Initial Study/Mitigated Negative Declaration

Division of Oil, Gas, and Geothermal Resources

PROJECT TITLE
Bloemer and Kirschenman Oil Well Project

LEAD AGENCY
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Division of Oil, Gas, and Geothermal Resources (Division)
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PROJECT DESCRIPTION AND LOCATION

Naftex Operating Company (Naftex) proposes to construct six (6) well sites, and drill one (1) oil well from each pad, and drilling approximately 940 feet to 990 feet (Santa Margarita Formation). The proposed oil wells are an extension of existing development within the Edison Oil Field. Naftex anticipates completing all drilling operations in the third quarter of 2013. The proposed project is located 2.9 miles northeast of Edison in central Kern County, California (Figure 1). The proposed project is located in the northwest quarter of the southeast quarter of Section 26, Township 29 South, Range 29 East) MDBM of the U.S. Geological Survey [USGS] *Rio Bravo Ranch* (1995) and *Edison* (1992) 7.5-minute quadrangle. The longitude and latitude for each of the proposed well sites in NAD 83 is listed in Table 1. The surface location for the proposed project sites is located on lands owned by Chris and Sandy Henriksen and Edward P. and Lucille L. Granillo. If economical quantities of oil are discovered, Naftex would install the necessary production equipment on the proposed project sites as described in the Production Phase section of this Project Description. No hydraulic fracturing is proposed as part of this project.

Table 1
Coordinates of the Proposed Well Sites

Well Name	Latitude	Longitude
Bloemer 1	35.374949	-118.8341000
Bloemer 2	35.376241	-118.8340937
Bloemer 3	35.3755525	-118.8337385
Bloemer 4	35.3749549	-118.8330825
Kirschenman 1	35.3742796	-118.8335941
Kirschenman 2	35.3735667	-118.8340511

Table 2
Surface Disturbance of the Proposed Well Sites

Well Name	Site Size	New Access Road	Total Acres of Land Disturbed
Bloemer 1	120 feet by 200 feet	20 feet by 350 feet	0.71 Acres
Bloemer 2	120 feet by 200 feet	20 feet by 350 feet	0.71 Acres
Bloemer 3	120 feet by 200 feet	20 feet by 350 feet	0.71 Acres
Bloemer 4	120 feet by 200 feet	20 feet by 350 feet	0.71 Acres
Kirschenman 1	120 feet by 200 feet	20 feet by 350 feet	0.71 Acres
Kirschenman 2	120 feet by 200 feet	20 feet by 350 feet	0.71 Acres
Totals		0.96 Acres	4.3 Acres

The proposed well sites are located in habitat that consists of disturbed/ruderal and non-native grassland habitats that are currently used for cattle grazing. Each of the proposed project sites would encompass an area of 120 feet by 200 feet (24,000 square feet, or 0.55 acres). Comanche Drive, Breckenridge Road (County Highway 218), and existing dirt roads provide access to the proposed project. A new access road will need to be constructed to each of the proposed project sites from existing dirt roads. Each new access road will be approximately 20 feet wide and 350 feet long as shown on Figure 2 the Project Location Map. The total estimated surface disturbance resulting from the construction of the access roads and the well sites would be 186,000 square feet, or 4.3 acres (see Table 2 above).

The proposed project is needed to develop additional oil reserves in the State of California. The objective of the proposed project is to locate untapped oil sources with potential for development. The proposed project includes three (3) phases: a site preparation phase, a drilling phase and a production phase. A detailed description of each phase is presented below.
The terms “project site” and “project area” are used within this document. The term “project site” is used to define the proposed area of disturbance such as the proposed project sites and proposed access roads. The term “project area” includes the area immediately adjacent to the proposed project sites and buffer areas.

Site Preparation Phase

Site preparation activities for each of the proposed project sites would include clearing, grading, and compaction of soil. Once a proposed project site has been cleared, it would be graded,

watered and compacted to establish a level and solid foundation for the drilling rig. If required a commercial base material such as aggregate ¾" base rock would be used to weatherize each of the proposed well pad areas.

A reserve pit may be excavated during site preparation for storage and handling of drilling mud and cuttings during the drilling process within the boundaries of a proposed project site. Soil will be stockpiled on site and used as backfill upon completion of drilling. If constructed, the reserve pit will be 75 feet long by 25 feet wide by six (6) feet deep. The reserve pit will hold 84,150 gallons with a two-foot freeboard. Reserve pits would be constructed by mechanical compaction. Compaction of the surface, combined with the deposition of bentonite drilling mud during drilling operations, would give the pit a bentonite seal with a maximum permeability of approximately 10^{-6} cm/sec (International Journal of the Physical Sciences Vol. 5(11) pp. 1647-1659, 18 Sept 2012). Should a shallow water table preclude the use of such a method, Naftex will use a closed loop system of above ground tanks for handling of all drilling mud and cuttings. The approximate depth to ground water is 320 feet to 325 feet (California Department of Water Resources Water Data Library 2012). Completing the site preparation process for each of the proposed project sites would require approximately three (3) days. Water shall be applied to access roads and each of the proposed project sites to facilitate movement of heavy equipment and to control dust.

Drilling Phase

Drilling equipment will be mobilized to each site and temporary facilities, equipment and materials necessary for the drilling operation would be set up and stored on site (i.e., drilling mud supplies, water, drilling materials and casing, crew support trailers, pumps and piping, portable generators, fuels and lubricants, etc.). Typically, this process is completed in approximately one (1) day. Night lighting will be available and required only during the drilling phase. However, to the greatest extent possible night lighting will be directed inward and down to minimize off site impacts without compromising safety. All hazardous materials such as diesel fuel will be stored according to applicable federal, state and local regulations. Portable tanks and mud pits will be used for mixing and storing drilling fluids. All fluids will be disposed of in accordance with the requirements of the Central Valley Regional Water Quality Control Board (RWQCB). If a reserve pit/sump is used, the use and closure of the reserve pit/sump will be handled in accordance with Title 27, CCR, Section 20090(g), and Regional Board Waiver Resolution No. R5-2008-0182.

Surface casing would be set, cemented, and blowout prevention equipment installed at each of the wellheads and tested. The amount of surface casing used depends upon factors such as expected well pressures, the depth of fresh water, and the competence of the strata in which the well casing will be cemented.

Blowout prevention equipment is bolted to the surface casing. All successive drilling occurs through the blowout prevention equipment, which can be operated to control well pressures at any time. Blowout prevention equipment will be regulated by the Division. Division engineers will be notified for required tests and other operations (blowout prevention, surface casing integrity).

Well casing is designed to protect fresh water zones. The Division's well construction standards have the fundamental purpose to ensure zonal isolation. Zonal isolation means that oil and gas coming up a well from the productive, underground geologic zone will not escape the well and migrate into other geologic zones, including zones that might contain fresh water. Zonal isolation also means that the fluids that are put down a well for any purpose will stay in that zone and not migrate to another zone. To achieve zonal isolation, Division regulations require that a cement barrier be placed between the well and surrounding geologic strata or stratum. The cement bonds to the surrounding rock and well casing and forms a barrier against fluid migration. Cement barriers must meet certain standards for strength and integrity. If these cement barriers do not meet the standards, the Division requires the oil or gas operator to remediate the cement barrier. Metal casings, which can be several layers depending on the depth of a well, also separate the fluids going up and down a well bore from the surrounding geology. If the integrity of a well is compromised by ground movement or other mechanisms, the well operator must remediate the well to ensure zonal isolation. Well casing standards are prescribed in CCR sections 1722.2 – 1722.4.

The approximate depth to ground water is 320 feet to 325 feet. Blowout prevention equipment would be regulated by the Division. Sufficient weighted drilling fluid would be used to prevent any uncontrolled flow from a well and additional quantities of drilling fluid would be available at each of the proposed project sites. It is anticipated that approximately 3,500 barrels (147,000 gallons) of treated production water from the Naftex Racetrack Water Plant would be needed for the drilling and site construction operations of each well. Drilling would continue until target depth is reached. Equipment, personnel and supply deliveries would continue through the course of the drilling program. Naftex estimates that approximately two (2) days would be required for drilling each well. Division engineers would be present for the required tests and other operations.

Equipment, personnel and supply deliveries would continue through the course of the drilling program. Drilling activities would operate 24 hours per day. Approximately 12-15 personnel would be on site at any given time during the drilling operations. The proposed wells will be drilled consecutively.

Production Phase

Once target depth is reached, each of the proposed wells would be fully evaluated, completed and either produced or plugged and abandoned. If economic quantities of oil are discovered, a given well will be completed and production equipment including a well head and API 10 hp electronic motor pumping unit will be installed on site. Flowlines will be installed aboveground adjacent to the proposed new access roads. The proposed flowlines will connect the proposed wells to existing pipeline infrastructure located west of the proposed Bloemer 1 well site. The proposed flowlines will be measure approximately 1,900 feet in length (see Figure 2). The proposed flowlines will be installed on sleepers to avoid impacts to small mammal burrows. Naftex proposes to paint all production equipment in camouflage or an earthen tone to blend in with the environment and to prevent glare. Naftex estimates that approximately three (3) days would be required for flow line installation activities.

Naftex anticipates 10 barrels of oil and 90 barrels of production water will be produced daily from each well. The oil will be transported from the wells through flow lines to Naftex's Section 26 Tank Farm (Figures 2 and 3) and sold to a local refinery. The production water will be transported to Naftex's Section 26 Tank Farm and will be disposed of in the Naftex Racetrack 76-27, 77-27 or 86-27 Division permitted Class II disposal wells. Each of the production sites will be inspected daily by Naftex personnel.

Once a well stops producing, it will be plugged and abandoned in accordance with Title 14 CCR, Division 2, Chapter 4, Subchapter 1, Article 3, Sections 1723 – 1723.8. Naftex estimates that the life expectancy of the proposed wells will be 15 to 20 years. In this case, a Notice of Intention to abandon the well will be submitted to the Division for review and approval. During a typical well abandonment, recoverable casing will be salvaged from the well and the hole will be plugged with cement. The wellhead (and any other equipment) will be removed, the casing cut off 6 feet below ground surface, capped with a welded plate and the cellar backfilled. This process will utilize the same equipment that will be used for the completion phase and the process will be completed in two (2) days. The land contours of each well site would be re-established to near grade conditions as present at the time of project initiation. After all equipment is removed, the site would be restored to its condition prior to construction of the well pad. Table 3 lists the estimated days it would take to complete each phase of the project at each site.

Table 3
Estimated Days to Complete Activity at Each Site

Activity	Days
Site Preparation	3
Drilling	2
Completion	2
Installation of Production Equipment	3
Plugging and Abandonment (if necessary)	2
Total days per site	**12**

MITIGATION MONITORING AND REPORTING PLAN

The proposed project incorporates Mitigation Measures designed to avoid or reduce environmental impacts to less-than-significant levels. Mitigation Measures are fully described in the following sections and are included in the Mitigation Monitoring and Reporting Plan (Attachment A).

Photographs representative of the proposed project sites are attached.

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WELL LOCATIONS

Figure 1 - Project Vicinity Map

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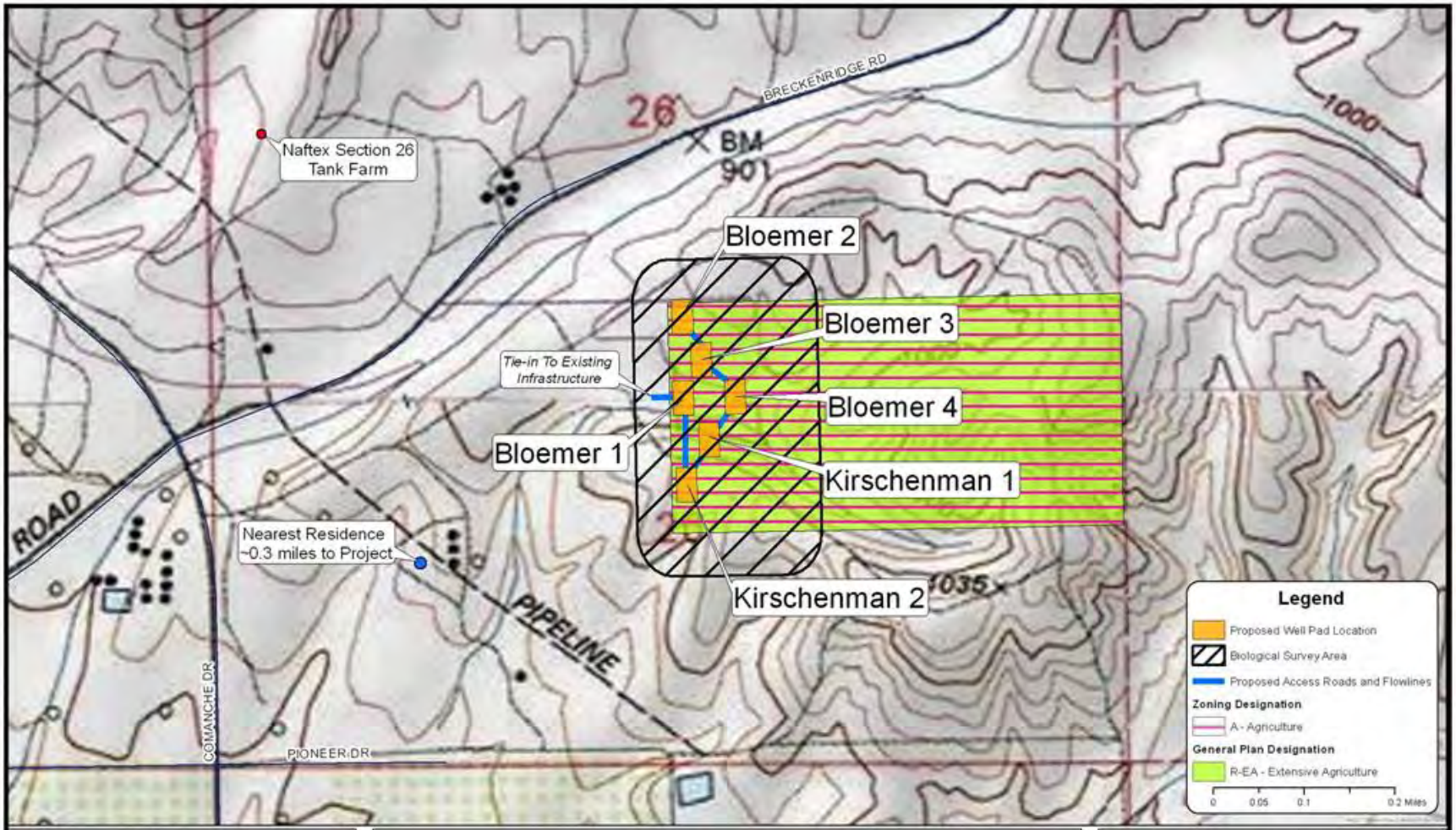

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WELL LOCATIONS

Figure 2 - Project Location Map

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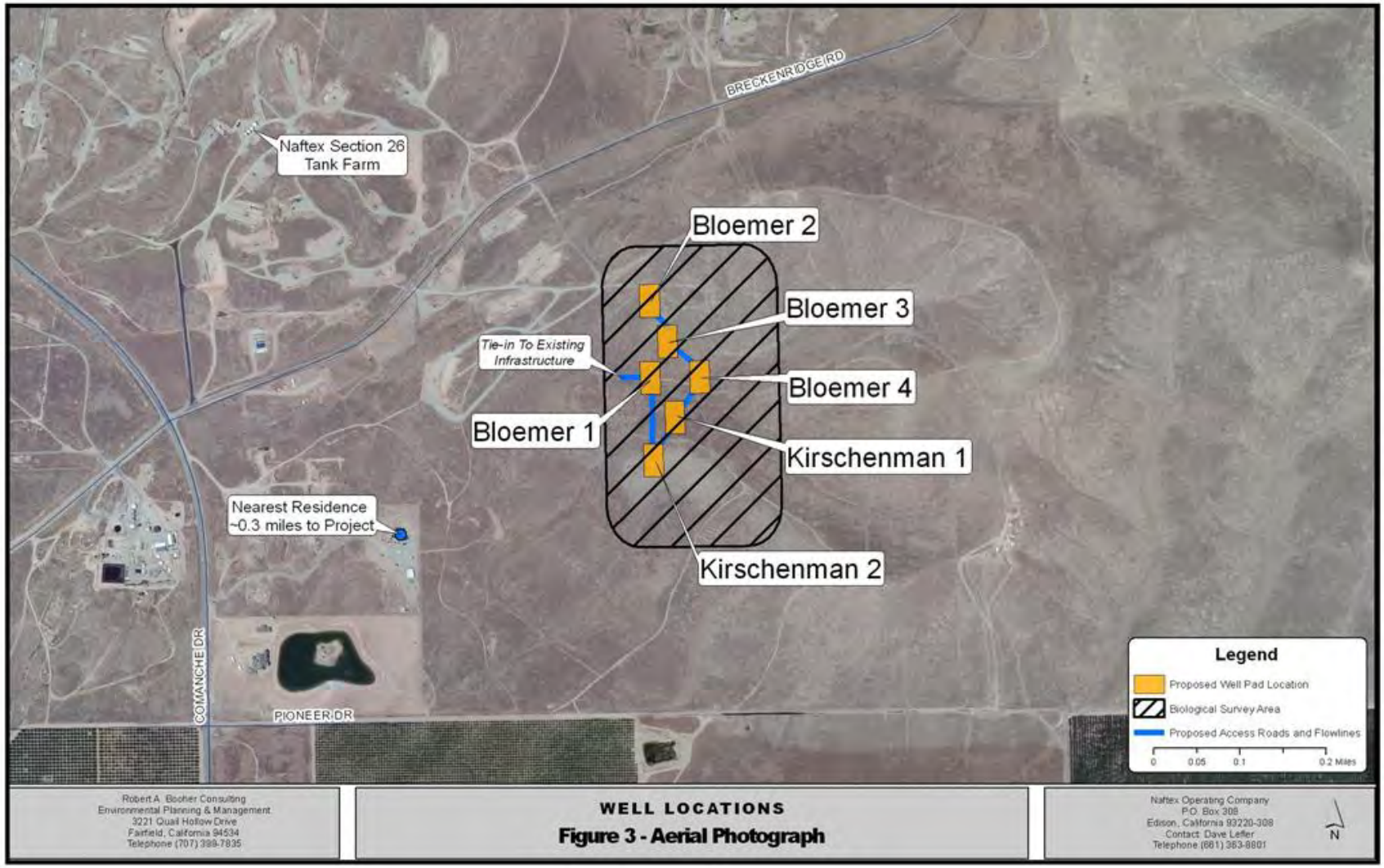

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WELL LOCATIONS

Figure 3 - Aerial Photograph

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Photograph 1
View looking south from north side of the proposed project sites.

Photograph 2
View looking north from south side of proposed project sites.

Photograph 3
View looking west from the proposed Bloemer 1 project site toward existing tie in point.

GENERAL PLAN DESIGNATION:

The proposed project sites are located on property designated as Resource Extensive Agriculture (R-EA) on the Kern County General Plan land use map. According to conversations with David Press with the Kern County Planning Department, mineral, aggregate, and petroleum exploration and extractions are acceptable uses with R-EA designated property. The proposed project is consistent with the land use and zoning designation for the area. The Kern County General Plan Land Use, Open Space and Conservation Element states that petroleum exploration and extraction are consistent uses with agricultural designations.

ZONING

The proposed project area is zoned Exclusive Agriculture (A). The project is consistent with the Exclusive Agriculture (A) zoning designations per Kern County, California Municipal Code Chapters 19.12.020 and 19.98.020 which include oil drilling and production as a permitted use.

ENVIRONMENTAL ANALYSIS
Bloemer and Kirschenman Oil Well Project

ISSUES	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
I. AESTHETICS				
Would the project:				
a. Have a substantial adverse effect on a scenic vista?	_____	_____	_____	X
b. Substantially damage scenic resources, including but not limited to trees, rock outcroppings, and historic buildings within a state scenic highway?	_____	_____	_____	X
c. Substantially degrade the existing visual character or quality of the site and its surroundings?	_____	_____	X	_____
d. Create a new source of substantial light or glare that would adversely affect day or nighttime views in the area?	_____	_____	X	_____

Discussion: The proposed project sites are located in annual grassland habitat. Annual grassland habitat surrounds the proposed project sites to the north, east and south. The Edison Oil Field, a well established oil field with numerous wells is located immediately adjacent to the west of the proposed project sites. According to Division records, the Edison Oil Field has approximately 1,093 active wells, 461 plugged wells, 746 unknown wells, 110 idle wells and 83 new wells within its field boundary. The proposed project sites are relatively flat and are visible from Breckenridge Road which is located northwest of the proposed project sites. No designated scenic roadways are located in the vicinity of the proposed project sites. The closest residence to the proposed project sites is located approximately 0.3 miles to the southwest (see Figures 2 and 3). No significant scenic resources are located at or near the proposed project sites. The project is consistent with polices in the Land Use, Open Space, and Conservation Element of the Kern County General Plan:

Policy 47 – Ensure that light and glare from discretionary new development projects are minimized in rural as well as urban areas.

Policy 48 – Encourage the use of low glare lighting to minimize nighttime glare effects on neighboring properties.

The project is consistent with land use and zoning designation for the area, and is, therefore, considered consistent with the associated visual resource for planning purposes and General Plan.

Ia. Annual grassland habitat surrounds the proposed project sites to the north, east and south. The Edison Oil Field, a well established oil field with numerous wells is located immediately adjacent to the west of the proposed project sites. The proposed project will not impact views of any scenic vistas as the proposed project is set back from roadways and residential structures, and views of the proposed project sites are blocked by surrounding hills. Additionally, the drilling phase is short term and temporary in nature lasting a total of 12 days for all 6 wells. Therefore, the proposed project will not have a substantial adverse effect on a scenic vista. The photo simulations presented in Figures 4a, 4b, 5a and 5b are intended to be representative of how drilling and production activities would appear from Breckenridge Road, a public road in the vicinity of the proposed project sites and the nearest residence located 0.3 miles to the southwest of the proposed project sites. Figure 4a below is a photo simulation of how the drill rig and associated drilling equipment would appear from Breckenridge Road. Figure 4b is a photo simulation of how the drill rig and associated drilling equipment would appear from the nearest residence located 0.3 miles to the southwest of the proposed project sites. Figure 5a is a photo simulation of how the production equipment would appear from Breckenridge Road. Figure 5b is a photo simulation of how the production equipment would appear from the nearest residence located 0.3 miles to the southwest of the proposed project sites. The well site visible in Figure 5a is an existing well site.

Ib. The proposed project sites are not located adjacent to a state scenic highway. Therefore, the proposed project would not damage the scenic resources within a state scenic highway. No impact.

Ic. Drilling an oil well will temporarily change the existing quality and visual character at each of the proposed project sites due to the presence of a drilling rig 100 feet in height at each of the proposed project sites during drilling activities. However, impacts to the existing visual quality and character of the project area associated with drilling activities will be short-term lasting only approximately two (2) days in length for each of the six (6) wells.

If economic quantities of oil are discovered, each well will be completed and production equipment including a well head and API 10 hp electronic motor pumping unit will be installed on site. This equipment is similar in size and shape to tanks, pumps and piping associated with agricultural facilities and other oil and gas sites located throughout the project area. Additionally, no production phase structure on-site will be taller than 25 feet, the proposed project sites are set back from residential structures, and views of the proposed project sites will be blocked by surrounding hills.

Impacts to the existing visual quality and character of the proposed project sites and their surroundings will be less than significant.

Id. Night lighting will be used during the short-term drilling phase of the project which is expected to last two (2) days for each of the six (6) wells. Night lighting will not be used for any other phase of the project. The project is designed so night lighting would be directed downward and inward to minimize potential offsite impacts. Based upon the result of site visits conducted by Robert A. Booher Consulting on April 17, 19, 20 and 21, May 28, 29, 30 and 31, June 25, 26, 27 and 28, August 30, and September 4, 5, 6 and 7, 2012, the closest residence to the proposed project sites is located approximately 0.3 miles to the southwest. This residence may be impacted by the temporary presence of night lighting during the drilling phase. However, the drilling phase for each of the proposed wells is short term and temporary in nature approximately two (2) days. Due to project design features (i.e. night lighting directed downward and inward), and because the project's proposed lighting will be minimal to maintain appropriate safety and security, the proposed project will not create a new source of substantial light that will adversely affect nighttime views in the area.

Conclusion: Impacts to aesthetics will be less than significant.

Mitigation Measures: No significant impacts identified. No mitigation necessary.

References:

California Department of Transportation. *Officially Designated State Scenic Highways*
Website: www.dot.ca.gov/hg/lLandArch/scenic/shwy.htm

County of Kern. *2009 General Plan*
Website: http://co.kern.ca.us/planning/pdfs/kcgp/KCGP.pdf

Figure 4a
Bloemer and Kirschenman Oil and Gas Exploration Project
Photo Simulation of Drill Rig
View to the Southeast of the Proposed Project Sites from Breckenridge Road
Approximately 0.32 Miles Northwest of Well Sites

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Figure 4b
Bloemer and Kirschenman Oil and Gas Exploration Project
Photo Simulation of Drill Rig
View to the Northeast of the Proposed Project Sites from Nearest Residence
Approximately 0.34 Miles Southwest of Well Sites

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Figure 5a
Bloemer and Kirschenman Oil and Gas Exploration Project
Photo Simulation of Production Facilities
View to the Southeast of the Proposed Project Sites from Breckenridge Road
Approximately 0.32 Miles Northwest of Well Sites

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Figure 5b
Bloemer and Kirschenman Oil and Gas Exploration Project
Photo Simulation of Production Facilities
View to the Northeast of the Proposed Project Sites from Closest Residence
Approximately 0.34 Miles Southwest of Well Sites

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ISSUES	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
II. AGRICULTURAL AND FOREST RESOURCES				
Would the project:				
a. Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	_____	_____	_____	X
b. Conflict with existing zoning for agricultural use, or a Williamson Act contract?	_____	_____	_____	X
c. Involve other changes in the existing environment that, due to their location or nature, could result in conversion of Farmland, to non-agricultural use, or conversion of forestland to non-forest use?	_____	_____	_____	X
d. Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)) or timberland (as defined by Public Resources Code section 4526)?	_____	_____	_____	X
e. Result in the loss of forest land or conversion of forest land to non-forest use?	_____	_____	_____	X

Discussion: The proposed project sites are located on annual grassland habitat. The project area is designated as Grazing Land (lands on which the existing vegetation is suited to the grazing of livestock) on the Kern County Important Farmland Map 2010. The Kern County Williamson Act Lands Map indicates that the proposed project sites are not currently under a Williamson Act contract. The proposed project sites are located on property designated as Resource Extensive Agriculture (R-EA) on the Kern County General Plan land use map. The proposed project is consistent with land use and zoning designation for the area.

IIa. The proposed project sites are designated as Grazing Land (lands on which the existing vegetation is suited to the grazing of livestock) on the Kern County Important Farmland Map 2010. The proposed project would convert 4.3 acres of

grazing land zoned Exclusive Agriculture to non-agricultural use. Petroleum exploration and extraction is an allowed use under the Kern County Zoning Ordinance 19.12 for Exclusive Agriculture (A). Thus, there would be no impact to Prime Farmland, Unique Farmland or Farmland of Statewide Importance.

IIb. The Kern County Williamson Act Lands Map indicates that the proposed project sites are not currently under a Williamson Act contract. The proposed project is consistent with the Kern County Zoning Ordinance, Chapters 19.12.020 and 19.98.020. The proposed project will not conflict with existing zoning for agricultural use, or a Williamson Act contract; therefore, there is no impact.

IIc. The project will impact 4.3 acres of grazing land. The project will not involve other changes in the existing environment which, due to their location or nature, could result in conversion of Prime Farmland, Unique Farmland, or Farmland of Statewide Importance Farmland (Farmland), to non-agricultural use, or conversion of forest land to non-forest use. No impact.

IId. No forest resources are located within the proposed project sites and the proposed project sites are not zoned for timber harvest. No impact.

IIe. No forest resources are located within the proposed project sites and the proposed project sites are not zoned for timber harvest. No impact.

Conclusion: No impact.

Mitigation Measures: No impact identified. No mitigation necessary.

References:

California Department of Conservation. *Farmland Mapping & Monitoring Program*. Website: http://www.conservation.ca.gov/dlrp/fmmp/Pages/Index.aspx.

California Department of Conservation. *Williamson Act Program*. Website: http://www.conservation.ca.gov/dlrp/lca/Pages/Index.aspx.

ISSUES	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
III. AIR QUALITY				
Would the project:				
a. Conflict with or obstruct implementation of the applicable air quality plan?	_____	_____	X	_____
b. Violate any air quality standard or contribute to an existing or projected air quality violation?	_____	X		_____
c. Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions that exceed quantitative thresholds for ozone precursors?	_____	X		_____
d. Expose sensitive receptors to substantial pollutant concentrations?	_____	_____	X	_____
e. Create objectionable odors affecting a substantial number of people?	_____	_____	X	_____

Discussion: The proposed project sites lie within the south central portion of the San Joaquin Valley Air Basin (SJVAB), which is the second largest air basin in the state. The SJVAB encompasses eight counties: San Joaquin, Stanislaus, Merced, Madera, Fresno, Kings, and Tulare Counties and the valley portion of Kern County. The SJVAB is managed by the San Joaquin Valley Air Pollution Control District (SJVAPCD) and is defined by the Sierra Nevada Mountains in the east, the Coast Ranges in the west, and the Tehachapi Mountains in the south. These surrounding mountains serve to confine or "trap" air pollution. The valley is characterized by low wind speed, and hot sunny weather which is conducive to the formation of ozone (smog).

The main sources of ozone precursors in the valley (NOx and ROG) are cars and trucks. Based on the 2010 emissions inventory for the San Joaquin Valley, cars and trucks contribute 81% of the NOx emissions and 35% of the ROG emissions. Stationary sources contribute 15% of the NOx emissions and 5% of the ROG emissions. Oil and gas production and marketing releases 0.007% of the NOx and 9.7% of the ROG emissions, while the majority of the ROG emissions from oil and gas production and marketing come from petroleum marketing and distribution—as opposed to oil exploration and production.

The SJVAPCD is in non-attainment for ozone for Federal and State standards and PM10 for State standards, the District is in attainment with PM10 for Federal Standards. To reduce emissions and bring the valley into compliance with ozone and PM-10 State standards, the SJVAPCD adopted the 2007 Ozone Plan. This Plan was reviewed and approved by CARB and the federal EPA. This Plan sets forth specific requirements which will substantially lessen

cumulative impacts from NOx and ROG emissions. The Plan was formally adopted by the SJVACPD through a public review process in 2007. Details of the Plan can be found at: http://www.valleyair.org/Air_Quality_Plans/Ozone_Plans.htm

Consistent with this Plan, SJVAPCD has adopted an aggressive set of policies, rules and regulations that include the adoption of indirect source review (ISR) and the nation's most stringent limits on NOx emissions from boilers, heater and IC engines. The following rules are aimed at reducing emissions from oil and gas production:

Rule 4306 – Reduction of NOx from boilers, heaters and steam generators
Rule 4624 – Transfer of organic liquids
Rule 4702 – Limits on NOx emissions from IC engines
Rule 4409 - Components at production facilities

Collectively, these policies are reducing NOx and ROG emissions. See attached forecast of NOx emissions in San Joaquin Valley for the period 2005 thru 2023. This forecast appears as Figure ES-1 in the Executive Summary for the 2007 Ozone Plan, dated April 30, 2007. The project will comply with the 2007 Ozone Plan and with the above noted rules.

The air pollutants emitted into the ambient air by stationary and mobile sources are regulated by federal and state law. These regulated air pollutants are known as "criteria air pollutants" and are categorized into primary and secondary pollutants. Primary air pollutants are those that are emitted directly from sources. Carbon monoxide (CO), volatile organic compounds (VOC), nitrogen oxides (NO_X), sulfur dioxide (SO_2), coarse inhalable particulate matter (PM_{10}), fine inhalable particulate matter ($PM_{2.5}$), and lead (Pb) are primary air pollutants. VOC and NO_X go on to form secondary criteria pollutants through chemical and photochemical reactions in the atmosphere. Ozone (O_3) and nitrogen dioxide (NO_2) are the principal secondary pollutants. Other pollutants, such as carbon dioxide (CO_2), a natural by-product of animal respiration that is also produced in the combustion process, have been linked to such phenomena as global climate change. A discussion of CO_2 and greenhouse gases is included in Section VII, Greenhouse Gas Emissions.

Some land uses are considered more sensitive to air pollution than others due to the types of population groups or activities involved. The SJVAPCD defines sensitive receptors as locations where there are human populations and where there is a reasonable expectation of continuous human exposure according to the averaging period for the ambient air quality standards (AAQS). The most sensitive portions of the population are children, the elderly, the acutely ill, and the chronically ill, especially those with cardiorespiratory diseases. Residential areas are considered to be sensitive receptors to air pollution because residents (including children and the elderly) tend to be at home for extended periods of time, resulting in sustained exposure to any pollutants present. Other sensitive receptors include retirement facilities, hospitals, and schools. The closest residence to the proposed project sites is located approximately 0.3 miles to the southwest. The project will not create objectionable odors that would affect a substantial number of people as it is located in a remote, rural location.

The SJVAPCD has established Thresholds of Significance: Criteria for Determining Environmental Significance. These thresholds separate a project's short-term emissions from its

long-term emissions. Short-term emissions are mainly related to the construction phase of the project and are recognized to be short in duration. Long-term emissions are primarily related to activities that will occur indefinitely as a result of project operations.

A producing well will result in operational emissions, which have the potential to contribute to the possible violation of an existing air quality standard or an existing or projected air quality violation. Sources of operational emissions include fugitive emissions from the well, some storage tanks, piping, compressors, separators, and loading racks and point source emissions from steam generators, some storage tanks, and internal combustion equipment installed as part of the operation of a new well, including thermally enhanced wells. Indirect operational emissions include vehicle trips associated with employees and contractors needed to operate and maintain the oil production operation.

The installation of the above equipment is subject to permit requirements of the SJVAPCD. One major requirement is that new and modified equipment that has air contaminant emissions must satisfy the requirements of New Source Review (NSR). The main requirements of NSR are to require the installation of best available control technology to minimize emission increases from such equipment and to mitigate emission increases over certain thresholds by providing emission reductions either by limiting the use of existing equipment or by providing emission offsets.

These requirements are intended to allow for economic growth but not interfere with the District's efforts to achieve or maintain attainment with ambient air quality standards. As a result of implementation of project design elements, compliance with SJVAPCD Air Pollution Control District permit requirements, and implementation of the identified operational procedures, project related impacts on air quality will be reduced to less than significant.

IIIa. The SJVAPCD has prepared an Air Quality Attainment Plan (AQAP) to enable the San Joaquin Valley to attain air quality standards by the earliest practicable date. Short-term emission impact is anticipated as part of the proposed project. Short-term emissions may impact implementation of the SJVAPCD AQAP, but with measures included in the project, it will be a less than significant impact. Short-term emission impacts include particulate matter emissions that are expected to occur during the construction of each drill site and from daily ingress and egress of vehicles on the unpaved access road. Construction also will produce exhaust emissions resulting from transportation of workers and machinery to and from each site as well as operation of equipment on-site. Typical equipment used for this project may include diesel drill rig, bulldozer, grader, loader, compacter, heavy-duty trucks, baker tanks, air compressors, pumps, and generators.

However, earthmoving activities at the proposed project sites will not exceed the non-residential project limit of 5.0 or more acres and will not move, deposit, or relocate more than 2,500 cubic yards per day of bulk materials on at least three days. Therefore, a Dust Control Plan will not be required as specified in Regulation VIII, Rule 8021, Section 6.3.1. The operator will provide written notification to the SJVAPCD at least 48 hours prior to beginning earthmoving operations as required. The proposed project would not significantly conflict with or obstruct implementation of the SJVAPCD Air Quality Attainment Plan.

IIIb,c. RAB Consulting prepared emissions calculations to determine the quantity of following category of air pollutants:

Criteria Air Pollutants (ROG, NOx, PM-10)
Toxic Air Pollutants
Greenhouse Gases (GHG)

The procedure for estimating these emissions and their significance is discussed below.

Estimate of Criteria Air Pollutant Emissions
Criteria pollutant emissions were estimated using Road Construction Emissions Model, Version 6.3.2 software, which is recommended by the SJVAPCD for use in calculating air emissions for this type of project. Criteria pollutant emissions for the project were estimated based upon lists of equipment for each phase of the project provided by Naftex. The duration of each phase per well is as follows:

- Site Preparation 3 days
- Drilling 2 days
- Completion 2 days
- Installation of Production Equipment 3 days
- Production 365 days
- Plugging and Abandonment 2 days

Equipment used for each phase of the project is summarized in Tables 4 through 9.

Table 4
Equipment Usage for Site Preparation Phase for Each Well

Equipment		***No.***	***Horsepower***	***Hrs/day***	***No. Days***
	Grader	1	245	8	2
	Front-End Loader	1	163	8	2
	Backhoe	1	107	4	1
Mobile Sources		***Trips/Day***	***Round Trip Miles***	***Hrs/Day***	***No. Days***
	Water Truck	2	50	8	3
	Passenger Cars/Pick-Up Trucks (2 hrs/trip)	2	100	8	3
	Heavy Duty Trucks/Semis (4 hrs/trip)	2	100	8	2

Table 5
Equipment Usage for Drilling Each Well

Equipment		***No.***	***Horsepower***	***Hrs/day***	***No. Days***
	Loader/Forklift	1	170	8	2
	Drill Rig	1	600	24	2
	Electric Generator	1	600	24	2
	Mud Pump	1	1,000	16	2
	Draw Works	1	530	24	2
Mobile Sources		***Trips/Day***	***Round Trip Miles***	***Hrs/Day***	***No. Days***
	Water Truck	2	50	6	2
	Passenger Cars/Pick-Up Trucks (2 hrs/trip)	10	100	8	2
	Heavy Duty Trucks/Semis (4 hrs/trip)	2	100	8	2
	Heavy Duty Trucks/Semis (4 hrs/trip) Mobilization and Demobilization	5	100	8	1
	Average number Heavy Duty Vehicle Trips (2 trips x 2 days + 5 trips over 1 day = 9 trips/2 days = 4.5 trips/day	4.5	100	8	2

Table 6
Equipment Usage for Completion Phase for Each Well

Equipment		***No.***	***Horsepower***	***Hrs/day***	***No. Days***
	Backhoe	1	107	4	2
	Workover Rig Motor	1	500	8	1
	Coil Tubing Rig Motor	1	500	4	2
	Cementing Truck	1	500	4	2
	Welding truck	1	32	4	1
Mobile Sources		***Trips/Day***	***Round Trip Miles***	***Hrs/Day***	***No. Days***
	Water Truck	2	50	4	2
	Passenger Cars	2	100	8	2
	Heavy Duty Truck/Semi – Coil Tubing Operations	2	100	8	2
	Heavy Duty Truck/Semi – Cementing Operations	2	100	8	1
	Heavy Duty Truck/Semi – Equipment Removal	2	100	8	1
	Pick-Up Trucks - Welder	1	100	4	1

Table 7
Equipment Usage Installation of Production Equipment (Flowline)

Equipment Type and Quantity of Each	Days of Operation	Hours Operation Daily	Maximum Daily Vehicle Trips	Mobilization and Demobilization Trips
Fork Lift (1)	3	12	0	0
Front End Loader (1)	3	12	0	0
Welding Truck (1)	3	12	0	0
Welder (1)	3	12	0	0
Side-Boom Crane (1)	3	12	0	0
Worker Transport - Light Trucks/Passenger Cars (3/Day)	3	**Round Trip Distance** 50	3 trips/day	0
Heavy Duty Trucks (Semi) (2)	1	**Round Trip Distance** 50	2 trips/day	0

Table 8
Equipment Usage for Production Phase

Equipment Type and Number of Equipment	Hours Operation
Well Head	24 hours per day/7 days per week
Pumping Unit (10 hp electric motor)	24 hours per day/7 days per week
Pickup Truck Operator (1)	7 days a week

Table 9
Equipment Usage for Plugging and Abandonment Phase for Each Well

Equipment		***No.***	***Horsepower***	***Hrs/day***	***No. Days***
	Backhoe	1	107	4	2
	Workover Rig Motor	1	500	8	1
	Coil Tubing Rig Motor	1	500	4	2
	Cementing Truck	1	500	4	2
	Welding truck	1	32	4	1
Mobile Sources		***Trips/Day***	***Round Trip Miles***	***Hrs/Day***	***No. Days***
	Water Truck	2	50	4	2
	Passenger Cars	2	100	8	2
	Heavy Duty Truck/Semi – Coil Tubing Operations	2	100	8	2
	Heavy Duty Truck/Semi – Cementing Operations	2	100	8	1
	Heavy Duty Truck/Semi – Equipment Removal	2	100	8	1
	Pick-Up Trucks - Welder	1	100	4	1

Emissions of Criteria Air Pollutants

Table 10 summarizes the tons per year of criteria pollutant emissions that would be produced from a single well site and a single well.

Table 10
Criteria Pollutant Emission Rates for One (1) Well Site and One (1) Well
(Emissions estimated as 0.0 tons/year in the Roadway Model are reported as 0.04 tons/year)

Project Phase	**ROG** *(tons)*	**NOX** *(tons)*	**PM-10** *(tons)*
Site Preparation Phase	0.04	0.04	0.04
Drilling Phase	0.04	0.2	0.04
Completion Phase	0.04	0.04	0.04
Installation of Production Equipment	0.04	0.04	0.04
Production Phase	0.04	0.04	0.04
Plugging and Abandonment Phase	0.04	0.04	0.04
Totals	**0.24**	**0.40**	**0.24**

Table 11 summarizes the tons per year of criteria pollutant emissions that would be produced by all six (6) Naftex well sites. Detailed calculations are presented in Attachment B.

Table 11
Criteria Pollutant Emissions Rates for All Six (6) Well Sites and Six (6) Wells

Project Phase	**ROG** *(ton/yr)*	**NOX** *(ton/yr)*	**PM-10** *(ton/yr)*
Site Preparation Phase	*0.24*	*0.24*	*0.24*
Drilling Phase	0.24	1.2	0.24
Completion Phase	0.24	0.24	0.24
Installation of Production Equipment	0.24	0.24	0.24
Production Phase	0.24	0.24	0.24
Plugging and Abandonment Phase	0.24	0.24	0.24
Total	**1.44**	**2.4**	**1.44**

<u>Project Impacts from Criteria Air Pollutants</u>

SJVAPCD has established thresholds of significance for several criteria air pollutants. The thresholds of significance are in terms of annual tons of PM10, ROG and NOx. CEQA Guidelines Section 15064.7 expressly authorizes the adoption of thresholds of significance and these thresholds may be used by a lead agency to determine the significance of a project's impacts.

A comparison of project emissions with the adopted thresholds of significance is presented in Table 12. As data in this table shows, project impacts are below the thresholds of significance. Consequently, the project would not lead to significant air quality impacts. Cumulative impacts are discussed in Section XVIII Mandatory Findings of Significance.

Table 12
SJVAPCD Significance Thresholds

Air Pollutant	**Significance Criteria Tons/Year**	**Maximum Annual Project Emissions 2013**
Reactive Organic Gas (ROG)	10	1.44
Nitrogen Oxides (NO_X)	10	2.4
Particulates (PM_{10})	15	1.44

IIId. The proposed project sites are located within an unincorporated area of Kern County. Scattered rural residences are located throughout the project area. The proposed project sites would be located away from rural residences. Rural residences are considered a sensitive receptor. The closest residence is located approximately 0.3 miles southwest of the proposed project sites.

Criteria Air Pollutant Concentrations

Project activities would create pollutants that would be released to the localized area of the proposed project sites. However, these pollutants would greatly disperse prior to reaching a sensitive receptor. Due to the distance of the proposed project sites from the sensitive residential receptor in the project area, and the fact that project emissions are below the thresholds of significance, the project is not expected to subject sensitive receptors to substantial pollutant concentrations.

Short-Term Emissions and Impacts

The main short-term toxic air contaminant associated with the construction phase (site-preparation, drilling and production installation phases) of this project is diesel particulate matter (DPM) released from on-site equipment. The emission rates of DPM were previously calculated using the Roadway Model for individual phases of the project. The emission rates appear under "Exhaust PM-10" in the emissions summary provided in Attachment B. Overall short-term construction related emissions are summarized below.

Table 13
Summary of Short-Term Emissions of Toxic Air Pollutants from a Single Well

Project Phase	DPM	Duration	Total
	(lbs/day)	*(days)*	*(lbs)*
Site Preparation	0.6	3	1.8
Drilling	9.0	2	18
Completion Phase	0.9	2	1.8
Production Equipment Installation	1.2	3	3.6
Plugging and Abandonment	0.9	2	1.8
TOTALS	12.6	12	27.0

Note: Exhaust PM-10 emission rates are calculated using the ROADWAY model.

Short-term impacts to public health were estimated on the basis of the facility risk prioritization score. The score is based on the AB 2588 Air Toxics Hotspots Information and Assessment Act of 1987. The spreadsheet for estimating the facility

score was obtained from the SJVAPCD. The facility score is based on 27.0 lbs/yr of DPM. A score of 0.14 "Low" was calculated at the nearest residence 1,584 feet from the proposed project sites. Given this low level of projected public health risk, a more refined risk analysis is not necessary. The risk would be lower at residences located beyond 0.3 miles. Since the facility prioritization score is well below 10, this indicates that short-term impacts associated with the proposed project would not lead to significant public health risks and that a detailed risk analysis is not required. A copy of the prioritization score is provided in Attachment B.

Long-Term Emissions and Impacts

There would be no on-site sources of toxic air contaminants at any of the proposed project sites. Sources of toxic emissions during the production phase would include passenger cars or pick-up trucks used by staff and workers. These emissions would occur off-site and would not contribute to health risks to residents near the proposed project sites. Fugitive emissions from the well head would be very small. According to EPA developed protocol for fugitive emissions of hydrocarbons from various components such as pumps, valves and flanges, the emission rate of VOCs depends on the severity of the leak. For well maintained equipment that is subject to leak detection and repair, the emission rate varies between 3.1×10^{-7} to 2.4×10^{-5} kg/hr. See Table C-3, "Protocol for Leak Equipment Emission Estimates". EPA document 453/R-95-017, November 1995.

Over one year, this translates into a maximum of 0.2 kg/year. Note that all equipment will be subject to District Rule 4409 that specifically requires regular inspection and maintenance of well components to prevent leaks.

IIIe. The proposed project sites are located within an unincorporated area of Kern County. Scattered rural residences are located throughout the project area. The proposed project sites would be located away from rural residences. Rural residences are considered a sensitive receptor. The closest residence is located approximately 0.3 miles southwest of the proposed project sites.

Project activities may create odors, but they would only be perceptible in close proximity approximately 250 feet to 500 feet from the proposed project sites. Due to the distance of the proposed project sites from the residence, the project is not expected to create objectionable odors that would be noticeable at this residence. As such, impacts from odors would be considered less than significant.

Conclusion: Mitigation measures shall reduce potential impacts to air quality to a level of less than significant.

Mitigation Measures: In order to reduce impacts to air quality to a less than significant level, the following mitigation measures will be implemented:

Air Quality 1 - All disturbed areas, including storage piles, which are not being actively used for construction purposes, shall be effectively stabilized using water.

Air Quality 2 - Unpaved access roads shall be effectively stabilized of dust emissions using water.

Air Quality 3 - All land clearing, grubbing, scraping, excavation, land leveling, grading, cut and fill, and demolition activities shall be effectively controlled of fugitive dust emissions by using the application of water or by presoaking.

Air Quality 4 - When materials are transported off-site, all material shall be covered, effectively wetted to limit visible dust emissions, or at least six (6) inches of freeboard space from the top of the container shall be maintained.

Air Quality 5 - Following addition of materials to, or removal of materials from the surface of outdoor storage piles, said piles shall be effectively stabilized of fugitive dust emissions by using sufficient water.

Air Quality 6 - Limit traffic speeds on unpaved access roads to 15 mph.

References:

San Joaquin Valley Air Pollution Control District, *Guide for Assessing and Mitigating Air Quality Impacts.*
Website: http://www.valleyair.org/transportation/ceqa_idx.htm

SJVAPCD Rules Website: http://www.valleyair.org/rules/1ruleslist.htm

California Environmental Quality Act (CEQA Guidelines)

California Environmental Protection Agency, *Air Toxics Hot Spots Program Risk Assessment Guidelines; The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessment* (August 2003)

ISSUES	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
IV. BIOLOGICAL RESOURCES				
Would the project:				
a. Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service?	_____	X	_____	_____
b. Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service?	_____	_____	X	_____
c. Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	_____	_____	_____	X
d. Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?	_____	_____	_____	X
e. Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	_____	_____	_____	X
f. Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community, Conservation Plan, or other approved local, regional, or state habitat conservation plan?	_____	_____	_____	X

Discussion: A biological assessment report was prepared for the proposed project in January 2013, and is attached to this initial study/mitigated negative declaration (Attachment C). This report provides a detailed discussion of the biological resources present and potentially present within the project area. Field surveys (including protocol-level surveys for blunt-nosed leopard lizards (BNLL) were conducted on April 17, 19, 20 and 21, May 28, 29, 30 and 31, June 25, 26, 27 and 28, August 30, and September 4, 5, 6 and 7, 2012 to determine if special-status plant or animal species or suitable habitats occurred within the proposed project sites, proposed access roads, existing access roads, and buffer areas. Surveys also sought to determine if the proposed project would have an adverse effect on these species or habitats.

The biological assessment found no sensitive plant or animal species present within the proposed project sites, proposed access roads or buffer area around these areas. However, suitable habitat for sensitive plant and animal species was observed within both the project sites and buffer areas during biological surveys. No riparian, wetland, stream, vernal pool, or other sensitive community types were observed during the biological assessment. The proposed project sites, proposed access roads, and the buffers of these areas consist of non-native grassland habitat.

Common animal species observed during biological surveys included Turkey vulture (*Cathartes aura*), American crow (*Corvus brachyrhynchos*), common raven (*Corvus corax*), house sparrow (*Passer domesticus*), Western meadowlark (*Sturnella neglecta*), mourning dove (*Zenaida macroura*), Black-tailed jackrabbit (*Lepus californicus),* Desert cottontail (*Sylvilagus audubonni*), Western whiptail (*Aspidoscelis tigris*), Pacific gopher snake (*Pituophis catenifer*), Western fence lizard (*Sceloporus occidentalis*), Common side-blotched lizard (*Uta stansburiana*) and California ground squirrel (*Otospermophilus beecheyi)*.

Plant species observed during field surveys included Blow wives (*Achyrachaena mollis),* Fiddleneck (*Amsinckia intermedia),* Ranchers fireweed (*Amsinckia menziesii),* Mt. Diablo locoweed (*Astragalus oxyphysus),* Saltbush (*Atriplex polycarpa),* Slender wild oats (*Avena barbata),* Wild oat (*Avena fatua* L.), Black mustard (*Brassica nigra* (L.) Koch), Soft chess brome (*Bromus hordeaceus),* Red brome (*Bromus madritensis ssp. Rubens),* Rip-gut brome (*Bromus rigidus* Roth), Red maids (*Calandrinia ciliate),* Shepherd's-purse (*Capsella bursa-pastoris),* Turkey mullein (*Croton setigerus),* Redstem filaree (*Erodium cicutarium),* Broadleaf filaree (*Erodium botrys),* California poppy (*Eschscholzia californica),* Hare barley (*Hordeum leporinum),* Common mallow (*Malva neglecta* Wallr.), Horehound (*Marrubium vulgare),* Pineapple-weed (*Matricaria matricariodes),* Perennial sowthistle (*Sonchus arvensis* L.), Spiny sowthistle (*Sonchus asper* (L.) Hill), Annual sowthistle (*onchus oleraceus* L.), Vinegar weed (*Trichostema lanceolatum)* and Red clover (*Trifolium pretense).*

Results from biological surveys for the proposed project are presented below:

San Joaquin Kit Fox - We observed no potential burrows within the proposed project sites and buffer areas that could be utilized by this species during our biological surveys. There were no "active signs" (i.e., adult and puppy scat, prey remains, tracks, fur, etc.) of use by San Joaquin kit fox observed during surveys. In addition, no known dens of this species were observed during biological surveys of the proposed project sites or buffer areas. San Joaquin kit foxes have been

documented approximately 0.95 miles northwest of the proposed Bloemer 2 well site (CDFW 2012) (see Figure 6).

American Badger - We observed no potential burrows within the proposed project sites and buffer areas that could be utilized by this species during our biological surveys. There were no "active signs" (i.e., adult and puppy scat, prey remains, tracks, fur, etc.) of use by American badgers observed during surveys. In addition, no known dens of this species were observed during biological surveys of the proposed project sites or buffer areas. American badgers have not been documented within the proposed project area by CNDDB (CDFW 2012) (see Figure 6).

Sensitive Small Mammal Species - We found no evidence (i.e., pit cache holes, scats, tracks, tail drags, etc.) of Tipton kangaroo rats within the proposed project sites or their buffer areas during biological surveys. We observed potential burrows (California ground squirrel burrows) within the proposed project sites or buffer areas. We found appropriate vegetative communities for this species (annual grassland habitat) within all areas surveyed during biological surveys. No individual Tipton kangaroo rats were observed during surveys. This species has not been documented within the proposed project area by CNDDB (CDFW 2012) (see Figure 6).

Potential habitat for Tulare grasshopper mice and San Joaquin pocket mice was observed in annual grassland habitat within the proposed project sites and buffer areas during biological surveys. We observed potential refuge burrows (California ground squirrel burrows) within the proposed project sites or buffer areas. We found no evidence (i.e., scat, tracks, etc.) of these species (recent and/or past use) within the proposed project sites or their buffer areas. No individual mice were observed during surveys. These species have not been documented within the proposed project area by CNDDB (CDFW 2012) (see Figure 6).

We observed potential foraging habitat for the pallid bat within all areas surveyed during biological surveys. However, we did not observe any known or potential maternity or roosting sites during biological surveys. No individual pallid bats were observed during biological surveys. This species has not been documented within the project area (CDFW 2012) (see Figure 6). This species may forage intermittently throughout the project area, but is not expected to nest.

Blunt-Nosed Leopard Lizard (BNLL) – No BNLLs (*Gambelia sila*) were observed during protocol level surveys conducted within the proposed project site and buffer area. We recorded western whiptails (*Aspidoscelis tigris*), western fence lizards (*Sceloporus occidentalis*), and common side-blotched lizards (*Uta stansburiana*) within the proposed project sites and buffer areas during surveys. We observed burrows within the proposed project sites and buffer areas that were large enough (entrance size, width, etc.) to provide refugia for BNLL. Table 14 below provides the results of BNLL surveys as well as the survey dates and weather conditions during our surveys at the project sites.

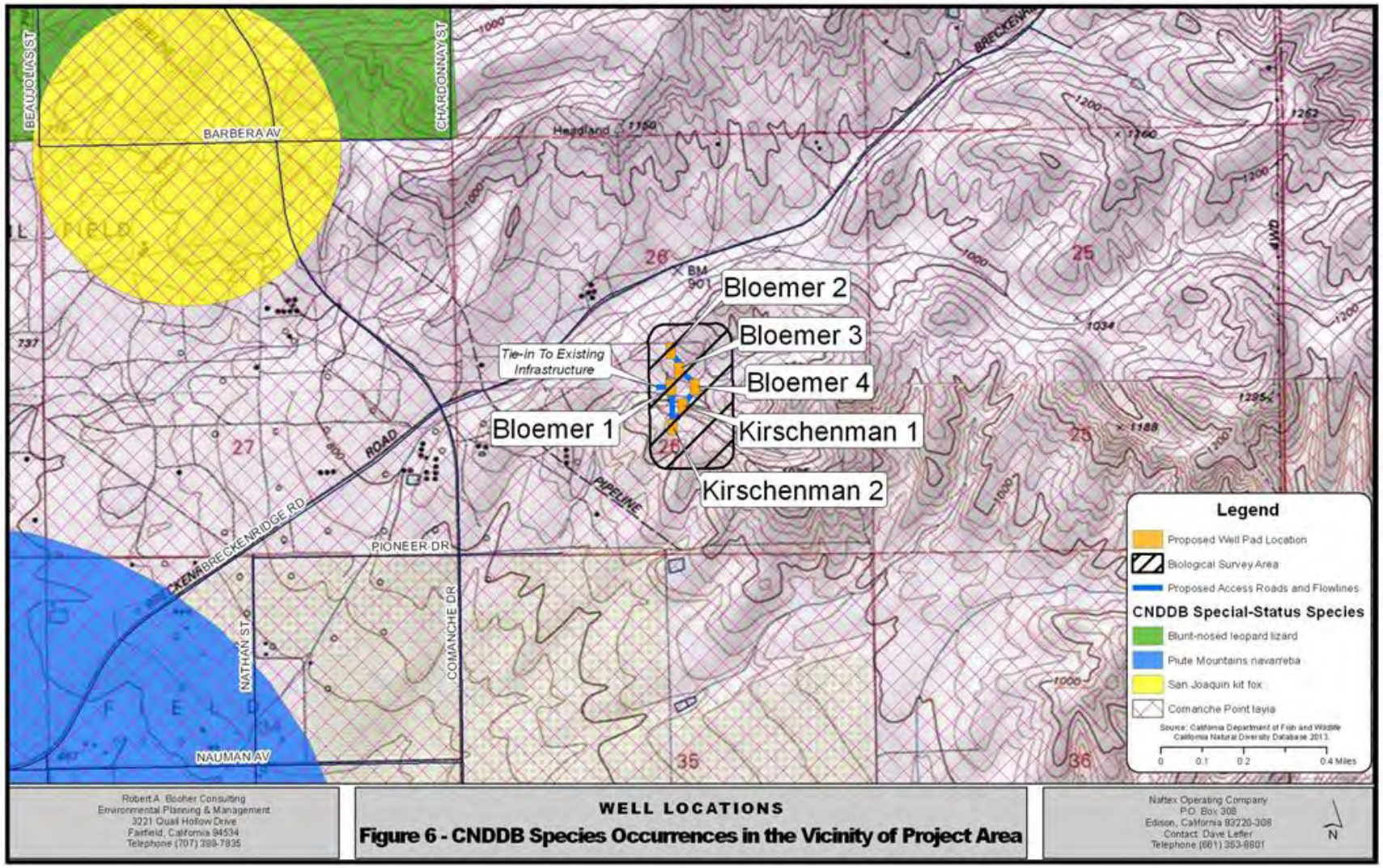

Figure 6 - CNDDB Species Occurrences in the Vicinity of Project Area

Chesmore (1980 and 1981) identified specific vegetation associations that could be used to assist in the identification of preferred habitat for BNLL: Arabian grass (*Schismus arabicus* and *S. barbatus*) is positively correlated with the occurrence of BNLL while red brome (*Bromus rubens*) is negatively correlated. While we did not take quantitative measurements of vegetation during our surveys, red brome was observed as being somewhat dense in the survey area. Dense red brome growth can become problematic for BNLL foraging. *Gambelia sila* (G. sila) is one of a number of species in the San Joaquin Valley whose habitat has been greatly modified by invasive annual grasses and might benefit from management actions that would keep habitats open (Germano et al. 2001).

We observed an adequate prey base of grasshoppers and beetles within the project area. In general, *G. sila* seems to be an opportunistic predator that eats whatever is most abundant and it is able to catch (Germano et al. 2007). It is known to eat invertebrates and lizards (Montanucci 1965, 1967), including its own young (Montanucci 1965, Germano and Williams 1994).

We evaluate the project sites and buffer areas as being suitable habitat in its current state for BNLL because suitable burrows that provide refuge cover for this species occur within the proposed project sites and buffer areas. Protocol-level surveys were conducted and no BNLL were detected.

Table 14
Blunt-Nosed Leopard Lizard Survey Results

Date	Start Time	End Time	Start Air Temp	End Air Temp	#BNLL Observed Adults/Hatchlings	Number of Biologist
04/17/12	1230	1500	80	87	0/0	2
04/19/12	1141	1349	77	80	0/0	2
04/20/12	1019	1245	80	87	0/0	2
04/21/12	0945	1150	84	93	0/0	2
05/28/12	1105	1400	78	83	0/0	2
05/29/12	1115	1345	81	87	0/0	4
05/30/12	1050	1250	81	87	0/0	2
05/31/12	1105	1310	88	95	0/0	2
06/25/12	1340	1428	90	92	0/0	4
06/26/12	1020	1320	81	89	0/0	3
06/27/12	0800	1140	77	95	0/0	2
06/28/12	0745	0580	77	82	0/0	4
08/30/12	0740	1000	77	89	0/0	2
09/04/12	0740	0900	78	85	0/0	4
09/05/12	0740	1015	78	90	0/0	2
09/06/12	0730	1015	77	95	0/0	2
09/07/12	0745	1012	77	92	0/0	2

Sensitive Avian Species - Potential habitat for burrowing owls was observed in annual grassland habitat within the proposed project sites and buffer areas during biological surveys. Potential burrows (California ground squirrel burrows) that could be used by this species for nesting

activities were observed during biological surveys in all areas surveys. However, no burrowing owls were observed during biological surveys, and no evidence of their presence (white wash, feathers, small mammal bones, owl pellets, etc.) was observed during surveys. This species has not been documented by CNDDB within the proposed project area (CDFW 2012) (see Figure 6).

A number of avian species protected under the Federal Migratory Bird Treaty Act were observed foraging during field surveys (see Table 4 within the attached Biological Assessment). No active or inactive nesting sites were observed during biological surveys. No potential nesting habitat for migratory avian species was observed within the proposed project sites and buffer areas during biological surveys. Therefore, migratory avian species have no potential to nest in the proposed project sites or buffer areas.

Special-Status Plants – No special-status plant species were identified during the course of botanical surveys within the proposed project sites and buffer areas. Surveys were conducted during the appropriate blooming period of all of the targeted special-status plant species identified in Table 2 within the attached Biological Assessment as potentially occurring within the proposed project sites and buffer areas. The annual grassland habitat found within the proposed project sites and buffer areas is disturbed due to ongoing cattle grazing and agricultural activities, and the likelihood of special-status plant species occurring within the proposed project sites is unlikely. Additionally, non-native weedy grassland species within the proposed project sites and buffer areas likely out compete special-status species that could occur within the proposed project sites and buffer areas.

Habitat Types – Habitat types observed during field surveys are described further below:

Ruderal/Disturbed

This habitat type was observed within and along the edges of the existing access road from which the proposed access roads to the proposed well sites would be constructed. Common plant species found in this community were composed primarily of weedy non-native and native species. Vegetative species observed included slender wild oats (*Avena barbata*), wild oat (*Avena fatua* L.), black mustard (*Brassica nigra* [L.] Koch), soft chess brome (*Bromus hordeaceus*), rip-gut brome (*Bromus rigidus* Roth), common mallow (*Malva neglecta* Wallr.), pineapple-weed (*Matricaria matricariodes*), perennial sowthistle (*Sonchus arvensis* L.), spiny sowthistle (*Sonchus asper* [L.] Hill), and annual sowthistle (*Sonchus oleraceus* L.).

Wildlife use of this community is limited due to the monocultural and weedy nature of plant species present. Although the diversity of wildlife is limited, species that do occur in the habitat type are often abundant and well adapted to the presence of humans.

Non-Native Annual Grassland

Non-native annual grassland was observed covering all six (6) proposed well sites, the proposed access roads to the six (6) proposed well sites, and the buffer areas of the proposed well sites and access roads. Common species found in this vegetative community were composed of introduced grasses and broadleaf weedy species. Plant species observed during field surveys included

fiddleneck (*Amsinckia intermedia*), ranchers fireweed (*Amsinckia menziesii*), Mt. Diablo locoweed (*Astragalus oxyphysus*), saltbush (*Atriplex polycarpa*), slender wild oats (*Avena barbata*), wild oat (*Avena fatua* L.), black mustard (*Brassica nigra* [L.] Koch), soft chess brome (*Bromus hordeaceus*), red brome (*Bromus madritensis ssp. rubens*), rip-gut brome (*Bromus rigidus* Roth), red maids (*Calandrinia ciliata*), shepherd's-purse (*Capsella bursa-pastoris*), turkey mullein (*Croton setigerus*), redstem filaree (*Erodium cicutarium*), broadleaf filaree (*Erodium botrys*), California poppy (*Eschscholzia californica*), hare barley (*Hordeum leporinum*), horehound (*Marrubium vulgare*), vinegar weed (*Trichostema lanceolatum*), and red clover (*Trifolium pratense*).

Wildlife species observed in this community during field surveys included western whiptail (*Aspidoscelis tigris*), turkey vulture (*Cathartes aura*), American crow (*Corvus brachyrhynchos*), common raven (*Corvus corax*), black-tailed jackrabbit (*Lepus californicus*), California ground squirrel (*Otospermophilus beecheyi*), house sparrow (*Passer domesticus*), Pacific gopher snake (*Pituophis catenifer*), western fence lizard (*Sceloporus occidentalis*), western meadowlark (*Sturnella neglecta*), desert cottontail (*Sylvilagus audubonni*), common side-blotched lizard (*Uta stansburiana*), and mourning dove (*Zenaida macroura*).

The biological assessment conducted for the proposed project found that no special-status animal or plant species were present within the proposed project sites or buffer areas. However, suitable habitat for sensitive plant and animal species was observed within both the proposed project sites and buffer areas during biological surveys. No riparian, wetland, stream, vernal pool, or other sensitive community types were observed during the biological assessment.

Direct mortality or injury to common wildlife and plant populations could occur during ground disturbance activities associated with implementation of the proposed project. Small vertebrate, invertebrate, and plant species are particularly prone to impact during project implementation because they are much less to non-mobile, and cannot easily move out of the path of project activities. Other more mobile wildlife species, such as most birds and larger mammals, can avoid project-related activities by moving to other adjacent areas temporarily. Increased human activity and vehicle traffic in the vicinity may disturb some wildlife species. However, common wildlife species have likely become acclimated to on-going ranching and drilling and production activities. Because common wildlife species found in the project area are locally and regionally common, potential impacts to these resources are considered less than significant. Therefore, no avoidance or minimization measures are proposed at this time.

Implementation of the proposed project could potentially impact individual and nesting burrowing owls should they become established within the proposed project sites and buffer areas prior to project implementation. As noted in the attached Biological Assessment this species was not observed during biological surveys. Impacts to this species could occur through crushing by construction equipment during the construction of the proposed project sites and the proposed access roads. Actively nesting burrowing owls could also be affected due to noise and vibration from project activities if nests are located closer than 500 meters to the proposed project sites and proposed access roads; project related noise and vibration could cause the abandonment of active nest sites. However, in the unlikely event that burrowing owls become established in a project site or buffer area in the future, measures included as recommendations

in the attached biological assessment report will be implemented as mitigation measures.

No evidence of San Joaquin kit fox or American badgers, or any potential/known burrows was observed within areas proposed for project activities during biological surveys. However, San Joaquin kit foxes and American badgers have the potential to become established in the proposed project sites and buffer areas prior to project implementation. Implementation of the proposed project could potentially result in significant impacts on individual American badgers and San Joaquin kit foxes should they take up residence in the proposed project sites and buffer areas prior to project implementation. Impacts to these species would likely occur through one of the following ways:

- Through crushing or injury of individual San Joaquin kit foxes or American badgers if they are present within proposed project work areas during project implementation. This could result in direct mortality to live individuals or small populations of these species.

- Through the destruction of burrows if they are excavated by San Joaquin kit foxes or American badgers within disturbance areas prior to proposed project implementation. As stated previously, no potential or known dens were identified within proposed disturbance areas or buffer areas during biological surveys. No signs were observed that would indicate the presence of this species within the proposed project sites or buffer areas.

- Through visual, noise, and vibration impacts. If San Joaquin kit foxes or American badgers become established in burrows adjacent to the proposed project sites, the presence of construction personnel, and the noise and vibration caused by construction activities could lead to the abandonment of actively used burrows/dens. As discussed previously, no potential or known burrows were identified within the proposed project sites and buffer areas. No “signs” (tracks, scats, active digging, etc.) of either species were documented. Proposed project activities could cause the abandonment of occupied burrows if they become established prior to project implementation.

Impacts to American badgers and San Joaquin kit foxes and their potential burrows/dens would be considered a potentially significant impact. However, in the unlikely event that American badgers and San Joaquin kit foxes become established in a project site or buffer area in the future, measures included as recommendations in the attached biological assessment report will be implemented as mitigation measures.

Implementation of the proposed project has the potential to impact Tipton kangaroo rat, Tulare grasshopper mice, and San Joaquin pocket mice by causing direct mortality of individuals of these species by crushing due to use of construction equipment. Individuals of this species could also be crushed or buried in potential burrows within the proposed project sites and buffer areas. Potential burrows (California ground squirrel burrows) were observed throughout the proposed project sites and buffer areas during biological surveys. These burrows could provide potential refuge burrows for these species. It should be noted that no evidence was observed of any of these species presence during biological surveys, and these species are expected to be absent from the proposed project sites and buffer areas. However, in the unlikely event that these

species become established in a project site or buffer area in the future, measures included as recommendations in the attached biological assessment report will be implemented as mitigation measures.

BNLL are not expected to be impacted by the proposed project. Potential habitat for these species was observed in annual grassland habitat within the proposed project sites and buffer areas during biological surveys. Protocol-level biological surveys were conducted within these areas; however, no BNLL were observed during these surveys. Therefore, this species is expected to be absent from the proposed project sites and buffer areas, and no impacts to this species are anticipated as a result of proposed project implementation.

Traffic, consisting predominantly of ranching and drilling and production vehicles and equipment within the project area is moderate. A short-term increase in vehicle traffic is anticipated during project implementation and less so after project completion. This will result in a short-term increase in associated noise, which may cause temporary disturbance to wildlife species. More tolerant species may adapt to and even take advantage of close human contact. Increased vehicular traffic could cause direct mortality to these species or impede normal activities such as dispersal (Luckenbach 1975, Weinstein 1978). Species intolerant of human activities may use the project sites less when humans are regularly present in the area (Bushnel 1978, Lee and Griffith 1977). Those species observed at or near the project sites appear to have acclimated to ongoing activities.

Direct mortality or injury to sensitive animal populations could occur if earth-moving activities are not confined to approved construction areas, access roads, and staging areas (assuming that sensitive animal populations are established in the construction zone during project implementation).

The project would not interfere with movements of wildlife species or with established native resident or migratory wildlife corridors. Native resident and/or migratory fish and known native wildlife nursery sites are not present within the proposed project sites or buffer areas.

IVa. The biological assessment found no sensitive plant or animal species present within the proposed project sites, proposed access roads, or the buffers of these areas. However, suitable habitat for sensitive plant and animal species was observed within both the project sites and buffer areas. Additionally, special-status species and their habitat have been documented in the areas surrounding the site (see discussion of sensitive animal and plant species above). Those species observed at or near the proposed project site or buffers of the proposed project sites appear to have acclimated to ongoing activities. To ensure there are no impacts to sensitive plants or sensitive animal species, Naftex will implement measures that were included in the biological assessment report as mitigation measures.

IVb. No riparian, wetland, stream, vernal pool, or other sensitive community types were observed within the proposed project sites, proposed access roads, or the buffers of these areas. To ensure there are no impacts to sensitive plants or sensitive animal species, Naftex will implement measures that were included in the biological

assessment report as mitigation measures. Therefore, the proposed project would have a less than significant impact on sensitive natural communities.

IVc. No federally protected wetland habitat was observed within the footprint of the proposed project sites, proposed access roads, or the buffers of these areas during the biological assessment. Therefore, the proposed project would not have any substantial adverse effect on federally protected wetlands.

IVd. The proposed project would not interfere with movement of any wildlife species or with established native resident or migratory wildlife corridors. Native resident and/or migratory fish and known native wildlife nursery sites are not present within the proposed project sites, proposed access roads, or the buffers of these areas.

IVe. The project, as proposed, would not conflict with any local policies or ordinances protecting biological resources or local tree preservation policies/ordinances. No native trees are present within the proposed project sites, proposed access roads, or the buffers of these areas. The project will be in compliance with applicable policies and ordinances. No impacts are anticipated. As discussed above, land uses of this type (oil well drilling) are allowed if appropriate mitigation measures are implemented during project implementation, and applicable agencies are consulted.

IVf. There are no adopted Habitat Conservation Plans, Natural Community Conservation Plans or other approved local, regional, or state habitat conservation plans in the project area. No conflict is anticipated with any conservation plans.

Conclusion: No sensitive plant or animal species were present within the proposed project sites or proposed access roads or the buffers of the proposed project sites and access roads; however, suitable habitat for sensitive plant and animal species was observed within both the project sites and buffer areas. Measures included in the biological assessment report will be implemented as mitigation measures to reduce potential impacts to biological resources to a level of less than significant.

Mitigation Measures: In order to reduce potential impacts to biological resources to a less than significant level, the following mitigation measures will be implemented:

Biological 1 - As close to beginning of construction as possible, but not more than 14 days prior to construction, a qualified biologist shall conduct a final pre-construction survey of the construction zone to insure that no special-status wildlife species have recently occupied the proposed project sites. A qualified biologist shall be present immediately prior to construction activities that have potential to impact sensitive species (i.e., well site preparation, access road grading, etc.) to identify and protect potentially sensitive resources.

Biological 2 - Proposed project sites boundaries shall be clearly delineated by stakes, flagging and /or rope or cord to minimize inadvertent degradation or loss of adjacent habitat during construction and drilling operations. Staff and/or its contractors shall post signs

and/or place fence around the sites to restrict access of vehicles and equipment unrelated to construction, drilling, and completion operations.

Biological 3 - A qualified biologist monitor will be present during initial ground disturbance and site construction activities.

Biological 4 - If San Joaquin kit foxes become established within the proposed project sites or buffer areas prior to project implementation, Naftex will implement the measures contained in the USFWS's "Standardized recommendations for protection of the San Joaquin kit fox prior to or during ground disturbance" (USFWS 2011). Naftex will implement the following measures:

a) If kit fox dens have become established within 200 feet of a construction area prior to project implementation that may be indirectly impacted by construction activities, exclusion zones shall be established prior to construction by a qualified biologist and dens shall not be disturbed in any way. Exclusion zone fencing should include untreated wood particle-board, silt fencing, orange construction fencing or other fencing as approved by the USFWS and CDFW[1]. Exclusion zones shall be roughly circular with a radius of the following distances measured outward from entrance; potential den 50 feet, and known den 100 feet. Fencing must contain openings for kit fox ingress/egress and keeps humans and equipment out. If a natal/pupping den is discovered within a project site or within 200 feet of the project site, the USFWS and CDFW shall be immediately notified and under no circumstances should the den be disturbed or destroyed without prior authorization. If the preconstruction survey reveals an active natal pupping or new information, the project applicant should contact the USFWS and CDFW immediately to obtain the necessary take authorization/permit. If the take authorization/permit has already been issued, then the biologist may proceed with den destruction within the project boundary, except natal/pupping den which may not be destroyed while occupied. A take authorization/permit is required to destroy these dens even after they are vacated. Protective exclusion zones can be placed around all known and potential dens which occur outside the project footprint.

b) San Joaquin Kit fox exclusion zone barriers shall be maintained until all construction and drilling activities have been completed, and then removed. If specified exclusion zones cannot be observed for any reason, USFWS and CDFW shall be contacted for guidance prior to ground disturbing activities at or near the subject den. In the event that USFWS and CDFW concur that an occupied San Joaquin kit fox den would be unavoidably destroyed by a planned project action, procedures detailed in the USFWS Standardized Recommendations for protection of the San Joaquin Kit Fox (USFWS 2011) shall be implemented. Den excavation shall be undertaken only by a qualified biologist pursuant to USFWS and CDFW authorization and direction for excavation of kit fox dens.

[1] The California Department of Fish and Game (CDFW) changed its name to the California Department of Fish and Wildlife (CDFW) on January 1, 2013.

c) In the event that a San Joaquin kit fox is injured or killed, the incident shall immediately be reported to the project biologist. The project biologist shall contact CDFW immediately in the case of a dead, injured or entrapped kit fox. The CDFW contact for immediate assistance is State Dispatch at (916) 445-0045. They will contact the local warden or the CDFW Central Region office at (559) 243-4014. The USFWS should be contacted at Endangered Species Division, (916) 414-6620 or (916) 414-6600. The USFWS and CDFW shall be notified in writing within three (3) working days of the accidental death or injury to a San Joaquin kit fox during project related activities. Notification must include the date, time, and location of the incident or of the finding of a dead or injured animal and any other pertinent information. The USFWS contact is the Chief of the Division of Endangered Species, 2800 Cottage Way, Suite W2605, Sacramento, California 95825-1846. The CDFW contact is the Central Region office (559) 243-4014. New sightings of kit fox shall be reported to the CNDDB. A copy of the reporting form and a topographic map clearly marked with the location of where the kit fox was observed should also be provided to the USFWS as well.

d) Kit foxes are attracted to den-like structures such as pipes and may enter stored pipes and become trapped or injured. All construction pipes, culverts, or similar structures with a diameter of 4 inches or greater that are stored at a construction site for one or more overnight periods should be thoroughly inspected for kit foxes before the pipe is subsequently buried, capped, or otherwise used or moved in any way. If a kit fox is discovered inside a pipe, that section of pipe should not be moved until the USFWS and CDFW has been consulted. If necessary, and under the direct supervision of the biologist, the pipe may be moved only once to remove it from the path of construction activity, until the fox has escaped.

e) Limited destruction of kit fox dens may be allowed, if avoidance is not a reasonable alternative, provided the following procedures are observed. Destruction of any known or natal/pupping kit fox den requires take authorization/permit from the USFWS and CDFW. Destruction of the den should be accomplished by careful excavation until it is certain that no kit foxes are inside. The den should be fully excavated, filled with dirt and compacted to ensure that kit foxes cannot reenter or use the den during the construction period. If at any point during excavation, a kit fox is discovered inside the den, the excavation activity shall cease immediately and monitoring of the den as described above should be resumed. Destruction of the den may be completed when in the judgment of the biologist, the animal has escaped, without further disturbance, from the partially destroyed den. Natal or pupping dens which are occupied cannot be destroyed until the pups and adults have vacated and then only after consultation with the USFWS and CDFW. Known dens occurring within the footprint of the activity must be monitored for three (3) days with tracking medium or an infra-red beam camera to determine the current use. If no kit fox activity is observed during this period, the den should be destroyed immediately to preclude subsequent use. If kit fox activity is observed at the den during this period, the den should be monitored for at least five (5) consecutive days from the time of the observation to allow any resident animal to move to another den during its normal

activity. Use of the den can be discouraged during this period by partially plugging its entrances(s) with soil in such a manner that any resident animal can escape easily. Only when the den is determined to be unoccupied may the den be excavated under the direction of the biologist. If the animal is still present after five (5) or more consecutive days of plugging and monitoring, the den may have to be excavated when, in the judgment of a biologist, it is temporarily vacant, for example during the animal's normal foraging activities. The USFWS and CDFW encourage hand excavation, but realize that soil conditions may necessitate the use of excavating equipment. However, extreme caution must be exercised. For potential dens, if a take authorization/permit has been obtained, den destruction may proceed without monitoring, unless other restrictions were issued with the take authorization/permit. If no take authorization/permit has been issued, then potential dens should be monitored as if they were known dens. If any den was considered to be a potential den, but is later determined during monitoring or destruction to be currently, or previously used by kit fox (e.g., if kit fox sign is found inside), then all construction activities shall cease and the USFWS and CDFW shall be notified immediately.

Biological 5 - The burrowing owl nesting season begins as early as February 1 and continues through August 31. If burrowing owls are located or become established within the proposed project sites or buffer areas at the time of the final pre-activity biological survey and are using burrows within the project sites or buffer areas, a qualified biologist will consult with CDFW; the following measures shall be implemented:

(a) Naftex will follow recommendations included in CDFW's *Staff Report on Burrowing Owl Mitigation* (CDFW 2012a) including avoidance of occupied burrows by implementation of a no-construction buffer zone of a minimum distance of 500 meters, unless a qualified biologist approved by CDFW verifies through non-invasive methods that either: 1) the birds have not begun egg laying and incubation; or 2) that juveniles from the occupied burrows are foraging independently and are capable of independent survival.

(b) On-site passive relocation of burrowing owls should be implemented if owls are using the burrows after August 31. Passive relocation is defined as encouraging owls to move from occupied burrows to alternate natural or artificial burrows that are beyond 150 feet from the impact zone and that are within or contiguous to a minimum of 6.5 acres of foraging habitat for each pair of relocated owls. Relocation of owls should only be implemented during the non-breeding season.

(c) Owls should be excluded from burrows in the immediate impact zone and within a 150 feet buffer zone by installing one-way doors in burrow entrances. One-way doors should be left in place 48 hours to insure owls have left the burrow before excavation. One alternate natural or artificial burrow should be provided for each burrow that will be excavated in the project impact zone. The project area should be monitored daily for one week to confirm owl use of alternate burrows before excavating burrows in the immediate impact zone.

(d) The project area shall be monitored daily for one week to confirm owl use of alternate burrows before excavating burrows in the immediate impact zone. Whenever possible, burrows shall be excavated using hand tools and refilled to prevent reoccupation. Sections of flexible plastic pipe or burlap bags shall be inserted into burrow tunnels to prevent tunnel collapse while soil is excavated around that portion of a tunnel.

Biological 6 – Suitable sensitive species small mammal burrows shall be avoided by 50 feet.

Biological 7 - A project representative shall establish restrictions on construction-related traffic to approved construction areas, storage areas, staging and parking areas via signage. Off-road traffic outside of designated project areas shall be prohibited. Project-related traffic shall observe a 15 mph speed limit in all project areas except on County roads and State and federal highways to avoid impacts to special-status wildlife species.

Biological 8 - Project activities during the drilling phase of the proposed project shall be scheduled to avoid evening hours, as feasible, to avoid special-status wildlife species that are active in the nighttime.

Biological 9 - All vehicle operators shall check under vehicles and equipment before moving them if they have remained parked and shut off for 10 minutes or longer.

Biological 10 - Hazardous materials, fuels, lubricants, and solvents that spill accidentally during project-related activities shall be cleaned up and removed from the project sites as soon as possible according to applicable federal, state and local regulations.

Biological 11 - All equipment storage and parking during site development, drilling, and operation shall be confined to the proposed project sites or to previously disturbed off site areas that are not suitable habitat for listed species.

Biological 12 - Environmental Awareness Training shall be presented to all personnel working on the proposed project site. Training shall consist of a brief presentation in which biologists knowledgeable of endangered species biology and legislative protection shall explain endangered species concerns. Training shall include a discussion of special-status plants and sensitive wildlife species. Species biology, habitat needs, status under the Endangered Species Act, and measures being incorporated for the protection of these species and their habitats shall also be discussed.

Biological 13- If wildlife proof barricade fencing is not used at the proposed well sites, all excavated steep-walled holes or trenches in excess of three feet in depth shall be provided with one or more escape ramps constructed of earth fill to prevent entrapment of endangered species or other animals during the construction phase. Ramps shall be located at no greater than 1,000-foot intervals and at not less than 45-degree angles. Trenches shall be inspected for entrapped wildlife each morning prior to onset of construction activities and immediately prior to the end of each working day. Before such holes or trenches are filled they shall be

inspected thoroughly for entrapped animals. Any animals discovered shall be allowed to escape voluntarily without harassment before construction activities resume, or removed from the trench or hole by a qualified biologist and allowed to escape unimpeded.

Biological 14 - All construction pipes, culverts, or similar structures stored at a project site overnight having a diameter of four inches or greater shall be inspected thoroughly for wildlife species before being buried, capped, or otherwise used or moved in any way. Pipes laid in trenches overnight shall be capped. If during construction a wildlife species is discovered inside a pipe, that section of pipe shall not be moved or, if necessary, moved only once to remove it from the path of construction activity, until the wildlife species has escaped.

Biological 15 - All food-related trash items such as wrappers, cans, bottles or food scraps generated during construction or during subsequent stages of the project shall be disposed of only in closed containers and regularly removed from the proposed project sites. Food items may attract wildlife species onto a project site, consequently exposing such animals to increased risk of injury or mortality. No deliberate feeding of wildlife shall be allowed.

Biological 16- To prevent harassment or mortality of wildlife species via predation, or destruction of their dens or nests, no domestic pets shall be permitted on the proposed project sites.

Biological 17 - Use of rodenticides and herbicides on the proposed project sites shall be permitted only as part of a USFWS and CDFW approved management plan unless such use is otherwise approved on a case-by-case basis. This is necessary to prevent primary or secondary poisoning of endangered species using adjacent habitats or depletion of prey upon which sensitive wildlife may depend.

References:

Robert A. Booher Consulting, *Biological Assessment Naftex Operating Company, Bloemer and Kirschenman Oil Project, Kern County, California* (January 2013)

United State Fish and Wildlife Service, *Standardized recommendation for protection of the San Joaquin kit fox prior to or during ground disturbance*, (USFWS 2011)

California Department of Fish and Wildlife, *Staff Report on Burrowing Owl Mitigation* (CDFW 2012).

California Department of Fish and Wildlife**.** *Conservation and Mitigation Banks in California Approved by the Department of Fish and Wildlife***.**
Website: http://www.dfg.ca.gov/habcon/conplan/mitbank/catalogue/

United States Fish and Wildlife Service. *Conservation Plans and Agreements Database*.
Website: http://ecos.fws.gov/conserv_plans/public.jsp

United State Fish and Wildlife Service, *Standardized recommendation for protection of the San Joaquin kit fox prior to or during ground disturbance*, (USFWS 2011)

California Department of Fish and Wildlife, *Staff Report on Burrowing Owl Mitigation* (CDFW 2012).

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Website: http://ecos.fws.gov/conserv_plans/public.jsp

United States Code. 1918. Migratory Bird Treaty Act. 16 U.S.C. §§ 703–712. Revised August 2006.

ISSUES	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
V. CULTURAL RESOURCES				
Would the project:				
a. Cause a substantial adverse change in the significance of a historical resource as defined in Section 15064.5?	_____	X	_____	_____
b. Cause a substantial adverse change in the significance of an archaeological resource pursuant to Section 15064.5?	_____	X	_____	_____
c. Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	_____	X	_____	_____
d. Disturb any human remains, including those interred outside of formal cemeteries?	_____	X	_____	_____

Discussion: Brunzell Cultural Resource Consulting **(**BCR Consulting) conducted cultural resources record and information search of the proposed project sites in June of 2012. BCR Consulting also requested a search of the "Sacred Lands Inventory" maintained by the Native American Heritage Commission (NAHC) for the proposed project sites. BCR Consulting Principal Archaeologist David Brunzell conducted a reconnaissance pedestrian inventory of the proposed project sites on June 11, 2012. During the survey, Mr. Brunzell walked 15-meter transects across the proposed project sites. Rodent back dirt and other natural soil exposures were inspected for cultural remains.

The cultural resources record and information search for the project area was conducted with the Southern San Joaquin Valley Information Center (SSJVIC) of the California Historical Resources Information System at the California State University, Bakersfield and included a review of:

- National Register of Historic Places (Directory of Determinations of Eligibility, California, Office of Historic Preservation, Volumes I and II, 2001);
- California Historical Landmarks (State of California 1996);
- California Points of Historical Interest listing (State of California 1992);
- California Historic Property Data File (State of California 2005);
- Other pertinent historic data on file with BCR Consulting.

The records search revealed that five (5) cultural resource studies were previously conducted, resulting in the recording of one (1) historic-period cultural resource within one mile of the proposed project. These results are summarized in Table 15 below.

BCR Consulting requested a search of the Sacred Lands File maintained by the Native American Heritage Commission (NAHC) on June 6, 2012. The request included a brief project description and location map sent by email to David Singleton of the NAHC. Mr. Singleton performed the Sacred Lands File search, and provided names of potentially interested tribes and individuals to BCR Consulting on June 8, 2012. BCR Consulting then communicated via certified letters and emails to the potentially interested parties on June 8, 2012. The list included Rueben Barrios, Chairperson of the Santa Rosa Rancheria; Katherine Montes-Morgan, Chairperson of the Tejon Indian Tribe; David Laughinghorse Robinson, Kawaiisu Tribe of Tejon Reservation; Neil Peyron, Chairperson of the Tule River Indian Tribe; Ron Wermuth; Robert Robinson, Co-Chairperson of the Kern Valley Indian Council; Delia Dominguez, Chairperson of the Kitanemuk & Yowlumne Tejon Indians; Dr. Donna Begay, Tribal Chairperson of the Tubatulabals of Kern County and Lalo Franco, Cultural Coordinator of the Santa Rosa Tachi Rancheria. BCR Consulting received an email from Ms. Montes Morgan on June 20, 2012. Ms Montes Morgan stated the Tejon Indian Tribe has no knowledge of cultural resources located within the proposed project and she wishes to be notified of any findings. Any additional responses received would be forwarded to Division if and when they are received.

Table 15
Records Search Results

California USGS 7.5 Minute Quadrangle	Archaeological Sites	Built Environmental Resources	Reports
Rio Bravo Ranch, CA (1995)	CA-KER-4740	None	KE-641, 1066, 1726, 1806, 3559
Edison, CA (1992)	None	None	KE-641, 1726, 3559

Va. The records search and Native American Consultation did not identify any cultural or historic resources at the proposed project sites. Based on these results, the proposed project is not anticipated to affect any historical resources; however during construction activities cultural or historic resources may be unearthed. Compliance with mitigation measures would reduce the potential impact to a less than significant level.

Vb. The records search and Native American Consultation did not identify any cultural or historic resources at the proposed project sites. The proposed project would include notification of personnel prior to ground disturbing activities of the possibility of buried prehistoric or historic cultural deposits. In the unlikely event prehistoric or historical cultural deposits are observed, compliance with mitigation measures would reduce the potential impact to a less than significant level.

Vc. The records search and Native American Consultation did not identify any cultural or historic resources at the proposed project sites. The proposed project would include notification of personnel prior to ground disturbing activities of the possibility of buried prehistoric or historic cultural deposits. In the unlikely event prehistoric or historical cultural deposits are observed, compliance with mitigation measures would reduce the potential impact to a less than significant level.

Vd. The records search and Native American Consultation did not identify any cultural or historic resources at the proposed project sites. In the unlikely event human remains are encountered, compliance with mitigation measures would reduce the potential impact to a less than significant level.

Conclusion: No impact to cultural resources. No cultural or historical resources were identified at the proposed project sites. In the unlikely event that such resources are unearthed during construction activities; the following mitigation measures and compliance with statute and regulations shall reduce potential impacts to cultural resources to a level of less than significant.

Mitigation Measures: In order to reduce potential impacts to cultural resources to a less than significant level, the following mitigation measures will be implemented:

Cultural 1 – In the unlikely event archeological resources are identified on a project site, all ground disturbing activities will cease and a qualified archaeologist will be retained by Naftex to assess the significance of any find. The archeologist will have the authority to stop or divert the construction excavation as necessary. The archaeologist will evaluate the find in conformance with section 15064.5 of CEQA. A plan to mitigate any adverse impacts will be prepared by the archaeologist and contain procedures to follow. Work may proceed on the site once evaluation of the find is complete.

Cultural 2 – In the unlikely event paleontological resources are identified on a project site, a qualified paleontologist will be retained by Naftex to assess the significance of any find and will have the authority to stop or divert the construction excavation as necessary. A plan to mitigate any adverse impacts will be prepared by the paleontologist and contain procedures to follow. Work may proceed on the site once evaluation of the find is complete.

Cultural 3 – In the unlikely event human remains are discovered during construction of a project site, site personnel will contact the County Coroner and stop work as required by Public Resources Code §5097.98-99 and Health and Safety Code §7050.5. If the remains are determined to be Native American, the County Coroner will notify the NAHC in accordance with PRC §5097.98. Naftex shall, in consultation with the identified descendants of the remains and/or NAHC, identify the appropriate measures for treatment or disposition of the remains.

References:

California Public Resources Code 5097.98-99, 15064.5

California Health and Safety Code §7050.5

BCR Consulting, Cultural Resources Assessment Report, June 2012

ISSUES	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
VI. GEOLOGY AND SOILS				
Would the project:				
a. Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i. Landslides?	_____	_____	_____	X
ii. Strong seismic ground shaking?	_____	_____	_____	X
iii. Seismic-related ground failure, including liquefaction?	_____	_____	_____	X
b. Result in substantial soil erosion or the loss of topsoil?	_____	_____	_____	X
c. Be located on a geologic unit or soil that is unstable, or that would become unstable as result of the project, and potentially result in on-or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?	_____	_____		X
d. Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1194), creating substantial risks to life or property?	_____	_____	_____	X
e. Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?	_____	_____	_____	X

Discussion: The proposed project sites consist of non-native grassland habitat and are located in the Breckenridge Bluffs area. Topography at the proposed project sites is relatively flat with gently sloping areas. Based on the observations from the site visit conducted by Robert A. Booher Consulting on April 17, 19, 20 and 21, May 28, 29, 30 and 31, June 25, 26, 27 and 28, August 30, and September 4, 5, 6 and 7, 2012, the slope at the proposed project sites average from 2 to 6 percent. No buildings or structures are currently present on the proposed project sites. The proposed project would not involve the construction of any permanent structures. The proposed wells on constructed level surfaces would be drilled to very shallow depths of approximately 940 feet to 990 feet (Santa Margarita Formation).

Regional Geological Setting

The proposed project is located in the Great Valley Geomorphic Province of California, which is an alluvial plain approximately 50 miles wide and 400 miles long. The Great Valley comprises

the Sacramento Valley in the north and the San Joaquin Valley in the south. The alluvial plain is composed of thousands of feet of sedimentary deposits that have undergone periods of subsidence and uplifting over millions of years. Most of the surface of the Great Valley is covered with Recent (Holocene, i.e., 10,000 years before present to present day) and Pleistocene (i.e., 10,000 to 1,800,000 years before present) alluvium. This alluvium is composed of sediments from the Sierra Nevada to the east and the Coast Range to the west that were carried by water and deposited on the valley floor. Siltstone, claystone, and sandstone are the primary types of sedimentary deposits. Surface elevations within the Great Valley generally range from several feet below mean sea level (msl) to more than 1,000 feet above msl.

The General Soil Map for Kern County Northeastern Part (2007) indicates that the general project area is located in the Chanac-Plieto area with very deep, gently sloping to very steep well drained soils the formed from alluvium derived from mixed rocks.

According to United States Department of Agriculture Natural Resource Conservation Service mapping, the soil at the proposed project area is identified as Soil Unit 185 – Brecken-Cuyama-Plieto which are deep, well drained gravely sandy loams on alluvial fans, stream terraces, and fan remnants. Available water capacity is high and runoff capacity is high. The hazard of water erosion is low.

The proposed project sites are in a seismically active region subject to future seismic shaking during earthquakes generated by active faults. There are unnamed faults (1952 earthquake fractures) in the project area (See Figure 7-Fault Map). The San Andreas Fault Cholame-Carrizo section is located approximately 53.0 miles west of the proposed project sites. It is a right-lateral strike slip fault that extends over 700 miles from the Gulf of California to Cape Mendocino in northern California. Several historic earthquakes on the San Andreas Fault zone have produced significant ground shaking in the northwestern areas of Kern County. The most notable examples is the January 9, 1857 Fort Tejon Earthquake, one of the greatest earthquakes ever recorded in the United States. The Fort Tejon Earthquake produced a surface rupture over 217 miles in length along the San Andreas Fault from Cholame on the north to the Cajon Pass area on the south. The epicenter of the Fort Tejon Earthquake was located approximately 35 miles south of the proposed project sites. This earthquake which was estimated to be near magnitude 8 produced an average slip of 15 feet and a maximum slip of 30 feet in the Carrizo Plain area. Strong shaking caused by the earthquake was reported to have lasted at least one minute. Accordingly, the proposed project would be subject to future seismic shaking and strong ground motion resulting from seismic activity along local and more distant active faults.

The proposed project sites are included within the regulatory map boundaries of an “Earthquake Fault Zone,” as defined by the State of California in the Alquist-Priolo Earthquake Fault Zoning Act. Un-named 1952 earthquake fractures are located in the Rio Bravo Ranch Quadrangle near the proposed project sites. The regulatory maps do not indicate the presence of “landslide or liquefaction zones in the project area.

Soil liquefaction is a phenomenon which can potentially occur during periods of oscillatory ground motion caused by an event such as an earthquake. The pore water in a loose, saturated granular soil and some fine grained soils increases to the point where the effective stress in the soil is zero and the soil loses a portion of its shear strength (initial liquefaction). Structures

founded on or above potentially liquefiable soils may experience bearing capacity failures, vertical settlement (both total and differential) and lateral displacement (due to lateral spreading of the ground). The factors known to influence liquefaction potential includes soil characteristics (particle size, distribution, plasticity, water content), relative density, presence or absence of groundwater, stress tensor (effective confining stresses, shear stress), and the intensity and duration of the seismic ground shaking. The granular soils most susceptible are loose, saturated sands and non-plastic silty soils located below the water table.

The potential for liquefaction at the proposed project sites are considered to be low. This is due to the absence of near surface groundwater and the generally dense subsurface materials. The California Department of Water Resources Water Data Library reported unconfined groundwater contour elevation in Well 29S29E34C001M approximately 1.2 miles west of the project area to be approximately 320-325 feet in 2009. The proposed project sites will not include any habitable structures that would expose occupants to liquefaction potential. Therefore, the impacts related to seismic-related ground failure are considered to be less than significant.

The proposed project sites are located in a relatively flat to moderate sloping topographic area, where landslides would not be expected to occur. Therefore, impacts related to landslides are not expected to occur or pose a hazard to the proposed project sites.

The topography for the proposed project sites is classified as relatively flat to moderate sloping. Each of the proposed project sites is relatively small in size, approximately 0.55 acres, and minimal grading will be required. A drainage plan will also be prepared for the proposed sites to ensure that the existing drainage patterns of the sites and areas are maintained and would not results in erosion or loss of topsoil. Therefore, these impacts are considered less than significant.

VIa. The proposed project would not expose people or structures to potential adverse effects from landslides as the project topography is relatively flat and there are no inhabited structures that would be impacted by strong seismic ground shaking, or seismic-related ground failure (including liquefaction and lateral spreading).

As described in the Regional Geological Setting Section above, there are unnamed faults (1952 earthquake fractures) in the project area (See Figure 7-Fault Map). The San Andreas Fault Cholame-Carrizo section is located approximately 53.0 miles west of the proposed project sites. The proposed project sites are included within the regulatory map boundaries of an “Earthquake Fault Zone,” as defined by the State of California in the Alquist-Priolo Earthquake Fault Zoning Act. Un-named 1952 earthquake fractures are located in the Rio Bravo Ranch Quadrangle near the proposed project sites. The regulatory maps do not indicate the presence of “landslide or liquefaction zones in the project area.

Furthermore, the proposed drill rig has a low center of gravity with heavy base sub-structures that up to smaller top member. This design, with low center of gravity, along with support cables used to additionally stabilize the tower, effectively allows the rig to with stand shaking and movement without falling over.

Project oil field equipment is designed to meet American Petroleum Institute (API) Standards as well the California Building Code (CBC) in particular Title 24, Part 2, Chapter 17. Section 1708 details structural testing for seismic resistance and seismic design category as determined in CBC Section 1613. Section 1708.4 outlines specific design compliance by referring to American Society of Civil Engineers (ASCE) ASCE 7 Chapter 13 (13.2.1 & 13.2.2) specifications and recommendations. Both API and ASCE have adopted the same recommendations regarding seismic design.

Kern County Building Code of Regulations provides oil field permit exemptions under section 17.08.060 providing compliance with API standards.

Additionally, in the event of an earthquake, the emergency response plan will be implemented to address potential releases of petroleum, produced water and other fluids. Accordingly, the proposed project will not expose people or structures to potential adverse effects from landslides, strong seismic ground shaking, or seismic-related ground failure (including liquefaction).

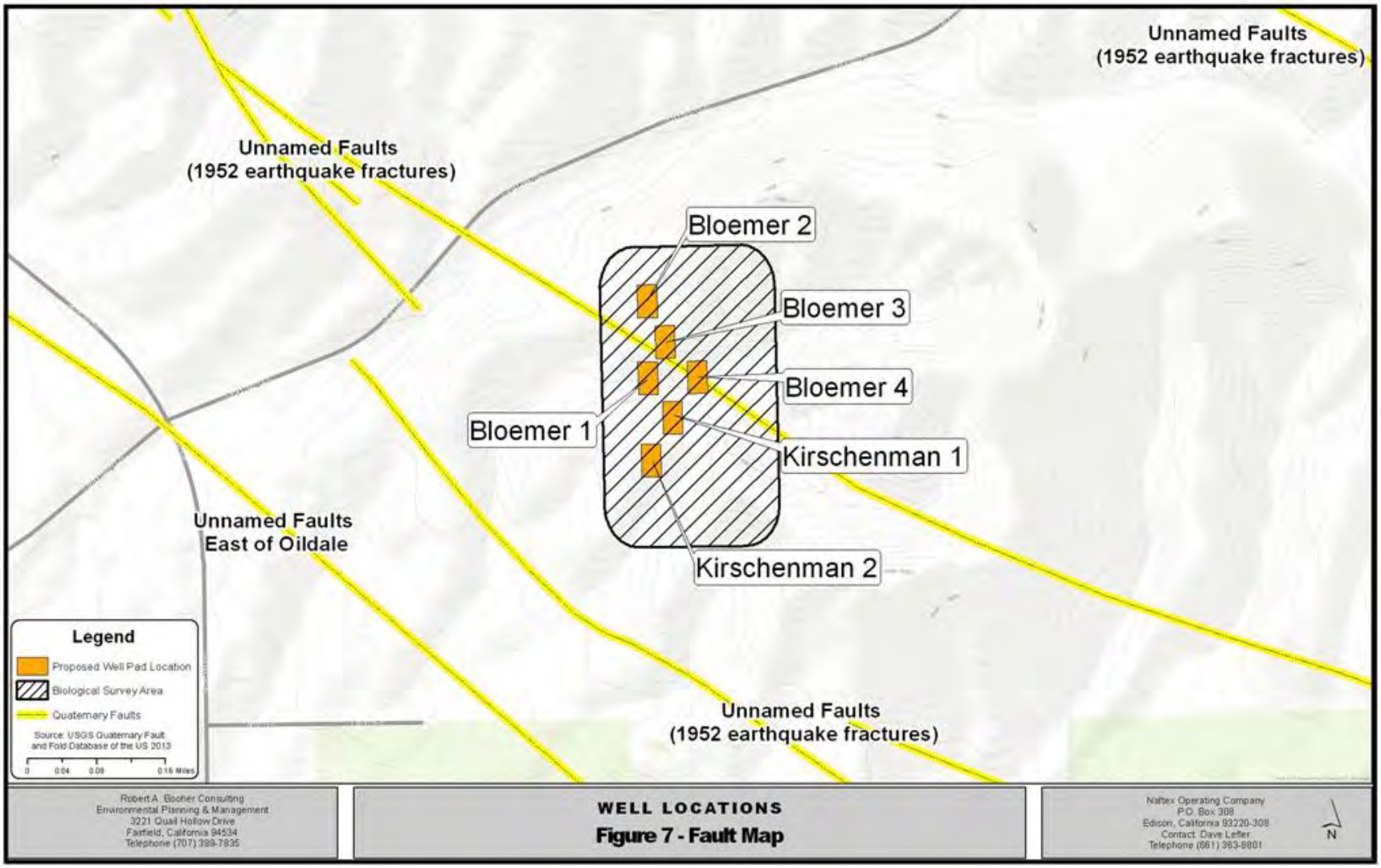
VIb. The proposed project will not result in substantial soil erosion or the loss of topsoil. The proposed project sites are relatively flat with gently sloping areas, and the existing drainage patterns will be maintained. No impact is anticipated from soil erosion or loss of topsoil.

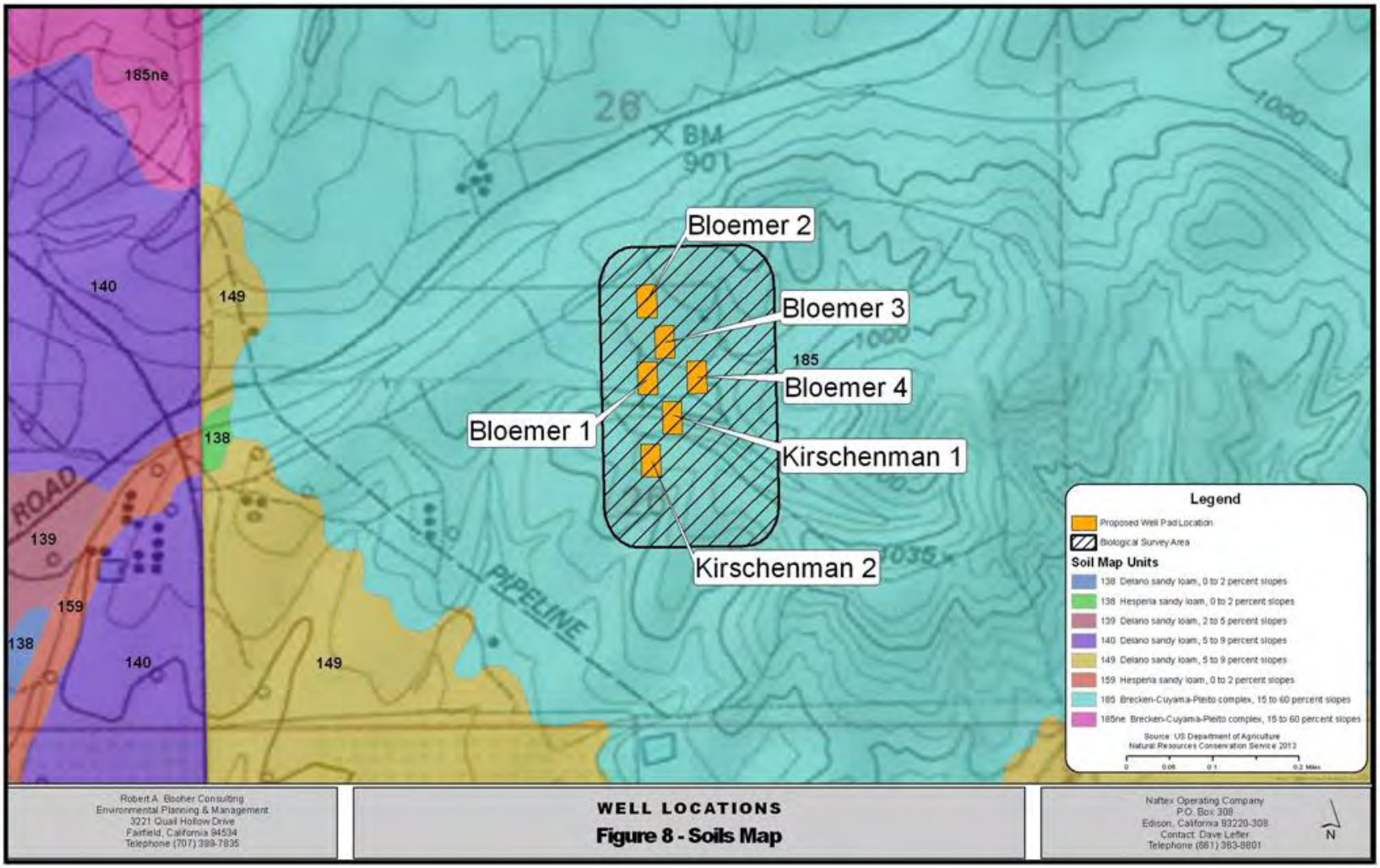
VIc. Any potential for subsidence resulting from the proposed project would be either as a result of groundwater overdraft or fluid withdrawal.

Groundwater overdraft subsidence is caused by aquifer-system compaction due to the lowering of ground-water levels by sustained ground-water overdraft. However, water would be supplied from the Naftex Racetrack Water Plant and not a local groundwater source. Accordingly water use during the site preparation and drilling phases will have no impact on subsidence as a result of groundwater overdraft.

Subsidence related to fluid withdrawal in oil operations will not be an issue due to the character and depth of the formation. The proposed wells would be drilled to target the Santa Margarita sandstone formation. Sandstone formations have porosity and permeability that allows fluids to flow through the formation in such a manner that structural stability is maintained. Unlike some areas of the softer, less dense diatomite type deposits, the formation targeted here has structural strength that is not hydration dependent for structural stability. Accordingly, based on the geological formation and target location the wells would have no impact on subsidence due to fluid withdrawal.

Topography in the proposed project area is relatively flat. Additionally, there are no identified landslide or mudslide hazards within the Breckenridge Hills Specific Plan Area. (Ref: adapted from page E-2 the Breckenridge Hills Specific Plan, Kern County, October 9, 1989) No buildings or structures are currently present or proposed


Unnamed Faults
(1952 earthquake fractures)
Unnamed Faults
(1952 earthquake fractures)
Bloemer 2
Bloemer 3
Bloemer 4
Bloemer 1
Kirschenman 1
Kirschenman 2
Unnamed Faults
East of Oildale
Unnamed Faults
(1952 earthquake fractures)
Legend
Proposed Well Pad Location
Biological Survey Area
Quaternary Faults
Source: USGS Quaternary Fault and Fold Database of the US 2013
0 0.04 0.08 0.16 Miles
Robert A. Booher Consulting
Environmental Planning & Management
3221 Quail Hollow Drive
Fairfield, California 94534
Telephone (707) 399-7835
WELL LOCATIONS
Figure 7 - Fault Map
Naftex Operating Company
P.O. Box 308
Edison, California 93220-308
Contact: Dave Leffler
Telephone (661) 363-8801
N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Bloemer 2
Bloemer 3
Bloemer 4
Kirschenman 1
Kirschenman 2
Legend
Proposed Well Pad Location
Biological Survey Area
Soil Map Units
138 Delano sandy loam, 0 to 2 percent slopes
138 Hesperia sandy loam, 0 to 2 percent slopes
139 Delano sandy loam, 2 to 5 percent slopes
140 Delano sandy loam, 5 to 9 percent slopes
149 Delano sandy loam, 5 to 9 percent slopes
159 Hesperia sandy loam, 0 to 2 percent slopes
185 Brecken-Cuyama-Pleito complex, 15 to 60 percent slopes
185ne Brecken-Cuyama-Pleito complex, 15 to 60 percent slopes
Source: US Department of Agriculture
Natural Resources Conservation Service 2013
0 0.05 0.1 0.2 Miles
Robert A. Booher Consulting
Environmental Planning & Management
3221 Quail Hollow Drive
Fairfield, California 94534
Telephone (707) 399-7835
WELL LOCATIONS
Figure 8 - Soils Map
Naftex Operating Company
P.O. Box 308
Edison, California 93220-308
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Telephone (661) 363-8801
N

on the any of the proposed project sites. During ongoing production activities, the proposed project sites would be un-manned. Therefore, no impacts are expected.

VId. The proposed project sites are underlain by Soil Unit 185 – Brecken-Cuyama-Plieto which are deep, well drained gravely sandy loams on alluvial fans, stream terraces, and fan remnants. Available water capacity is high and runoff capacity is high. The hazard of water erosion is low. These soil types consist of non-expansive gravelly sandy loam. Due to the loamy content in the soil along with proper moisture conditioning during compaction activities, these soils are not considered expansive. Therefore, there would be no impacts due to expansive soils.

VIe. The proposed project does not involve the construction of any facilities requiring the use of septic tanks or any waste disposal systems. Production water is the only potential wastewater that would be generated during project activities, and production water would be transported by flowlines to Naftex's Section 26 Tank Farm and will be disposed of in Naftex's Racetrack 76-27, 77-27 or 86-27 water disposal wells, Division permitted Class II disposal wells. Naftex anticipates that 90 barrels (3,780 gallons) of production water a day would be generated at each of the well sites that are put into production.

Conclusion: No impact.

Mitigation Measures: No impact identified. No mitigation necessary.

References:

Department of Conservation, California Geological Survey, *Probabilistic Seismic Hazards Mapping Ground Motion Page*.
Website: http://redirect.conservation.ca.gov/cgs/rghm/pshamap/pshamap.asp

Department of Conservation, California Geological Survey, *Alquist-Priolo Earthquake Fault Zone Maps*.
Website: http://www.quake.ca.gov/gmaps/ap/ap_maps.htm

Page E-2 the Breckenridge Hills Specific Plan, Kern County, October 9, 1989

Soil Survey of Kern County, Northeastern Part, Natural Resources Conservation Service, USDA – websites - 1) http://soildatamart.nrcs.usda.gov/manuscripts/CA666/0/kern.pdf, and 2) http://soildatamart.nrcs.usda.gov/manuscripts/CA666/0/map5.pdf.

Kern County Planning Department, Lost Hills Solar by NextLight, Notice of Draft Environmental Impact Report, March 2010 -
http://www.co.kern.ca.us/planning/pdfs/notices/lost_hills_solar_nop.pdf

http://www.quake.ca.gov/gmaps/WH/regulatorymaps.htm

http://gmw.consrv.ca.gov/shmp/download/quad/RIO_BRAVO_RANCH/maps/RIOBRVO_RCH.PDF

http://www.water.ca.gov/waterdatalibrary/

http://www.water.ca.gov/waterdatalibrary/groundwater/hydrographs/report_html.cfm?wellNumber=29S29E34C001M

ISSUES	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
VII. GREENHOUSE GAS EMISSIONS				
Would the project:				
a. Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?	_____	_____	X	_____
b. Conflict with any applicable plan, policy, or regulation of an agency adopted for the purpose of reducing the emissions of greenhouse gases?	_____	_____	X	_____

Discussion: Global warming refers to an increase in the earth's average temperature as a result of increased concentration of greenhouse gases (GHG) in the atmosphere. GHGs include any gas that absorbs infrared radiation in the atmosphere. GHGs include water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), halogenated fluorocarbons (HCFCs), ozone (O_3), perfluorinated carbons (PFCs), hydrofluorocarbons (HFCs), and sulfur hexafluoride (SF_6).

Over the past decades, there is growing evidence of increase temperatures and increased concentrations of GHGs in the atmosphere. In response to the possibility that the increased temperatures are a result of human activity, the California Environmental Protection Agency (CalEPA), California Air Resources Board (CARB) and local governments have enacted regulations aimed at curbing GHG emissions. Several of these regulations are listed below.

- Revisions to the Clean Air Act (USEPA) affecting Title V and Prevention of Significant Deterioration (PSD) Sources (Tailoring Rule)
- Mandatory Reporting of GHG Emissions (CalEPA and CARB)
- CEQA Guidelines (California SB 97)
- Statewide GHG Reductions (California AB-32)

The current project would be exempt from permit requirements under the Title V or PSD programs as the annual emissions of criteria air pollutants are below 100 tons per year. The project would also be exempt from mandatory state and federal reporting since annual emissions are below 25,000 tons per year.

The project is subject to the December 2009 amended CEQA Guidelines Sections 15064 and 15064.4. These sections address the determination of significance of impacts from greenhouse gas emissions from a project as well as cumulative impacts. The updated CEQA Guidelines assert that a project would not have a significant impact either at a project level or cumulatively if the project complies with a previously approved plan or mitigation.

On December 17, 2009, SJVAPCD adopted District Policy for addressing GHG emissions and impacts. This policy was for both the District and other lead agencies when addressing GHG impacts. This policy does not recommend the use numerical thresholds. Instead, it advocates that projects comply with other emission reduction plans under AB 32. Projects complying with such plans are considered to have less than significant impact on global climate change. Under such a scenario, impacts will be considered less than significant individually and cumulatively.

IIa,b. RAB Consulting prepared emissions calculations to determine GHGs emitted by the proposed project. GHG emissions were estimated using Road Construction Emissions Model, Version 6.3.2 software, which is recommended by the SJVAPCD for use in calculating air emissions for this type of project. This program determined that CO_2 would be released from the project. In addition to CO_2, trace amounts of N_20 and CH_4 would also be released during the fuel combustion process. However, these constituents would contribute less than 1% to the overall GHG budget.

Fugitive emissions from well components such as, tanks, valves, flanges, pumps, etc. are subject to SJVAPCD's Rule 4409. This Rule requires regular inspection and maintenance of well components. The emission rate of fugitive emissions is extremely low. Typically, the emission rates of VOCs are 0.00000005 kg/hour as noted in the EPA guidance leak detection and repair. Available at: http://www.epa.gov/ttnchie1/efdocs/equiplks.pdf

GHG emissions for the project were estimated based on lists of equipment for each phase of the project and the corresponding assumptions provided by Naftex. Equipment proposed for use during the proposed project and corresponding assumptions are found in Tables 4, 5, 6, 7, 8 and 9 in Section III, Air Quality.

Table 16 summarizes the tons per year of GHG emissions that could be produced during the site preparation, drilling, completion, production, and plugging and abandonment phases of the proposed project. A total of 319.7 tons of GHGs would be emitted if all wells are completed through all phases of the project.

Table 16
Summary of Greenhouse Gas Emissions

	CO_2			CO_2(e)	
	1 Well	All Wells	Ratio[1]	1 Well	All Wells
Project Phase	*(ton/yr)*	*(ton/yr)*	*CO2(e)/CO2*	*(ton/yr)*	*(ton/yr)*
Site Preparation	2.50	15	1.0034	2.51	15.1
Drilling Phase	31.6	189.6	1.0034	31.7	190.2
Completion Phase	5.3	31.8	1.0034	5.32	31.9
Installation of Production Equipment	5.2	31.2	1.0034	5.22	31.3
Production Phase	3.2	19.2	1.0034	3.51	19.3
Plugging and Abandonment Phase	5.3	31.8	1.0034	5.32	31.9
Project Totals	53.1	318.6		53.6	319.7

1 - See Attachment B for calculation of the CO2(e)/CO2 Ratio

Significance of GHG Emissions

Naftex is a private company engaged in drilling and production of oil and gas resources in California. As a company, Naftex is subject to and compliant with Cap and Trade regulations. Cap and Trade is has been adopted in California for reducing GHG emissions from certain industries, such as oil and gas drilling and production.

Compliance with Cap and Trade regulations specifically allow for growth in emissions from individual projects as long as there is an overall reduction in emissions. As a result, emissions of GHG emissions from the current project would be fully mitigated.

Conclusion: Impacts resulting from GHG generation will be less than significant.

Mitigation Measures: No significant impact identified. No mitigation necessary.

References:

San Joaquin Valley Unified Air Pollution Control District, Final Draft *Addressing Greenhouse Gas Emission Impacts Under the California Environmental Quality Act. (*December 2009*)* Website: http://www.valleyair.org/programs/CCAP/12-17-09/1%20CCAP%20-%20FINAL%20CEQA%20GHG%20Staff%20Report%20-%20Dec%2017%202009.pdf

San Joaquin Valley Unified Air Pollution Control District, *Guidance for Valley Land-use Agencies in Addressing GHG Emission Impacts for New Projects under CEQA,(*December 2009)

Website: http://www.valleyair.org/Programs/CCAP/12-17-09/3%20CCAP%20-%20FINAL%20LU%20Guidance%20-%20Dec%2017%202009.pdfGas Emissions under the California Environmental Quality Act"

San Joaquin Valley Unified Air Pollution Control District, *Rule 2280 Portable Equipment Registration*
Website: http://www.valleyair.org/rules/1ruleslist.htm

EPA Standards for Non-Road Diesel Engines
The engines must comply with federal 40 CFR 1068 requirements. Tier 3 and older engines must comply with 40 CFR 89. Newer engines (Tier 4) must comply with 40 CFR 1039. We note that compliance with these requirements is handled by the engine manufacturer before the engines can be sold in California.

CARB Standards
The engines must meet CARB standards as regulated in the California Code of Regulations, Sections 2421 to 2427 of Title 13, Division 3, Chapter 9, Article 4.

ISSUES	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
VIII. HAZARDS & HAZARDOUS MATERIALS				
Would the project:				
a. Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	_____	X	_____	_____
b. Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?	_____	X	_____	_____
c. Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?	_____	_____	_____	X
d. Be located on a site which is included on a list of hazardous materials compiled pursuant to Government Code Section 65962.5 and, as a result, would create a significant hazard to the public or the environment?	_____	_____	_____	X
e. For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?	_____	_____	_____	X
f. For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?	_____	_____	_____	X
g. Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	_____	_____	_____	X
h. Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?	_____	_____	_____	X

Discussion: The proposed project sites are located on annual grassland habitat. Project activities with the exception of production require minimal transportation, use or storage of hazardous materials including fuels, oils, lubricants, hydraulic fluids and solvents used at each of the proposed project sites. All hazardous materials will be transported and stored according to the following applicable federal, state and local regulations:

Federal:
- Clean Water Act
- Resource Conservation and Recovery Act – 40 Code of Federal Regulations (CFR) Parts 240-299
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
- National Oil and Hazardous Substances Pollution Contingency Plan
- Spill Prevention, Control, and Countermeasures Plan – 40 CFR Part 112
- Occupational Safety and Health Standards (Title 29 CFR Parts 1910 and 1926)

State:
- Porter-Cologne Water Quality Control Act (Porter-Cologne) (Cal. Water Code, § 13000 et seq.)
- Hazardous Waste Control Law, California Health and Safety Code Sections 25100-25249
- California Health and Safety Code Sections 25359.60-25395.106 and Sections 25395.110-25395.119

Local:
- Kern County General Plan, Safety Element
- Kern County Hazardous Waste Management Plan
- Kern County Emergency Operations Plan
- Kern County Multi-Hazard Mitigation Plan

Portable tanks and mud pits will be used for mixing and storing drilling fluids. All fluids will be disposed of in accordance with the requirements of the Central Valley Regional Water Quality Control Board (RWQCB). If a reserve pit/sump is used, the use and closure of the reserve pit/sump will be handled in accordance with Title 27, CCR, Section 20090(g), and Regional Board Waiver Resolution No. R5-2008 - 0182.

If economic quantities of oil are discovered, a given well will be completed and production equipment including a well head and API 10 hp electronic motor pumping unit will be installed on site. Flowlines will be installed aboveground adjacent to the proposed new access roads. The proposed flowlines will connect the proposed wells to existing pipeline infrastructure located west of the proposed Bloemer 1 well site. The proposed flowlines will be installed on sleepers to avoid impacts to small mammal burrows. Naftex proposes to paint all production equipment in camouflage or an earthen tone to blend in with the environment and to prevent glare. Naftex estimates that approximately three (3) days would be required for flow line installation activities. Naftex anticipates 10 barrels of oil and 90 barrels of production water will be produced daily from each well. The oil will be transported from the wells through flow lines to Naftex's Section

26 Tank Farm and sold to a local refinery. The production water will be transported to Naftex's Section 26 Tank Farm and will be disposed of in Naftex's Racetrack 76-27, 77-27 or 86-27; Division permitted Class II disposal wells. Each of the production sites will be inspected by Naftex personnel daily.

VIIIa. There is potential for accidental releases of hazardous materials during project operations, also including a potential for an accidental release during drilling operations if there were a blowout; however, as required by Division regulations (CCR §1722.2-§1724.10) surface casing will be set, cemented, and blowout prevention equipment will be installed at each of the wellheads and tested to minimize the potential releases associated with blowouts. Potential impacts associated with the accidental release of these materials depend on the quantity and type, the location where it is used, the toxicity or other hazardous characteristics of the material, and whether it is transported, stored, and used in a solid, liquid, or gaseous form. Naftex has an existing Spill Contingency Plan in accordance with CCR § 1772.9 on file with the Division. The Spill Contingency Plan will be amended to include the proposed project sites and a copy of the plan shall be kept on site. The plan discusses methods to avoid and/or minimize impacts in the event of a release. The purpose of the plan is to ensure that adequate containment will be provided to control accidental spills, that adequate spill response equipment and absorbents will be readily available, and that personnel will be properly trained in how to control and clean up any spills.

Due to implementation of the standard preventive and mitigation measures presented below, the proposed project will not impact the public or the environment through the routine transport, use, or disposal of hazardous materials.

VIIIb. See VIIIa.

VIIIc. No existing or proposed schools are located within one-quarter mile of the proposed project sites. The nearest school to the proposed project sites is the Edison Middle School located at 721 South Edison Road, Bakersfield, California 93307 and is approximately 3.5 miles southwest of the proposed project sites. Therefore, the proposed project would not have the potential to emit hazardous emissions or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school. There is no impact.

VIIId. The proposed project sites are not located on listed hazardous material sites compiled pursuant to Government Code section 65962.5. Therefore, the proposed project would not create a significant hazard to the public or environment.

VIIIe,f. The nearest public airport is the Bakersfield Municipal Airport (2000 S Union Ave., Bakersfield, CA 93307) located approximately 9.8 miles southwest of the proposed project sites. Therefore, the proposed project sites would not result in a safety hazards for people residing or working in the project area related to public airport activities.

VIIIg. Implementation of the proposed project will not impair or physically interfere with the implementation of any existing and/or adopted emergency response plans or emergency evacuation plans for the local area.

VIIIh. The proposed project is not located in a wildlands area or adjacent to urbanized areas or where residences are intermixed with wildlands. There are no existing structures in the project areas. No permanent structures are proposed as part of the project. Therefore, the proposed project would not increase fire risk in wildland areas. Fire protection is provided by the Kern County Fire Department and its Fire Station No. 45 located at 11809 Edison Highway is approximately 3 miles from the proposed project sites.

Conclusion: Mitigation measures shall reduce any potential impacts relative to hazards and hazardous materials to a level of less than significant.

Mitigation Measures: The following mitigation measures will be implemented to avoid and/or minimize potential impacts resulting from hazards or hazardous materials:

Hazards 1 - All hazardous materials such as diesel fuel shall be stored according to the California Code of Regulations (CCR) Title 22, 23, 26 & 27 and California Fire Codes (CFR) Title 24 and Kern County hazardous materials ordinance and Material Safety Data Sheets shall be on the site. Waste materials shall be managed properly in accordance with requirements that comply with, or are authorized by, the Code of Federal Regulations (40 CFR) and refined in California through CCR, Title 14, 22, 23, 26 & 27. Training shall be provided to all personnel involved in handling of hazardous materials/waste.

Hazards 2 - In order to minimize potential impacts associated with a blowout, Naftex shall comply with CCR Title 14, Division 2, Chapter 4, Articles 3 and 4, specifically Article 4, 1941-1942. Requirements for well casing design and blowout prevention equipment are regulated by the Division. Division engineers shall be notified for required tests and other operations.

Hazards 3 - All above ground storage tanks will be located within a bermed area which provides a storage volume of at least 110% of the storage volume of the largest tank. Daily inspections of the above ground storage tanks will be conducted and an inspection log will be maintained for review by regulatory agency personnel. The inspection log will also document corrective actions taken, if necessary.

Hazards 4 - Fluid disposal shall follow RWQCB regulations (CCR Title 23 Waters).

Hazards 5 - If project development uncovers any previously unknown oil, gas, or injection wells, the Division shall be notified. If unrecorded wells are uncovered during excavation or grading, remedial plugging operations may be required.

References:

Central Valley Regional Water Quality Control Board, *Laws and Regulations*
Website: http://www.waterboards.ca.gov/centralvalley/laws_regulations/

California State Water Resources Control Board, *Geotracker*
Website: http://geotracker.waterboards.ca.gov

California Department of Forestry and Fire Protection, *Kern County FHSZ Maps*
Website: http://www.fire.ca.gov/fire_prevention/fhsz_maps/fhsz_maps_kern.php and

California Department of Conservation, Division of Oil, Gas, and Geothermal Resources, *Publications: Laws and Regulations*
Website: http://www.conservation.ca.gov/dog/pubs_stats/Pages/law_regulations.aspx

California Code Regulations
Website: *http://www.oal.ca.gov/ccr.htm*

ISSUES	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
IX. HYDROLOGY AND WATER QUALITY				
Would the project:				
a. Violate any water quality standards or waste discharge standards?	_____	_____	_____	X
b. Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?	_____	_____	_____	X
c. Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on-or off-site?	_____	_____	_____	X
d. Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on-or off-site?	_____	_____	_____	X
e. Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?	_____	X	_____	_____
f. Otherwise substantially degrade water quality?	_____	_____	_____	X
g. Place housing within a 100-year flood hazard area?	_____	_____	_____	X
h. Place within a 100-year flood hazard area structures which would impede or redirect flood flows?	_____	_____	_____	X
i. Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?	_____	_____	_____	X
j. Inundation by mudflow?	_____	_____	_____	X

Discussion: The proposed project sites are located within the Kern Bluffs Watershed. (Ref: California Department of Conservation Watershed Portal- Kern Bluffs) Implementation of the proposed project would not alter current drainage patterns in the project area. It is anticipated that approximately 3,500 barrels (147,000 gallons) of treated production water from the Naftex Racetrack Water Plant would be needed for the drilling and site construction operations of each well. All water required during implementation of drilling would be imported to the proposed project sites from Naftex's Racetrack Water Plant which has existing water entitlements.

IXa. The project area does not conflict with applicable water quality and waste discharge standards relating to hydrology and water quality. The project would comply with all requirements established by the Central Valley Regional Water Quality Control Board (CVRWQCB). CVRWQCB Waiver Resolution No. R5-2008-0182 waives the requirement to file a Report of Waste Discharge and/or issue Waste Discharge Requirements for the temporary discharge of drilling mud to a sump (pit). Resolution No. R5-2008-0182 includes several conditions such as a sump design must assure no overflow; drilling mud can remain in a sump only if it can be demonstrated to be non-hazardous; drilling mud in a sump must be dried by evaporation or pumping; and, the site must be restored to pre-sump conditions and the area shall be restored within 60 days of completion of a well. The solids that may accumulate in the mud pits/tanks can be reused if it is demonstrated that they are nonhazardous. If any waste tests positive as a hazardous waste it would be disposed of at the Clean Harbors Buttonwillow, LLC, located at 2500 West Lokern Road, Buttonwillow, CA, 93206. The Clean Harbors Buttonwillow, LLC a licensed Class 1, 2 and 3 disposal site. This facility is permitted to receive up to 10,482 tons/day (*Active Landfills Profile*, www.calrecycle.ca.gov).

As previously stated, the documented depth in the area to the first encountered groundwater is 320 feet to 325 feet. As a result, groundwater is not expected to be encountered during site preparation or other project surface activity and operations. However, in the unlikely event that shallow ground water is encountered while constructing the sump, drilling mud shall be contained in aboveground tanks. The project will not cause direct or indirect wastewater discharges that will result in an exposure to levels of hazardous materials that will adversely affect human health, wildlife or plant species. The project would comply with all water quality and waste discharge standards established by CVRWQCB.

IXb. Naftex shall follow all applicable statutes and regulations; therefore, the project would not degrade groundwater quality or interfere with groundwater recharge, or deplete groundwater resources in a manner that would cause water-related hazards such as subsidence. Water would be purchased from a local water source and no new entitlements will be required. In compliance with Division regulations, California Code of Regulations (CCR) Title 14 Division 2, Chapter 4, Articles 3, Naftex shall install and cement surface casing to prevent blowouts and contamination of fresh water aquifers. Division regulations specify that the base of fresh water must be protected with cemented casing to prevent any contamination from migrating fluids

encountered in oil and gas zones. The regulations also specify that oil and gas zones must be protected with cemented casing to prevent any contamination from infiltrating water. Division engineers review the drilling and completion operations to ensure these requirements have been met. As previously stated, the documented depth in the area to the first encountered groundwater is 320 feet to 325 feet. Produced water generated during the production phase of the project will be transported by flowlines to Naftex's Section 26 Tank Farm and will be disposed of in Naftex's Racetrack 76-27, 77-27 or 86-27 water disposal wells, Division permitted Class II disposal wells. Therefore, the project would not be expected to substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level.

IXc,d. Even though the total area of disturbance exceeds 1.0 acre and compliance with the General Permit to Discharge Storm Water with Construction Activity (Order No. 2009-0009-DWQ) is required; the project would not alter the current drainage pattern of the proposed project in a manner that would promote flooding, erosion or siltation either on or off the sites. The project would maintain existing agricultural drainage patterns. The project would create minimal runoff as the drill sites are approximately 0.55 acres in size and are not completely impervious. However, as there are no existing or planned stormwater drainage systems, the capacity of these systems cannot be exceeded.

IXe. There are no existing or planned stormwater drainage systems; therefore the capacity of these systems cannot be exceeded. The total project area of disturbance is greater than one (1) acre. The calculated rainfall erosivity factor (R-factor) for the proposed project is 0.34. As the calculated R-factor is less than 5, Naftex will be required to submit a Notice Of Intent (NOI) to the State Water Resources Control Board for a erosivity waiver certification for the proposed project. Accordingly, Naftex will not be required to prepare and submit a Storm Water Pollution Prevention Plan to comply with the terms of the General Permit to Discharge Storm Water with Construction Activity (Order No. 2009-0009 DWQ).

IXf. See IXa-e.

IXg. The proposed project sites are not located within the 100 year or 500 year flood zone plain. (Ref. Kern County Flood Plain Dam Inundation Areas - Kern Master Environmental Resource 2004 and Maps ID 06020C186E and 06029C1865E (Ref: www.fema.gov). There are no housing structures located in the proposed project sites.

IXh. The proposed project sites are not located within the 100 year flood zone (Maps ID 06020C186E and 06029C1865E, www.fema.gov). There are no permanent structures proposed. Portable drilling equipment would be temporarily located on the proposed

project sites during the drilling phase and a well head and API 10 hp electronic motor pumping unit would be installed for the production phase. Accordingly, there are no structures which would impede or redirect flood flows.

IXi. The proposed project sites are not located within the 100 year flood zone. The closest dam to the proposed project sites is the Brite Valley Dam and it is located 25 miles to the southeast of the proposed project sites. Based upon the result of site visits conducted by Robert A. Booher Consulting on April 17, 19, 20 and 21, May 28, 29, 30 and 31, June 25, 26, 27 and 28, August 30, and September 4, 5, 6 and 7, 2012, there were no levees observed within two miles of the proposed project site. Accordingly, the project as proposed will not expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam.

IXj. The project area is relatively flat with gently sloping areas. The proposed project sites will be flat when constructed eliminating the possibility of mudflow. No evidence of past mudflows was observed within or adjacent to the proposed project area.

Conclusion: Mitigation measures shall reduce any potential impacts relative to hydrology and water quality to a level of less than significant.

Mitigation Measure: The following mitigation measure will be implemented to reduce any potential impacts relative to hydrology and water quality:

Hydrology 1 – Naftex will provide a copy of the submitted NOI and verification of an approved erosivity waiver from the SWRCB to the Division prior to initiation of the project.

References:

Calflora, *Watersheds in Kern County*
Website: http://www.calflora.org/app/wgh?page=wcprofile&cc=KRN

California Department of Resources, Recycle, and Recovery, *Active Landfills Profile*
Website: www.calrecycle.ca.gov

California Department of Water Resources, *Water Data Library*
Website: http://www.water.ca.gov/waterdatalibrary/

Federal Emergency Management Agency, *Map Service Center, Map ID 06020C186E and 06029C1865E* Website: http://www.fema.gov/national-flood-insurance-program-flood-hazard-mapping

Kern Council of Government, *Flood Plain & Dam Inundation Areas* –
Website: http://www.kerncog.org/maps/MEAR_atlas/21FloodPlainandDamInnundationAreas.pdf)

ISSUES	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
X. LAND USE AND PLANNING *Would the project:*				
a. Physically divide an established community?	_____	_____	_____	X
b. Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?	_____	_____	_____	X
c. Conflict with any applicable habitat conservation plan or natural community conservation plan?	_____	_____	_____	X

Discussion: Primary land use for the proposed project area is agriculture and ranching. Additional land uses in the area include drilling, production and transportation of oil. The proposed project sites are located on property designated as Resource Extensive Agriculture (R-EA) on the Kern County General Plan land use map. According to conversations with David Press with the Kern County Planning Department, mineral, aggregate, and petroleum exploration and extractions are acceptable uses with R-EA designated property. The proposed project is consistent with the land use and zoning designation for the area. The Kern County General Plan Land Use, Open Space and Conservation Element states that petroleum exploration and extraction are consistent uses with agricultural designations.

The proposed project area is zoned Exclusive Agriculture (A). The project is consistent with the Exclusive Agriculture (A) zoning designations per Kern County, California Municipal Code Chapters 19.12.020 and 19.98.020 which include oil drilling and production as a permitted use. The proposed project is consistent with existing land uses.

Xa. The proposed project sites would not physically divide an established community as the proposed project sites are located in un-incorporated agricultural area, 2.9 miles northeast of Edison.

Xb. The proposed project is consistent with the land use and zoning designation for the area, and is therefore considered consistent with associated agricultural resource planning purposes and General Plan requirements. The Kern County General Plan Land Use, Open Space and Conservation Element states that petroleum exploration and extraction are consistent uses with agricultural designations. Additionally, the project is temporary in nature and compatible with agricultural usage in accordance with the Kern County Ordinance Code (July 2003), Chapter 19.98 “Oil and Gas Production.”

Xc. There are no adopted Habitat Conservation Plans, Natural Community Conservation Plans or other approved local, regional, or state habitat conservation plans in the project area.

Conclusion: No impact to land use and planning.

Mitigation Measures: No impacts identified. No mitigation necessary.

References:

Kern County *General Plan 2009*
Website: http://pcd.kerndsa.com/planning/planning-documents/general-plans

Kern County, Zoning Ordinance
Website: http://www.co.kern.ca.us/planning/pdfs/KCZOJul12.pdf

California Department of Fish and Wildlife**.** *Conservation and Mitigation Banks in California Approved by the Department of Fish and Wildlife***.**
Website: http://www.dfg.ca.gov/habcon/conplan/mitbank/catalogue/

United States Fish and Wildlife Service. *Conservation Plans and Agreements Database*.
Website: http://ecos.fws.gov/conserv_plans/public.jsp

ISSUES	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
XI. MINERAL RESOURCES				
Would the project:				
a. Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	_____	_____	_____	X
b. Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?	_____	_____	_____	X

Discussion: Kern County serves as an important regional source of oil and natural gas. Oil facilities and transmission pipelines are located throughout the general project area. According to the Division Online Mapping System, the proposed project sites are located adjacent to the eastern edge of the Edison Oil Field. According to Division records, there are approximately 1,122 active wells, 614 plugged wells, 851 unknown wells, 117 idle wells and 83 new wells within six miles of the proposed project sites (Figure 9). According to DOMS, the closest classified active well, the Naftex Mitchell 16 is located 0.05 miles to the west of the proposed Bloemer 1 project site (Figure 9). No other mineral resources have been identified within six miles of the proposed project sites.

The proposed project sites are located in the MRZ-3 Zone (areas containing mineral deposits the significance of which cannot be evaluated from available data) as identified in Special Report 147 and the updated Special Report 210 for the Bakersfield Production-Consumption Region; however, the proposed project would not preclude the future evaluation of this potential resource.

The objective of this project is to identify and develop further mineral resources. If successful, its impacts will enhance rather than negatively impact the realization of the values and policies protected by this specific point of inquiry. If the project is not successful, the well or wells will be plugged and abandoned, and the site restored, with no negative impact on this point.

The proposed project is consistent with the Kern County Land Use, Open Space and Conservation Element of the Kern County General Plan. The Kern County General Plan Land Use, Open Space and Conservation Element states that petroleum exploration and extraction are consistent uses with agricultural designations. Additionally, the project is consistent with agricultural usage in accordance with the Kern County Ordinance Code (July 2003), Chapter 19.98 “Oil and Gas Production.”

XIa,b. The proposed project will not result in the loss of availability of a known mineral resource, or the loss of a locally important mineral resource recovery site.

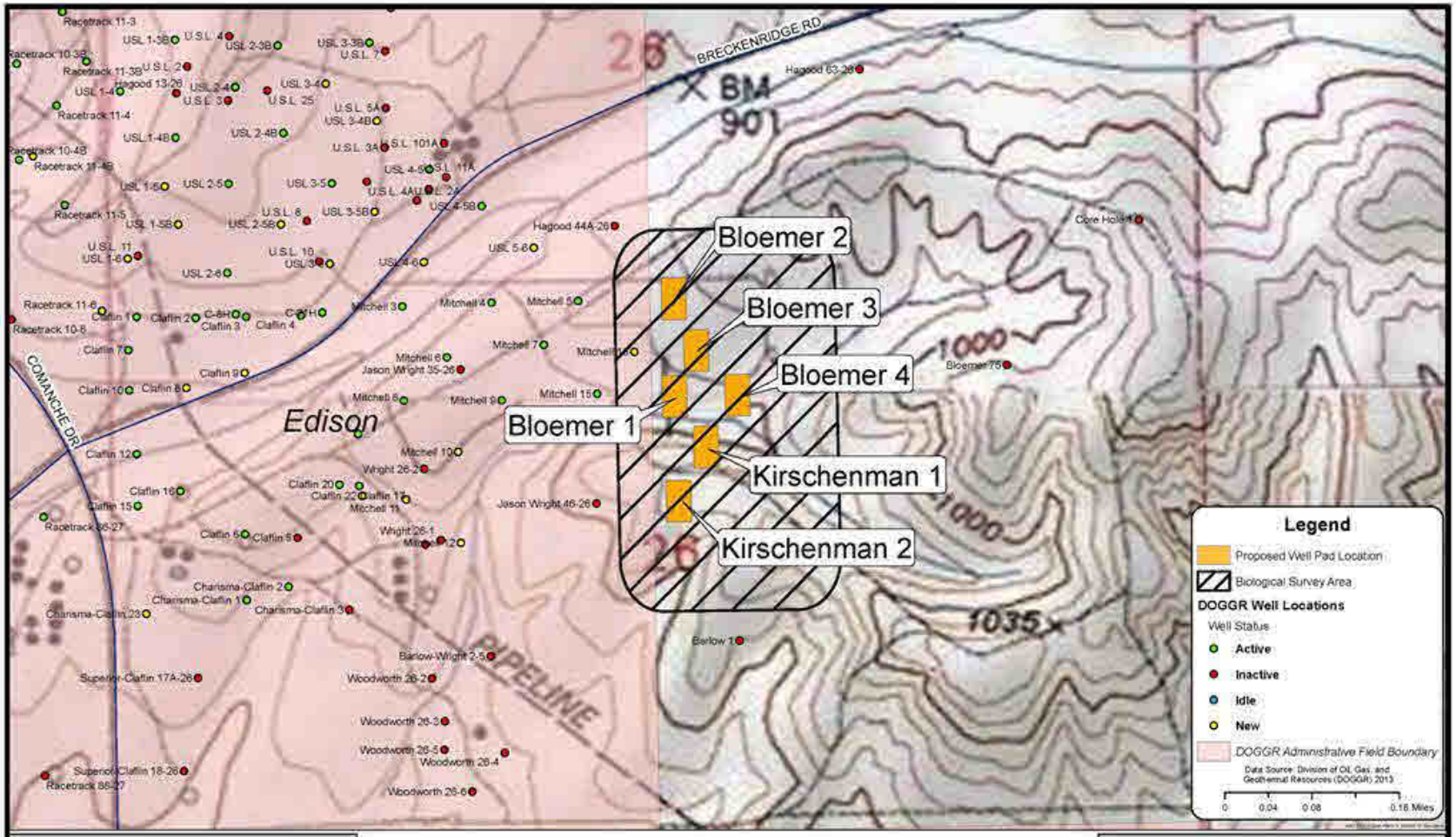
Conclusion: No impact to mineral resources.

Mitigation Measures: No impacts identified. No mitigation necessary.

References:

Kern County *General Plan 2009*
Website: http://pcd.kerndsa.com/planning/planning-documents/general-plans

Kern County, Zoning Ordinance
Website: http://www.co.kern.ca.us/planning/pdfs/KCZOJul12.pdf



Robert A. Booher Consulting
Environmental Planning & Management
3221 Quail Hollow Drive
Fairfield, California 94534
Telephone (707) 399-7835

WELL LOCATIONS

Figure 9 - Division Well Locations

Naftex Operating Company
P.O. Box 308
Edison, California 93220-308
Contact: Dave Lefler
Telephone (661) 363-8801

ISSUES	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
XII. NOISE				
Would the project:				
a. Exposure of people to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	_____	_____	X	_____
b. Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?	_____	_____	X	_____
c. A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?	_____	_____	_____	X
d. For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?	_____	_____	_____	X
e. For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?	_____	_____	_____	X

Discussion: The proposed project is compatible with existing land uses in the project area and areas immediately adjoining the project parcel.

Drilling and completion activities will result in short term noise impacts and would use the following types of equipment: drilling equipment, truck-mounted crane, pumps, pneumatic tools, loaders, and a variety of miscellaneous equipment including air compressors. The number and type of equipment used during drilling and completion activities will vary from day to day.

The U.S. EPA has found that the noisiest equipment types operating at construction sites typically range from 88 dBA to 101 dBA at a distance of 50 feet. *Table 17: Noise Levels Generated by Construction Equipment* below lists noise levels typically generated by construction equipment.

TABLE 17
Noise Level Generated by Construction Equipment

Type of Equipment	Typical Sound Level (dBA at 50 feet)
Pump	76
Generator	76
Air Compressor	81
Concrete Mixer (truck)	85
Pneumatic Tools	85
Backhoe	85
Excavator	86
Dozer	87
Front-End Loader	88
Dump Truck	88
Jack Hammer	88
Scraper	88
Pavers	89
Pile Driver	101

Sources: *U.S. Environmental Protection Agency, 1974; Noise Control for Building and Manufacturing Plants, BBN Layman Miller Lecture Notes, 1987.*

In order to determine typical sound levels associated with oil well drilling operations, Robert A. Booher Consulting conducted a sound survey on November 18, 2005 of Kenai Rig #38 using a Metrosonics 3080 Metrologger, Portable Audio Dosimeter. At the time of the survey, Kenai Rig #38 was drilling a natural gas well in Sutter County, California. Weather conditions at the time were clear with little to no wind, and a temperature of 48 degrees Fahrenheit. At the time of the survey, all drilling equipment was operating including multiple engines and both drilling mud pumps. The results of the survey are presented below in Table 18. Naftex anticipates using the same or equivalent drilling rig for its proposed project.

Table 18
Sound Survey Kenai Rig #38

Distance (feet)	North (dBA)	South (dBA)	West (dBA)	East (dBA)
50	87	78	85	83
100	80	72	78	76
150	75	68	72	69

Source: Robert A. Booher Consulting, November 18, 2005. Sound Survey Kenai Rig#38. Sutter County, CA.

Based on the data in Tables 17 and 18, equipment associated with the construction of a drill site and drilling will produce maximum sound levels of 87 dBA at a distance of 50 feet from each of the proposed drill sites during construction and 83 dBA during drilling. The closest residence to the proposed project sites is located approximately 0.3 miles to the southwest.

The noise level during drilling at the closest residence to the proposed project sites was calculated using the equation below (www.animations.physics.unsw.edu).

$L_1 = L_2 + 20\log_{10}(R_2/R_1)$
$L_2 = L_1 - 20\log_{10}(R_2/R_1)$
$L_2 = 83 – 20\log_{10} (1{,}584'/50')$
$L_2 = 83 – 30.0$
$L_2 = 53$ dBA

$\Delta L = L_1 – L_2$
L_1 = Sound level at Object 1, the dosimeter of the noise source (83 dBA).
L_2 = Estimated sound Level at Object 2, the nearest residence
R_1 = Distance from the source of noise to the southeast dosimeter (50 feet)
R_2 = Distance from the source of noise to the nearest residence (1,584 feet)

Production activities will result in long term noise impacts. In order to quantify these impacts, RAB Consulting conducted a sound survey at the Naftex USL 1-3 site located west of the proposed project sites in the Edison Oil Field in Kern County, California. At the time of the survey, a 10.6 hp Westinghouse torkmate oil field electric motor, model T70D, Serial #8010, 460 volt was operating on site. Weather conditions were sunny with wind 2-6 mph from the west. The sound meter used was an Extech Instruments, model 407780 integration sound level meter, range 30-130 dB datalogger. Naftex will install like or equivalent equipment at each of the proposed project sites. The results of the survey are presented in Table 19.

Table 19
Sound Survey Measurements (dBA)

Direction From Unit	50 feet from unit	100 feet from unit	200 feet from unit
North	51.2	46.0	39.6
South	56.0	49.2	42.1
East(directly facing the engine)	54.1	48.7	40.8
West	49.6	44.7	40.1

Based on the data in Table 18, the maximum sound level resulting from production activities will be 56.0 dBA at a distance of 50 feet from a proposed project site.

The closest residence to the proposed project sites is approximately 0.3 (1,584 feet) away. Noise levels during production at the closest residence to each of the proposed project sites were calculated using the equation below and the calculated noise levels are presented in Table 16 (www.animations.physics.unsw.edu).

$L_1 = L_2 + 20\log_{10} (R_2/R_1)$
$L_2 = L_1 - 20\log_{10} (R_2/R_1)$
$L_2 = 56.0 – 20\log_{10} (1{,}584'/50')$
$L_2 = 56.0 – 30.0$
$L_2 =$ **26 dBA**

$\Delta L = L_1 – L_2$
L_1 = Sound level at Object 1, the dosimeter due west of the noise source (56.0 dBA).
L_2 = Estimated sound Level at Object 2, the nearest residence
R_1 = Distance from the source of noise to the south dosimeter (50 feet)
R_2 = Distance from the source of noise to the nearest residence (1,584 feet)

XIIa. Based upon the results presented above, the outdoor noise level at the nearest residence is expected to be 53 dBA during drilling activities and 26 dBA during production. The proposed project will be in compliance with the Noise Control Ordinance in the Kern County Code (Section 8.36.020 et seq.) and with Kern County General Plan Noise Element. The Noise Control Ordinance in the Kern County Code (Section 8.36.020 et seq.) prohibits a variety of nuisance noises but does not specifically mention construction or related noise. The Kern County General Plan Noise Element establishes a 65 dBA maximum Day-Night Average Noise Level (Ldn) as being considered consistent with residential uses or development. Accordingly, noise impacts at the nearest residence throughout the life of the project are well within regulatory limits for residential uses.

State and federal standards set by the U.S. Department of Labor Occupational Safety and Health Administration (OSHA) regulate worker exposure time to sound levels above 90 decibels. However, the outdoor noise level at the edge of a proposed project site is expected to be 77 dBA [$L_2 = 83 – 20\log_{10} (100'/50')$] during drilling activities and 50 dBA [$L_2 = 56.0 – 20\log_{10} (100'/50')$] during production. Accordingly, farm personnel working in the vicinity of each of the proposed project sites would not be exposed to sound levels exceeding state or federal standards. Therefore people will not be exposed to noise levels in excess of applicable standards.

XIIb. Vibration is oscillating motion of structures or the ground. The rumbling sound caused by the vibration in the ground is called ground-borne vibration. The proposed project is expected to create ground-borne vibration as a result of project activities (e.g. during drilling and production activities). Two elements need to be generally concerned regarding ground-borne vibration impacts: damage to buildings and annoyance to humans.

One of the accepted measurements for evaluating building damage associated with ground-borne vibration is peak particle velocity (PPV). According to the U.S. Department of Transportation, Surface Transportation Board (2009), "PPV is the maximum instantaneous positive or negative peak of the vibration signal, measured as distance per time (inches per second). PPV has been used historically to evaluate shock wave type vibrations from actions like blasting, pile driving and mining activities and their relationship to building damage." Table 20 shows effects of construction vibrations on buildings.

Table 20
Effects of Construction Vibration

Peak Particle Velocity (in/sec)	Effects on Buildings
< 0.05	No effect on buildings
0.1 to 0.5	Minimal potential for damage to weak and sensitive structures
0.5 to 1.0	Threshold at which there is a risk of architectural damage to buildings with plastered ceilings and walls. Some risk to ancient monuments and ruins.
1.0 to 2.0	U.S. Bureau of Mines data indicates that blasting vibrations in this range will not harm most buildings. Most construction vibration limits are in this range.
>3.0	Potential for architectural damage and possible minor structural damage.

Modified from Vibration at http://www.drnoise.com/PDF_files/Vibration%20Primer.pdf

In order to estimate ground-borne vibration impacts associated with the proposed project activities, RAB Consulting retained the services of Gasch Geophyiscal Services, Inc. (GGSI) to conduct a ground vibration monitoring study of a triple rig operating near Lost Hills, California. The proposed study used Instantel vibration monitoring instruments and all units were calibrated according to manufacturer's specifications. A 3-component tri-axial geophone was utilized to record vibration levels in the longitudinal (toward the source), transverse (horizontally orthogonal to the longitudinal direction), and vertical (up and down) directions. Measurements were recorded on two sides (north side and south side) of the drill rig. The power system including mud pumps, water and fuel storage and compressors were located on the north side of the drill rig. The catwalk and other minor transient vibration generating equipment were located on the south side of the drill rig. The results of the study are presented in Table 21.

Table 21*
Vibration Monitoring Study Results

Distance from Drill Hole (feet)	Transverse Direction (in/sec)	Vertical Direction	Longitudinal Direction
87 feet north	0.0550	0.105	0.0600
152 feet north	0.0400	0.0300	0.0200
225 feet north	0.0150	0.01000	0.01000
321 feet north	0.01000	0.01000	0.01000
105 feet south	0.0150	0.01000	0.01000
188 feet south	0.0150	0.0150	0.01000
335 feet south	0.01000	0.01000	0.01000

*Gasch Geophysical Services, Inc. Vibration Monitoring of a Large Drill Rig, December 2012.

GGSI recorded a PPV of 0.105 inches/second at 87 feet during drilling activities associated with a triple rig. The following calculation was used to determine the PPV (in/sec) at the nearest residence to the proposed project site.

$$PPV_{equipment} = PPVref_{(}25/D)^{n}$$

Where:

$PPV_{equipment}$ = peak particle velocity in in/sec of the equipment adjusted for the distance
PPV_{ref} = reference vibration level in in/sec at 87 feet (drill rig)
D = distance from equipment to the nearest residence in feet
n = 1.5 (the value related to the attenuation rate through the ground)

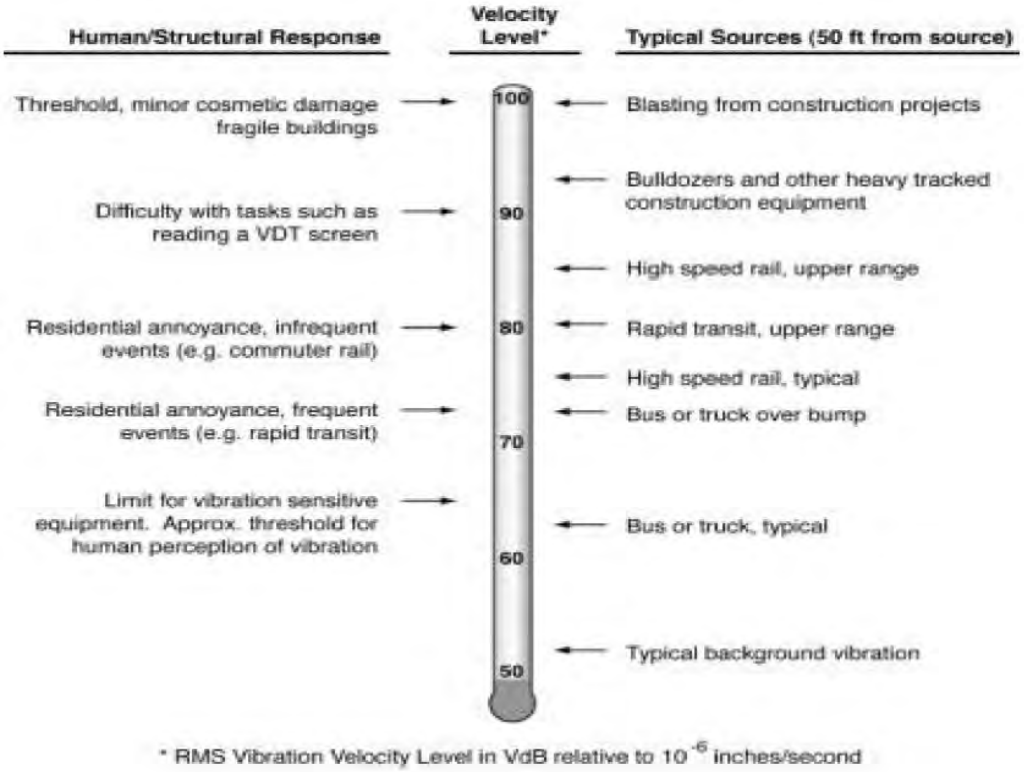
$$PPV = 0.105(87/1{,}584)^{1.5} = 0.0013 \text{ in/sec}$$

Ground borne vibration impacts are based upon a study of a triple rig described above. Naftex proposes to use a double rig for the proposed drilling activities; therefore, our analysis presents a more conservative value where impacts will be even less than calculated above. The estimated PPV at the nearest residences is lower than the PPV of 0.05 in/sec that may cause effects on buildings as shown in (Table 20). Therefore, the estimated ground-borne vibration generated by the proposed project will have less than significant impact to structures.

Another widely accepted source of measurements, as an alternative to using PPV, for evaluating human annoyance associated with ground-borne vibration is root-mean-square (rms) amplitude. According to the U.S. Department of Transportation, Federal Transit Administration (2006), “It takes some time for human body to respond to vibration signals. In a sense, the human body responds to an average vibration amplitude. Because the net average of a vibration is zero, the root mean square (rms) amplitude is used to describe the “smoothed” vibration amplitude. The root mean square of a signal is the square root of the average of the squared amplitude of the signal. The average is typically calculated over a one-second period.” The rms,

connoted as vibration decibels (VdB) on a log scale, is used to evaluate human annoyance against ground-borne vibration. Figure 10 shows the human/structural response to different levels of ground-borne vibration velocity levels.

Figure 10
Human/Structural Response to Different Levels of Ground-Bourne Vibration Velocity Levels



According to the U.S. Department of Transportation, Federal Transit Administration (2006), the background vibration velocity level in residential areas is usually 50 VdB or lower well below the threshold of perception for humans which is around 65 VdB. The range of interest is from approximately 50 VdB to 100 VdB." Although the *CEQA Guidelines* do not specifically define the levels at which ground-borne vibration is considered "excessive.", Table 22 is an example to show the human response to different levels of ground-borne noise and vibration.

Table 22
Human response to different levels of ground-borne noise and vibration

Vib. Velocity Level	Noise Level		Human Response
	Low Freq1	Mid Freq2	
65 VdB	25 dBA	40 dBA	Approximate threshold of perception for many humans. Low-frequency sound usually inaudible, mid-frequency sound excessive for quiet sleeping areas.
75 VdB	35 dBA	50 dBA	Approximate dividing line between barely perceptible and distinctly perceptible. Many people find transit vibration at this level annoying. Low-frequency noise acceptable for sleeping areas, mid-frequency noise annoying in most quiet occupied areas.
85 VdB	45 dBA	60 dBA	Vibration acceptable only if there are an infrequent number of events per day. Low-frequency noise annoying for sleeping areas, mid-frequency noise annoying even for infrequent events with institutional land uses such as schools and churches.

Notes:
1. Approximate noise level when vibration spectrum peak is near 30 Hz.
2. Approximate noise level when vibration spectrum peak is near 60 Hz.

In order to estimate ground-borne vibration impacts to humans by the proposed project activities, the velocity level in decibels, Lv (VdB) at the nearest residence to the proposed project sites is calculated using the following equation:

$$Lv = 20 \times \log_{10}(v/v_{ref})$$

Where:

Lv = velocity level in decibels (VdB)
v = RMS velocity amplitude = PPV/Crest Factor
v_{ref} = reference velocity amplitude (1×10^{-6})

Crest Factor is defined as the ratio of the PPV amplitude to the RMS velocity amplitude. To calculate the RMS velocity amplitude, a crest factor of 4 for random ground vibration was used[†3].

RMS velocity amplitude = PPV/Crest Factor = 0.0013/4= 0.00033

Vibration velocity level for the proposed project sites is calculated below:

$$Lv = 20 \times \log_{10}(0.00033/1 \times 10^{-6}) = 50.4 \text{ VdB}$$

The calculated vibration velocity at the nearest residence is lower than the threshold of perception for humans of 65 VdB as shown in Table 22. Therefore, the estimated

ground-borne vibration generated by the proposed project would have less than significant impact to structures.

XIIc. The site preparation, drilling, completion and installation of production equipment phases of the proposed project are short term and temporary in nature. The production phase of the proposed project will continue through the life of each well. Based upon the results presented above, the average outdoor noise level at a proposed project site is expected to be 53 dBA during drilling activities and 26 dBA during production at the nearest residence. There will be no increase in the permanent ambient noise levels in the project vicinity.

XIId,e. The proposed project sites are not located within an airport land use plan or within two miles of a public airport or public use airport. Therefore, the project would not expose people to excessive noise levels.

Conclusion: Impacts will be less than significant.

Mitigation Measures: No significant impacts identified. No mitigation necessary.

References:

U.S. Environmental Protection Agency, *1974; Noise Control for Building and Manufacturing Plants,* BBN Layman Miller Lecture Notes, 1987.

California Department of Transportation, Noise, Vibration, and Hazardous Waste Management Office (2004) *Transportation and Construction Induced Vibration Guidance Manual*. Prepared by Jones & Stokes, Sacramento, CA

Kern County *General Plan 2009*
Website: http://pcd.kerndsa.com/planning/planning-documents/general-plans

Kern County, Zoning Ordinance
Website: http://www.co.kern.ca.us/planning/pdfs/KCZOJul12.pdf

U.S. Department of Transportation, Surface Transportation Board (2009*) Northern Rail Extension Final Environmental Impact Statement, Appendix J – Noise and Vibration, for STB Finance Docket No. 35468, Alaska Railroad Corporation – Petition for Exemption – To Construct and Operate a Rail Line Between North Pole, Alaska and Delta Junction, Alaska*.

U.S. Department of Transportation, Federal Transit Administration (2006) *Transit Noise and Vibration Impact Assessment.* FTA-VA-90-1003-06

Vibration at http://www.drnoise.com/PDF_files/Vibration%20Primer.pdf

ISSUES	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
XIII. POPULATION AND HOUSING				
Would the project:				
a. Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension or roads or other infrastructure?	_____	_____	_____	X
b. Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?	_____	_____	_____	X
c. Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?	_____	_____	_____	X

Discussion: The proposed project sites are located in an unincorporated area of central Kern County. The closest community to the proposed project sites is Edison, which is located approximately 2.9 miles to the southwest of the proposed project sites. The project area is used primarily for oil exploration and extraction. The closest residence to the proposed project sites is located approximately 0.3 miles to the southwest.

XIIIa. Naftex project personnel, drilling company employees and other support personnel currently reside in the local area primarily within the city of Bakersfield. Accordingly, the proposed project would not induce population growth in the project area.

XIIIb,c. The project does not propose to displace or relocate any existing housing or persons. Therefore, no persons would be displaced nor housing be constructed elsewhere during project implementation.

Conclusion: No impact.

Mitigation Measures: No impacts identified. No mitigation necessary.

References:

Kern County *General Plan 2009*
Website: http://pcd.kerndsa.com/planning/planning-documents/general-plans

ISSUES	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
XIV. PUBLIC SERVICES				
Would the project:				
a. result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:				
Fire protection?	_____	_____	_____	X
Police protection?	_____	_____	_____	X
Schools?	_____	_____	_____	X
Parks?	_____	_____	_____	X
Other public facilities?	_____	_____	_____	X

Discussion: The proposed project sites are located on private lands in an unincorporated area within central Kern County.

XIVa. The Lamont Sheriff's Department provides law enforcement services in the project area and its main office located at 122202 Main Street, Lamont, CA 93241 is approximately 9 miles to the southwest of the proposed project sites. Fire protection is provided by the Kern County Fire Department and its Fire Station No. 45 located at 11809 Edison Highway is approximately 3 miles from the proposed project sites. No cities, schools, parks, or other public facilities are located in the general vicinity of the proposed project sites. No existing or proposed schools are located within one-quarter mile of the proposed project site. The nearest school (Edison Middle School located at 721 South Edison Road, Bakersfield, California 93307) is approximately 3.5 miles southwest of the proposed project sites. The proposed project site is not located within two miles of a public airport, public use airport, or private airstrip. The nearest public airport is the Bakersfield Municipal Airport (2000 S Union Ave., Bakersfield, CA 93307)which is located approximately 9.8 miles to southwest of the proposed project sites. Therefore, implementation of the proposed project is not expected to interfere with or adversely affect fire protection, police protection, school, airports, park, or other public services or facilities in the project area.

Conclusion: No impact.

Mitigation Measures: No impacts identified. No mitigation necessary.

References:

Kern County Online Mapping System
Website: http://maps.co.kern.ca.us/imf/imf.jsp?site=krn_pub

ISSUES	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
XV. RECREATION				
Would the project:				
a. Increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	_____	_____	_____	X

Discussion: The proposed project area and well sites are located on private land that is used primarily for ranchland, farming and oil production. This land does not provide recreational activities to the public.

XVa. There are no recreational facilities within the project area. The proposed project would not require the use of recreational resources and would not create the need for new recreational facilities. Therefore, no impacts to recreational facilities are expected.

Conclusion: No impact.

Mitigation Measures: No impacts identified. No mitigation necessary.

References:

Kern County Online Mapping System
Website: http://maps.co.kern.ca.us/imf/imf.jsp?site=krn_pub

ISSUES	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
XVI. TRANSPORTATION/TRAFFIC				
Would the project:				
a. Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e. result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections?	_____	_____	X	_____
b. Exceed, either individually or cumulatively, a level of service standard established by the county congestion management agency for designated roads or highways?	_____	_____	X	_____
c. Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?	_____	_____	_____	X
d. Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	_____	_____	_____	X
e. Result in inadequate emergency access?	_____	_____	_____	X
f. Result in inadequate parking capacity?	_____	_____	_____	X
g. Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?	_____	_____	_____	X

Discussion: California State Highway 58, Comanche Drive, and Breckenridge Road provide access to the proposed project sites. There are additional dirt and/or gravel roads that serve as farm access roads in the proposed project area that have limited public access.

XVIa. As reflected in Table 23, the maximum number of daily vehicle trips would be 18 (36 one way trips). This would occur during the mobilization/demobilization when drilling equipment is moved on and off site. The 18 vehicle round trips would include seven (7) heavy truck/semi round trips, ten (10) car / pickup truck roundtrips and one (1) water truck round trip.

Table 23
Maximum Daily Vehicle Trip Generation

Vehicle Type / Number	**One Way Trips**
Water Truck / 1	2
Car and Pickup Trucks Roundtrips / 10	20
Heavy Truck/Semi - Mobilization and Demobilization of Equipment / 5	10
Heavy Truck/Semi-Drilling Phase/2	4
Total Trips	**36**

RAB Consulting reviewed traffic counts conducted by Caltrans at the intersection of Comanche Drive and State Highway 58 during 2011 (approximately 2.5 miles south of the project site) to quantify the average annual daily traffic (AADT) levels. According to Caltrans, the AADT for this segment of State Highway 58 is 25,000 vehicles (Ref: Caltrans Website 2010, http://traffic-counts.dot.ca.gov/index.htm). Accordingly the project would contribute a maximum of 18 additional vehicles trips per day during the proposed drilling phase of the project. As such, the proposed project increases the roadway traffic on State Highway 58 a maximum of 0.14% (36/25,000) during the drilling phase of the proposed project. Therefore, the proposed project would not cause the designed capacity of State Highway 58 to be exceeded during the proposed project.

Traffic count data was also acquired from the Kern Council of Governments website. Comanche Drive approximately 0.5 south of Breckenridge Road has an AADT of 2,537 (April 12, 2011) and has LOS B rating (Steve Young, Kern County Roads Development Review Section). Accordingly the project would contribute a maximum of 18 additional vehicles trips per day during the proposed drilling phase of the project. As such, the proposed project increases the roadway traffic on Comanche Drive a maximum of 1.4% (36/2,537) during the drilling phase of the proposed project. Therefore, the proposed project would not cause the designed capacity of Comanche Drive to be exceeded during the proposed project.

Breckenridge Road approximately 0.5 mile east of Comanche Drive had an AADT of 203 (May 17, 2011) with a LOS A (Kern Council of Governments - http://206.227.45.77/kerncog). Accordingly the project would contribute a maximum of 18 additional vehicles trips per day during the proposed drilling phase of the project. As such, the proposed project increases the roadway traffic on Breckenridge Road a maximum of 17.7% (36/203)during the drilling phase of the proposed project. Therefore, the proposed project would not cause the designed capacity of Breckenridge Road to be exceeded during the proposed project.

The maximum number of daily vehicle trips during the production phase of the proposed project will be 1 (2 one way trips) assuming all six (6) wells are producing. RAB Consulting reviewed traffic counts conducted by Caltrans at the intersection of

Comanche Drive and State Highway 58 during 2011 (approximately 2.5 miles south of the project site) to quantify the average annual daily traffic (AADT) levels. According to Caltrans, the AADT for this segment of State Highway 58 is 25,000 vehicles (Ref: Caltrans Website 2010, http://traffic-counts.dot.ca.gov/index.htm). Accordingly the project would contribute a maximum of 18 additional vehicles trips per day during the proposed drilling phase of the project. As such, the proposed project increases the roadway traffic on State Highway 58 a maximum of 0.008% (2/25,000) during the production phase of the proposed project. Therefore, the proposed project would not cause the designed capacity of State Highway 58 to be exceeded during the proposed project.

Traffic count data was also acquired from the Kern Council of Governments website. Comanche Drive approximately 0.5 south of Breckenridge Road has an AADT of 2,537 (April 12, 2011) and has LOS B rating (Steve Young, Kern County Roads Development Review Section). Accordingly the project would contribute a maximum of 18 additional vehicles trips per day during the proposed drilling phase of the project. As such, the proposed project increases the roadway traffic on Comanche Drive a maximum of 0.08% (2/2,537) during the production phase of the proposed project. Therefore, the proposed project would not cause the designed capacity of Comanche Drive to be exceeded during the proposed project.

Breckenridge Road approximately 0.5 mile east of Comanche Drive had an AADT of 203 (May 17, 2011) with a LOS A (Kern Council of Governments - http://206.227.45.77/kerncog). Accordingly the project would contribute a maximum of 18 additional vehicles trips per day during the proposed drilling phase of the project. As such, the proposed project increases the roadway traffic on Breckenridge Road a maximum of 1.0% (2/203) during the production phase of the proposed project. Therefore, the proposed project would not cause the designed capacity of Breckenridge Road to be exceeded during the proposed project.

XVIb. The General Plan classifies roadway Level of Service (LOS) for rural and unincorporated areas of the County with a rating of A, B, C, D, E, or F with A representing the best LOS, and F representing the worst LOS. LOS ratings are defined briefly below:

LOS A - Conditions of free flow. Speed is controlled by drivers' desires, speed limits, or physical roadway conditions, not other vehicles.

LOS B - Conditions of stable flow. Operating speeds beginning to be restricted, but little or no restrictions on maneuverability.

LOS C - Conditions of stable flow. Speeds and maneuverability somewhat restricted. Occasional back-ups behind left-turning vehicles at intersections.

LOS D - Conditions approach unstable flow. Tolerable speeds can be maintained, but temporary restrictions may cause extensive delays. Speeds may decline to as low as

40% of free flow speeds. Little freedom to maneuver; comfort and convenience low.

LOS E - Unstable flow with stoppages of momentary duration. Average travel speeds decline to one-third the free flow speeds or lower, and traffic volumes approach capacity. Maneuverability severely limited.

LOS F - Forced Flow. Represents jammed conditions. Intersection operates below capacity with several delays; may block upstream intersections.

The Kern County General Plan establishes LOS D as the minimum acceptable standard for principal arterial roadways. The segment of State Highway 58 through the project area is classified as LOS C (Caltrans Website 2011 - http://www.dot.ca.gov/). Therefore, the segment of State Highway 58 in the project area is considered to have a good LOS with stable traffic flow with few restrictions. Under the Kern County General Plan, the segments of Breckenridge Road through the project area is classified as LOS A (Steve Young, Kern County Roads Development Review Section). Therefore, Breckenridge Road in the project area is considered to have a good LOS with stable traffic flow with little or no restrictions. The Comanche Drive approach to Breckenridge Drive in the project area has a LOS B with conditions of stable flow and operating speeds beginning to be restricted, but little or no restrictions on maneuverability. The addition of a maximum of 36 vehicle trips traveling to the proposed project sites on a daily basis would not be considered a significant increase in the AADT, and as such, would not have a significant effect on the existing LOS ratings for State Highway 58, Breckenridge Road or Comanche Drive.

XVIc. The project would not have a significant impact on air traffic patterns. The proposed project sites do not occur within the immediate vicinity of any public airstrips as the nearest public airport is the Bakersfield Municipal Airport (2000 S Union Ave., Bakersfield, CA 93307) located 9.8 miles to the southwest of the proposed project sites. The project will be less than 200 feet above ground level and will be more than 10,000 feet from an airport with a runway of 3,200 feet. In addition, the project area is not located in an airport influence area.

XVId. No public roads would be constructed or improved as part of this project. Therefore, the project is not expected to increase the hazards due to a design feature or incompatible uses of a roadway.

XVIe. The proposed project sites have adequate emergency access.

XVIf. The proposed project sites will have adequate parking for workers and equipment required to drill and produce each well. The proposed project will not use any public parking and will not result in inadequate parking capacity.

XVIg. Drilling and producing an oil well will not affect pedestrian or bicycle circulation as no public roadways will be altered or improved during project activities. The

proposed project will have restricted access; accordingly, bicyclists and pedestrians will not have access to each of the proposed project sites. Additionally, the proposed project is in a remote area and pedestrians and bicyclists are not common in this area.

Conclusion: Impacts will be less than significant.

Mitigation Measures: No significant impacts identified. No mitigation necessary.

References:

California Department of Transportation, Caltrans Website 2011
Website: http://traffic-counts.dot.ca.gov/index.htm

Kern County *General Plan 2009*

Website: http://pcd.kerndsa.com/planning/planning-documents/general-plans

ISSUES	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
XVII. UTILITY AND SERVICE SYSTEMS				
Would the project:				
a. Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?	_____	_____	_____	X
b. Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	_____	_____	_____	X
c. Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	_____	_____	_____	X
d. Have sufficient water supplies available to serve the project from existing entitlements and resources, or new or expended entitlements needed?	_____	_____	_____	X
e. Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?	_____	_____	_____	X
f. Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?	_____	_____	_____	X

Discussion: No utility or service systems expansion will be required to support the drilling or operation of the wells, or other aspects of the project.

XVIIa. The project does not conflict with applicable water quality and waste discharge standards relating to water quality. Production water is the only potential wastewater that would be generated during project activities, and production water would be transported by flowlines to Naftex's Section 26 Tank Farm and will be disposed of in Naftex's Racetrack 76-27, 77-27 or 86-27 water disposal wells, Division permitted Class II disposal wells. Naftex anticipates that 90 barrels (3,780 gallons) of production water a day would be generated at each of the well sites that are put into

production. Accordingly the proposed project would not exceed wastewater treatment requirements of the CVRWQCB.

XVIIb. The project as proposed would not require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects.

XVIIc. The project would create negligible runoff as each of the proposed project sites are approximately 0.55 acres in size, topography is relatively flat with gently sloping areas and the proposed project sites are not completely impervious. Accordingly, the proposed project would not require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects.

XVIId. Water would be obtained from Naftex's Racetrack Water Plant with existing entitlements to water and no new entitlements would be required. There is no impact anticipated on water supplies.

XVIIe. See XVIIb.

XVIIf. Naftex does not anticipate any non-hazardous solid waste to be produced during project activities; however, if any non hazardous solid waste is produced it would be disposed at the Kern County Waste Management Bena Landfill, located at 2951 Neumarkel Road, Bakersfield, California 93307. The Kern County Waste Management Bena Landfill is located approximately 6.5 miles to the southeast of the proposed project site. This landfill is permitted to receive up to 4,500 tons/day. The minimal amount of waste generated during the proposed project would not exceed capacity of waste disposal facilities.

Conclusion: No Impact.

Mitigation Measures: No impacts identified. No mitigation necessary.

References:

California Department of Resources, Recycle, and Recovery, *Active Landfills Profile*
Website: www.calrecycle.ca.gov/SWFaciliates/Landfills/

ISSUES	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
XVIII. MANDATORY FINDINGS OF SIGNIFICANCE				
a. Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	_____	X	_____	_____
b. Does the project have impacts that are individually limited, but cumulatively considerable ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)?	_____	_____	X	_____
c. Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	_____	_____	_____	X

XVIIIa. Impacts on the Environment and Special Status Species

With the incorporation of required mitigation measures as outlined in this initial study, the project does not have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory.

XVIIIb. Cumulative Impacts

CEQA Guidelines state that a Lead Agency shall consider whether the cumulative impact of a project is significant and whether the effects of the project are cumulatively considerable (CCR 15065). The assessment of the significance of the cumulative effects of the project must, therefore, be conducted in connection with the effects of past projects, other current projects, and probable future projects.

Past, Current and Probable Future Projects

The proposed project is not a part of any larger, planned development.

According to the Division Online Mapping System, the proposed project sites are located adjacent to the eastern edge of the Edison Oil Field. According to Division records, there are 117 active wells, 57 plugged wells, 37 unknown wells, 8 idle wells and 23 new wells within one mile of the proposed project sites (Figure 9). The majority of these wells are located within the Edison Oil Field, a high density oil field that was discovered in 1928. The closest classified new well, the Naftex Mitchell 16 is located 0.05 miles to the west of the proposed Bloemer 1 project site (Figure 9). No other oil and gas wells are currently being permitted within one (1) mile of the proposed project sites.

A review of Kern County Planning Department Notice of Preparation records failed to identify any proposed project within one (1) mile of the proposed project sites.

Potential Cumulative Impacts

Based upon the results of the initial study, it was determined that there would be no impacts associated with Agriculture and Forest Resources, Geology and Soil, Hydrology and Water Quality, Land Use and Planning, Mineral Resources, Population and Housing, Public Services, Recreation and Utility and Service Systems. Accordingly, the proposed project would not result in cumulative impacts to Agriculture and Forest Resources, Geology and Soil, Hydrology and Water Quality, Land Use and Planning, Mineral Resources, Population and Housing, Public Services, Recreation and Utility and Service Systems.

The following is a discussion of cumulative impacts that could result from the proposed project in conjunction with past, other current and probable future projects as described above. The term “cumulatively considerable", for the purposes of this analysis, means the effects of a project are considerable when viewed in connection with effects of past projects, other current and probable future projects.

Aesthetics

Project related drilling activities viewed in conjunction with existing oil and gas activities and/or reasonably foreseeable projects could result in potential cumulative impacts that could degrade the visual existing character of the area and its surrounding. However, no reasonably foreseeable projects were identified. Additionally, as drilling activities are short-term and existing oil and gas operations and agricultural facilities are not visible from the proposed project sites, short term impacts would not be cumulatively considerable impact.

Likewise, production activities viewed in conjunction with existing oil and gas operations in the project area could cumulatively degrade the visual existing character

of the area and its surroundings. However, the proposed well sites are not visible from public roads. Additionally, as production equipment is similar in size and shape to tanks, pumps and piping associated with existing oil and gas sites located throughout the project area, there will be no considerable change to the visual character of the area and its surroundings. Additionally, production equipment will be painted in earth tones. No cumulatively considerable impact associated with aesthetics has been identified.

Air Quality

The current project is in compliance with the SJVAPCD 2007 Ozone Plan. This Plan was reviewed and approved by CARB and the federal EPA. This Plan sets forth specific requirements that will substantially lessen cumulative impacts from NOx and ROG emissions and was formally adopted by the SJVAPCD through a public review process in 2007. Details of the Plan can be found at:
http://www.valleyair.org/Air_Quality_Plans/Ozone_Plans.htm

Consistent with this Plan, SJVAPCD has adopted an aggressive set of policies, rules and regulations. These include adoption of indirect source review (ISR) and the nation's most stringent limits on NOx emissions from boilers, heater and IC engines. The following rules aimed at reducing emissions from oil and gas production:

Rule 4306 – Reduction of NOx from boilers, heaters and steam generators
Rule 4624 – Transfer of organic liquids
Rule 4702 – Limits on NOx emissions from IC engines

CEQA Guidelines subsection (h)(3) of Section 15064 allows the Lead Agency to determine that cumulative impacts are less than significant when a project complies with a previously approved plan or mitigation program. Since the air quantity impacts of the present project are individually insignificant, and the present project is in compliance with the SJVAPCD's approved plan emission reduction plans, we conclude that the air quality impacts of the present project are not only individually insignificant but also not cumulatively considerable.

Biological Resources

The biological assessment found no sensitive plant or animal species present within the proposed project sites or within the buffer area around the proposed project sites and proposed access roads. An area of approximately 20 acres was surveyed as exact well sites were not determined at the time of biological surveys. As a result, a buffer area significantly larger than 250 feet was surveyed around the proposed project sites. No riparian, wetland, stream, vernal pool, federally protected wetland habitat or other natural or sensitive community types were observed within the footprint of the proposed project sites, existing or proposed access roads, or buffer areas during the biological assessment. The proposed project sites would not interfere with movement

of any wildlife species or with established native resident or migratory wildlife corridors. Native resident and/or migratory fish and known native wildlife nursery sites are not present within the proposed project sites or area. The project as proposed would not conflict with any local policies or ordinances protecting biological resources or local tree preservation policies/ordinances.

As previously stated, the proposed project is located in an area used primarily for extensive oil and gas production and for agricultural purposes (grazing land). The project sites are located adjacent to the Edison Oil Field to the west and agricultural grazing land (annual grassland habitat) to the east. Approximately, 2,010 acres of grazing land (annual grassland habitat) are located within a one (1) mile radius of the proposed project sites. There are 117 active wells, 57 plugged wells, 37 unknown wells, 8 idle wells and 23 new wells within one mile of the proposed project sites. A review of aerial photographs indicates that 146 of these sites have been restored and the 96 remaining sites occupy approximately 47 acres. Accordingly, when combined with 4.3 acres of annual grassland habitat disturbed by the proposed project, 51.3 acres of annual grassland habitat will be cumulatively impacted within a one (1) mile radius of the proposed project sites. This represents a cumulative impact of 2.5% to annual grassland habitat within a one (1) mile radius of the proposed project sites. Accordingly, the project will not have a cumulatively considerable effect on biological resources.

Cultural Resources

The cultural resources records search and Native American Consultation did not identify any cultural or historic resources within the proposed project sites. The records search revealed that five (5) cultural resource studies were previously conducted, resulting in the recording of one (1) historic-period cultural resource within one mile of the proposed project; however, these resources will not be impacted. Additionally, existing oil and gas well sites and agricultural sites identified within the vicinity of the proposed project sites have been previously disturbed. Accordingly, there will be no cumulative impact to cultural resources.

Greenhouse Gas Emissions

Naftex is subject to compliance with CARB's cap-and-trade regulations. Consistent with CCR 15064 (h)(3), the SJVAPCD finds that compliance with CARB's cap-and-trade regulation would avoid or substantially lessen the impact of project specific GHG emissions on global climate change. Facilities subject to cap-and-trade regulation are subject to an industry-wide cap on overall GHG emissions. As such, any growth in emissions must be accounted for under that cap, such that a corresponding and equivalent reduction in emissions must occur to allow any increase. The SJVAPCD therefore concludes that projects occurring at facilities

subject to CARB's cap-and-trade regulation would have a less than significant individual and cumulative impact on global climate change. Considering the above, cumulative impacts from GHG emissions are less than significant.

Hazards and Hazardous Materials*:*

The proposed project includes the transportation and storage of hazardous materials including fuels, oils, lubricants, hydraulic fluids, and solvents. All hazardous materials, such as diesel fuel, will be transported and stored according to applicable federal, state, and local regulations. In the event of a hazardous materials spill at a proposed project site, impacts would be localized, not extending beyond the specific spill. If a spill occurs at another oil well site location, resulting impacts would also be localized. The closest oil facility, the Naftex Mitchell 16 is located 0.05 miles to the west of the proposed project sites and the closest residence is located approximately 0.3 miles southwest of the proposed project sites. Accordingly, no cumulative impacts are anticipated.

Noise

The geographic scope of the cumulative noise analysis consists of the immediate project vicinity (adjacent parcels) and surrounding sensitive receptors.
No impacts were identified with respect to vibration. Accordingly, there would be no cumulative impact due to vibration.

Noise impacts associated with the proposed project would result in short term impacts associated with project activities prior to the ongoing production phase and long term impacts associated with production phase of the project.

The Division identified no other projects in the vicinity of the proposed project. In addition, the Division understands that Naftex would not drill the wells at the same time. Accordingly, there would be no short term cumulative impact associated with the proposed project.

Long term impacts associated with equipment associated with the production phase, existing production equipment and production equipment associated with planned projects would result in minimal cumulative impacts.

However, noise is a highly localized phenomenon and the other existing and planned projects are expected to be located a considerable distance from the proposed project sites. The closest existing well is located 0.05 miles from the proposed project site. Sound levels associated with this well are expected to be in the same range as the sound levels resulting from the proposed project during the production phase. It is also important to keep in mind that because decibels are logarithmic ratios, they cannot be manipulated in the same way as arithmetic numbers. Addition of decibels produces such results as 70 dBA + 70 dBA = 73 dBA. Accordingly, if a single production facility produced a sound level of 26 dBA and another identical facility

was located adjacent to the first site, the two production sites would produce a total sound level of 29 dBA. This is twice as much acoustic energy, however, with only a 3 dBA change. As a second example of decibel addition, if one production site produces a sound level of 70 dB and the other 60 dB, the combined sound level will be 70.4 dB. When the difference between two sound levels is greater than 10 decibels, the lesser sound is negligible in terms of affecting the total level. As a result of the proposed project, if all five (5) wells are producing at the same time, the sound level would be 33 dBA. In addition the sound level associated with the closet well would be approximately 26 dBA. The combined cumulative impact would be 33.8 dBA. It is therefore reasonable to conclude that project generated noise would not combine with noise from other projects in a manner resulting in cumulatively considerable noise impacts.

The combined cumulative impact of noise from the proposed project would not result in cumulative noise levels in excess of 33.8 dBA at any sensitive receptor. Implementation of the proposed project would not exceed noise thresholds; therefore, the project would not contribute in a cumulatively considerable manner to noise impacts.

Transportation

California State Highway 58, Comanche Drive, and Breckenridge Road provide access to the proposed project sites. The segment of State Highway 58 through the project area is classified as LOS C. The segment of Breckenridge Road through the project area is classified as LOS A. The Comanche Drive approach to Breckenridge Drive in the project area has a LOS B. The Kern County General Plan Circulation element establishes LOS D as the minimum acceptable standard for principal arterial roadways. The increase in traffic trips due to the project are not considered to be a significant impact to the established LOS ratings since the additional traffic from the project when added to the current traffic on State Highway 58, Comanche Drive, and Breckenridge Road will not alter the Level of Service ratings on the roadways or increase traffic so as to cause the roadways to be reclassified to an unacceptable LOS rating. As no planned, pending, or recently approved projects have been identified, there would be no increase to traffic volume or the LOS ratings for State Highway 58, Comanche Drive, and Breckenridge Road. Accordingly, there would be no cumulative impact.

XVIIIc. Impacts on Humans

The analyses of environmental issues contained in this Initial Study indicate that the project is not expected to have a substantial impact on human beings, either directly or indirectly. Mitigation measures have been incorporated into the project to reduce all potentially significant impacts to less than significant.

ENVIRONMENTAL DETERMINATION

On the basis of this initial evaluation:

I find that the proposed project COULD NOT have a significant effect on the environment, and a **NEGATIVE DECLARATION** will be prepared. _____

I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because the mitigation measures described on an attached sheet have been added to the project. A **MITIGATED NEGATIVE DECLARATION** will be prepared. *Attach Mitigation Measures & Monitoring Program.* X

I find that the proposed project MAY have a significant effect on the environment, and an **ENVIRONMENTAL IMPACT REPORT** is required. _____

I find that the proposed project MAY have a significant effect on the environment, but at least one effect 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets, if the effect is a "potentially significant impact" or "potentially significant unless mitigated." An **ENVIRONMENTAL IMPACT REPORT** is required, but it must analyze only the effects that remain to be addressed. _____

I find that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier **EIR** or **NEGATIVE DECLARATION** pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier **EIR** or **NEGATIVE DECLARATION**, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required. _____

Signature: _____ Date: 8/10/13
State Oil and Gas Supervisor

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ATTACHMENT A

MITIGATION MONITORING AND REPORTING PLAN

Bloemer and Kirschenman Exploratory Oil and Gas Project MITIGATION MONITORING AND REPORTING PLAN						
Environmental Impact	**Mitigation Measures**	**Timing of Monitoring Requirement**	**Responsibility for Compliance**	**Method for Compliance**	**Enforcement**	**Checkoff Date/ Initials**
III. Air Quality						
b) Violate any air quality standard or contribute to an existing or projected air quality violation?	Air Quality 1.All disturbed areas, including storage piles, which are not being actively used for construction purposes, shall be effectively stabilized using water.	Ongoing during project activities.	Division and Naftex.	Inspection by environmental monitor.	Require as condition of approval.	
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions that exceed quantitative thresholds for ozone precursors?	Air Quality 2. Unpaved access roads shall be effectively stabilized of dust emissions using water.	Ongoing during project activities.	Division and Naftex.	Inspection by environmental monitor.	Require as condition of approval.	
	Air Quality 3. All land clearing, grubbing, scraping, excavation, land leveling, grading, cut and fill, and demolition activities shall be effectively controlled of fugitive dust emissions by using the application of water or by presoaking.	Ongoing during project activities.	Division and Naftex.	Inspection by environmental monitor.	Require as condition of approval.	
	Air Quality 4. When materials are transported off-site, all material shall be covered, effectively wetted to limit visible dust emissions, or at least six (6) inches of freeboard space from the top of the container shall be maintained.	Ongoing during project activities.	Division and Naftex.	Inspection by environmental monitor.	Require as condition of approval.	
	Air Quality 5. Following addition of materials to, or removal of materials from the surface of outdoor storage piles, said piles shall be effectively stabilized of fugitive dust emissions by using sufficient water.	Ongoing during project activities.	Division and Naftex.	Inspection by environmental monitor.	Require as condition of approval.	
	Air Quality 6. Limit of traffic speeds on unpaved access roads to 15mph.	Ongoing during project activities.	Division and Naftex.	Inspection by environmental monitor.	Require as condition of approval.	

Bloemer and Kirschenman Exploratory Oil and Gas Project MITIGATION MONITORING AND REPORTING PLAN						
Environmental Impact	**Mitigation Measures**	**Timing of Monitoring Requirement**	**Responsibility for Compliance**	**Method for Compliance**	**Enforcement**	**Checkoff Date/ Initials**
IV. Biological Resources						
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations or by the California Dept. of Fish & Game or US Fish & Wildlife Service?	Biological 1. As close to beginning of project activities as possible, but not more than 14 days prior to project activities, a qualified biologist shall conduct a final pre-construction survey of the proposed well site to insure that no special-status wildlife species have recently occupied the project site or buffer. A qualified biologist shall be present immediately prior to project activities that have potential to impact sensitive species to identify and protect potentially sensitive resources.	Prior to initiation of construction activities.	Division and Naftex.	Submission of pre-activity biological clearance to Division.	Require as condition of approval.	
	Biological 2 - Project site boundaries shall be clearly delineated by stakes, flagging and /or rope or cord to minimize inadvertent degradation or loss of adjacent habitat during construction and drilling operations. Staff and/or its contractors shall post signs and/or place fence around the site to restrict access of vehicles and equipment unrelated to drilling operations.	Ongoing during project activities.	Division and Naftex.	Site inspection by environmental monitor.	Require as condition of approval.	
	Biological 3 - A biological monitor will be present during initial ground disturbance and site construction activities.	Ongoing during initial ground disturbance and construction.	Division and Naftex.	Site inspection by environmental monitor.	Require as condition of approval.	
	Biological 4. If San Joaquin kit foxes become established within the proposed project site or buffer area prior to project implementation,	Ongoing during project activities.	Division and Naftex.	Site inspection by environmental monitor.	Require as condition of approval.	

Environmental Impact	Mitigation Measures	Timing of Monitoring Requirement	Responsibility for Compliance	Method for Compliance	Enforcement	Checkoff Date/ Initials
	Naftex will implement the measures contained in the United States Fish and Wildlife Service's (USFWS) "Standardized recommendations for protection of the San Joaquin kit fox prior to or during ground disturbance" (USFWS 2011). Naftex will implement the following measures: a. If kit fox dens have become established within 200 feet of the construction area prior to project implementation that may be indirectly impacted by construction activities exclusion zones shall be established prior to construction by a qualified biologist and dens shall not be disturbed in any way. Exclusion zone fencing should include untreated wood particle-board, silt fencing, orange construction fencing or other fencing as approved by the USFWS and CDFW. Exclusion zones shall be roughly circular with a radius of the following distances measured outward from entrance; potential den 50 feet, and known den 100 feet. Fencing must contain openings for kit fox ingress/egress and keeps humans and equipment out. If a natal/pupping den is discovered within a project site or within 200 feet of the project site, the USFWS and CDFW shall be immediately notified and under no circumstances should the den be disturbed or destroyed without prior authorization. If the preconstruction survey reveals an active natal pupping or new information, the project applicant should contact the USFWS and CDFW immediately to obtain the necessary take authorization/permit. If the take authorization/permit has already been issued,		.			

Environmental Impact	Mitigation Measures	Timing of Monitoring Requirement	Responsibility for Compliance	Method for Compliance	Enforcement	Checkoff Date/ Initials
	then the biologist may proceed with den destruction within the project boundary, except natal/pupping den which may not be destroyed while occupied. A take authorization/permit is required to destroy these dens even after they are vacated. Protective exclusion zones can be placed around all known and potential dens which occur outside the project footprint. b. San Joaquin Kit fox exclusion zone barriers shall be maintained until all construction and drilling activities have been completed, and then removed. If specified exclusion zones cannot be observed for any reason, USFWS and CDFW shall be contacted for guidance prior to ground disturbing activities at or near the subject den. In the event that USFWS and CDFW concur that an occupied San Joaquin kit fox den would be unavoidably destroyed by a planned project action, procedures detailed in the USFWS Standardized Recommendations for protection of the San Joaquin Kit Fox (USFWS 2011) shall be implemented. Den excavation shall be undertaken only by a qualified biologist pursuant to USFWS and CDFW authorization and direction for excavation of kit fox dens. c. In the event that a San Joaquin kit fox is injured or killed, the incident shall immediately be reported to the project biologist. The project biologist shall contact CDFW immediately in the case of a dead, injured or entrapped kit fox. The CDFW					

Environmental Impact	Mitigation Measures	Timing of Monitoring Requirement	Responsibility for Compliance	Method for Compliance	Enforcement	Checkoff Date/ Initials
	contact for immediate assistance is State Dispatch at (916)445-0045. They will contact the local warden or the CDFW Central Region office at (559) 243-4014. The USFWS should be contacted at Endangered Species Division, (916) 414-6620 or (916) 414-6600. The USFWS and CDFW shall be notified in writing within three (3) working days of the accidental death or injury to a San Joaquin kit fox during project related activities. Notification must include the date, time, and location of the incident or of the finding of a dead or injured animal and any other pertinent information. The USFWS contact is the Chief of the Division of Endangered Species, 2800 Cottage Way, Suite W2605, Sacramento, California 95825-1846. The CDFW contact is the Central Region office at (559) 243-4014. New sightings of kit fox shall be reported to the CNDDB. A copy of the reporting form and a topographic map clearly marked with the location of where the kit fox was observed will also be provided to the USFWS as well. d. Kit foxes are attracted to den-like structures such as pipes and may enter stored pipes and become trapped or injured. All construction pipes, culverts, or similar structures with a diameter of 4 inches or greater that are stored at a construction site for one or more overnight periods shall be thoroughly inspected for kit foxes before the pipe is subsequently buried, capped, or otherwise used or moved in any way. If a kit fox is discovered inside a pipe, that section of pipe shall not be moved until					

Environmental Impact	Mitigation Measures	Timing of Monitoring Requirement	Responsibility for Compliance	Method for Compliance	Enforcement	Checkoff Date/ Initials
	the USFWS and CDFW has been consulted. If necessary, and under the direct supervision of the biologist, the pipe may be moved only once to remove it from the path of construction activity, until the fox has escaped. e. Limited destruction of kit fox dens may be allowed, if avoidance is not a reasonable alternative, provided the following procedures are observed. Destruction of any known or natal/pupping kit fox den requires take authorization/permit from the USFWS and CDFW. Destruction of the den shall be accomplished by careful excavation until it is certain that no kit foxes are inside. The den shall be fully excavated, filled with dirt and compacted to ensure that kit foxes cannot reenter or use the den during the construction period. If at any point during excavation, a kit fox is discovered inside the den, the excavation activity shall cease immediately and monitoring of the den as described above shall be resumed. Destruction of the den may be completed when in the judgment of the biologist, the animal has escaped, without further disturbance, from the partially destroyed den. Natal or pupping dens which are occupied cannot be destroyed until the pups and adults have vacated and then only after consultation with the USFWS and CDFW. Known dens occurring within the footprint of the activity must be monitored for three (3) days with tracking medium or an infra-red beam camera to determine the current use. If no kit fox activity is observed during					

Environmental Impact	Mitigation Measures	Timing of Monitoring Requirement	Responsibility for Compliance	Method for Compliance	Enforcement	Checkoff Date/ Initials
	this period, the den should be destroyed immediately to preclude subsequent use. If kit fox activity is observed at the den during this period, the den should be monitored for at least five (5) consecutive days from the time of the observation to allow any resident animal to move to another den during its normal activity. Use of the den can be discouraged during this period by partially plugging its entrances(s) with soil in such a manner that any resident animal can escape easily. Only when the den is determined to be unoccupied may the den be excavated under the direction of the biologist. If the animal is still present after five (5) or more consecutive days of plugging and monitoring, the den may have to be excavated when, in the judgment of a biologist, it is temporarily vacant, for example during the animal's normal foraging activities. The USFWS and CDFW encourage hand excavation, but realize that soil conditions may necessitate the use of excavating equipment. However, extreme caution must be exercised. For potential dens, if a take authorization/permit has been obtained, den destruction may proceed without monitoring, unless other restrictions were issued with the take authorization/permit. If no take authorization/permit has been issued, then potential dens shall be monitored as if they were known dens. If any den was considered to be a potential den, but is later determined during monitoring or destruction to be currently, or previously used by kit fox (e.g., if kit fox sign is found inside), then all					

Environmental Impact	Mitigation Measures	Timing of Monitoring Requirement	Responsibility for Compliance	Method for Compliance	Enforcement	Checkoff Date/ Initials
	construction activities shall cease and the USFWS and CDFW shall be notified immediately.					
	Biological 5. The burrowing owl nesting season begins as early as February 1 and continues through August 31. If burrowing owls are located or become established within the project site or exclusion areas at the time of the final pre-activity biological survey and are using burrows within the project site or exclusion area, a qualified biologist will consult with CDFW; the following measures shall be implemented: a. Naftex will follow recommendations included in CDFG's Staff Report on Burrowing Owl Mitigation (CDFW 2012) including avoidance of occupied burrows by implementation of a no-construction zone of a minimum distance of 500 meters, unless a qualified biologist approved by CDFW verifies through non-invasive methods that either : 1) the birds have not begun egg laying and incubation; or 2) that juveniles from the occupied burrows are foraging independently and are capable of independent survival. b. On-site passive relocation of burrowing owls shall be implemented if owls are using the burrows after August 31. Passive relocation is defined as encouraging owls to move from occupied burrows to alternate natural or artificial burrows that are beyond 150 feet from the impact zone and that are	Ongoing during project activities	Division and Naftex	Submission of pre-activity biological clearance to Division.	Require as condition of approval	

Environmental Impact	Mitigation Measures	Timing of Monitoring Requirement	Responsibility for Compliance	Method for Compliance	Enforcement	Checkoff Date/ Initials
	within or contiguous to a minimum of 6.5 acres of foraging habitat for each pair of relocated owls. Relocation of owls shall only be implemented during the non-breeding season. c. Owls shall be excluded from burrows in the immediate impact zone and within a 150 feet exclusion zone by installing one-way doors in burrow entrances. One-way doors shall be left in place 48 hours to insure owls have left the burrow before excavation. One alternate natural or artificial burrow shall be provided for each burrow that will be excavated in the project impact zone. d. The project area shall be monitored daily for one week to confirm owl use of alternate burrows before excavating burrows in the immediate impact zone. Whenever possible, burrows shall be excavated using hand tools and refilled to prevent reoccupation. Sections of flexible plastic pipe or burlap bags shall be inserted into burrow tunnels to prevent tunnel collapse while soil is excavated around that portion of a tunnel.			.		
	Biological 6. A project representative shall establish restrictions on project-related traffic to approved project areas, storage areas, staging and parking areas via signage. Off-road traffic outside of designated project areas shall be prohibited. Project-related traffic shall observe a 15 mph speed limit in all project areas except on county roads and state and federal highways to	Ongoing during project activities.	Division and Naftex	Site inspection by environmental monitor.	Require as condition of approval.	

Environmental Impact	Mitigation Measures	Timing of Monitoring Requirement	Responsibility for Compliance	Method for Compliance	Enforcement	Checkoff Date/ Initials
	avoid impacts to special-status and common wildlife species.					
	Biological 7 - Project activities during the drilling phase of the proposed project shall be scheduled to avoid evening hours, as feasible, to avoid special-status wildlife species that are active in the nighttime.	Ongoing during project activities.	Division and Naftex.	Site inspection by environmental monitor	Require as condition of approval.	
	Biological 8 - All vehicle operators shall check under vehicles and equipment before moving them if they have remained parked and shut off for 10 minutes or longer.	Ongoing during project activities.	Division and Naftex	Inspections by environmental monitor.	Require as condition of approval.	
	Biological 9 - Hazardous materials, fuels, lubricants, and solvents that spill accidentally during project-related activities shall be cleaned up and removed from the project as soon as possible according to applicable federal, state and local regulations.	Ongoing during project activities.	Division and Naftex.	Inspections by environmental monitor.	Require as condition of approval.	
	Biological 10 - All equipment storage and parking during site development and operation shall be confined to the project sites or to previously disturbed off site areas that are not suitable habitat for listed species.	Ongoing during project activities.	Division and Naftex.	Site inspection by environmental monitor.	Require as condition of approval.	
	Biological 11 - Environmental Awareness Training shall be presented to all personnel working on the proposed project sites. Training shall consist of a brief presentation in which biologists knowledgeable of endangered species biology and legislative protection shall explain endangered species concerns. Training shall include a discussion of special-status plants and sensitive	Prior to initiation of construction activities.	Division and Naftex.	Sign in sheets for Environmental Awareness Training Records will be provided to the Division upon completion.	Require as condition of approval.	

Environmental Impact	Mitigation Measures	Timing of Monitoring Requirement	Responsibility for Compliance	Method for Compliance	Enforcement	Checkoff Date/ Initials
	wildlife species. Species biology, habitat needs, status under the Endangered Species Act, and measures being incorporated for the protection of these species and their habitats shall also be discussed.					
	Biological 12 - If wildlife proof barricade fencing is not used at the proposed well sites, all excavated steep-walled holes or trenches in excess of three feet in depth shall be provided with one or more escape ramps constructed of earth fill to prevent entrapment of endangered species or other animals during the construction phase. Ramps shall be located at no greater than 1,000-foot intervals (for pipelines etc.) and at not less than a 45-degree angles. Trenches shall be inspected for entrapped wildlife each morning prior to onset of construction activities and immediately prior to the end of each working day. Before such holes or trenches are filled they shall be inspected thoroughly for entrapped animals. Any animals discovered shall be allowed to escape voluntarily without harassment before construction activities resume, or removed from the trench or hole by a qualified biologist and allowed to escape unimpeded.	Ongoing during project activities.	Division and Naftex.	Site inspection by environmental monitor.	Require as condition of approval.	
	Biological 13 - All construction pipes, culverts, or similar structures stored at a construction site overnight having a diameter of four inches or greater shall be inspected thoroughly for wildlife species before being buried, capped, or otherwise used or moved in any way. Pipes laid in trenches overnight shall be capped. If during construction a wildlife species is discovered inside a pipe, that	Ongoing during project activities.	Division and Naftex.	Site inspection by environmental monitor.	Require as condition of approval.	

Environmental Impact	Mitigation Measures	Timing of Monitoring Requirement	Responsibility for Compliance	Method for Compliance	Enforcement	Checkoff Date/ Initials
	section of pipe shall not be moved or, if necessary, moved only once to remove it from the path of construction activity, until the wildlife species has escaped.					
	Biological 14 - All food-related trash items such as wrappers, cans, bottles or food scraps generated during construction or during subsequent operation shall be disposed of only in closed containers and regularly removed from the project sites. Food items may attract wildlife species onto a project site, consequently exposing such animals to increased risk of injury or mortality. No deliberate feeding of wildlife shall be allowed.	Ongoing during project activities.	Division and Naftex.	Provide trash containers. Site inspection by environmental monitor.	Require as condition of approval.	
	Biological 15 - To prevent harassment or mortality of wildlife species via predation, or destruction of their dens or nests, no domestic pets shall be permitted on the proposed project sites.	Ongoing during project activities.	Division and Naftex.	Site inspection by environmental monitor.	Require as condition of approval.	
	Biological 16 - Use of rodenticides and herbicides on the project sites shall be permitted only as part of a USFWS and CDFW approved management plan unless such use is otherwise approved on a case-by-case basis. This is necessary to prevent primary or secondary poisoning of endangered species using adjacent habitats or depletion of prey upon which sensitive wildlife may depend.	Ongoing during project activities.	Division and Naftex.	Site inspection by environmental monitor.	Require as condition of approval.	
V. Cultural Resources						
a. Cause a substantial adverse		Ongoing during project				

Environmental Impact	Mitigation Measures	Timing of Monitoring Requirement	Responsibility for Compliance	Method for Compliance	Enforcement	Checkoff Date/ Initials
change in the significance of a historical resource as defined in Section 15064.5? b. Cause a substantial adverse change in the significance of an archaeological resource pursuant to Section 15064.5? c. Directly or indirectly destroy a unique paleontological resources or site or unique geologic feature? d. Disturb any human remains, including those interred outside of formal cemeteries?	Cultural -1. In the unlikely event archeological resources are identified on the project site, all ground disturbing activities will cease and a qualified archaeologist will be retained by Naftex to assess the significance of any find. The archeologist will have the authority to stop or divert the construction excavation as necessary. The archaeologist will evaluate the find in conformance with section 15064.5 of CEQA. A plan to mitigate any adverse impacts will be prepared by the archaeologist and contain procedures to follow. Work may proceed on the site once evaluation of the find is complete.	activities.	Division and Naftex.	Include archeological awareness in environmental awareness training.	Require as condition of approval.	
	Cultural 2 – In the unlikely event paleontological resources are identified on the project site, a qualified paleontologist will be retained by Naftex to assess the significance of any find and will have the authority to stop or divert the construction excavation as necessary. A plan to mitigate any adverse impacts will be prepared by the paleontologist and contain procedures to follow. Work may proceed on the site once evaluation of the find is complete.	Ongoing during project activities.	Division and Naftex.	Include paleontological awareness in environmental awareness training.	Require as condition of approval.	
	Cultural 3 – In the unlikely event human remains are discovered during construction of the site, site personnel will contact the County Coroner and stop work as required by Public Resources Code §5097.98-99 and Health and Safety Code §7050.5. If the remains are determined to be Native American, the County Coroner will notify the NAHC in accordance with PRC §5097.98. Naftex shall, in consultation with the identified descendants of the remains and/or NAHC,	Ongoing during project activities.	Division and Naftex.	Include archeological awareness in environmental awareness training.	Require as condition of approval.	

Environmental Impact	Mitigation Measures	Timing of Monitoring Requirement	Responsibility for Compliance	Method for Compliance	Enforcement	Checkoff Date/ Initials
	identify the appropriate measures for treatment or disposition of the remains.					
VIII. Hazards & Hazardous Materials						
a. Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials? b. Create a significant hazard to public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?	Hazards 1. All hazardous materials such as diesel fuel shall be stored according to the California Code of Regulations (CCR) Title 22, 23, 26 & 27 and California Fire Codes (CFR) Title 24 and Kern County hazardous materials ordinance and Material Safety Data Sheets shall be on each site. Waste materials shall be managed properly in accordance with requirements that comply with or given authority by the Code of Federal Regulations (40 CFR) and refined in California through CCR, Title 14, 22, 23, 26 & 27. Training shall be provided to all personnel involved in handling of hazardous materials/waste.	Ongoing during project activities.	Division and Naftex.	Include handling of hazardous materials/wastes training in environmental awareness training. Inspection by environmental monitor.	Require as condition of approval.	
	Hazards 2. In order to minimize potential impacts associated with a blowout, Naftex shall comply with CCR Title 14, Division 2, Chapter 4, Articles 3 and 4, specifically Article 4, 1941-1942. Requirements for well casing design and blowout prevention equipment are regulated by Division. Division engineers shall be notified for required tests and other operations.	Ongoing during drilling and completion activities for each well.	Division and Naftex.	Inspection by Division.	Require as a condition of approval.	
	Hazards 3. A Spill Contingency Plan shall be required in accordance with CCR § 1772.9 and a copy of the plan shall be kept on site. The plan shall discuss methods to avoid and/or minimize impacts in the event of a release. The purpose of	Prior to construction activities.	Division and Naftex.	Spill Contingency Plan will be kept on site.	Require as a condition of approval.	

Environmental Impact	Mitigation Measures	Timing of Monitoring Requirement	Responsibility for Compliance	Method for Compliance	Enforcement	Checkoff Date/ Initials
	the plan shall be to ensure that adequate containment would be provided to control accidental spills, that adequate spill response equipment and absorbents would be readily available, and that personnel would be properly trained in how to control and clean up any spills.					
	Hazards 4 - All above ground storage tanks will be located within a bermed area which provides a storage volume of at least 110% of the storage volume of the largest tank. Daily inspections of the above ground storage tanks will be conducted and an inspection log will be maintained for review by regulatory agency personnel. The inspection log will also document corrective actions taken, if necessary.	Ongoing during project activities.	Division and Naftex.	Inspection of environmental monitor.	Require as a condition of approval.	
	Hazards 5. Fluid disposal shall follow RWQCB regulations (CCR Title 23 Waters).	Ongoing during project activities.	Division and Naftex.	Inspection by environmental monitor	Require as a condition of approval.	
	Hazards 6. If project development uncovers any previously unknown oil, gas, or injection wells, the Division shall be notified. If unrecorded wells are uncovered during excavation or grading, remedial plugging operations may be required.	Ongoing during project activities.	Division and Naftex.	Inspection by environmental monitor and notification of Division if unknown wells discovered.	Require as a condition of approval.	
Hydrology and Water Quality						
e. Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional	Hydrology 1 – Naftex will provide a copy of the submitted NOI and verification of an approved erosivity waiver from the SWRCB to the Division prior to initiation of the project.	Prior to project initiation.	Division and Naftex.	Except as where otherwise noted, the environmental monitor shall verify the mitigation measures and send documentation to the	Require as a condition of project approval.	

Environmental Impact	Mitigation Measures	Timing of Monitoring Requirement	Responsibility for Compliance	Method for Compliance	Enforcement	Checkoff Date/ Initials
sources of polluted runoff?				Division's CEQA Unit at 801 K Street, MS 18-05, Sacramento, CA 95841		

ATTACHMENT B

AIR CALCULATIONS

ATTACHMENTS
Naftex Project

1. Copies of Emission Report and Input Data for Site Preparation
2. Copies of Emission Report and Input Data for Drilling
3. Copies of Emission Report and Input Data for Well Completion
4. Evaluation of GHG Emissions
5. Copies of Emission Report and Input Data for Equipment Installation
6. Copies of Emission Report and Input Data for Production
7. Copies of Risk Prioritization Spreadsheets (Short-Term)
8. Copies of Emission Report and Input Data for Plugging & Abandonment

Attachment 1

Copies of Emission Reports and Input Data for Site Preparation
Based on the Road Construction Model

Road Construction Emissions Model, Version 6.3.2

Emission Estimates for -> Naftex Site Prep Project Phases (English Units)	ROG (lbs/day)	CO (lbs/day)	NOx (lbs/day)	Total PM10 (lbs/day)	Exhaust PM10 (lbs/day)	Fugitive Dust PM10 (lbs/day)	Total PM2.5 (lbs/day)	Exhaust PM2.5 (lbs/day)	Fugitive Dust PM2.5 (lbs/day)	CO2 (lbs/day)
Grubbing/Land Clearing	1.6	13.8	9.2	7.7	0.6	7.1	2.0	0.5	1.5	2,206.2
Grading/Excavation	1.1	12.8	8.2	7.5	0.4	7.1	1.8	0.3	1.5	2,483.6
Drainage/Utilities/Sub-Grade	-	-	-	-	-	-	-	-	-	-
Paving	-	-	-	-	-	-	-	-	-	-
Maximum (pounds/day)	1.6	13.8	9.2	7.7	0.6	7.1	2.0	0.5	1.5	2,483.6
Total (tons/construction project)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5

Notes:

Project Start Year ->	2012
Project Length (months) ->	0
Total Project Area (acres) ->	1
Maximum Area Disturbed/Day (acres) ->	1
Total Soil Imported/Exported (yd^3/day)->	0

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.

Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns H and I. Total PM2.5 emissions shown in Column J are the sum of exhaust and fugitive dust emissions shown in columns K and L.

Emission Estimates for -> Naftex Site Prep Project Phases (Metric Units)	ROG (kgs/day)	CO (kgs/day)	NOx (kgs/day)	Total PM10 (kgs/day)	Exhaust PM10 (kgs/day)	Fugitive Dust PM10 (kgs/day)	Total PM2.5 (kgs/day)	Exhaust PM2.5 (kgs/day)	Fugitive Dust PM2.5 (kgs/day)	CO2 (kgs/day)
Grubbing/Land Clearing	0.7	6.3	4.2	3.5	0.3	3.2	0.9	0.2	0.7	1,002.8
Grading/Excavation	0.5	5.8	3.7	3.4	0.2	3.2	0.8	0.1	0.7	1,128.9
Drainage/Utilities/Sub-Grade	-	-	-	-	-	-	-	-	-	-
Paving	-	-	-	-	-	-	-	-	-	-
Maximum (kilograms/day)	0.7	6.3	4.2	3.5	0.3	3.2	0.9	0.2	0.7	1,128.9
Total (megagrams/construction project)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3

Notes:

Project Start Year ->	2012
Project Length (months) ->	0
Total Project Area (hectares) ->	0
Maximum Area Disturbed/Day (hectares) ->	0
Total Soil Imported/Exported (meters ^{3}/day)->	0

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.

Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns H and I. Total PM2.5 emissions shown in Column J are the sume of exhaust and fugitive dust emissions shown in columns K and L.

Road Construction Emissions Model

Version 6.3.2

Data Entry Worksheet

Note: Required data input sections have a yellow background.
Optional data input sections have a blue background. Only areas with a yellow or blue background can be modified. Program defaults have a white background.
The user is required to enter information in cells C10 through C25.

Input Type

Project Name	Naftex Site Prep	
Construction Start Year	2013	Enter a Year between 2005 and 2025 (inclusive)
Project Type	1	1 New Road Construction 2 Road Widening 3 Bridge/Overpass Construction
Project Construction Time	0.1	months
Predominant Soil/Site Type: Enter 1, 2, or 3	2	1. Sand Gravel 2. Weathered Rock-Earth 3. Blasted Rock
Project Length		miles
Total Project Area	0.7	acres
Maximum Area Disturbed/Day	0.7	acres
Water Trucks Used?	1	1. Yes 2. No
Soil Imported	0.0	yd^3/day
Soil Exported	0.0	yd^3/day
Average Truck Capacity	20.0	yd^3 (assume 20 if unknown)

To begin a new project, click this button to clear data previously entered. This button will only work if you opted not to disable macros when loading this spreadsheet.

The remaining sections of this sheet contain areas that can be modified by the user, although those modifications are optional.

Note: The program's estimates of construction period phase length can be overridden in cells C34 through C37.

Construction Periods	User Override of Construction Months	Program Calculated Months	2005	%	2006	%	2007
Grubbing/Land Clearing	0.07	0.01	0.00	0.00	0.00	0.00	0.00
Grading/Excavation	0.03	0.05	0.00	0.00	0.00	0.00	0.00
Drainage/Utilities/Sub-Grade		0.03	0.00	0.00	0.00	0.00	0.00
Paving		0.02	0.00	0.00	0.00	0.00	0.00
Totals	0.10	0.10					

Hauling emission default values can be overridden in cells C45 through C46.

Soil Hauling Emissions

User Input	User Override of Soil Hauling Defaults	Default Values
Miles/round trip	100.00	30
Round trips/day	2.00	0
Vehicle miles traveled/day (calculated)		200

Hauling Emissions	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate (grams/mile)	0.93	11.59	6.20	0.45	0.38	1868.60
Emission rate (grams/trip)	10.89	7.79	185.47	0.02	0.01	209.04
Pounds per day	0.4	5.1	2.7	0.2	0.2	823.2
Tons per contruction period	0.00	0.00	0.00	0.00	0.00	0.30

Worker commute default values can be overridden in cells C60 through C65.

Worker Commute Emissions

	User Override of Worker Commute Default Values	Default Values
Miles/ one-way trip	50.00	20
One-way trips/day	4.00	2
No. of employees: Grubbing/Land Clearing	6.00	3
No. of employees: Grading/Excavation		5
No. of employees: Drainage/Utilities/Sub-Grade		5
No. of employees: Paving		4

	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate - Grubbing/Land Clearing (grams/mile)	0.135	0.244	2.515	0.033	0.018	426.920
Emission rate - Grading/Excavation (grams/mile)	0.132	0.235	2.427	0.033	0.018	426.640
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Paving (grams/mile)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Grubbing/Land Clearing (grams/trip)	0.839	0.359	8.253	0.130	0.012	192.050
Emission rate - Grading/Excavation (grams/trip)	0.809	0.343	7.916	0.130	0.012	192.280
Emission rate - Draining/Utilities/Sub-Grade (gr/trip)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Paving (grams/trip)	0.000	0.000	0.000	0.000	0.000	0.000
Pounds per day - Grubbing/Land Clearing	0.446	0.683	7.520	0.101	0.049	1148.728
Tons per const. Period - Grub/Land Clear	0.000	0.001	0.006	0.000	0.000	0.842
Pounds per day - Grading/Excavation	0.434	0.657	7.252	0.101	0.049	1148.012
Tons per const. Period - Grading/Excavation	0.000	0.000	0.003	0.000	0.000	0.421
Pounds per day - Drainage/Utilities/Sub-Grade	0.000	0.000	0.000	0.000	0.000	0.000
Tons per const. Period - Drain/Util/Sub-Grade	0.000	0.000	0.000	0.000	0.000	0.000
Pounds per day - Paving	0.000	0.000	0.000	0.000	0.000	0.000
Tons per const. Period - Paving	0.000	0.000	0.000	0.000	0.000	0.000
tons per construction period	0.000	0.001	0.008	0.000	0.000	1.263

Water truck default values can be overriden in cells C91 through C93 and E91 through E93.

Water Truck Emissions	User Override of Default # Water Trucks	Program Estimate of Number of Water Trucks	User Override of Truck Miles Traveled/Day	Default Values Miles Traveled/Day		
Grubbing/Land Clearing - Exhaust	1.00	1	20.00	40		
Grading/Excavation - Exhaust		1		40		
Drainage/Utilities/Subgrade		1		40		
	ROG	**NOx**	**CO**	**PM10**	**PM2.5**	**CO2**
Emission rate - Grubbing/Land Clearing (grams/mile)	0.97	12.07	6.48	0.47	0.39	1866.20
Emission rate - Grading/Excavation (grams/mile)	0.93	11.59	6.20	0.45	0.38	1868.60
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Grubbing/Land Clearing	0.04	0.53	0.29	0.02	0.02	82.21
Tons per const. Period - Grub/Land Clear	0.00	0.00	0.00	0.00	0.00	0.03
Pound per day - Grading/Excavation	0.08	1.02	0.55	0.04	0.03	164.63
Tons per const. Period - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.06
Pound per day - Drainage/Utilities/Subgrade	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Drainage/Utilities/Subgrade	0.00	0.00	0.00	0.00	0.00	0.00

Fugitive dust default values can be overridden in cells C110 through C112.

Fugitive Dust	User Override of Max Acreage Disturbed/Day	Default Maximum Acreage/Day	PM10 pounds/day	PM10 tons/per period	PM2.5 pounds/day	PM2.5 tons/per period
Fugitive Dust - Grubbing/Land Clearing		0.71	7.1	0.0	1.5	0.0
Fugitive Dust - Grading/Excavation		0.71	7.1	0.0	1.5	0.0
Fugitive Dust - Drainage/Utilities/Subgrade		0	0.0	0.0	0.0	0.0

Off-Road Equipment Emissions

Grubbing/Land Clearing Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00
		Excavators	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00
1.00		Graders	0.85	3.85	6.60	0.38	0.35
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00
		Pavers	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00
		Rollers	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00
0.00	1	Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00
0.00	1	Scrapers	0.00	0.00	0.00	0.00	0.00
	0	Signal Boards	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00
1.00		Tractors/Loaders/Backhoes	0.21	2.15	1.39	0.06	0.06
		Trenchers	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00
	Grubbing/Land Clearing	pounds per day	1.1	6.0	8.0	0.4	0.4
	Grubbing/Land Clearing	tons per phase	0.0	0.0	0.0	0.0	0.0

Grading/Excavation	Default Number of Vehicles		ROG	CO	NOx	PM10	PM2.5
Override of Default Number of Vehicles	*Program-estimate*	Type	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00
	0	Cranes	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00
0.00	1	Excavators	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00
0.00	1	Graders	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00
	0	Other Construction Equipment	0.03	0.13	0.19	0.02	0.01
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00
		Pavers	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00
		Rollers	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00
0.00	1	Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00
0.00	1	Scrapers	0.00	0.00	0.00	0.00	0.00
	0	Signal Boards	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00
1.00		Tractors/Loaders/Backhoes	0.19	2.14	1.25	0.05	0.04
		Trenchers	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00
	Grading/Excavation	pounds per day	0.2	2.3	1.4	0.1	0.1
	Grading	tons per phase	0.0	0.0	0.0	0.0	0.0

Drainage/Utilities/Subgrade Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00
		Excavators	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00
0.00	1	Graders	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00
		Pavers	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00
0.00	1	Plate Compactors	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00
		Rollers	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00
0.00	1	Scrapers	0.00	0.00	0.00	0.00	0.00
	0	Signal Boards	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00
0.00	1	Trenchers	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00
	Drainage	pounds per day	0.0	0.0	0.0	0.0	0.0
	Drainage	tons per phase	0.0	0.0	0.0	0.0	0.0

Paving	Default Number of Vehicles		ROG	CO	NOx	PM10	PM2.5
Override of Default Number of Vehicles	*Program-estimate*	Type	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00
		Excavators	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00
		Graders	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00
0.00	1	Pavers	0.00	0.00	0.00	0.00	0.00
0.00	1	Paving Equipment	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00
0.00	1	Rollers	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00
		Scrapers	0.00	0.00	0.00	0.00	0.00
	0	Signal Boards	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00
		Trenchers	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00
	Paving	pounds per day	0.0	0.0	0.0	0.0	0.0
	Paving	tons per phase	0.0	0.0	0.0	0.0	0.0
Total Emissions all Phases (tons per construction period) =>			0.0	0.0	0.0	0.0	0.0

Equipment default values for horsepower, load factor, and hours/day can be overridden in cells C285 through C317, E285 through E317, and G285 through G317.

Equipment		Default Values Horsepower		Default Values Load Factor		Default Values Hours/day
Aerial Lifts		60		0.46		8
Air Compressors		106		0.48		8
Bore/Drill Rigs		291		0.75		8
Cement and Mortar Mixers		10		0.56		8
Concrete/Industrial Saws		19		0.73		8
Cranes		399		0.43		8
Crushing/Proc. Equipment		142		0.78		8
Excavators		168		0.57		8
Forklifts		145		0.30		8
Generator Sets		549		0.74		8
Graders		174		0.61		8
Off-Highway Tractors		267		0.65		8
Off-Highway Trucks		479		0.57		8
Other Construction Equipment		75		0.62		8
Other General Industrial Equipment		238		0.51		8
Other Material Handling Equipment		191		0.59		8
Pavers		100		0.62		8
Paving Equipment		104		0.53		8
Plate Compactors		8		0.43		8
Pressure Washers		1		0.60		8
Pumps		53		0.74		8
Rollers		95		0.56		8
Rough Terrain Forklifts		93		0.60		8
Rubber Tired Dozers		357		0.59		8
Rubber Tired Loaders		157		0.54		8
Scrapers		313		0.72		8
Signal Boards		20		0.78		8
Skid Steer Loaders		44		0.55		8
Surfacing Equipment		362		0.45		8
Sweepers/Scrubbers		91		0.68		8
Tractors/Loaders/Backhoes		108		0.55		8
Trenchers		63		0.75		8
Welders		45		0.45		8

0

END OF DATA ENTRY SHEET

Attachment 2

Copies of Emission Reports and Input Data for Drilling
Based on the Road Construction Model

Road Construction Emissions Model, Version 6.3.2

Emission Estimates for -> Naftex Drilling Project Phases (English Units)	ROG (lbs/day)	CO (lbs/day)	NOx (lbs/day)	Total PM10 (lbs/day)	Exhaust PM10 (lbs/day)	Fugitive Dust PM10 (lbs/day)	Total PM2.5 (lbs/day)	Exhaust PM2.5 (lbs/day)	Fugitive Dust PM2.5 (lbs/day)	CO2 (lbs/day)
Grubbing/Land Clearing	25.7	124.3	288.3	9.0	9.0	-	8.1	8.1	-	43,210.9
Grading/Excavation	-	-	-	-	-	-	-	-	-	-
Drainage/Utilities/Sub-Grade	-	-	-	-	-	-	-	-	-	-
Paving	-	-	-	-	-	-	-	-	-	-
Maximum (pounds/day)	25.7	124.3	288.3	9.0	9.0	-	8.1	8.1	-	43,210.9
Total (tons/construction project)	0.0	0.1	0.2	0.0	0.0	-	0.0	0.0	-	31.6

Notes: Project Start Year -> 2012
Project Length (months) -> 0
Total Project Area (acres) -> 1
Maximum Area Disturbed/Day (acres) -> 0
Total Soil Imported/Exported (yd^3/day)-> 0

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.

Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns H and I. Total PM2.5 emissions shown in Column J are the sum of exhaust and fugitive dust emissions shown in columns K and L.

Emission Estimates for -> Naftex Drilling Project Phases (Metric Units)	ROG (kgs/day)	CO (kgs/day)	NOx (kgs/day)	Total PM10 (kgs/day)	Exhaust PM10 (kgs/day)	Fugitive Dust PM10 (kgs/day)	Total PM2.5 (kgs/day)	Exhaust PM2.5 (kgs/day)	Fugitive Dust PM2.5 (kgs/day)	CO2 (kgs/day)
Grubbing/Land Clearing	11.7	56.5	131.1	4.1	4.1	-	3.7	3.7	-	19,641.3
Grading/Excavation	-	-	-	-	-	-	-	-	-	-
Drainage/Utilities/Sub-Grade	-	-	-	-	-	-	-	-	-	-
Paving	-	-	-	-	-	-	-	-	-	-
Maximum (kilograms/day)	11.7	56.5	131.1	4.1	4.1	-	3.7	3.7	-	19,641.3
Total (megagrams/construction project)	0.0	0.1	0.2	0.0	0.0	-	0.0	0.0	-	28.7

Notes: Project Start Year -> 2012
Project Length (months) -> 0
Total Project Area (hectares) -> 0
Maximum Area Disturbed/Day (hectares) -> 0
Total Soil Imported/Exported (meters ^{3}/day)-> 0

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.

Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns H and I. Total PM2.5 emissions shown in Column J are the sume of exhaust and fugitive dust emissions shown in columns K and L.

Road Construction Emissions Model

Version 6.3.2

Data Entry Worksheet

Note: Required data input sections have a yellow background.
Optional data input sections have a blue background. Only areas with a yellow or blue background can be modified. Program defaults have a white background.
The user is required to enter information in cells C10 through C25.

SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT

Input Type

Project Name	Naftex Drilling	
Construction Start Year	2013	Enter a Year between 2005 and 2025 (inclusive)
Project Type	1	1 New Road Construction 2 Road Widening 3 Bridge/Overpass Construction
Project Construction Time	0.1	months
Predominant Soil/Site Type: Enter 1, 2, or 3	2	1. Sand Gravel 2. Weathered Rock-Earth 3. Blasted Rock
Project Length		miles
Total Project Area	0.7	acres
Maximum Area Disturbed/Day	0.0	acres
Water Trucks Used?	1	1. Yes 2. No
Soil Imported	0.0	yd^3/day
Soil Exported	0.0	yd^3/day
Average Truck Capacity	20.0	yd^3 (assume 20 if unknown)

To begin a new project, click this button to clear data previously entered. This button will only work if you opted not to disable macros when loading this spreadsheet.

The remaining sections of this sheet contain areas that can be modified by the user, although those modifications are optional.

Note: The program's estimates of construction period phase length can be overridden in cells C34 through C37.

Construction Periods	User Override of Construction Months	Program Calculated Months	2005	%	2006	%	2007
Grubbing/Land Clearing	0.07	0.01	0.00	0.00	0.00	0.00	0.00
Grading/Excavation		0.03	0.00	0.00	0.00	0.00	0.00
Drainage/Utilities/Sub-Grade		0.02	0.00	0.00	0.00	0.00	0.00
Paving		0.01	0.00	0.00	0.00	0.00	0.00
Totals	0.07	0.07					

Hauling emission default values can be overridden in cells C45 through C46.

Soil Hauling Emissions

User Input	User Override of Soil Hauling Defaults	Default Values
Miles/round trip	100.00	30
Round trips/day	4.50	0
Vehicle miles traveled/day (calculated)		450

Hauling Emissions	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate (grams/mile)	0.00	0.00	0.00	0.00	0.00	0.00
Emission rate (grams/trip)	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day	0.0	0.0	0.0	0.0	0.0	0.0
Tons per contruction period	0.00	0.00	0.00	0.00	0.00	0.00

Worker commute default values can be overridden in cells C60 through C65.

Worker Commute Emissions

	User Override of Worker Commute Default Values	Default Values
Miles/ one-way trip	50.00	20
One-way trips/day	20.00	2
No. of employees: Grubbing/Land Clearing	6.00	0
No. of employees: Grading/Excavation		0
No. of employees: Drainage/Utilities/Sub-Grade		0
No. of employees: Paving		0

	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate - Grubbing/Land Clearing (grams/mile)	0.135	0.244	2.515	0.033	0.018	426.920
Emission rate - Grading/Excavation (grams/mile)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Paving (grams/mile)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Grubbing/Land Clearing (grams/trip)	0.839	0.359	8.253	0.130	0.012	192.050
Emission rate - Grading/Excavation (grams/trip)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Draining/Utilities/Sub-Grade (gr/trip)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Paving (grams/trip)	0.000	0.000	0.000	0.000	0.000	0.000
Pounds per day - Grubbing/Land Clearing	2.228	3.414	37.601	0.505	0.244	5743.639
Tons per const. Period - Grub/Land Clear	0.002	0.003	0.028	0.000	0.000	4.212
Pounds per day - Grading/Excavation	0.000	0.000	0.000	0.000	0.000	0.000
Tons per const. Period - Grading/Excavation	0.000	0.000	0.000	0.000	0.000	0.000
Pounds per day - Drainage/Utilities/Sub-Grade	0.000	0.000	0.000	0.000	0.000	0.000
Tons per const. Period - Drain/Util/Sub-Grade	0.000	0.000	0.000	0.000	0.000	0.000
Pounds per day - Paving	0.000	0.000	0.000	0.000	0.000	0.000
Tons per const. Period - Paving	0.000	0.000	0.000	0.000	0.000	0.000
tons per construction period	0.002	0.003	0.028	0.000	0.000	4.212

Water truck default values can be overriden in cells C91 through C93 and E91 through E93.

Water Truck Emissions	User Override of Default # Water Trucks	Program Estimate of Number of Water Trucks	User Override of Truck Miles Traveled/Day	Default Values Miles Traveled/Day		
Grubbing/Land Clearing - Exhaust	1.00	0	50.00	0		
Grading/Excavation - Exhaust		0		0		
Drainage/Utilities/Subgrade		0		0		
	ROG	**NOx**	**CO**	**PM10**	**PM2.5**	**CO2**
Emission rate - Grubbing/Land Clearing (grams/mile)	0.97	12.07	6.48	0.47	0.39	1866.20
Emission rate - Grading/Excavation (grams/mile)	0.00	0.00	0.00	0.00	0.00	0.00
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Grubbing/Land Clearing	0.11	1.33	0.71	0.05	0.04	205.53
Tons per const. Period - Grub/Land Clear	0.00	0.00	0.00	0.00	0.00	0.07
Pound per day - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00
Pound per day - Drainage/Utilities/Subgrade	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Drainage/Utilities/Subgrade	0.00	0.00	0.00	0.00	0.00	0.00

Fugitive dust default values can be overridden in cells C110 through C112.

Fugitive Dust	User Override of Max Acreage Disturbed/Day	Default Maximum Acreage/Day	PM10 pounds/day	PM10 tons/per period	PM2.5 pounds/day	PM2.5 tons/per period
Fugitive Dust - Grubbing/Land Clearing		0	0.0	0.0	0.0	0.0
Fugitive Dust - Grading/Excavation		0	0.0	0.0	0.0	0.0
Fugitive Dust - Drainage/Utilities/Subgrade		0	0.0	0.0	0.0	0.0

Off-Road Equipment Emissions

Grubbing/Land Clearing Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00
1.00		Bore/Drill Rigs	4.58	18.01	45.47	1.48	1.36
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00
		Excavators	0.00	0.00	0.00	0.00	0.00
1.00		Forklifts	0.15	0.76	1.10	0.07	0.06
1.00		Generator Sets	5.77	22.00	78.80	2.25	2.07
		Graders	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00
1.00		Other Construction Equipment	3.79	13.14	42.19	1.39	1.28
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00
		Pavers	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00
1.00		Pumps	9.09	32.07	116.01	3.28	3.02
		Rollers	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00
	0	Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00
	0	Scrapers	0.00	0.00	0.00	0.00	0.00
	0	Signal Boards	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00
		Trenchers	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00
	Grubbing/Land Clearing	pounds per day	23.4	86.0	283.6	8.5	7.8
	Grubbing/Land Clearing	tons per phase	0.0	0.1	0.2	0.0	0.0

Grading/Excavation	Default Number of Vehicles		ROG	CO	NOx	PM10	PM2.5
Override of Default Number of Vehicles	*Program-estimate*	Type	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00
	0	Cranes	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00
	0	Excavators	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00
	0	Graders	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00
	0	Other Construction Equipment	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00
		Pavers	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00
		Rollers	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00
	0	Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00
	0	Scrapers	0.00	0.00	0.00	0.00	0.00
	0	Signal Boards	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00
		Trenchers	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00
	Grading/Excavation	pounds per day	0.0	0.0	0.0	0.0	0.0
	Grading	tons per phase	0.0	0.0	0.0	0.0	0.0

Drainage/Utilities/Subgrade	Default Number of Vehicles		ROG	CO	NOx	PM10	PM2.5
Override of Default Number of Vehicles	*Program-estimate*		pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00
		Excavators	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00
	0	Graders	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00
		Pavers	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00
	0	Plate Compactors	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00
		Rollers	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00
	0	Scrapers	0.00	0.00	0.00	0.00	0.00
	0	Signal Boards	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00
	0	Trenchers	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00
	Drainage	pounds per day	0.0	0.0	0.0	0.0	0.0
	Drainage	tons per phase	0.0	0.0	0.0	0.0	0.0

Paving	Default Number of Vehicles		ROG	CO	NOx	PM10	PM2.5
Override of Default Number of Vehicles	*Program-estimate*	Type	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00
		Excavators	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00
		Graders	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00
	0	Pavers	0.00	0.00	0.00	0.00	0.00
	0	Paving Equipment	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00
	0	Rollers	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00
		Scrapers	0.00	0.00	0.00	0.00	0.00
	0	Signal Boards	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00
		Trenchers	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00
	Paving	pounds per day	0.0	0.0	0.0	0.0	0.0
	Paving	tons per phase	0.0	0.0	0.0	0.0	0.0
Total Emissions all Phases (tons per construction period) =>			0.0	0.1	0.2	0.0	0.0

Equipment default values for horsepower, load factor, and hours/day can be overridden in cells C285 through C317, E285 through E317, and G285 through G317.

Equipment		Default Values Horsepower		Default Values Load Factor		Default Values Hours/day
Aerial Lifts		60		0.46		8
Air Compressors		106		0.48		8
Bore/Drill Rigs	600.00	291		0.75	24.00	8
Cement and Mortar Mixers		10		0.56		8
Concrete/Industrial Saws		19		0.73		8
Cranes		399		0.43		8
Crushing/Proc. Equipment		142		0.78		8
Excavators		168		0.57		8
Forklifts		145		0.30		8
Generator Sets	600.00	549		0.74	24.00	8
Graders		174		0.61		8
Off-Highway Tractors		267		0.65		8
Off-Highway Trucks		479		0.57		8
Other Construction Equipment	530.00	75		0.62	24.00	8
Other General Industrial Equipment		238		0.51		8
Other Material Handling Equipment		191		0.59		8
Pavers		100		0.62		8
Paving Equipment		104		0.53		8
Plate Compactors		8		0.43		8
Pressure Washers		1		0.60		8
Pumps	1000.00	53		0.74	16.00	8
Rollers		95		0.56		8
Rough Terrain Forklifts		93		0.60		8
Rubber Tired Dozers		357		0.59		8
Rubber Tired Loaders		157		0.54		8
Scrapers		313		0.72		8
Signal Boards		20		0.78		8
Skid Steer Loaders		44		0.55		8
Surfacing Equipment		362		0.45		8
Sweepers/Scrubbers		91		0.68		8
Tractors/Loaders/Backhoes		108		0.55		8
Trenchers		63		0.75		8
Welders		45		0.45		8

2818

END OF DATA ENTRY SHEET

Attachment 3

Copies of Emission Report and Input Data for Well Completion and Abandoment

Road Construction Emissions Model, Version 6.3.2

Emission Estimates for -> Naftex Completion Rev 2 Project Phases (English Units)	ROG (lbs/day)	CO (lbs/day)	NOx (lbs/day)	Total PM10 (lbs/day)	Exhaust PM10 (lbs/day)	Fugitive Dust PM10 (lbs/day)	Total PM2.5 (lbs/day)	Exhaust PM2.5 (lbs/day)	Fugitive Dust PM2.5 (lbs/day)	CO2 (lbs/day)
Grubbing/Land Clearing	2.9	16.3	24.9	0.9	0.9	-	0.8	0.8	-	5,237.2
Grading/Excavation	1.6	15.4	14.3	0.7	0.7	-	0.5	0.5	-	3,912.8
Drainage/Utilities/Sub-Grade	-	-	-	-	-	-	-	-	-	-
Paving	-	-	-	-	-	-	-	-	-	-
Maximum (pounds/day)	2.9	16.3	24.9	0.9	0.9	-	0.8	0.8	-	5,237.2
Total (tons/construction project)	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	-	5.3

Notes:

Project Start Year ->	2013
Project Length (months) ->	0
Total Project Area (acres) ->	4
Maximum Area Disturbed/Day (acres) ->	0
Total Soil Imported/Exported (yd^3/day)->	0

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.

Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns H and I. Total PM2.5 emissions shown in Column J are the sum of exhaust and fugitive dust emissions shown in columns K and L.

Emission Estimates for -> Naftex Completion Rev 2 Project Phases (Metric Units)	ROG (kgs/day)	CO (kgs/day)	NOx (kgs/day)	Total PM10 (kgs/day)	Exhaust PM10 (kgs/day)	Fugitive Dust PM10 (kgs/day)	Total PM2.5 (kgs/day)	Exhaust PM2.5 (kgs/day)	Fugitive Dust PM2.5 (kgs/day)	CO2 (kgs/day)
Grubbing/Land Clearing	1.3	7.4	11.3	0.4	0.4	-	0.4	0.4	-	2,380.6
Grading/Excavation	0.7	7.0	6.5	0.3	0.3	-	0.2	0.2	-	1,778.5
Drainage/Utilities/Sub-Grade	-	-	-	-	-	-	-	-	-	-
Paving	-	-	-	-	-	-	-	-	-	-
Maximum (kilograms/day)	1.3	7.4	11.3	0.4	0.4	-	0.4	0.4	-	2,380.6
Total (megagrams/construction project)	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	-	4.8

Notes:

Project Start Year ->	2013
Project Length (months) ->	0
Total Project Area (hectares) ->	2
Maximum Area Disturbed/Day (hectares) ->	0
Total Soil Imported/Exported (meters ^{3}/day)->	0

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.

Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns H and I. Total PM2.5 emissions shown in Column J are the sume of exhaust and fugitive dust emissions shown in columns K and L.

Road Construction Emissions Model

Version 6.3.2

Data Entry Worksheet

Note: Required data input sections have a yellow background.
Optional data input sections have a blue background. Only areas with a yellow or blue background can be modified. Program defaults have a white background.
The user is required to enter information in cells C10 through C25.

SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT

Input Type

Project Name	Naftex Completion Rev 2	
Construction Start Year	2013	Enter a Year between 2005 and 2025 (inclusive)
Project Type	1	1 New Road Construction 2 Road Widening 3 Bridge/Overpass Construction
Project Construction Time	0.1	months
Predominant Soil/Site Type: Enter 1, 2, or 3	2	1. Sand Gravel 2. Weathered Rock-Earth 3. Blasted Rock
Project Length		miles
Total Project Area	4.3	acres
Maximum Area Disturbed/Day	0.0	acres
Water Trucks Used?	2	1. Yes 2. No
Soil Imported	0.0	yd^3/day
Soil Exported	0.0	yd^3/day
Average Truck Capacity	20.0	yd^3 (assume 20 if unknown)

To begin a new project, click this button to clear data previously entered. This button will only work if you opted not to disable macros when loading this spreadsheet.

The remaining sections of this sheet contain areas that can be modified by the user, although those modifications are optional.

Note: The program's estimates of construction period phase length can be overridden in cells C34 through C37.

Construction Periods	User Override of Construction Months	Program Calculated Months	2005	%	2006	%	2007
Grubbing/Land Clearing	0.07	0.01	0.00	0.00	0.00	0.00	0.00
Grading/Excavation	0.03	0.03	0.00	0.00	0.00	0.00	0.00
Drainage/Utilities/Sub-Grade		0.02	0.00	0.00	0.00	0.00	0.00
Paving		0.01	0.00	0.00	0.00	0.00	0.00
Totals	0.10	0.07					

Please note: You have entered a different number of months than the project length shown in cell C13.

Hauling emission default values can be overridden in cells C45 through C46.

Soil Hauling Emissions

User Input	User Override of Soil Hauling Defaults	Default Values
Miles/round trip	100.00	30
Round trips/day	6.00	0
Vehicle miles traveled/day (calculated)		600

Hauling Emissions	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate (grams/mile)	0.84	10.25	5.45	0.40	0.33	1874.76
Emission rate (grams/trip)	10.32	7.57	172.85	0.01	0.01	199.87
Pounds per day	1.1	13.6	7.2	0.5	0.4	2477.7
Tons per contruction period	0.00	0.00	0.00	0.00	0.00	0.91

Worker commute default values can be overridden in cells C60 through C65.

Worker Commute Emissions

	User Override of Worker Commute Default Values	Default Values
Miles/ one-way trip	50.00	20
One-way trips/day	5.00	2
No. of employees: Grubbing/Land Clearing	6.00	0
No. of employees: Grading/Excavation		0
No. of employees: Drainage/Utilities/Sub-Grade		0
No. of employees: Paving		0

	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate - Grubbing/Land Clearing (grams/mile)	0.118	0.211	2.201	0.033	0.018	426.660
Emission rate - Grading/Excavation (grams/mile)	0.118	0.211	2.201	0.033	0.018	426.660
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Paving (grams/mile)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Grubbing/Land Clearing (grams/trip)	0.746	0.316	7.305	0.130	0.013	192.690
Emission rate - Grading/Excavation (grams/trip)	0.746	0.316	7.305	0.130	0.013	192.690
Emission rate - Draining/Utilities/Sub-Grade (gr/trip)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Paving (grams/trip)	0.000	0.000	0.000	0.000	0.000	0.000
Pounds per day - Grubbing/Land Clearing	0.488	0.739	8.237	0.126	0.061	1435.135
Tons per const. Period - Grub/Land Clear	0.000	0.001	0.006	0.000	0.000	1.052
Pounds per day - Grading/Excavation	0.488	0.739	8.237	0.126	0.061	1435.135
Tons per const. Period - Grading/Excavation	0.000	0.000	0.003	0.000	0.000	0.526
Pounds per day - Drainage/Utilities/Sub-Grade	0.000	0.000	0.000	0.000	0.000	0.000
Tons per const. Period - Drain/Util/Sub-Grade	0.000	0.000	0.000	0.000	0.000	0.000
Pounds per day - Paving	0.000	0.000	0.000	0.000	0.000	0.000
Tons per const. Period - Paving	0.000	0.000	0.000	0.000	0.000	0.000
tons per construction period	0.001	0.001	0.009	0.000	0.000	1.579

Water truck default values can be overriden in cells C91 through C93 and E91 through E93.

Water Truck Emissions	User Override of Default # Water Trucks	Program Estimate of Number of Water Trucks	User Override of Truck Miles Traveled/Day	Default Values Miles Traveled/Day		
Grubbing/Land Clearing - Exhaust		0	0.00	0		
Grading/Excavation - Exhaust		0		0		
Drainage/Utilities/Subgrade		0		0		
	ROG	**NOx**	**CO**	**PM10**	**PM2.5**	**CO2**
Emission rate - Grubbing/Land Clearing (grams/mile)	0.84	10.25	5.45	0.40	0.33	1874.76
Emission rate - Grading/Excavation (grams/mile)	0.84	10.25	5.45	0.40	0.33	1874.76
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grub/Land Clear	0.00	0.00	0.00	0.00	0.00	0.00
Pound per day - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00
Pound per day - Drainage/Utilities/Subgrade	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Drainage/Utilities/Subgrade	0.00	0.00	0.00	0.00	0.00	0.00

Fugitive dust default values can be overridden in cells C110 through C112.

Fugitive Dust	User Override of Max Acreage Disturbed/Day	Default Maximum Acreage/Day	PM10 pounds/day	PM10 tons/per period	PM2.5 pounds/day	PM2.5 tons/per period
Fugitive Dust - Grubbing/Land Clearing		0	0.0	0.0	0.0	0.0
Fugitive Dust - Grading/Excavation		0	0.0	0.0	0.0	0.0
Fugitive Dust - Drainage/Utilities/Subgrade		0	0.0	0.0	0.0	0.0

Off-Road Equipment Emissions

Grubbing/Land Clearing Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00
		Excavators	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00
		Graders	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00
1.00		Other Construction Equipment	1.65	5.95	17.28	0.56	0.51
1.00		Other General Industrial Equipment	0.72	2.15	6.88	0.23	0.21
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00
		Pavers	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00
		Rollers	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00
	0	Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00
	0	Scrapers	0.00	0.00	0.00	0.00	0.00
	0	Signal Boards	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00
		Trenchers	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00
	Grubbing/Land Clearing	pounds per day	2.4	8.1	24.2	0.8	0.7
	Grubbing/Land Clearing	tons per phase	0.0	0.0	0.0	0.0	0.0

Grading/Excavation	Default Number of Vehicles		ROG	CO	NOx	PM10	PM2.5
Override of Default Number of Vehicles	*Program-estimate*	Type	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00
	0	Cranes	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00
	0	Excavators	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00
	0	Graders	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00
	0	Other Construction Equipment	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00
		Pavers	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00
		Rollers	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00
	0	Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00
	0	Scrapers	0.00	0.00	0.00	0.00	0.00
	0	Signal Boards	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00
		Trenchers	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00
	Grading/Excavation	pounds per day	0.0	0.0	0.0	0.0	0.0
	Grading	tons per phase	0.0	0.0	0.0	0.0	0.0

Drainage/Utilities/Subgrade Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00
		Excavators	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00
	0	Graders	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00
		Pavers	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00
	0	Plate Compactors	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00
		Rollers	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00
	0	Scrapers	0.00	0.00	0.00	0.00	0.00
	0	Signal Boards	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00
0.00	0	Trenchers	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00
	Drainage	pounds per day	0.0	0.0	0.0	0.0	0.0
	Drainage	tons per phase	0.0	0.0	0.0	0.0	0.0

Paving	Default Number of Vehicles		ROG	CO	NOx	PM10	PM2.5
Override of Default Number of Vehicles	*Program-estimate*	Type	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00
		Excavators	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00
		Graders	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00
	0	Pavers	0.00	0.00	0.00	0.00	0.00
	0	Paving Equipment	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00
	0	Rollers	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00
		Scrapers	0.00	0.00	0.00	0.00	0.00
	0	Signal Boards	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00
		Trenchers	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00
	Paving	pounds per day	0.0	0.0	0.0	0.0	0.0
	Paving	tons per phase	0.0	0.0	0.0	0.0	0.0
Total Emissions all Phases (tons per construction period) =>			0.0	0.0	0.0	0.0	0.0

Equipment default values for horsepower, load factor, and hours/day can be overridden in cells C285 through C317, E285 through E317, and G285 through G317.

Equipment		Default Values Horsepower		Default Values Load Factor		Default Values Hours/day
Aerial Lifts		60		0.46		8
Air Compressors		106		0.48		8
Bore/Drill Rigs		291		0.75		8
Cement and Mortar Mixers		10		0.56		8
Concrete/Industrial Saws		19		0.73		8
Cranes		399		0.43		8
Crushing/Proc. Equipment		142		0.78		8
Excavators		168		0.57		8
Forklifts		145		0.30		8
Generator Sets		549		0.74		8
Graders		174		0.61		8
Off-Highway Tractors		267		0.65		8
Off-Highway Trucks		479		0.57		8
Other Construction Equipment	500.00	75		0.62	12.00	8
Other General Industrial Equipment	350.00	238		0.51	8.00	8
Other Material Handling Equipment		191		0.59		8
Pavers		100		0.62		8
Paving Equipment		104		0.53		8
Plate Compactors		8		0.43		8
Pressure Washers		1		0.60		8
Pumps		53		0.74		8
Rollers		95		0.56		8
Rough Terrain Forklifts		93		0.60		8
Rubber Tired Dozers		357		0.59		8
Rubber Tired Loaders		157		0.54		8
Scrapers		313		0.72		8
Signal Boards		20		0.78		8
Skid Steer Loaders		44		0.55		8
Surfacing Equipment		362		0.45		8
Sweepers/Scrubbers		91		0.68		8
Tractors/Loaders/Backhoes		108		0.55		8
Trenchers		63		0.75		8
Welders		45		0.45		8

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END OF DATA ENTRY SHEET

Attachment 4

Evaluation of GHG Emissions

Evaluation of GHG Emissions in Terms of CO2 Equivalents (CO2(e)) from Natural Gas and Diesel Combustion

Basis: 1 mmbtu of Natural Gas

Pollutant	Emission Factor *(kg/mmbtu)*	Global Warming Potential (GWP)	*kg*	*kg CO2(e)*
CO2	53.02	1	53.02	53.02
CH4	0.0009	21	0.0009	0.0189
N2O	0.0001	310	0.0001	0.031
			53.0	*53.1*
	Ratio CO2(e)/CO2			*1.0009*

Notes

CO2 (e) - carbon dioxide equivalents

CO2 (e) = kg x GWP

Emission factors from Appendix A, Subchapter 10 (Climate Change), Article 2, Sections 951000 to 95133, California Code of Regulations (CCR) Title 17. Excerpts attached.

Basis: 1 mmbtu of Diesel

Pollutant	Emission Factor *(kg/mmbtu)*	Global Warming Potential (GWP)	*kg*	*kg CO2(e)*
CO2	73.1	1	73.1	73.1
CH4	0.003	21	0.003	0.063
N2O	0.0006	310	0.0006	0.186
	Totals		73.1	*73.3*
	Ratio CO2(e)/CO2			*1.0034*

Notes

CO2 (e) - carbon dioxide equivalents

CO2 (e) = kg x GWP

Emission factors from Appendix A, Subchapter 10 (Climate Change), Article 2, Sections 951000 to 95133, California Code of Regulations (CCR) Title 17. Excerpts attached.

APPENDIX A

to the Regulation for the Mandatory Reporting
of Greenhouse Gas Emissions

ARB COMPENDIUM OF EMISSION FACTORS AND METHODS TO SUPPORT MANDATORY REPORTING OF GREENHOUSE GAS EMISSIONS

ARB COMPENDIUM OF EMISSION FACTORS AND METHODS TO SUPPORT MANDATORY REPORTING OF GREENHOUSE GAS EMISSIONS

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   i. Oil/Water Separators
   j. Gas Service Components Fugitive Emission Factors
6. **Method for Calculating Emissions of High Global Warming Potential Compounds**

1. Introduction

The contents of this compendium specify acceptable methods and emission factors that operators must use when preparing greenhouse gas emissions data reports for submission to the California Air Resources Board (ARB), as specified in the ARB Regulation for the Mandatory Reporting of Greenhouse Gas Emissions.

2. Unit Conversions

Table 1. Conversion Table		
To Convert From	**To**	**Multiply By**
Grams (g)	Tonnes (metric)	1×10^{-6}
Kilograms (kg)	Tonnes (metric)	1×10^{-3}
Megagrams	Tonnes (metric)	1
Gigagrams	Tonnes (metric)	1×10^{3}
Pounds (lbs)	Tonnes (metric)	4.5359×10^{-4}
Tons (long)	Tonnes (metric)	1.016
Tons (short)	Tonnes (metric)	0.9072
Barrels	Cubic metres (m^3)	0.15898
Cubic feet (ft^3)	Cubic metres (m^3)	0.028317
Liters	Cubic meters (m^3)	1×10^{-3}
Cubic yards	Cubic meters (m^3)	0.76455
Gallons (liquid, US)	Cubic meters (m^3)	3.7854×10^{-3}
Imperial gallon	Cubic meters (m^3)	4.54626×10^{-3}
Joule	Gigajoules (GJ)	1×10^{-9}
Kilojoule	Gigajoules (GJ)	1×10^{-6}
Megajoule	Gigajoules (GJ)	1×10^{-3}
Terajoule (TJ)	Gigajoules (GJ)	1×10^{3}
Btu	Gigajoules (GJ)	1.05506×10^{-6}
Kilocalorie	Gigajoules (GJ)	4.187×10^{-6}
Tonne oil eq. (toe)	Gigajoules (GJ)	41.86
kWh	Gigajoules (GJ)	3.6×10^{-3}
Btu / ft^3	GJ / m^3	3.72589×10^{-5}
Btu / lb	GJ / Tonnes (metric)	2.326×10^{-3}
Lb / ft^3	Tonnes (metric) / m^3	1.60185×10^{-2}
Psi	Bar	0.0689476
Kgf / cm^3 (tech atm)	Bar	0.980665
Atm	Bar	1.01325
Mile	Kilometer	1.6093
Hectares	Acres	2.471
Barrels	Gallons (liquid, US)	42

3. Global Warming Potentials

According to the Intergovernmental Panel on Climate Change (IPCC), the global warming potential (GWP) of a greenhouse gas is defined as the ratio of the time-integrated radiative forcing from the instantaneous release of 1 kilogram (kg) of a trace substance relative to that of 1 kg of a reference gas. The reference gas used is CO_2. The values given below are those reported in the IPCC Second Assessment Report (IPCC 1996). These values are used to be consistent with other statewide and national Greenhouse Gas (GHG) inventories. Operators must use these values when converting emissions of greenhouse gases to carbon dioxide equivalent values (CO_2e) for purposes of estimating *de minimis* or other emissions as specified in this article.

Table 2. Global Warming Potentials (100-Year Time Horizon)

Gas	GWP
CO_2	1
CH_4*	21
N_2O	310
HFC-23	11,700
HFC-32	650
HFC-125	2,800
HFC-134a	1,300
HFC-143a	3,800
HFC-152a	140
HFC-227ea	2,900
HFC-236fa	6,300
HFC-4310mee	1,300
CF_4	6,500
C_2F_6	9,200
C_4F_{10}	7,000
C_6F_{14}	7,400
SF_6	23,900

* The CH_4 GWP includes the direct effects and those indirect effects due to the production of tropospheric ozone and stratospheric water vapor. The indirect effect due to the production of CO_2 is not included.

Source: IPCC Climate Change 1995: The Science of Climate Change. (1996) Intergovernmental Panel on Climate Change, J.T. Houghton, L.G. Meira Filho, B.A. Callander, N. Harris, A. Kattenberg, and K. Maskell, eds. Cambridge University Press. Cambridge, U.K.

5. Emission Factors

When working with the following emission factor tables the molar mass ratio of carbon dioxide to carbon (CO_2/C) is assumed to be 3.664. Complete oxidation is assumed for all fuels (oxidation factor = 1).

(a) Default Carbon Content, Heat Content, and Carbon Dioxide Emission Factors for Stationary Combustion

The default heat contents specified in Table 4 are provided for use with sections 95125(a) and (b) of the regulation.

The default carbon dioxide emission factors from stationary combustion on a heat content basis (kg CO_2 / MMBtu) specified in Table 4 and Table 5 are provided for use with sections 95125(a), (c) and (h) of the regulation.

Table 4. Default Carbon Content, Heat Content, and Carbon Dioxide Emission Factors from Stationary Combustion by Fuel Type

Fuel Type	**Default Carbon Content**	**Default Heat Content**	**Default CO_2 Emission Factor**	**Default CO_2 Emission Factor**
Coal and Coke	**kg C / MMBtu**	**MMBtu / Short Ton**	**kg CO_2 / Short Ton**	**kg CO_2 / MMBtu**
Anthracite	28.26	25.09	2,597.94	103.54
Bituminous	25.49	24.93	2,328.35	93.40
Sub-bituminous	26.48	17.25	1,673.64	97.02
Lignite	26.30	14.21	1,369.32	96.36
Unspecified (Residential/Commercial)	26.00	22.24	2,118.67	95.26
Unspecified (Industrial Coking)	25.56	26.28	2,461.17	93.65
Unspecified (Other Industrial)	25.63	22.18	2,082.89	93.91
Unspecified (Electric Power)	25.76	19.97	1,884.86	94.38
Coke	27.85	24.80	2,530.65	102.04
Natural Gas (By Heat Content)	**kg C / MMBtu**	**Btu / Standard cubic foot**	**kg CO_2 / Standard cubic ft.**	**kg CO_2 / MMBtu**
975 to 1,000 Btu / Standard cubic foot	14.73	n/a	n/a	53.97
1000 to 1,025 Btu / Std cubic foot	14.43	n/a	n/a	52.87
1025 to 1,050 Btu / Std cubic foot	14.47	n/a	n/a	53.02
1050 to 1,075 Btu / Std cubic foot	14.58	n/a	n/a	53.42
1075 to 1,100 Btu / Std cubic foot	14.65	n/a	n/a	53.68
Greater than 1,100 Btu / Std cubic foot	14.92	n/a	n/a	54.67
Unspecified (Weighted U.S. Average)	14.47	1,027	0.0544	53.02

Table 4. Default Carbon Content, Heat Content, and Carbon Dioxide Emission Factors from Stationary Combustion by Fuel Type (continued)

Petroleum Products	**kg C / MMBtu**	**MMBtu / Barrel**	**kg CO_2 / gallon**	**kg CO_2 / MMBtu**
Asphalt & Road Oil	20.62	6.636	11.94	75.55
Aviation Gasoline	18.87	5.048	8.31	69.14
Distillate Fuel Oil (#1, 2 & 4)	19.95	5.825	10.14	73.10
Jet Fuel	19.33	5.670	9.56	70.83
Kerosene	19.72	5.670	9.75	72.25
LPG (energy use)	17.19	3.861	5.79	62.98
Propane	17.20	3.824	5.74	63.02
Ethane	16.25	2.916	4.13	59.54
Isobutane	17.75	4.162	6.44	65.04
n-Butane	17.72	4.328	6.69	64.93
Lubricants	20.24	6.065	10.71	74.16
Motor Gasoline	19.33	5.218	8.80	70.83
Residual Fuel Oil (#5 & 6)	21.49	6.287	11.79	78.74
Crude Oil	20.33	5.800	10.29	74.49
Naphtha (<401 deg. F)	18.14	5.248	8.30	66.46
Natural Gasoline	18.24	4.620	7.35	66.83
Other Oil (>401 deg. F)	19.95	5.825	10.14	73.10
Pentanes Plus	18.24	4.620	7.35	66.83
Petrochemical Feedstocks	19.37	5.428	9.17	70.97
Petroleum Coke	27.85	6.024	14.64	102.04
Still Gas	17.51	6.000	9.17	64.16
Special Naphtha	19.86	5.248	9.09	72.77
Unfinished Oils	20.33	5.825	10.33	74.49
Waxes	19.81	5.537	9.57	72.58
Other Solid Fuels	**kg C / MMBtu**	**MMBtu / Short Ton**	**kg CO_2 / Short Ton**	**kg CO_2 / MMBtu**
Biomass Derived Fuels (Solid). Wood and Wood Waste (12% moisture content) or other solid biomass-derived fuels	25.60	15.38	1,442.62	93.80
Municipal Solid Waste (MSW)	24.74	8.7	788.7	90.65
Biomass-derived Fuels (Gas)	**kg C / MMBtu**	**Btu / Standard cubic foot**	**kg CO_2 / Standard cubic ft.**	**kg CO_2 / MMBtu**
Biogas*	28.4	Varies	Varies	104.06

Note: Heat content factors are based on higher heating values (HHV).
* The emission factors for biogas include both the CO_2 from combustion and the pass-through CO_2, which are assumed to be in equal proportions.

Source: U.S. EPA, *Inventory of Greenhouse Gas Emissions and Sinks: 1990-2005* (2007), Annex 2.1, Tables A-28, A-31, A-32, A-35, and A-36, except: Heat Content factors for Unspecified Coal (by sector), Coke, Naphtha (<401 deg. F), and Other Oil (>401 deg. F) (from U.S. Energy Information Administration, *Annual Energy Review 2005* (2006), Tables A-1, A-4, and A-5); Heat Content factors for Coal (by type) and LPG and all factors for Wood and Wood Waste, Landfill Gas, and Wastewater Treatment Biogas (from EPA Climate Leaders, Stationary Combustion Guidance (2004), Tables B-1 and B-2). MSW from Energy Information Administration, http://www.eia.doe/gov/oiaf/1605/factors.html and from California Air Resources Board, MSW California Air Resources Board, 2008.

(b) Methane and Nitrous Oxide Emission Factors for Stationary Combustion

The default methane and nitrous oxide emission factors for stationary combustion in Table 6 are provided for use with section 95125(b) of the regulation. For readability, these emission factors are provided in units of grams/MMBtu, but should be converted to kg/MMBtu (i.e., divided by 1000) when using them in the equations in section 95125(b).

Table 6. Default CH_4 and N_2O Emission Factors from Stationary Combustion by Fuel Type

Fuel Type	Default CH_4 Emission Factor (g CH_4/ MMBtu)	Default N_2O Emission Factor (g N_2O / MMBtu)
Asphalt	3.0	0.6
Aviation Gasoline	3.0	0.6
Coal	10.0	1.5
Crude Oil	3.0	0.6
Derived Gases (low Btu gases)	0.3	0.1
Digester Gas	0.9	0.1
Distillate	3.0	0.6
Gasoline	3.0	0.6
Jet Fuel	3.0	0.6
Kerosene	3.0	0.6
Landfill Gas	0.9	0.1
LPG	1.0	0.1
Lubricants	3.0	0.6
MSW	30.0	4.0
Naphtha	3.0	0.6
Natural Gas	0.9	0.1
Natural Gas Liquids	3.0	0.6
Other Biomass	30.0	4.0
Petroleum Coke	3.0	0.6
Propane	1.0	0.1
Refinery Gas	0.9	0.1
Residual Fuel Oil	3.0	0.6
Tires	3.0	0.6
Waste Oil	30.0	4.0
Waxes	3.0	0.6
Wood (Dry)	30.0	4.0

Notes: Heat content factors are based on higher heating values (HHV). Values were converted from LHV to HHV assuming that LHV are 5 percent lower than HHV for solid and liquid fuels and 10 percent lower for gaseous fuels. Those employing this table are assumed to fall under the IPCC definitions of the "Energy Industry" or "Manufacturing Industries and Construction". In all fuels except for coal the values for these two categories are identical. For coal combustion, those who fall within the IPCC "Energy Industry" category may employ a value of 1 g of CH_4/MMBtu.

Source: Intergovernmental Panel on Climate Change, *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (2006), Volume 2, Tables 2.2, 2.3, and 2.4.

Attachment 5

Copies of Emission Reports and Input Data for Equipment Installation
Based on Road Construction Model

Road Construction Emissions Model, Version 6.3.2

Emission Estimates for -> Naftex Equip Install Rev Feb 5 Project Phases (English Units)	ROG (lbs/day)	CO (lbs/day)	NOx (lbs/day)	Total PM10 (lbs/day)	Exhaust PM10 (lbs/day)	Fugitive Dust PM10 (lbs/day)	Total PM2.5 (lbs/day)	Exhaust PM2.5 (lbs/day)	Fugitive Dust PM2.5 (lbs/day)	CO2 (lbs/day)
Grubbing/Land Clearing	-	-	-	-	-	-	-	-	-	-
Grading/Excavation	4.0	15.7	31.0	1.2	1.2	-	1.1	1.1	-	4,686.9
Drainage/Utilities/Sub-Grade	-	-	-	-	-	-	-	-	-	-
Paving	-	-	-	-	-	-	-	-	-	-
Maximum (pounds/day)	4.0	15.7	31.0	1.2	1.2	-	1.1	1.1	-	4,686.9
Total (tons/construction project)	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	-	5.2

Notes:	
Project Start Year ->	2013
Project Length (months) ->	0
Total Project Area (acres) ->	4
Maximum Area Disturbed/Day (acres) ->	0
Total Soil Imported/Exported (yd^3/day)->	0

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.

Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns H and I. Total PM2.5 emissions shown in Column J are the sum of exhaust and fugitive dust emissions shown in columns K and L.

Emission Estimates for -> Naftex Equip Install Rev Feb 5 Project Phases (Metric Units)	ROG (kgs/day)	CO (kgs/day)	NOx (kgs/day)	Total PM10 (kgs/day)	Exhaust PM10 (kgs/day)	Fugitive Dust PM10 (kgs/day)	Total PM2.5 (kgs/day)	Exhaust PM2.5 (kgs/day)	Fugitive Dust PM2.5 (kgs/day)	CO2 (kgs/day)
Grubbing/Land Clearing	-	-	-	-	-	-	-	-	-	-
Grading/Excavation	1.8	7.1	14.1	0.6	0.6	-	0.5	0.5	-	2,130.4
Drainage/Utilities/Sub-Grade	-	-	-	-	-	-	-	-	-	-
Paving	-	-	-	-	-	-	-	-	-	-
Maximum (kilograms/day)	1.8	7.1	14.1	0.6	0.6	-	0.5	0.5	-	2,130.4
Total (megagrams/construction project)	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	-	4.7

Notes:	
Project Start Year ->	2013
Project Length (months) ->	0
Total Project Area (hectares) ->	2
Maximum Area Disturbed/Day (hectares) ->	0
Total Soil Imported/Exported (meters ^{3}/day)->	0

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.

Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns H and I. Total PM2.5 emissions shown in Column J are the sume of exhaust and fugitive dust emissions shown in columns K and L.

Road Construction Emissions Model

Version 6.3.2

Data Entry Worksheet

Note: Required data input sections have a yellow background.
Optional data input sections have a blue background. Only areas with a yellow or blue background can be modified. Program defaults have a white background.
The user is required to enter information in cells C10 through C25.

SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT

Input Type

Project Name	Naftex Equip Install Rev Feb 5	
Construction Start Year	2013	Enter a Year between 2005 and 2025 (inclusive)
Project Type	1	1 New Road Construction 2 Road Widening 3 Bridge/Overpass Construction
Project Construction Time	0.1	months
Predominant Soil/Site Type: Enter 1, 2, or 3	2	1. Sand Gravel 2. Weathered Rock-Earth 3. Blasted Rock
Project Length		miles
Total Project Area	4.3	acres
Maximum Area Disturbed/Day	0.0	acres
Water Trucks Used?	2	1. Yes 2. No
Soil Imported	0.0	yd^3/day
Soil Exported	0.0	yd^3/day
Average Truck Capacity	20.0	yd^3 (assume 20 if unknown)

To begin a new project, click this button to clear data previously entered. This button will only work if you opted not to disable macros when loading this spreadsheet.

The remaining sections of this sheet contain areas that can be modified by the user, although those modifications are optional.

Note: The program's estimates of construction period phase length can be overridden in cells C34 through C37.

Construction Periods	User Override of Construction Months	Program Calculated Months	2005	%	2006	%	2007	%
Grubbing/Land Clearing		0.01	0.00	0.00	0.00	0.00	0.00	0.00
Grading/Excavation	0.10	0.05	0.00	0.00	0.00	0.00	0.00	0.00
Drainage/Utilities/Sub-Grade		0.03	0.00	0.00	0.00	0.00	0.00	0.00
Paving		0.02	0.00	0.00	0.00	0.00	0.00	0.00
Totals	0.10	0.10						

Hauling emission default values can be overridden in cells C45 through C46.

Soil Hauling Emissions

User Input	User Override of Soil Hauling Defaults	Default Values
Miles/round trip	50.00	30
Round trips/day	2.00	0
Vehicle miles traveled/day (calculated)		100

Hauling Emissions	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate (grams/mile)	0.84	10.25	5.45	0.40	0.33	1874.76
Emission rate (grams/trip)	10.32	7.57	172.85	0.01	0.01	199.87
Pounds per day	0.2	2.3	1.2	0.1	0.1	412.9
Tons per contruction period	0.00	0.00	0.00	0.00	0.00	0.45

Worker commute default values can be overridden in cells C60 through C65.

Worker Commute Emissions

	User Override of Worker Commute Default Values	Default Values
Miles/ one-way trip	25.00	20
One-way trips/day	3.00	2
No. of employees: Grubbing/Land Clearing		0
No. of employees: Grading/Excavation	3.00	0
No. of employees: Drainage/Utilities/Sub-Grade		0
No. of employees: Paving		0

	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate - Grubbing/Land Clearing (grams/mile)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Grading/Excavation (grams/mile)	0.118	0.211	2.201	0.033	0.018	426.660
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Paving (grams/mile)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Grubbing/Land Clearing (grams/trip)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Grading/Excavation (grams/trip)	0.746	0.316	7.305	0.130	0.013	192.690
Emission rate - Draining/Utilities/Sub-Grade (gr/trip)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Paving (grams/trip)	0.000	0.000	0.000	0.000	0.000	0.000
Pounds per day - Grubbing/Land Clearing	0.000	0.000	0.000	0.000	0.000	0.000
Tons per const. Period - Grub/Land Clear	0.000	0.000	0.000	0.000	0.000	0.000
Pounds per day - Grading/Excavation	0.000	0.000	0.000	0.000	0.000	0.000
Tons per const. Period - Grading/Excavation	0.000	0.000	0.000	0.000	0.000	0.000
Pounds per day - Drainage/Utilities/Sub-Grade	0.000	0.000	0.000	0.000	0.000	0.000
Tons per const. Period - Drain/Util/Sub-Grade	0.000	0.000	0.000	0.000	0.000	0.000
Pounds per day - Paving	0.000	0.000	0.000	0.000	0.000	0.000
Tons per const. Period - Paving	0.000	0.000	0.000	0.000	0.000	0.000
tons per construction period	0.000	0.000	0.000	0.000	0.000	0.000

Water truck default values can be overriden in cells C91 through C93 and E91 through E93.

Water Truck Emissions	User Override of Default # Water Trucks	Program Estimate of Number of Water Trucks	User Override of Truck Miles Traveled/Day	Default Values Miles Traveled/Day		
Grubbing/Land Clearing - Exhaust	0.00	0	0.00	0		
Grading/Excavation - Exhaust		0		0		
Drainage/Utilities/Subgrade		0		0		
	ROG	**NOx**	**CO**	**PM10**	**PM2.5**	**CO2**
Emission rate - Grubbing/Land Clearing (grams/mile)	0.00	0.00	0.00	0.00	0.00	0.00
Emission rate - Grading/Excavation (grams/mile)	0.84	10.25	5.45	0.40	0.33	1874.76
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grub/Land Clear	0.00	0.00	0.00	0.00	0.00	0.00
Pound per day - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00
Pound per day - Drainage/Utilities/Subgrade	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Drainage/Utilities/Subgrade	0.00	0.00	0.00	0.00	0.00	0.00

Fugitive dust default values can be overridden in cells C110 through C112.

Fugitive Dust	User Override of Max Acreage Disturbed/Day	Default Maximum Acreage/Day	PM10 pounds/day	PM10 tons/per period	PM2.5 pounds/day	PM2.5 tons/per period
Fugitive Dust - Grubbing/Land Clearing		0	0.0	0.0	0.0	0.0
Fugitive Dust - Grading/Excavation		0	0.0	0.0	0.0	0.0
Fugitive Dust - Drainage/Utilities/Subgrade		0	0.0	0.0	0.0	0.0

Off-Road Equipment Emissions

Grubbing/Land Clearing Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	CO2 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Excavators	0.00	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00
		Graders	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
		Rollers	0.00	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Scrapers	0.00	0.00	0.00	0.00	0.00	0.00
	0	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Grubbing/Land Clearing	pounds per day	0.0	0.0	0.0	0.0	0.0	0.0
	Grubbing/Land Clearing	tons per phase	0.0	0.0	0.0	0.0	0.0	0.0

Grading/Excavation	Default Number of Vehicles		ROG	CO	NOx	PM10	PM2.5	CO2
Override of Default Number of Vehicles	*Program-estimate*	Type	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
1.00	0	Cranes	0.96	3.26	8.77	0.32	0.29	1109.46
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Excavators	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Forklifts	0.20	1.15	1.47	0.08	0.08	195.65
		Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Graders	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Off-Highway Trucks	1.86	5.46	15.36	0.54	0.50	2339.50
	0	Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
		Rollers	0.00	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Scrapers	0.00	0.00	0.00	0.00	0.00	0.00
	0	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Tractors/Loaders/Backhoes	0.28	3.21	1.76	0.06	0.06	491.07
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Welders	0.50	1.44	1.34	0.12	0.11	138.33
	Grading/Excavation	pounds per day	3.8	14.5	28.7	1.1	1.0	4274.0
	Grading	tons per phase	0.0	0.0	0.0	0.0	0.0	4.7

Drainage/Utilities/Subgrade Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	CO2 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Excavators	0.00	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Graders	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
0.00		Rollers	0.00	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Scrapers	0.00	0.00	0.00	0.00	0.00	0.00
	0	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Drainage	pounds per day	0.0	0.0	0.0	0.0	0.0	0.0
	Drainage	tons per phase	0.0	0.0	0.0	0.0	0.0	0.0

Paving	Default Number of Vehicles		ROG	CO	NOx	PM10	PM2.5	CO2
Override of Default Number of Vehicles	*Program-estimate*	Type	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Excavators	0.00	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00
		Graders	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Pavers	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Rollers	0.00	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Scrapers	0.00	0.00	0.00	0.00	0.00	0.00
	0	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Paving	pounds per day	0.0	0.0	0.0	0.0	0.0	0.0
	Paving	tons per phase	0.0	0.0	0.0	0.0	0.0	0.0
Total Emissions all Phases (tons per construction period) =>			0.0	0.0	0.0	0.0	0.0	4.7

Equipment default values for horsepower, load factor, and hours/day can be overridden in cells C285 through C317, E285 through E317, and G285 through G317.

Equipment		Default Values Horsepower		Default Values Load Factor		Default Values Hours/day
Aerial Lifts		60		0.46		8
Air Compressors		106		0.48		8
Bore/Drill Rigs		291		0.75		8
Cement and Mortar Mixers		10		0.56		8
Concrete/Industrial Saws		19		0.73		8
Cranes		399		0.43	12.00	8
Crushing/Proc. Equipment		142		0.78		8
Excavators		168		0.57		8
Forklifts		145		0.30	12.00	8
Generator Sets		549		0.74		8
Graders		174		0.61		8
Off-Highway Tractors		267		0.65		8
Off-Highway Trucks		479		0.57	12.00	8
Other Construction Equipment		75		0.62		8
Other General Industrial Equipment		238		0.51		8
Other Material Handling Equipment		191		0.59		8
Pavers		100		0.62		8
Paving Equipment		104		0.53		8
Plate Compactors		8		0.43		8
Pressure Washers		1		0.60		8
Pumps		53		0.74		8
Rollers		95		0.56		8
Rough Terrain Forklifts		93		0.60		8
Rubber Tired Dozers		357		0.59		8
Rubber Tired Loaders		157		0.54		8
Scrapers		313		0.72		8
Signal Boards		20		0.78		8
Skid Steer Loaders		44		0.55		8
Surfacing Equipment		362		0.45		8
Sweepers/Scrubbers		91		0.68		8
Tractors/Loaders/Backhoes		108		0.55	12.00	8
Trenchers		63		0.75		8
Welders		45		0.45	12.00	8

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END OF DATA ENTRY SHEET

Attachment 6

Copies of Emission Reports and Input Data for Production
Based on Road Construction Model

Road Construction Emissions Model, Version 6.3.2

Emission Estimates for -> Naftex Production Rev Feb 5 Project Phases (English Units)	ROG (lbs/day)	CO (lbs/day)	NOx (lbs/day)	Total PM10 (lbs/day)	Exhaust PM10 (lbs/day)	Fugitive Dust PM10 (lbs/day)	Total PM2.5 (lbs/day)	Exhaust PM2.5 (lbs/day)	Fugitive Dust PM2.5 (lbs/day)	CO2 (lbs/day)
Grubbing/Land Clearing	-	-	-	-	-	-	-	-	-	-
Grading/Excavation	0.0	0.2	0.0	0.0	0.0	-	0.0	0.0	-	24.3
Drainage/Utilities/Sub-Grade	-	-	-	-	-	-	-	-	-	-
Paving	-	-	-	-	-	-	-	-	-	-
Maximum (pounds/day)	0.0	0.2	0.0	0.0	0.0	-	0.0	0.0	-	24.3
Total (tons/construction project)	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	-	3.2

Notes:	
Project Start Year ->	2013
Project Length (months) ->	12
Total Project Area (acres) ->	4
Maximum Area Disturbed/Day (acres) ->	0
Total Soil Imported/Exported (yd^3/day)->	0

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.

Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns H and I. Total PM2.5 emissions shown in Column J are the sum of exhaust and fugitive dust emissions shown in columns K and L.

Emission Estimates for -> Naftex Production Rev Feb 5 Project Phases (Metric Units)	ROG (kgs/day)	CO (kgs/day)	NOx (kgs/day)	Total PM10 (kgs/day)	Exhaust PM10 (kgs/day)	Fugitive Dust PM10 (kgs/day)	Total PM2.5 (kgs/day)	Exhaust PM2.5 (kgs/day)	Fugitive Dust PM2.5 (kgs/day)	CO2 (kgs/day)
Grubbing/Land Clearing	-	-	-	-	-	-	-	-	-	-
Grading/Excavation	0.0	0.1	0.0	0.0	0.0	-	0.0	0.0	-	11.1
Drainage/Utilities/Sub-Grade	-	-	-	-	-	-	-	-	-	-
Paving	-	-	-	-	-	-	-	-	-	-
Maximum (kilograms/day)	0.0	0.1	0.0	0.0	0.0	-	0.0	0.0	-	11.1
Total (megagrams/construction project)	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	-	2.9

Notes:	
Project Start Year ->	2013
Project Length (months) ->	12
Total Project Area (hectares) ->	2
Maximum Area Disturbed/Day (hectares) ->	0
Total Soil Imported/Exported (meters ^{3}/day)->	0

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.

Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns H and I. Total PM2.5 emissions shown in Column J are the sume of exhaust and fugitive dust emissions shown in columns K and L.

Road Construction Emissions Model

Version 6.3.2

Data Entry Worksheet

Note: Required data input sections have a yellow background.
Optional data input sections have a blue background. Only areas with a yellow or blue background can be modified. Program defaults have a white background.
The user is required to enter information in cells C10 through C25.

Input Type

Project Name	Naftex Production Rev Feb 5	
Construction Start Year	2013	Enter a Year between 2005 and 2025 (inclusive)
Project Type	1	1 New Road Construction 2 Road Widening 3 Bridge/Overpass Construction
Project Construction Time	12.0	months
Predominant Soil/Site Type: Enter 1, 2, or 3	2	1. Sand Gravel 2. Weathered Rock-Earth 3. Blasted Rock
Project Length		miles
Total Project Area	4.3	acres
Maximum Area Disturbed/Day	0.0	acres
Water Trucks Used?	2	1. Yes 2. No
Soil Imported	0.0	yd^3/day
Soil Exported	0.0	yd^3/day
Average Truck Capacity	20.0	yd^3 (assume 20 if unknown)

To begin a new project, click this button to clear data previously entered. This button will only work if you opted not to disable macros when loading this spreadsheet.

The remaining sections of this sheet contain areas that can be modified by the user, although those modifications are optional.

Note: The program's estimates of construction period phase length can be overridden in cells C34 through C37.

Construction Periods	User Override of Construction Months	Program Calculated Months	2005	%	2006	%	2007	%
Grubbing/Land Clearing		1.20	0.00	0.00	0.00	0.00	0.00	0.00
Grading/Excavation	12.00	5.40	0.00	0.00	0.00	0.00	0.00	0.00
Drainage/Utilities/Sub-Grade		3.60	0.00	0.00	0.00	0.00	0.00	0.00
Paving		1.80	0.00	0.00	0.00	0.00	0.00	0.00
Totals	12.00	12.00						

Hauling emission default values can be overridden in cells C45 through C46.

Soil Hauling Emissions

User Input	User Override of Soil Hauling Defaults	Default Values
Miles/round trip	0.00	30
Round trips/day	0.00	0
Vehicle miles traveled/day (calculated)		0

Hauling Emissions	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate (grams/mile)	0.84	10.25	5.45	0.40	0.33	1874.76
Emission rate (grams/trip)	10.32	7.57	172.85	0.01	0.01	199.87
Pounds per day	0.0	0.0	0.0	0.0	0.0	0.0
Tons per contruction period	0.00	0.00	0.00	0.00	0.00	0.00

Worker commute default values can be overridden in cells C60 through C65.

Worker Commute Emissions

	User Override of Worker Commute Default Values	Default Values
Miles/ one-way trip	25.00	20
One-way trips/day	1.00	2
No. of employees: Grubbing/Land Clearing	1.00	0
No. of employees: Grading/Excavation		0
No. of employees: Drainage/Utilities/Sub-Grade		0
No. of employees: Paving		0

	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate - Grubbing/Land Clearing (grams/mile)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Grading/Excavation (grams/mile)	0.118	0.211	2.201	0.033	0.018	426.660
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Paving (grams/mile)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Grubbing/Land Clearing (grams/trip)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Grading/Excavation (grams/trip)	0.746	0.316	7.305	0.130	0.013	192.690
Emission rate - Draining/Utilities/Sub-Grade (gr/trip)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Paving (grams/trip)	0.000	0.000	0.000	0.000	0.000	0.000
Pounds per day - Grubbing/Land Clearing	0.000	0.000	0.000	0.000	0.000	0.000
Tons per const. Period - Grub/Land Clear	0.000	0.000	0.000	0.000	0.000	0.000
Pounds per day - Grading/Excavation	0.010	0.013	0.153	0.002	0.001	24.343
Tons per const. Period - Grading/Excavation	0.001	0.002	0.020	0.000	0.000	3.213
Pounds per day - Drainage/Utilities/Sub-Grade	0.000	0.000	0.000	0.000	0.000	0.000
Tons per const. Period - Drain/Util/Sub-Grade	0.000	0.000	0.000	0.000	0.000	0.000
Pounds per day - Paving	0.000	0.000	0.000	0.000	0.000	0.000
Tons per const. Period - Paving	0.000	0.000	0.000	0.000	0.000	0.000
tons per construction period	0.001	0.002	0.020	0.000	0.000	3.213

Water truck default values can be overriden in cells C91 through C93 and E91 through E93.

Water Truck Emissions	User Override of Default # Water Trucks	Program Estimate of Number of Water Trucks	User Override of Truck Miles Traveled/Day	Default Values Miles Traveled/Day
Grubbing/Land Clearing - Exhaust	0.00	0	0.00	0
Grading/Excavation - Exhaust		0		0
Drainage/Utilities/Subgrade		0		0

	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate - Grubbing/Land Clearing (grams/mile)	0.00	0.00	0.00	0.00	0.00	0.00
Emission rate - Grading/Excavation (grams/mile)	0.84	10.25	5.45	0.40	0.33	1874.76
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grub/Land Clear	0.00	0.00	0.00	0.00	0.00	0.00
Pound per day - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00
Pound per day - Drainage/Utilities/Subgrade	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Drainage/Utilities/Subgrade	0.00	0.00	0.00	0.00	0.00	0.00

Fugitive dust default values can be overridden in cells C110 through C112.

Fugitive Dust	User Override of Max Acreage Disturbed/Day	Default Maximum Acreage/Day	PM10 pounds/day	PM10 tons/per period	PM2.5 pounds/day	PM2.5 tons/per period
Fugitive Dust - Grubbing/Land Clearing		0	0.0	0.0	0.0	0.0
Fugitive Dust - Grading/Excavation		0	0.0	0.0	0.0	0.0
Fugitive Dust - Drainage/Utilities/Subgrade		0	0.0	0.0	0.0	0.0

Off-Road Equipment Emissions

Grubbing/Land Clearing Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	CO2 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Excavators	0.00	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00
		Graders	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
		Rollers	0.00	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Scrapers	0.00	0.00	0.00	0.00	0.00	0.00
	0	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Grubbing/Land Clearing	pounds per day	0.0	0.0	0.0	0.0	0.0	0.0
	Grubbing/Land Clearing	tons per phase	0.0	0.0	0.0	0.0	0.0	0.0

Grading/Excavation	Default Number of Vehicles		ROG	CO	NOx	PM10	PM2.5	CO2
Override of Default Number of Vehicles	*Program-estimate*	Type	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
	0	Cranes	0.00	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Excavators	0.00	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Graders	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
0.00		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
		Rollers	0.00	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Scrapers	0.00	0.00	0.00	0.00	0.00	0.00
	0	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Grading/Excavation	pounds per day	0.0	0.0	0.0	0.0	0.0	0.0
	Grading	tons per phase	0.0	0.0	0.0	0.0	0.0	0.0

Drainage/Utilities/Subgrade Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	CO2 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Excavators	0.00	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Graders	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
0.00		Rollers	0.00	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Scrapers	0.00	0.00	0.00	0.00	0.00	0.00
	0	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Drainage	pounds per day	0.0	0.0	0.0	0.0	0.0	0.0
	Drainage	tons per phase	0.0	0.0	0.0	0.0	0.0	0.0

Paving	Default Number of Vehicles		ROG	CO	NOx	PM10	PM2.5	CO2
Override of Default Number of Vehicles	*Program-estimate*	Type	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Excavators	0.00	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00
		Graders	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Pavers	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0	Rollers	0.00	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Scrapers	0.00	0.00	0.00	0.00	0.00	0.00
	0	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Paving	pounds per day	0.0	0.0	0.0	0.0	0.0	0.0
	Paving	tons per phase	0.0	0.0	0.0	0.0	0.0	0.0
Total Emissions all Phases (tons per construction period) =>			0.0	0.0	0.0	0.0	0.0	0.0

Equipment default values for horsepower, load factor, and hours/day can be overridden in cells C285 through C317, E285 through E317, and G285 through G317.

Equipment		Default Values Horsepower		Default Values Load Factor		Default Values Hours/day
Aerial Lifts		60		0.46		8
Air Compressors		106		0.48		8
Bore/Drill Rigs		291		0.75		8
Cement and Mortar Mixers		10		0.56		8
Concrete/Industrial Saws		19		0.73		8
Cranes		399		0.43		8
Crushing/Proc. Equipment		142		0.78		8
Excavators		168		0.57		8
Forklifts		145		0.30		8
Generator Sets		549		0.74		8
Graders		174		0.61		8
Off-Highway Tractors		267		0.65		8
Off-Highway Trucks		479		0.57		8
Other Construction Equipment		75		0.62		8
Other General Industrial Equipment		238		0.51		8
Other Material Handling Equipment		191		0.59		8
Pavers		100		0.62		8
Paving Equipment		104		0.53		8
Plate Compactors		8		0.43		8
Pressure Washers		1		0.60		8
Pumps		53		0.74		8
Rollers		95		0.56		8
Rough Terrain Forklifts		93		0.60		8
Rubber Tired Dozers		357		0.59		8
Rubber Tired Loaders		157		0.54		8
Scrapers		313		0.72		8
Signal Boards		20		0.78		8
Skid Steer Loaders		44		0.55		8
Surfacing Equipment		362		0.45		8
Sweepers/Scrubbers		91		0.68		8
Tractors/Loaders/Backhoes		108		0.55		8
Trenchers		63		0.75		8
Welders		45		0.45		8

0

END OF DATA ENTRY SHEET

Attachment 7

Copies of Risk Prioritization Evaluation
Short-Term (Construction) Emissions
Based on the SJVAPCD Spreadsheet Ver 2.0

Name	Air Toxics "Hot Spots" Information and Assessment Act of 1987 Facility Prioritization Scores Prioritization 2.0 SJVAPCD								
Applicability	Use this spreadsheet to generate a Prioritization when emission rates of HAPs are known. Entries required in yellow areas, output in grey areas.								
Author or updater	R Kapahi	*Last Update*	January 11, 2013						
Facility:	Naftex Short-Term Risk								
ID#:	Construction Phase								
Project #:									
Data Entered by:	RK								
Data Reviewed by:									
Location	Kern County								
Inputs	Operating Hours hr/yr	Release Height (m)							
	8760	5							
	Receptor Proximity &	**Emissions Potency Method**			**Dispersion Adjustment Method**				
	Proximity Factors	**Carc**	**Non-Carc**	**Facility**	**Carc**	**Non-Carc**	**Facility**		
	(Meters)	**Scores**	**Scores**	**Ranking**	**Scores**	**Scores**	**Ranking**		
	0< R<100 1.000	12.85	0.09	**High Priority**	12.70080	0.08630	**High Priority**		**Medium Priority**
	100≤R<250 0.250	3.21	0.02	**Medium Priority**	3.17520	0.02158	**Medium Priority**		**Medium Priority**
	250≤R<500 0.040	0.51	0.00	**Low Priority**	0.50803	0.00345	**Low Priority**		**Low Priority**
Naftex Short-Term Risk	500≤R<1000 0.011	0.14	0.00	**Low Priority**	0.13971	0.00095	**Low Priority**		**Low Priority**
	1000≤R<1500 0.003	0.04	0.00	**Low Priority**	0.03810	0.00026	**Low Priority**		**Low Priority**
	1500≤R<2000 0.002	0.03	0.00	**Low Priority**	0.02540	0.00017	**Low Priority**		**Low Priority**
	2000<R 0.001	0.01	0.00	**Low Priority**	0.01270	0.00009	**Low Priority**		**Low Priority**
Height Adjustment		<100m	<250m	<500m	<1000m	<1500m	<2000m	>=2000m	
<20m	60	1	0.25	0.04	0.011	0.003	0.002	0.001	
20m<= <45m	9	1	0.85	0.22	0.064	0.018	0.009	0.006	
=>45m	1	1	1	0.9	0.4	0.13	0.066	0.042	

CAS#	Substance	Annual Emissions	Maximum Hourly	Average Hourly	Disp Adj Method Carc	EP Method Carc	EP Method Chronic	EP Method Acute	EP Max of Chronic and Acute
79345	1,1,2,2-Tetrachloroethane			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
79005	1,1,2-Trichloroethane			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
75343	1,1-Dichloroethane			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0	1,2,3,4,5,6,78-OctaD			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0	1,2,3,4,5,6,78-OctaF			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
39001020	1,2,3,4,6,7,8,9-Octachlorodibenzofuran			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3268879	1,2,3,4,6,7,8,9-Octachlorodibenzo-P-dioxin			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
67562394	1,2,3,4,6,7,8-Heptachlorodibenzofuran			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
35822469	1,2,3,4,6,7,8-Heptachlorodibenzo-P-dioxin			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
55673897	1,2,3,4,7,8,9-Heptachlorodibenzofuran			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
70648269	1,2,3,4,7,8-Hexachlorodibenzofuran			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
39227286	1,2,3,4,7,8-Hexachlorodibenzo-P-dioxin			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
57117449	1,2,3,6,7,8-Hexachlorodibenzofuran			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
57653857	1,2,3,6,7,8-Hexachlorodibenzo-P-dioxin			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
72918219	1,2,3,7,8,9-Hexachlorodibenzofuran			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
19408743	1,2,3,7,8,9-Hexachlorodibenzo-P-dioxin			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
57117416	1,2,3,7,8-Pentachlorodibenzofuran			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40321764	1,2,3,7,8-Pentachlorodibenzo-P-dioxin			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
96128	1,2-Dibromo-3-chloropropane			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
78875	1,2-Dichloropropane			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
122667	1,2-Diphenylhydrazine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
106887	1,2-Epoxybutane			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
106990	1,3-Butadiene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
542756	1,3-Dichloropropene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1120714	1,3-Propane sultone			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
123911	1,4-Dioxane			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
42397648	1,6-Dinitropyrene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
42397659	1,8-Dinitropyrene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5522430	1-Nitropyrene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
39635319	2,3,3',4,4',5,5'-HEPTACHLORBIPHENYL (PCB 189)			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
38380084	2,3,3',4,4',5-HEXACHLOROBIPHENYL (PCB 156)			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

69782907	2,3,3',4,4',5'-HEXACHLOROBIPHENYL (PCB 157)			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32598144	2,3,3',4,4'-Pentachlorobiphenyl {PCB 105}			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
52663726	2,3',4,4',5,5'-HEXACHLOROBIPHENYL (PCB 167)			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
74472370	2,3,4,4',5-PENTACHLOBIPHENYL (PCB114)			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
31508006	2,3',4,4',5-PENTACHLOROBIPHENYL (PCB 118)			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
65510443	2,3',4,4',5'-PENTACHOROBIPHENYL (PCB 123)			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
60851345	2,3,4,6,7,8-Hexachlorodibenzofuran			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
57117314	2,3,4,7,8-Pentachlorodibenzofuran			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
51207319	2,3,7,8-Tetrachlorodibenzofuran			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1746016	2,3,7,8-Tetrachlorodibenzo-P-Dioxin			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
88062	2,4,6-Trichlorophenol			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
615054	2,4-Diaminoanisole			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
95807	2,4-Diaminotoluene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
121142	2,4-Dinitrotoluene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
53963	2-Acetylaminofluorene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
117793	2-Aminoanthraquinone			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
607578	2-Nitrofluorene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32774166	3,3',4,4',5,5'-HEXACHLOROBIPHENYL (PCB 169)			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
57465288	3,3',4,4',5-PENTACHLOROBIPHENYL (PCB 126)			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32598133	3,3',4,4'-TETRACHLORBIPHENYL (PCB77)			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
91941	3,3'-Dichlorobenzidine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
70362504	3,4,4',5-TETRACHLOROBIPHENYL (PCB 81)			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
56495	3-Methylcholanthrene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
101144	4,4'-Methylene bis(2 Chloroaniline) (MOCA)			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
101779	4,4'-Methylenedianiline			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
92671	4-Aminobiphenyl			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

95830	4-Chloro-o-phenylenediamine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
60117	4-Dimethylaminoazobenzene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
57835924	4-Nitropyrene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3697243	5-Methylchrysene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
602879	5-Nitroacenaphthene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7496028	6-Nitrochrysene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
57976	7,12-Dimethylbenz[a]anthracene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
194592	7H-Dibenzo[c,g]carbazole			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
75070	Acetaldehyde			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
60355	Acetamide			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
107028	Acrolein			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
79061	Acrylamide			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
79107	Acrylic acid			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
107131	Acrylonitrile			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
107051	Allyl chloride			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
319846	alpha-Hexachlorocyclohexane			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
61825	Amitrole			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7664417	Ammonia			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
62533	Aniline			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7440382	Arsenic			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1016	Arsenic compounds (inorganic)			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7784421	Arsine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1332214	Asbestos			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10294403	Barium chromate			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
56553	Benz[a]anthracene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
71432	Benzene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
92875	Benzidine (and its salts)			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1020	Benzidine-based dyes			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50328	Benzo[a]pyrene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
205992	Benzo[b]fluoranthene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
205823	Benzo[j]fluoranthene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
207089	Benzo[k]fluoranthene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
100447	Benzyl chloride			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7440417	Beryllium			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
319857	beta-Hexachlorocyclohexane			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
57578	beta-Propiolactone			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
111444	Bis(2-chloroethyl) ether {DCEE}			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
542881	Bis(chloromethyl) ether			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7440439	Cadmium			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
13765190	Calcium chromate			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2425061	Captafol			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
133062	Captan			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
75150	Carbon disulfide			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
630080	Carbon monoxide			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
56235	Carbon tetrachloride			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
57749	Chlordane			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
108171262	Chlorinated paraffin			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7782505	Chlorine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10049044	Chlorine dioxide			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

108907	Chlorobenzene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
510156	Chlorobenzilate			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0	Chlorodifluoromethane			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
67663	Chloroform			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
107302	Chloromethyl methyl			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
76062	Chloropicrin			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1333820	Chromium trioxide			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
18540299	Chromium, hexavalent			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
218019	Chrysene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1066	Coke oven emissions			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7440508	Copper			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1319773	Cresols (mixtures of) {Cresylic acid}			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
135206	Cupferron			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1073	Cyanide compounds			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
57125	CYANIDE COMPOUNDS [Inorganic)			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
117817	Di(2-ethylhexyl) phthalate			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
226368	Dibenz[a,h]acridine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2263680	Dibenz[a,h]acridine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
53703	Dibenz[a,h]anthracene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
224420	Dibenz[a,j]acridine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
192645	Dibenzo[a,e]pyrene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
189640	Dibenzo[a,h]pyrene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
189559	Dibenzo[a,i]pyrene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
191300	Dibenzo[a,l]pyrene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1080	Dibenzofurans (chlorinated) {PCDFs} [Treated as 2378TCDD for HRA]			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0	Dichlorodifluoromethene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
72559	Dichlorodiphenyldichloroethylene {DDE}			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
73354	Dichloroethylene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
62737	Dichlorovos {DDVP}			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
9901	Diesel engine exhaust, particulate matter (Diesel PM)	2.52E+01		2.88E-03	2.12E-01	1.29E+01	8.63E-02	0.00E+00	8.63E-02
111422	Diethanolamine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
79447	Dimethyl carbamoyl chloride			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
68122	Dimethyl formamide			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
124403	Dimethylamine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1086	Dioxins, total, w/o individ. isomers reported {PCDDs} [Treat as 2378TCDD for HRA			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1937377	Direct Black 38			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2602462	Direct Blue 6			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
16071866	Direct Brown 95 (technical grade)			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
106898	Epichlorohydrin			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
100414	Ethyl benzene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
75003	Ethyl chloride {Chlorethane}			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

106934	Ethylene dibromide {EDB}			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
107062	Ethylene dichloride {EDC}			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
107211	Ethylene glycol			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
111762	Ethylene glycol monobutyl ethe			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
110805	Ethylene glycol monoethyl ethe			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
111159	Ethylene glycol monoethyl ether acetate			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
109864	Ethylene glycol monomethyl ethe			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
110496	Ethylene glycol monomethyl ether acetate			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
75218	Ethylene oxide			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
96457	Ethylene thiourea			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
151564	Ethyleneimine {Aziridine}			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1101	Fluorides			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50000	Formaldehyde			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
111308	Glutaraldehyde			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
76448	Heptachlor			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118741	Hexachlorobenzene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1120	Hexachlorocyclohexane			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
608731	Hexachlorocyclohexanes (mixed or technical grade)			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
67721	Hexachloroethane			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
110543	Hexane			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
302012	Hydrazine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7647010	Hydrochloric acid			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
74908	Hydrocyanic acid			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7664393	Hydrogen fluoride			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7783075	Hydrogen Selenide			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7783075	HYDROGEN SELENIDE			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7783064	Hydrogen sulfide			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
193395	Indeno[1,2,3-cd]pyrene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
78591	Isophorone			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
67630	Isopropyl alcohol			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7439921	Lead			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
301042	Lead acetate			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7758976	Lead chromate			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1128	Lead compounds (inorganic)			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7446277	Lead phosphate			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1335326	Lead subacetate			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
58899	Lindane {gamma-Hexachlorocyclohexane}			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
108316	Maleic anhydride			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7439965	Manganese			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
108394	m-Cresol			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7487947	Mercuric chloride			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7439976	Mercury			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
67561	Methanol			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
74839	Methyl bromide {Bromomethane}			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

71556	Methyl chloroform {1,1,1-Trichloroethane}			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
78933	Methyl ethyl ketone			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
624839	Methyl isocyanate			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1634044	Methyl tert-butyl ether			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
75092	Methylene chloride {Dichloromethane}			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
101688	Methylene diphenyl diisocyanate {MDI}			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
90948	Michler's ketone			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
108383	m-Xylene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
91203	Naphthalene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7440020	Nickel			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
373024	Nickel acetate			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3333673	Nickel carbonate			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3333393	Nickel carbonate			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
13463393	Nickel carbonyl			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
12054487	Nickel hydroxide			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1313991	Nickel oxide			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1146	Nickel refinery dust			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
12035722	Nickel subsulfide			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1271289	Nickelocene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7697372	Nitric acid			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
139139	Nitrilotriacetic acid			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10102440	NITROGEN DIOXIDE			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1116547	N-Nitrosodiethanolamine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
55185	N-Nitrosodiethylamine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
62759	N-Nitrosodimethylamine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
924163	N-Nitrosodi-n-butylamine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
621647	N-Nitrosodi-n-propylamine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
86306	N-Nitrosodiphenylamine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10595956	N-Nitrosomethylethylamine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
59892	N-Nitrosomorpholine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
684935	N-Nitroso-N-methylurea			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
100754	N-Nitrosopiperidine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
930552	N-Nitrosopyrrolidine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
90040	o-Anisidine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
95487	o-Cresol			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8014957	OLEUM			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
95534	o-Toluidine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
95476	o-Xylene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10028156	OZONE			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1151	PAHs, total, w/o individ. components reported [Treated as B(a)P for HRA]			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1336363	PCBs {Polychlorinated biphenyls}			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
95692	p-Chloro-o-toluidine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
120718	p-Cresidine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
106445	p-Cresol			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
106467	p-Dichlorobenzene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

87865	Pentachlorophenol			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
127184	Perchloroethylene {Tetrachloroethene}			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
108952	Phenol			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
75445	Phosgene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7803512	Phosphine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7664382	Phosphoric acid			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
85449	Phthalic anhydride			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
156105	p-Nitrosodiphenylamine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7758012	Potassium bromate			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
115071	Propylene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
107982	Propylene glycol monomethyl ethe			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
75569	Propylene oxide			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
75569	Propylene oxide			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
106423	p-Xylene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50555	Reserpine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7782492	Selenium			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7446346	Selenium sulfide			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1175	Silica, crystalline			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7631869	Silica, crystalline			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10588019	Sodium dichromate			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1310732	Sodium hydroxide			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7789062	Strontium chromate			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
100425	Styrene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
9960	Sulfates			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
9960	SULFATES			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7446095	Sulfur Dioxide			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7446719	Sulfur Trioxide			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7664939	Sulfuric acid			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0	Tetrachlorophenols			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
62555	Thioacetamide			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
62566	Thiourea			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
108883	Toluene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1204	Toluene diisocyanate			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26471625	TOLUENE DIISOCYANATE			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
584849	Toluene-2,4-diisocyanate			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
91087	Toluene-2,6-diisocyanate			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8001352	Toxaphene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
79016	Trichloroethylene			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0	Trichlororfluormethane			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0	Trichlorotrifluormethane			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
121448	Triethylamine			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
51796	Urethane			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7440622	Vanadium (fume or dust)			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1314621	VANADIUM PENTOXIDE			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
108054	Vinyl acetate			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
75014	Vinyl chloride			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
75354	Vinylidene chloride			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1330207	XYLENES (mixed xylenes)			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Attachment 8

Copies of Emissions Report and Input Data for Plugging and Abandonment
Based on the Road Construction Model

Road Construction Emissions Model, Version 6.3.2

Emission Estimates for -> Naftex Plugging and Abandonment Rev 2 Project Phases (English Units)	ROG (lbs/day)	CO (lbs/day)	NOx (lbs/day)	Total PM10 (lbs/day)	Exhaust PM10 (lbs/day)	Fugitive Dust PM10 (lbs/day)	Total PM2.5 (lbs/day)	Exhaust PM2.5 (lbs/day)	Fugitive Dust PM2.5 (lbs/day)	CO2 (lbs/day)
Grubbing/Land Clearing	2.3	15.2	18.4	0.7	0.7	-	0.6	0.6	-	4,337.9
Grading/Excavation	3.4	21.3	31.3	1.2	1.2	-	1.0	1.0	-	6,653.4
Drainage/Utilities/Sub-Grade	-	-	-	-	-	-	-	-	-	-
Paving	-	-	-	-	-	-	-	-	-	-
Maximum (pounds/day)	3.4	21.3	31.3	1.2	1.2	-	1.0	1.0	-	6,653.4
Total (tons/construction project)	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	-	5.6

Notes:	
Project Start Year ->	2013
Project Length (months) ->	0
Total Project Area (acres) ->	4
Maximum Area Disturbed/Day (acres) ->	0
Total Soil Imported/Exported (yd^3/day)->	0

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.

Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns H and I. Total PM2.5 emissions shown in Column J are the sum of exhaust and fugitive dust emissions shown in columns K and L.

Emission Estimates for -> Naftex Plugging and Abandonment Rev 2 Project Phases (Metric Units)	ROG (kgs/day)	CO (kgs/day)	NOx (kgs/day)	Total PM10 (kgs/day)	Exhaust PM10 (kgs/day)	Fugitive Dust PM10 (kgs/day)	Total PM2.5 (kgs/day)	Exhaust PM2.5 (kgs/day)	Fugitive Dust PM2.5 (kgs/day)	CO2 (kgs/day)
Grubbing/Land Clearing	1.1	6.9	8.3	0.3	0.3	-	0.3	0.3	-	1,971.8
Grading/Excavation	1.5	9.7	14.2	0.6	0.6	-	0.5	0.5	-	3,024.3
Drainage/Utilities/Sub-Grade	-	-	-	-	-	-	-	-	-	-
Paving	-	-	-	-	-	-	-	-	-	-
Maximum (kilograms/day)	1.5	9.7	14.2	0.6	0.6	-	0.5	0.5	-	3,024.3
Total (megagrams/construction project)	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	-	5.1

Notes:	
Project Start Year ->	2013
Project Length (months) ->	0
Total Project Area (hectares) ->	2
Maximum Area Disturbed/Day (hectares) ->	0
Total Soil Imported/Exported (meters ^{3}/day)->	0

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.

Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns H and I. Total PM2.5 emissions shown in Column J are the sume of exhaust and fugitive dust emissions shown in columns K and L.

Road Construction Emissions Model

Version 6.3.2

Data Entry Worksheet

Note: Required data input sections have a yellow background.
Optional data input sections have a blue background. Only areas with a yellow or blue background can be modified. Program defaults have a white background.
The user is required to enter information in cells C10 through C25.

Input Type

Project Name	ex Plugging and Abandonment Rev 2	
Construction Start Year	2013	Enter a Year between 2005 and 2025 (inclusive)
Project Type	1	1 New Road Construction 2 Road Widening 3 Bridge/Overpass Construction
Project Construction Time	0.1	months
Predominant Soil/Site Type: Enter 1, 2, or 3	2	1. Sand Gravel 2. Weathered Rock-Earth 3. Blasted Rock
Project Length		miles
Total Project Area	4.3	acres
Maximum Area Disturbed/Day	0.0	acres
Water Trucks Used?	2	1. Yes 2. No
Soil Imported	0.0	yd^3/day
Soil Exported	0.0	yd^3/day
Average Truck Capacity	20.0	yd^3 (assume 20 if unknown)

To begin a new project, click this button to clear data previously entered. This button will only work if you opted not to disable macros when loading this spreadsheet.

The remaining sections of this sheet contain areas that can be modified by the user, although those modifications are optional.

Note: The program's estimates of construction period phase length can be overridden in cells C34 through C37.

Construction Periods	User Override of Construction Months	Program Calculated Months	2005	%	2006	%	2007
Grubbing/Land Clearing	0.07	0.01	0.00	0.00	0.00	0.00	0.00
Grading/Excavation	0.03	0.03	0.00	0.00	0.00	0.00	0.00
Drainage/Utilities/Sub-Grade		0.02	0.00	0.00	0.00	0.00	0.00
Paving		0.01	0.00	0.00	0.00	0.00	0.00
Totals	0.10	0.07					

Please note: You have entered a different number of months than the project length shown in cell C13.

Hauling emission default values can be overridden in cells C45 through C46.

Soil Hauling Emissions

User Input	User Override of Soil Hauling Defaults	Default Values
Miles/round trip	100.00	30
Round trips/day	6.00	0
Vehicle miles traveled/day (calculated)		600

Hauling Emissions	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate (grams/mile)	0.84	10.25	5.45	0.40	0.33	1874.76
Emission rate (grams/trip)	10.32	7.57	172.85	0.01	0.01	199.87
Pounds per day	1.1	13.6	7.2	0.5	0.4	2477.7
Tons per contruction period	0.00	0.00	0.00	0.00	0.00	0.91

Worker commute default values can be overridden in cells C60 through C65.

Worker Commute Emissions

	User Override of Worker Commute Default Values	Default Values
Miles/ one-way trip	50.00	20
One-way trips/day	5.00	2
No. of employees: Grubbing/Land Clearing	6.00	0
No. of employees: Grading/Excavation		0
No. of employees: Drainage/Utilities/Sub-Grade		0
No. of employees: Paving		0

	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate - Grubbing/Land Clearing (grams/mile)	0.118	0.211	2.201	0.033	0.018	426.660
Emission rate - Grading/Excavation (grams/mile)	0.118	0.211	2.201	0.033	0.018	426.660
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Paving (grams/mile)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Grubbing/Land Clearing (grams/trip)	0.746	0.316	7.305	0.130	0.013	192.690
Emission rate - Grading/Excavation (grams/trip)	0.746	0.316	7.305	0.130	0.013	192.690
Emission rate - Draining/Utilities/Sub-Grade (gr/trip)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Paving (grams/trip)	0.000	0.000	0.000	0.000	0.000	0.000
Pounds per day - Grubbing/Land Clearing	0.488	0.739	8.237	0.126	0.061	1435.135
Tons per const. Period - Grub/Land Clear	0.000	0.001	0.006	0.000	0.000	1.052
Pounds per day - Grading/Excavation	0.488	0.739	8.237	0.126	0.061	1435.135
Tons per const. Period - Grading/Excavation	0.000	0.000	0.003	0.000	0.000	0.526
Pounds per day - Drainage/Utilities/Sub-Grade	0.000	0.000	0.000	0.000	0.000	0.000
Tons per const. Period - Drain/Util/Sub-Grade	0.000	0.000	0.000	0.000	0.000	0.000
Pounds per day - Paving	0.000	0.000	0.000	0.000	0.000	0.000
Tons per const. Period - Paving	0.000	0.000	0.000	0.000	0.000	0.000
tons per construction period	0.001	0.001	0.009	0.000	0.000	1.579

Water truck default values can be overriden in cells C91 through C93 and E91 through E93.

Water Truck Emissions	User Override of Default # Water Trucks	Program Estimate of Number of Water Trucks	User Override of Truck Miles Traveled/Day	Default Values Miles Traveled/Day
Grubbing/Land Clearing - Exhaust		0	0.00	0
Grading/Excavation - Exhaust		0		0
Drainage/Utilities/Subgrade		0		0

	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate - Grubbing/Land Clearing (grams/mile)	0.84	10.25	5.45	0.40	0.33	1874.76
Emission rate - Grading/Excavation (grams/mile)	0.84	10.25	5.45	0.40	0.33	1874.76
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grub/Land Clear	0.00	0.00	0.00	0.00	0.00	0.00
Pound per day - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00
Pound per day - Drainage/Utilities/Subgrade	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Drainage/Utilities/Subgrade	0.00	0.00	0.00	0.00	0.00	0.00

Fugitive dust default values can be overridden in cells C110 through C112.

Fugitive Dust	User Override of Max Acreage Disturbed/Day	Default Maximum Acreage/Day	PM10 pounds/day	PM10 tons/per period	PM2.5 pounds/day	PM2.5 tons/per period
Fugitive Dust - Grubbing/Land Clearing		0	0.0	0.0	0.0	0.0
Fugitive Dust - Grading/Excavation		0	0.0	0.0	0.0	0.0
Fugitive Dust - Drainage/Utilities/Subgrade		0	0.0	0.0	0.0	0.0

Off-Road Equipment Emissions

Grubbing/Land Clearing Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00
		Excavators	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00
		Graders	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00
1.00		Off-Highway Trucks	0.65	1.90	5.51	0.19	0.18
1.00		Other Construction Equipment	1.10	3.96	11.52	0.37	0.34
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00
		Pavers	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00
		Rollers	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00
	0	Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00
	0	Scrapers	0.00	0.00	0.00	0.00	0.00
	0	Signal Boards	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00
1.00		Tractors/Loaders/Backhoes	0.09	1.06	0.58	0.02	0.02
		Trenchers	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00
	Grubbing/Land Clearing	pounds per day	1.8	6.9	17.6	0.6	0.5
	Grubbing/Land Clearing	tons per phase	0.0	0.0	0.0	0.0	0.0

Grading/Excavation	Default Number of Vehicles		ROG	CO	NOx	PM10	PM2.5
Override of Default Number of Vehicles	*Program-estimate*	Type	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00
	0	Cranes	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00
	0	Excavators	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00
	0	Graders	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00
1.00		Off-Highway Trucks	0.65	1.90	5.51	0.19	0.18
1.00	0	Other Construction Equipment	1.10	3.96	11.52	0.37	0.34
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00
		Pavers	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00
		Rollers	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00
	0	Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00
	0	Scrapers	0.00	0.00	0.00	0.00	0.00
	0	Signal Boards	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00
		Trenchers	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00
	Grading/Excavation	pounds per day	1.8	5.9	17.0	0.6	0.5
	Grading	tons per phase	0.0	0.0	0.0	0.0	0.0

Drainage/Utilities/Subgrade Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00
		Excavators	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00
	0	Graders	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00
		Pavers	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00
	0	Plate Compactors	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00
		Rollers	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00
	0	Scrapers	0.00	0.00	0.00	0.00	0.00
	0	Signal Boards	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00
0.00	0	Trenchers	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00
	Drainage	pounds per day	0.0	0.0	0.0	0.0	0.0
	Drainage	tons per phase	0.0	0.0	0.0	0.0	0.0

Paving	Default Number of Vehicles		ROG	CO	NOx	PM10	PM2.5
Override of Default Number of Vehicles	*Program-estimate*	Type	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00
		Excavators	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00
		Graders	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00
	0	Pavers	0.00	0.00	0.00	0.00	0.00
	0	Paving Equipment	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00
	0	Rollers	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00
		Scrapers	0.00	0.00	0.00	0.00	0.00
	0	Signal Boards	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00
		Trenchers	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00
	Paving	pounds per day	0.0	0.0	0.0	0.0	0.0
	Paving	tons per phase	0.0	0.0	0.0	0.0	0.0
Total Emissions all Phases (tons per construction period) =>			0.0	0.0	0.0	0.0	0.0

Equipment default values for horsepower, load factor, and hours/day can be overridden in cells C285 through C317, E285 through E317, and G285 through G317.

Equipment		Default Values Horsepower		Default Values Load Factor		Default Values Hours/day
Aerial Lifts		60		0.46		8
Air Compressors		106		0.48		8
Bore/Drill Rigs		291		0.75		8
Cement and Mortar Mixers		10		0.56		8
Concrete/Industrial Saws		19		0.73		8
Cranes		399		0.43		8
Crushing/Proc. Equipment		142		0.78		8
Excavators		168		0.57		8
Forklifts		145		0.30		8
Generator Sets		549		0.74		8
Graders		174		0.61		8
Off-Highway Tractors		267		0.65		8
Off-Highway Trucks	500.00	479		0.57	4.00	8
Other Construction Equipment	500.00	75		0.62	8.00	8
Other General Industrial Equipment		238		0.51		8
Other Material Handling Equipment		191		0.59		8
Pavers		100		0.62		8
Paving Equipment		104		0.53		8
Plate Compactors		8		0.43		8
Pressure Washers		1		0.60		8
Pumps		53		0.74		8
Rollers		95		0.56		8
Rough Terrain Forklifts		93		0.60		8
Rubber Tired Dozers		357		0.59		8
Rubber Tired Loaders		157		0.54		8
Scrapers		313		0.72		8
Signal Boards		20		0.78		8
Skid Steer Loaders		44		0.55		8
Surfacing Equipment		362		0.45		8
Sweepers/Scrubbers		91		0.68		8
Tractors/Loaders/Backhoes	107.00	108		0.55	4.00	8
Trenchers		63		0.75		8
Welders		45		0.45		8

1123

END OF DATA ENTRY SHEET

ATTACHMENT C

BIOLOGICAL ASSESSMENT

Biological Assessment
Naftex Operating Company
Bloemer and Kirschenman Oil and Gas Exploration Project
Kern County, California

Prepared for:

Naftex Operating Company
P.O. Box 308
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Contact: Dave Lefler
(661) 363-8801

Prepared by:

Robert A. Booher Consulting
Environmental Planning and Management
3221 Quail Hollow Drive
Fairfield, California 94534
Contact: Bob Booher, R.E.A.
(707) 399-7835

January 2013

INTRODUCTION

Naftex Operating Company (Naftex) proposes to construct six (6) well sites, construct new access roads to all six (6) proposed well sites, and drill one (1) exploratory oil and gas well from each of the proposed well sites for a total of six (6) exploratory wells within annual grassland and ruderal habitat in central Kern County, California. Naftex retained the services of Robert A. Booher Consulting (RAB Consulting) to conduct a biological survey and assessment of the proposed well sites, proposed access roads, proposed oil and gas flow lines, and buffer areas for submittal to the State of California, Department of Conservation, Division of Oil, Gas and Geothermal Resources (DOGGR).

On April 17, April 19-21, May 28-31, June 25-28, August 30, and September 4-7, 2012, RAB Consulting conducted biological surveys (including protocol-level surveys for blunt-nosed leopard lizards) of the proposed project area including the proposed well sites, proposed access roads, proposed oil and gas flow lines, as well as buffer areas to identify known or potential habitat for special-status wildlife and plant species. This report presents the results of our biological surveys and includes recommendations for avoidance and minimization measures to be implemented during the proposed project to avoid or minimize potential impacts to sensitive wildlife and plants and their habitats.

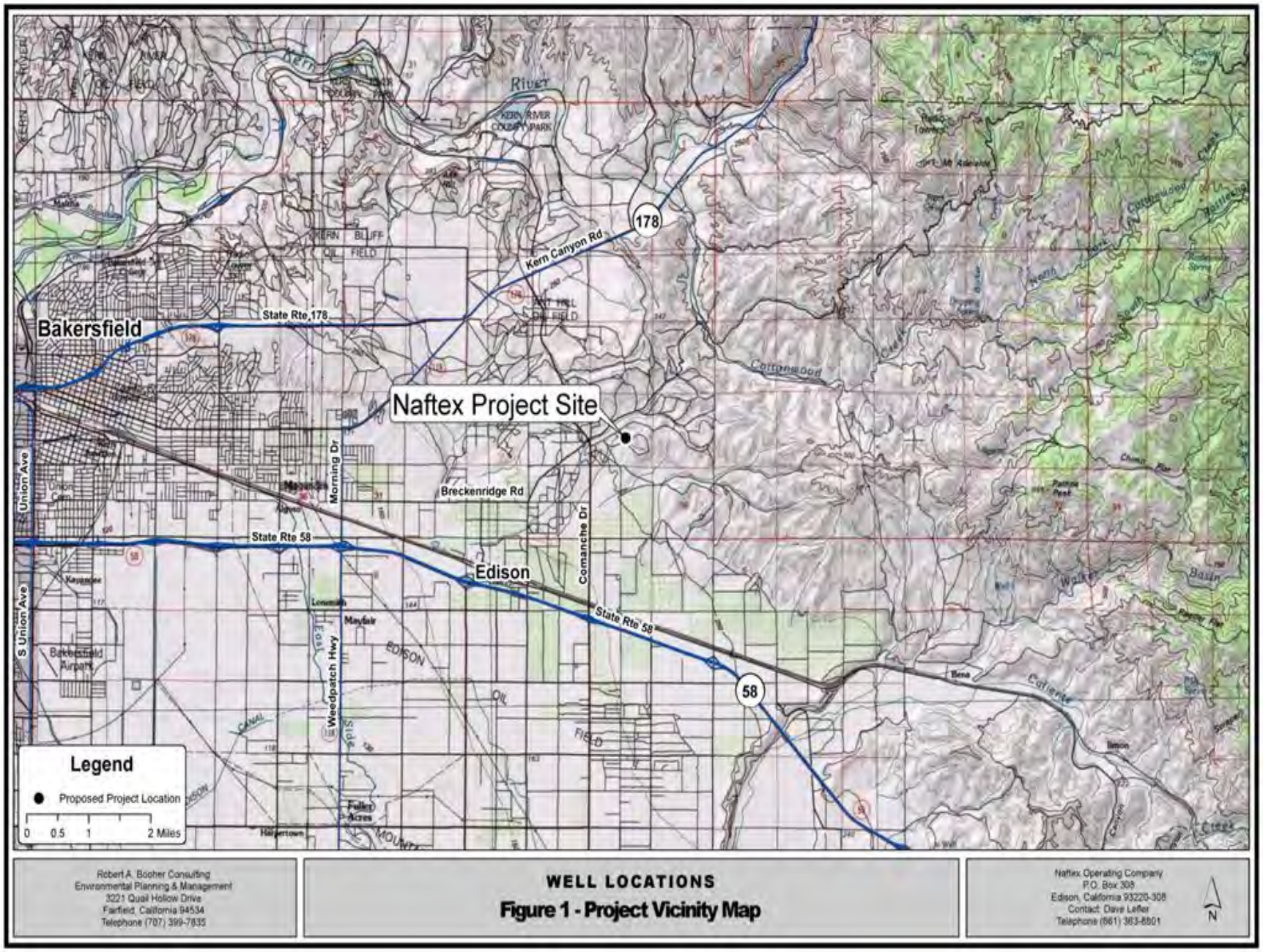
PROJECT LOCATION AND ENVIRONMENTAL SETTING

The proposed project is located 2.9 miles northeast of Edison in central Kern County, California (see Figures 1 and 2). The longitude and latitude using mapping datum WGS 84 for each of the proposed project sites are presented in Table 1.

Table 1
Locations of Proposed Project Sites

Well Name	Latitude	Longitude	Section, Township, and Range
Bloemer 1	35.374949	-118.8341000	Section 26, Township 29 South, Range 29 East
Bloemer 2	35.376241	-118.8340937	Section 26, Township 29 South, Range 29 East
Bloemer 3	35.3755525	-118.8337385	Section 26, Township 29 South, Range 29 East
Bloemer 4	35.3749549	-118.8330825	Section 26, Township 29 South, Range 29 East
Kirschenman 1	35.3742796	-118.8335941	Section 26, Township 29 South, Range 29 East
Kirschenman 2	35.3735667	-118.8340511	Section 26, Township 29 South, Range 29 East

The proposed well sites are located in habitat that consists of disturbed/ruderal and non-native grassland habitats that are currently used for cattle grazing. Each of the proposed project sites would encompass an area of 120 feet by 200 feet (24,000 square feet, or 0.55 acres). Comanche Drive, County Highway 218 and existing dirt roads provide access to the proposed project. A new access road will need to be constructed to each of the proposed project sites from existing dirt roads. Each new access road will be approximately 20 feet wide and 350 feet long as shown on Figure 2 the Project Location Map. The total estimated surface disturbance resulting from the construction of the access roads and the well sites would be 186,000 square feet, or 4.3 acres.


Bakersfield
Naftex Project Site
Edison
State Rte 178
State Rte 58
Kern Canyon Rd
Breckenridge Rd
Morning Dr
Comanche Dr
Weedpatch Hwy
S Union Ave
178
58
Legend
Proposed Project Location
0 0.5 1 2 Miles
Robert A. Booher Consulting
Environmental Planning & Management
3221 Quail Hollow Drive
Fairfield, California 94534
Telephone (707) 399-7635
WELL LOCATIONS
Figure 1 - Project Vicinity Map
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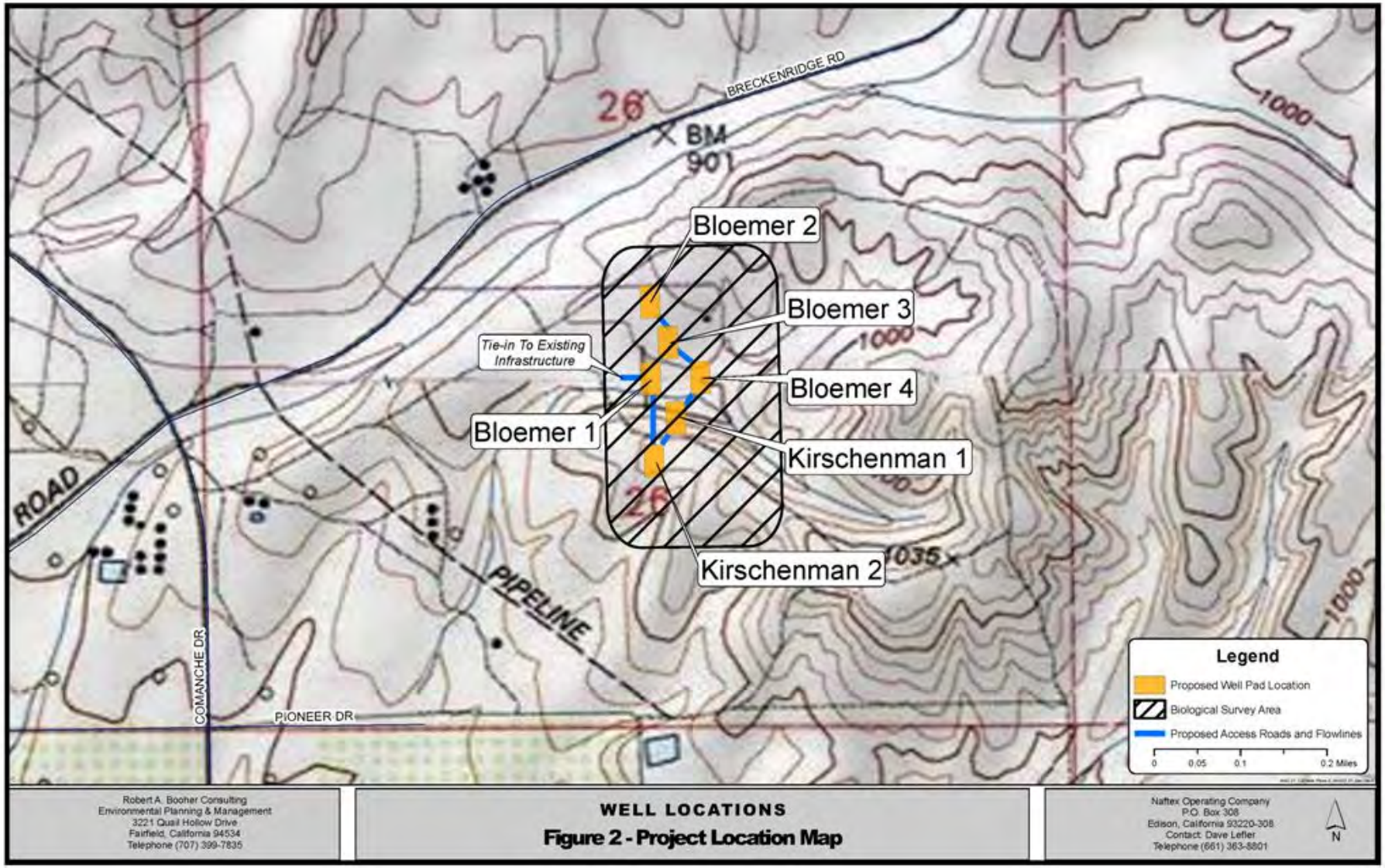
N



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WELL LOCATIONS

Figure 2 - Project Location Map

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The proposed project is needed to develop additional oil and natural gas reserves in the State of California. The objective of the proposed project is to locate untapped oil and gas sources with potential for development. The proposed project includes three (3) phases: a site preparation phase, a drilling phase and a production phase. A detailed description of each phase is presented below.

The terms "project site" and "project area" are used within this document. The term "project site" is used to define the proposed area of disturbance such as the proposed project sites, etc. The term "project area" includes the area surrounding the proposed project sites.

Site Preparation Phase

Site preparation activities for each of the proposed project sites would include clearing, grading, and compaction of soil. Once a proposed project site has been cleared, it would be graded, watered and compacted to establish a level and solid foundation for the drilling rig. If required a commercial base material such as aggregate ¾" base rock would be used to weatherize each of the proposed well pad areas.

A reserve pit may be excavated during site preparation for storage and handling of drilling mud and cuttings during the drilling process within the boundaries of a proposed project site. Soil will be stockpiled on site and used as backfill upon completion of drilling. If constructed, the reserve pit will be 75 feet long by 25 feet wide by six (6) feet deep. The reserve pit will hold 84,150 gallons with a two-foot freeboard. Reserve pits would be constructed by mechanical compaction. Compaction of the surface, combined with the deposition of bentonite drilling mud during drilling operations, would give the pit a bentonite seal with a maximum permeability of approximately 10^{-6} cm/sec. Should a shallow water table preclude the use of such a method, Naftex will use a closed loop system of above ground tanks for handling of all drilling mud and cuttings. The approximate depth to ground water is 460 feet (California Department of Water Resources Water Data Library 2012). Completing the site preparation process for each of the proposed project sites would require approximately three (3) days. Water may be applied to access roads and each of the proposed project sites to facilitate movement of heavy equipment and to control dust.

Drilling Phase

Drilling equipment, will be mobilized to each site and temporary facilities, equipment and materials necessary for the drilling operation would be set up and stored on site (i.e., drilling mud supplies, water, drilling materials and casing, crew support trailers, pumps and piping, portable generators, fuels and lubricants, etc.). Typically, this process is completed in approximately one (1) day. Night lighting will be required and available only during the drilling phase. However, to the greatest extent possible night lighting will be directed inward and down to minimize off site impacts without compromising safety. All hazardous materials such as diesel fuel will be stored according to applicable federal, state and local regulations. Portable tanks and mud pits will be used for mixing and storing drilling fluids. All fluids will be disposed of in accordance with the requirements of the Central Valley Regional Water Quality Control Board (RWQCB). If a reserve pit/sump is used, the use and closure of the reserve pit/sump will be

handled in accordance with Title 27, CCR, Section 20090(g), and Regional Board Waiver Resolution No. R5-2008-0182.

Surface casing would be set, cemented, and blowout prevention equipment installed at each of the wellheads and tested. Well casing is designed to protect fresh water zones. The approximate depth to ground water is 460 feet. Blowout prevention equipment would be regulated by California Division of Oil, Gas and Geothermal Resources (Division). Division engineers would be notified for required tests and other operations. Sufficient weighted drilling fluid would be used to prevent any uncontrolled flow from a well and additional quantities of drilling fluid would be available at each of the proposed project sites. It is anticipated that approximately 3,500 barrels (147,000 gallons) of water would be needed for the drilling and site construction operations. Drilling would continue until target depth is reached. Equipment, personnel and supply deliveries would continue through the course of the drilling program. Naftex estimates that approximately two (2) days would be required for drilling each well. Division engineers would be present for the required tests and other operations.

Equipment, personnel and supply deliveries would continue through the course of the drilling program. Drilling activities would operate 24 hours per day. Approximately 12-15 personnel would be on site at any given time during the drilling operations.

Production Phase

Once target depth is reached, each of the proposed wells would be fully evaluated, completed and either produced or plugged and abandoned. If economic quantities of oil or gas are discovered, a given well will be completed and production equipment including a well head and API 10 hp electronic motor pumping unit will be installed on site. Flowlines will be installed aboveground adjacent to the proposed new access roads. The proposed flowlines will connect the proposed wells to existing pipeline infrastructure located west of the proposed Bloemer 1 well site. The proposed flowlines will be measure approximately 1,900 feet in length (see Figure 2). The proposed flowlines will be installed on sleepers to avoid impacts to small mammal burrows. Naftex proposes to paint all production equipment in camouflage or an earthen tone to blend in with the environment and to prevent glare. Naftex estimates that approximately three (3) days would be required for flow line installation activities.

Naftex anticipates 10 barrels of oil and 90 barrels of production water will be produced daily from each well. The oil will be transported from the wells through flow lines to Naftex's existing production facility and sold to a local refinery. The production water will be transported to Naftex's existing production facility and will be disposed of in existing Naftex Division permitted Class II disposal wells. Each of the production sites will be visited daily.

Once a well stops producing, it will be plugged and abandoned in accordance with Title 14 CCR, Division 2, Chapter 4, Subchapter 1, Article 3, Sections 1723 – 1723.8. In this case, a Notice of Intention to abandon the well will be submitted to the Division for review and approval. During a typical well abandonment, recoverable casing will be salvaged from the well and the hole will be plugged with cement. The wellhead (and any other equipment) will be removed, the casing cut off 6 feet below ground surface, capped with a welded plate and the cellar backfilled. This process

will utilize the same equipment that will be used for the completion phase and the process will be completed in two (2) days. The land contours of each well site would be re-established to near grade conditions as present at the time of project initiation. After all equipment is removed, the site would be restored to its condition prior to construction of the well pad.

No valley saltbush scrub, wetlands, streams, or other sensitive habitats are present within the boundaries of the proposed project sites, proposed access roads, or the buffers of these areas. The project area is utilized for cattle and sheep grazing, as well as oil and gas exploration and production activities.

SURVEY METHODOLOGIES

Literature Review: We reviewed RAB Consulting data files, records from the California Natural Diversity Database (CNDDB) (California Department of Fish and Wildlife [CDFW] 2012), the United States Fish and Wildlife Service (USFWS) online electronic database of threatened and endangered species (USFWS 2012), and the California Native Plant Society's (CNPS) *Inventory of Rare and Endangered Vascular Plants of California* (CNPS 2012) for the USGS Edison and Rio Bravo Ranch 7.5-minute quadrangle maps for special-status species that have potential to occur within the project area. Special-status species that potentially occur within and/or adjacent to the proposed project sites and buffer areas are identified in Table 2. Figure 3 illustrates the location of documented special-status plant and animal occurrences within the proposed project area.

Background information for listed wildlife and plant species (including biology, reasons for decline, limiting factors, etc.) that have potential to occur within and/or adjacent to the proposed project sites and buffer areas is found in the recovery plan for upland species of the San Joaquin Valley, California (Williams et al. 1998). Species that do not have potential to occur are not discussed within this report.

Sources consulted for information on distribution of special-status wildlife species, as well as local and regional sensitive fauna include Remsen 1978 [birds], Williams 1986 [mammals], Jennings and Hayes 1994 [reptiles and amphibians], and Moyle et al. 1989 [fish] and Williams et al. (1998) for federal and state listed animal and plant species.

Special-Status Species - Special-status species are those taxa that are legally protected under the State or Federal Endangered Species Act (ESAs) or other regulations and considered sufficiently rare by the scientific community to qualify for such listing. Special-status plants and animals generally fall into one or more of the following categories:

- Plants or animals listed or proposed for listing as threatened or endangered under the federal ESA (50 Code of Federal Regulations [CFR] 17.12 [listed plants], 1711 [listed animal] and various notices in the Federal Register [FR][proposed species]);

- Plants or animals that are candidates for possible future listing as threatened or endangered under the federal ESA (61 FR 40, February 28, 1996);

- Plants or animals listed or proposed for listing by the State of California as threatened or endangered under the California ESA (14 California Code of Regulations [CCR] 670.5);

- Animal species of special concern to the California Department of Fish and Wildlife (CDFW) (Remsen 1978 [birds], Williams 1986 [mammals], Jennings and Hayes 1994 [reptiles and amphibians], Moyle et al. 1989 [fish]);

- Animals fully protected in California (California Fish and Wildlife Code, Sections 3511 [birds], 4700 [mammals], and 5050 [reptiles and amphibians]);

- Plants considered under the CNPS to be rare, threatened, or endangered in California (Lists 1B and 2) in CNPS (2001 and 2012) and Skinner and Pavlik (1994); and

- Plants identified by CNPS for which more information is needed to determine their status (List 3) and plants of limited distribution (List 4) in CNPS (2001 and 2012) and Skinner and Pavlik (1994) – these taxa may be included as special-status species on the basis of local significance or recent biological information.

SENSITIVE WILDLIFE SPECIES SURVEYS

We surveyed the proposed well site locations, proposed flow line routes, proposed access roads to the well site locations, and the buffer area of around the proposed well sites, proposed flow line routes, and proposed access roads for sensitive wildlife and special-status plant species, their habitats, and other sensitive habitats on April 17, April 19-21, May 28-31, June 25-28, August 30, and September 4-7, 2012. An area of approximately 20 acres was surveyed as exact well sites were not determined at the time of our surveys. As a result, a buffer area significantly larger than 250 feet was surveyed (see Figure 2). Wildlife species that we observed are discussed in text format and are presented in Table 4. A list of plant species observed during our surveys is presented in Table 5.

We used portions of standard agency approved methods to survey for special-status wildlife species. These methods are identified in the following references: CNPS (CNPS 1991, 2001b), CDFW (1984, 1990, 1995, 2000, 2003, 2009, and 2012a), Orloff (1987), Nelson (1987), The California Burrowing Owl Consortium (1993), Tollestrup (1976), and USFWS (1989, 1995, 1996b, 1999, 2000, and 2011). In addition, guidelines given in Section 402.12 of the Federal Register Vol. 51, No. 106, pp. 19960-19963 for Biological Assessments were used to prepare this report. Surveys were conducted to identify the following:

Table 2
Special-Status Species Potentially Occurring in the Project Area

Common Name	Scientific Name	Federal Status	State Status	Habitat/Observances	Potential to Occur in Project Area
Mammals					
Pallid bat	*Antrozous pallidus*	-	CSC	Found in deserts, grasslands, shrublands, woodlands, and forests. Most common in dry habitats with rocky areas for roosting. Roosts must protect bats from high temperatures. Very sensitive to disturbance of roosting sites.	Potentially present. Potential foraging habitat for this species is present within the proposed project sites and buffer areas. However, no maternity or nesting sites observed during biological surveys. This species was not observed during biological surveys. This species has not been documented within the proposed project area (CDFW 2012) (see Figure 3).
Tipton kangaroo rat	*Dipodomys nitratoides nitratoides*	FE	CE	Found in saltbush scrub and sink scrub communities in the Tulare Lake Basin of the southern San Joaquin Valley. Require soft friable soils which escape seasonal flooding. Dig burrows in elevated soil mounds at bases of shrubs.	Potentially present. Potential habitat for this species was observed in annual grassland habitat within the proposed project sites, proposed access roads, proposed flow lines, and buffer areas. Potential burrows were observed within all areas surveyed. No individual Tipton kangaroo rats or signs of their activity observed during surveys. This species has not been documented within the proposed project area (CDFW 2012) (see Figure 3).
Tulare grasshopper mouse	*Onychomys torridus tularensis*	-	CSC	Hot, arid valleys and scrub deserts in the southern San Joaquin Valley. Require abundant supply of insects.	Potentially present. Potential habitat for this species was observed in annual grassland habitat within the proposed project sites, proposed access roads, proposed flow lines, and buffer areas. Potential burrows were observed within all areas surveyed. No individual San Joaquin pocket mice or signs of their activity observed during surveys. This species has not been documented within the proposed project area (CDFW 2012) (see Figure 3).
San Joaquin pocket mouse	*Perognathus inornatus*	-	CSC	This species typically occurs on fine textured sandy soils on ridge tops and hillsides supporting grasslands, saltbush scrub, or blue oak savannah. *P. inornatus* is distributed within the Central Valley from Yolo and Sutter counties to the southern-most portions of the San Joaquin Valley and within and near the dry interior valleys of the Coast Range (e.g., Salinas Valley and	Potentially present. Potential habitat for this species was observed in annual grassland habitat within the proposed project sites, proposed access roads, proposed flow lines, and buffer areas. Potential burrows were observed within all areas surveyed. No individual San Joaquin pocket mice or signs of their activity observed during surveys. This species has not been documented within the proposed project area (CDFW 2012) (see Figure 3).

Table 2
Special-Status Species Potentially Occurring in the Project Area

Common Name	Scientific Name	Federal Status	State Status	Habitat/Observances	Potential to Occur in Project Area
				Carrizo Plain).	
American badger	*Taxidea taxus*	-	CSC	Found in drier open stages of most shrub, forest, and herbaceous habitats with friable soils. Require uncultivated ground. Prey on burrowing rodents. The American badger digs their own burrows.	Potentially present. Potential habitat for this species was observed in annual grassland habitat within the proposed project sites and buffer areas during biological surveys. No potential or known burrows of this species were observed within the areas surveyed. No individual San Joaquin kit foxes or signs of their activity observed during surveys. This species has not been documented within the proposed project area (CDFW 2012) (see Figure 3).
San Joaquin kit fox	*Vulpes macrotis mutica*	FE	CT	Inhabit annual grasslands or grassy open stages with scattered shrubby vegetation. Require loose-textured sandy soils for burrowing, and a suitable prey base.	Potentially present. Potential habitat for this species was observed in annual grassland habitat within the proposed project sites and buffer areas during biological surveys. No potential or known burrows of this species were observed within the areas surveyed. No individual San Joaquin kit foxes or signs of their activity observed during surveys. This species has been documented approximately 0.95 miles northwest of the proposed Bloemer 2 well site (CDFW 2012) (see Figure 3).
Birds					
Tricolored blackbird	*Agelaius tricolor*	-	CSC	Highly colonial species. Most numerous in Central Valley and Vicinity. Largely endemic to California. Requires open water, protected nesting substrate, and foraging area with insect prey within a few kilometers of their colony.	No potential. No potential habitat found within the proposed project sites or buffer areas.
Burrowing owl	*Athene cunicularia*	-	CSC	Open grasslands, prairies, farmlands, and deserts.	Potentially present. Potential habitat for this species was observed within annual grassland habitat within the proposed project sites and buffer areas. Potential burrows were observed within all areas surveyed (California ground squirrel burrows). No burrowing owls were observed during biological surveys, nor were any signs of their presence observed. This species has not been documented within the proposed project area (CDFW 2012) (see Figure 3).

Table 2
Special-Status Species Potentially Occurring in the Project Area

Common Name	Scientific Name	Federal Status	State Status	Habitat/Observances	Potential to Occur in Project Area
Southwestern willow flycatcher	*Empidonax traillii extimus*	FE	CE	Riparian woodlands in southern California.	No potential. No potential habitat found within the proposed project sites or buffer areas.
Invertebrates					
Vernal pool fairy shrimp	*Branchinecta lynchii*	FT	-	Found in short-lived seasonal cool-water vernal pools with low to moderate dissolved solids.	No potential. No potential habitat found within the proposed project sites or buffer areas.
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	FT	-	Occurs only in the Central Valley of California, in association with blue elderberry (*Sambucus mexicana*). Prefers to lay eggs in elderberries 2-8 inches in diameter; some preference shown for stressed elderberry shrubs.	No potential. No potential habitat (elderberry bushes) found within the proposed project sites or buffer areas.
Amphibians and Reptiles					
Western pond turtle	*Emys marmorata*	-	CSC	A thoroughly aquatic turtle of ponds, marshes, rivers, streams, and irrigation ditches with aquatic vegetation. Require basking sites and suitable upland habitat (sandy banks or grassy open fields) for egg-laying.	No potential. No potential habitat found within the proposed project sites or buffer areas.
Blunt-nosed leopard lizard	*Gambelia sila*	FE	CE, Fully Protected	Resident of sparsely vegetated alkali and desert scrub habitats, in areas of low topographic relief. Seeks cover in mammal burrows, under shrubs or structures such as fence posts. They do not excavate their own burrows.	Potentially present. Potential habitat for this species was observed in annual grassland habitat within the proposed project sites, proposed access roads, proposed flow lines, and buffer areas. Potential burrows were observed within all areas surveyed. Protocol-level surveys were conducted, and no individual blunt-nosed leopard lizards or signs of their activity observed during surveys. This species has been documented approximately 0.75 miles northwest of the proposed Bloemer 2 well site (CDFW 2012) (see Figure 3).
California red-legged frog	*Rana draytonii*	FT	CSC	Lowlands and foothills in or near permanent sources of deep water with dense, shrubby or emergent riparian vegetation. Requires 11 to 20 weeks of permanent water for larval development. Must have access to aestivation habitat, consisting of small mammal burrows and moist leaf litter.	No potential. No potential habitat found within the proposed project sites or buffer areas.
Giant garter snake	*Thamnophis gigas*	FT	CT	Prefers fresh water marsh and low	No potential. No potential habitat found within the

Table 2
Special-Status Species Potentially Occurring in the Project Area

Common Name	Scientific Name	Federal Status	State Status	Habitat/Observances	Potential to Occur in Project Area
				gradient streams. Has adapted to drainage ditches and irrigation canals.	proposed project sites or buffer areas.
Plants					
Round-leaved filaree	*California macrophylla*	-	List 1B	Cismontane woodland, valley and Foothill Grassland on clay soils. Elevational range: 15 to 1,200 meters. Blooming period: March through May.	Potentially present. Potential habitat for this species was observed in annual grassland habitat within the proposed project sites and buffer areas. No individuals of this species were observed during surveys. This species has not been documented within the proposed project area (CDFW 2012) (see Figure 3).
California jewel-flower	*Caulanthus californicus*	FE	CE/List 1B	Chenopod scrub, pinyon and juniper woodlands, and valley and foothill grasslands. Elevation range: 61 to 1,000 meters. Blooming period: February through May.	Potentially present. Potential habitat for this species was observed in annual grassland habitat within the proposed project sites and buffer areas. No individuals of this species were observed during surveys. This species has not been documented within the proposed project area (CDFW 2012) (see Figure 3).
Vasek's clarkia	*Clarkia tembloriensis ssp. calientensis*	-	List 1B	Valley and foothill grasslands. Elevation range: 275 to 500 meters. Blooming period: April.	Potentially present. Potential habitat for this species was observed in annual grassland habitat within the proposed project sites and buffer areas. No individuals of this species were observed during surveys. This species has not been documented within the proposed project area (CDFW 2012) (see Figure 3).
Rose-flowered larkspur	*Delphinium purpusii*	-	List 1B	Chaparral, cismontane woodland, and pinyon and juniper woodlands Elevation range: 300 to 1,340 meters. Blooming period: April through May.	No potential. No suitable habitat found within the proposed project sites or buffer areas.
Striped adobe-lily	*Fritillaria striata*	-	CE, List 1B	Cismontane woodland and valley and foothill grassland. Elevation range: 135 to 1,455 meters. Blooming period: February through April.	Potentially present. Potential habitat for this species was observed in annual grassland habitat within the proposed project sites and buffer areas. No individuals of this species were observed during surveys. This species has not been documented within the proposed project area (CDFW 2012) (see Figure 3).
Shevock's golden aster	*Heterotheca shevockii*	-	List 1B	Chaparral, cismontane woodland, and riparian woodland. Elevational range: 230 to 900 meters. Blooming period: August through November.	No potential. No suitable habitat found within the proposed project sites or buffer areas.

Table 2
Special-Status Species Potentially Occurring in the Project Area

Common Name	Scientific Name	Federal Status	State Status	Habitat/Observances	Potential to Occur in Project Area
Pale-yellow Layia	*Layia heterotricha*	-	List 1B	Pinyon and juniper woodland, valley and foothill grassland, and cismontane woodland. Elevational range: 300 to 1,750 meters. Blooming period: March through June.	Potentially present. Potential habitat for this species was observed in annual grassland habitat within the proposed project sites and buffer areas. No individuals of this species were observed during surveys. This species has not been documented within the proposed project area (CDFW 2012) (see Figure 3).
Comanche Point layia	*Layia leucopappa*	-	List 1B	Chenopod scrub and valley and foothill grassland. Elevational range: 100 to 350 meters. Blooming period: March through April.	Potentially present. Potential habitat for this species was observed in annual grassland habitat within the proposed project sites and buffer areas. No individuals of this species were observed during surveys. This species has not been documented within the proposed project area (CDFW 2012) (see Figure 3).
Calico monkeyflower	*Mimulus pictus*	-	List 1B	Broadleaved upland forest and Cismontane woodland. Elevational range: 100 to 1,300 meters. Blooming period: March through May.	No potential. No suitable habitat found within the proposed project sites or buffer areas.
San Joaquin woollythreads	*Monolopia congdonii*	FE	List 1B	Chenopod scrub, valley and foothill grasslands. Elevation range: 60 to 800 meters. Blooming period: February through May.	Potentially present. Potential habitat for this species was observed in annual grassland habitat within the proposed project sites and buffer areas. No individuals of this species were observed during surveys. This species has not been documented within the proposed project area (CDFW 2012) (see Figure 3).
Piute Mountains navarretia	*Navarretia setiloba*	-	List 1B	Cismontane woodland, pinyon and juniper woodland, and valley and foothill grassland. Elevational range: 305 to 2,100 meters. Blooming period: April through July.	Potentially present. Potential habitat for this species was observed in annual grassland habitat within the proposed project sites and buffer areas. No individuals of this species were observed during surveys. This species has been documented approximately 1.1 miles southwest of the proposed Kirschenman 2 well site (CDFW 2012) (see Figure 3).
Bakersfield cactus	*Opuntia treleasei*	FE	CE, List 1B	Chenopod scrub, cismontane woodland, and valley and foothill grassland. Elevational range: 120 to 1,140 meters. Blooming period: April through May.	Potentially present. Potential habitat for this species was observed in annual grassland habitat within the proposed project sites and buffer areas. No individuals of this species were observed during surveys. This species has not been documented within the proposed project area

Table 2
Special-Status Species Potentially Occurring in the Project Area

Common Name	Scientific Name	Federal Status	State Status	Habitat/Observances	Potential to Occur in Project Area
					(CDFW 2012) (see Figure 3).
San Joaquin adobe sunburst	*Pseudobahia peirsonii*	FT	CE, List 1B	Valley and foothill grassland and cismontane woodland. Elevational range: 90 to 800 meters. Blooming period: March through April.	Potentially present. Potential habitat for this species was observed in annual grassland habitat within the proposed project sites and buffer areas. No individuals of this species were observed during surveys. This species has not been documented within the proposed project area (CDFW 2012) (see Figure 3).
Oil neststraw	*Stylocline citroleum*	-	List 1B	Chenopod scrub and coastal scrub. Found on flat areas with clay soils in oil-producing areas. Elevation range: 50 to 400 meters. Blooming period: March through April.	No potential. No suitable habitat found within the proposed project sites or buffer areas.
Sensitive Habitats					
Stabilized Interior Dunes (not present)					

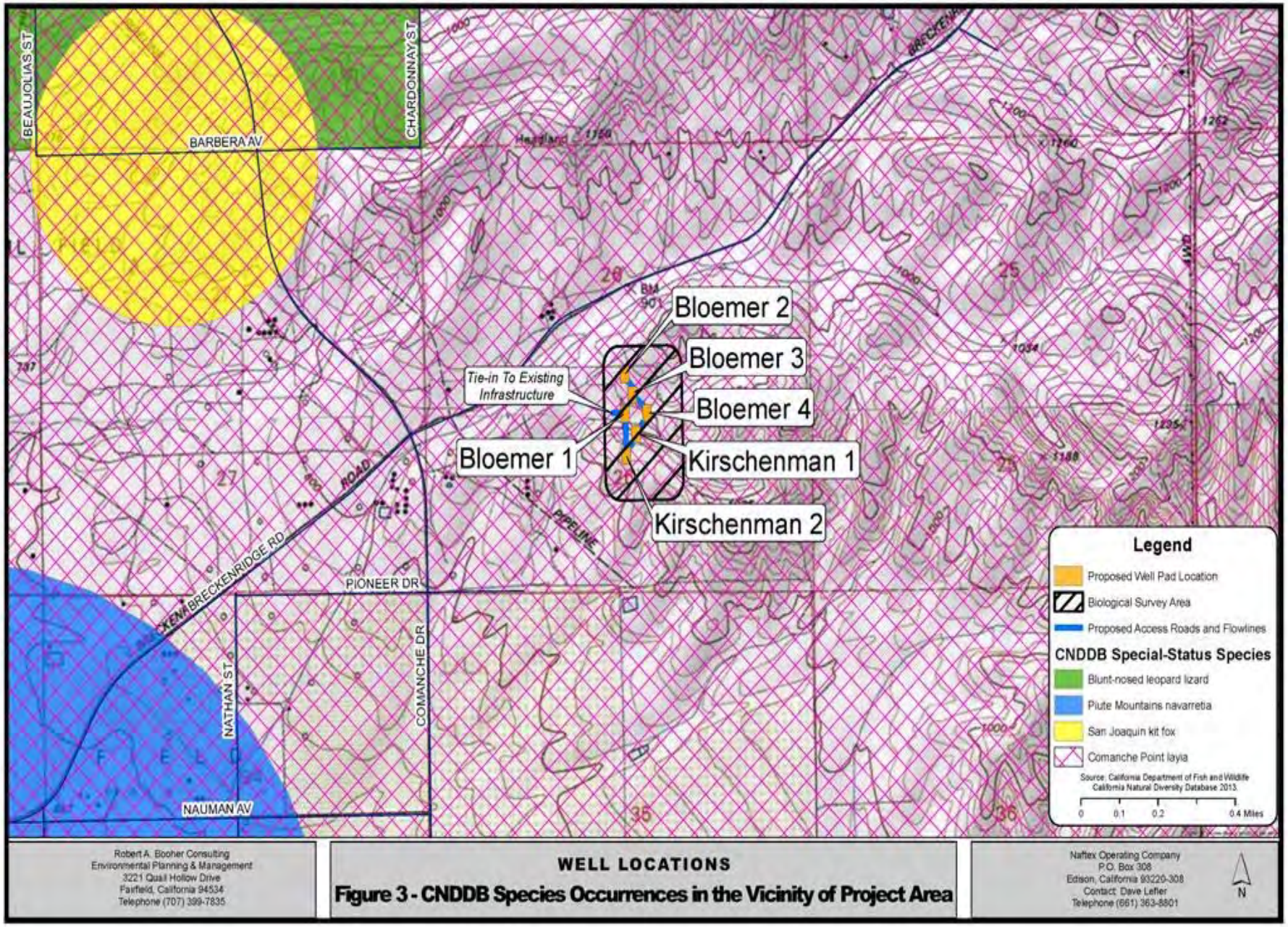
Status Codes:

Federal
FE = Federally listed as Endangered
FT = Federally listed as Threatened
FC = Federal Candidate species

State
CE = California listed as Endangered
CT = California listed as Threatened
CR = California listed as Rare
CFP = California Fully Protected

California Native Plant Society
CNPS 1B = Plants rare or endangered in California and elsewhere
CNPS 2 = Plants rare or endangered in California, but more common elsewhere
CNPS 3 = Plants about which we need more information
CNPS 4 = Plants of limited distribution; a watch list.

Status and habitat information from California Natural Diversity Database (CDFW 2012), California Native Plant Society Electronic Inventory (CNPS 2012), and USFWS Online Endangered Species Database (USFWS 2012).



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WELL LOCATIONS

Figure 3 - CNDDB Species Occurrences in the Vicinity of Project Area

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- Suitability of habitat(s) to support special-status wildlife species
- Presence of known and potential San Joaquin kit fox dens
- Presence of blunt-nosed leopard lizard (BNLL) habitat and individuals
- Sightings, burrows, and "sign", of sensitive small mammal species
- Sightings, burrows, and "sign", of western burrowing owls and other sensitive avian species
- Vegetation association, habitat types, and special-status plant species
- Dominant plant canopy and ground cover species
- Habitat condition and quality
- On-site, adjacent, and surrounding land uses

We conducted surveys by walking parallel meandering transects spaced 30 to 50 feet apart to identify special-status wildlife species. Presence of these species was confirmed by direct observation or by identification of "sign" (e.g., tracks, scats, dens and/or burrows, etc.) unique to a particular species.

San Joaquin Kit Fox - We conducted diurnal surveys for San Joaquin kit fox dens and their "sign." Scats measuring 15 to 20 millimeter in diameter of appropriate canid shape was attributed to kit fox. No other vulpid is known to inhabit the project area, and scats larger than 20 millimeter in diameter probably belong to coyote (*Canis latrans*) or domestic dog (*Canis familiaris*). Canid tracks up to 45 by 38 millimeter in size were attributed to kit fox. Tracks larger than this are probably attributable to coyote or domestic dog (Murie 1974).

We conducted surveys along transects spaced 30 to 50 feet apart following CDFW Approved Survey Methodologies for Sensitive Species (CDFW 1990) and by USFWS guidelines (USFWS 1989, 1995, 1999, and 2011). If San Joaquin kit fox "sign" and dens were identified, they were recorded and mapped on USGS topographic maps. In addition, we used knowledge gained from past experiences working with numerous kit fox dens and their "sign" (tracks, scats, etc.) during radio telemetry studies, and kit fox den identifications during other preactivity surveys. We classified underground dens according to the following USFWS kit fox den definitions (USFWS 2011):

> "Known Den": Any existing natural den or manmade structure that <u>is used or has been used at any time in the past</u> by a San Joaquin kit fox. Evidence of use may include historical records, past or current radiotelemetry or spotlighting data, kit fox sign such as tracks, scat, and/or prey remains, or other reasonable proof that a given den is being or has been used by a kit fox. The Service discourages use of the terms "active" and "inactive" when referring to any kit fox den because a great percentage of occupied dens show no evidence of use, and because kit foxes change dens so often, with the result that the status of a given den may change frequently and abruptly.
>
> "Potential Den": Any subterranean hole within the species' range that has entrances of appropriate dimensions for which available evidence is insufficient to conclude that it is being used or has been used by a kit fox. Potential dens shall include the following: (1) any suitable subterranean hole; or (2) any den or burrow of another species (e.g., coyote, badger, red fox, or ground squirrel) that otherwise has appropriate characteristics for kit fox use.

"Natal or Pupping Den": Any den used by kit foxes to whelp and/or rear their pups. Natal/pupping dens may be larger with more numerous entrances than dens occupied exclusively by adults. These dens typically have more kit fox tracks, scat, and prey remains in the vicinity of the den, and may have a broader apron of matted dirt and/or vegetation at one or more entrances. A natal den, defined as a den in which kit fox pups are actually whelped but not necessarily reared, is a more restrictive version of the pupping den. In practice, however, it is difficult to distinguish between the two, therefore, for purposed of this definition either term applies.

"Atypical Den": Any manmade structure which has been or is being occupied by a San Joaquin kit fox den. Atypical dens may include pipes, culverts, and diggings beneath concrete slabs and buildings.

BNLL – Protocol-level surveys for adult BNLL were conducted from April 17 to June 28, 2012 within the project sites and buffer areas for presence of BNLL and to evaluate suitability of habitat to support this species. Fall surveys for hatchling and juvenile BNLL were conducted from August 30 to September 7, 2012. Surveys were conducted in accordance with the *Approved Survey Methodology for the Blunt-Nosed Leopard Lizard* (CDFW 2004).

Two qualified biologists walked parallel adjacent transects approximately 30 to 50 feet apart. Transects were walked in a north-south orientation to minimize glare from the sun. Surveys were conducted when the air temperature ranged between 77 and 95 degrees Fahrenheit. Surveys were conducted between sunrise and 2:00 PM when the above air temperature criterions were met. Surveys were not conducted on overcast days (cloud cover > 90%) or when sustained wind velocity exceeded 10 miles per hour. Surveys were conducted by foot, and biologists surveyed all areas with potential BNLL habitat. Biologists stopped periodically and scanned transects for BNLL using close-focusing binoculars.

Both spring adult surveys (between April 15 and July 15) and fall hatchling surveys (between August 1 and September 15) were conducted. BNLL surveys were conducted for 12 days within the adult optimal survey period (April 15 to July 15), with a maximum of four (4) survey days per week and 8 days within any 30-day time period. BNLL hatchling surveys were conducted for five (5) days.

A report detailing the findings of these surveys is attached as Appendix B to this document.

Other Sensitive Wildlife - We surveyed for evidence of pallid bat, Tipton kangaroo rat, Tulare grasshopper mouse, San Joaquin pocket mouse, American badger, burrowing owl, southwestern willow flycatcher, and other targeted species of concern (see Table 2) while conducting transect surveys. This consisted of recording sightings of the species and/or their "sign" (tracks, scats, dens and/or burrows, etc.).

SPECIAL-STATUS PLANT SURVEYS

Literature Review: Prior to conducting field surveys, we reviewed information from published and unpublished sources to determine special-status plant species known, or that have potential to occur in the vicinity of the proposed project sites. Special-status plant species include species listed as Endangered, Threatened, or Rare by USFWS (1990, 2000, and 2012), or by CDFW (1989, 2009, and 2012), and species listed by Smith and Berg (1988) and CNPS (2001 and 2012). Sources consulted for information on the distribution of special-status plant species include regional and local floras (Abrams 1923, 1944, 1951, Abrams and Ferris 1960, Hickman 1996, Twisselmann 1956, 1967, Moe 1995, Munz and Keck 1968), occurrence records and maps from CNDDB (CDFW 2012), county and USGS quadrangle records in Smith and Berg (1988), CNPS (2001 and 2012), and occurrence records from previous surveys in the region. In addition, we consulted Taylor (1987) and Taylor and Davilla (1986) for locations of endemic San Joaquin Valley listed plant species that have potential to occur within the area surrounding the proposed project.

Plant Species Surveys and Identification - We surveyed 30 to 50 feet wide transects within the proposed project sites and buffer areas on April 17, April 19-21, May 28-31, June 25-28, August 30, and September 4-7, 2012. We identified vascular plant species encountered in the surveys, which were in identifiable condition using standard manuals (Abrams 1923, 1944, 1951, Abrams and Ferris 1960, Hickman 1996, Moe 1995, Munz and Keck 1968 and Twisselmann 1956, 1967). Scientific nomenclature used for plant species in this report follows Hickman (1996), Munz and Keck (1968), and Kartesz and Kartesz (1980). We used modifications of Cheatham and Haller (1975) and Holland (1986) to describe habitat types found on the proposed project sites. Our plant surveys were conducted during the appropriate blooming period of all targeted special-status plant species identified in Table 2 as potentially occurring within the proposed project sites and buffer areas.

RESULTS AND DISCUSSION

Results of our biological surveys for the proposed project are presented below. The following discussion focuses on special-status wildlife species that could potentially occur within the proposed project sites and buffer areas. Special-status wildlife species that have no potential to occur within the proposed project sites or buffer areas are not discussed further. Wildlife species observed during our surveys are presented in Table 4.

San Joaquin Kit Fox - We observed no potential burrows within the proposed project sites and buffer areas that could be utilized by this species during our biological surveys. There were no "active signs" (i.e., adult and puppy scat, prey remains, tracks, fur, etc.) of use by San Joaquin kit fox observed during surveys. In addition, no known dens of this species were observed during biological surveys of the proposed project sites or buffer areas. San Joaquin kit foxes have been documented approximately 0.95 miles northwest of the proposed Bloemer 2 well site (CDFW 2012) (see Figure 3).

American Badger - We observed no potential burrows within the proposed project sites and buffer areas that could be utilized by this species during our biological surveys. There were no "active signs" (i.e., adult and puppy scat, prey remains, tracks, fur, etc.) of use by American

badgers observed during surveys. In addition, no known dens of this species were observed during biological surveys of the proposed project sites or buffer areas. American badgers have not been documented within the proposed project area by CNDDB (CDFW 2012) (see Figure 3).

Sensitive Small Mammal Species - We found no evidence (i.e., pit cache holes, scats, tracks, tail drags, etc.) of Tipton kangaroo rats within the proposed project sites or their buffer areas during biological surveys. We observed potential burrows (California ground squirrel burrows) within the proposed project sites or buffer areas. We found appropriate vegetative communities for this species (annual grassland habitat) within all areas surveyed during biological surveys. No individual Tipton kangaroo rats were observed during surveys. This species has not been documented within the proposed project area by CNDDB (CDFW 2012) (see Figure 3).

Potential habitat for Tulare grasshopper mice and San Joaquin pocket mice was observed in annual grassland habitat within the proposed project sites and buffer areas during biological surveys. We observed potential refuge burrows (California ground squirrel burrows) within the proposed project sites or buffer areas. We found no evidence (i.e., scat, tracks, etc.) of these species (recent and/or past use) within the proposed project sites or their buffer areas. No individual mice were observed during surveys. These species have not been documented within the proposed project area by CNDDB (CDFW 2012) (see Figure 3).

We observed potential foraging habitat for the pallid bat within all areas surveyed during biological surveys. However, we did not observe any known or potential maternity or roosting sites during biological surveys. No individual pallid bats were observed during biological surveys. This species has not been documented within the project area (CDFW 2012) (see Figure 3). This species may forage intermittently throughout the project area, but is not expected to nest.

Blunt-Nosed Leopard Lizard (BNLL) – No BNLLs were observed during protocol level surveys conducted within the proposed project sites and buffer areas. We recorded western whiptails (*Aspidoscelis tigris*), western fence lizards (*Sceloporus occidentalis*), and common side-blotched lizards (*Uta stansburiana*) within the proposed project sites and buffer areas during surveys. We observed burrows within the proposed project sites and buffer areas that were large enough (entrance size, width, etc.) to provide refugia for BNLL. Table 3 below provides the results of BNLL surveys as well as the survey dates and weather conditions during our surveys at the proposed project sites.

Chesmore (1980 and 1981) identified specific vegetation associations that could be used to assist in the identification of preferred habitat for BNLL: Arabian grass (*Schismus arabicus* and *S. barbatus*) is positively correlated with the occurrence of BNLL while red brome (*Bromus rubens*) is negatively correlated. While we did not take quantitative measurements of vegetation during our surveys, red brome was observed as being somewhat dense in the survey area. Dense red brome growth can become problematic for BNLL foraging. *Gambelia sila* is one of a number of species in the San Joaquin Valley whose habitat has been greatly modified by invasive annual grasses and might benefit from management actions that would keep habitats open (Germano et al. 2001).

We observed an adequate prey base of grasshoppers and beetles within the project area. In general, *G. sila* seems to be an opportunistic predator that eats whatever is most abundant and it is able to catch (Germano et al. 2007). It is known to eat invertebrates and lizards (Montanucci 1965, 1967), including it's own young (Montanucci 1965, Germano and Williams 1994).

We evaluate the project sites and buffer areas as being suitable habitat in its current state for BNLL because suitable burrows that provide refuge cover for this species occur within the proposed project sites and buffer areas. Protocol-level surveys were conducted and no BNLL were detected.

Sensitive Avian Species - Potential habitat for burrowing owls was observed in annual grassland habitat within the proposed project sites and buffer areas during biological surveys. Potential burrows (California ground squirrel burrows) that could be used by this species for nesting activities were observed during biological surveys in all areas surveys. However, no burrowing owls were observed during biological surveys, and no evidence of their presence (white wash, feathers, small mammal bones, owl pellets, etc.) was observed during surveys. This species has not been documented by CNDDB within the proposed project area (CDFW 2012) (see Figure 3).

A number of avian species protected under the Federal Migratory Bird Treaty Act were observed foraging during field surveys (see Table 4 below for a list of these species). No active or inactive nesting sites were observed during biological surveys. No potential nesting habitat for migratory avian species was observed within the proposed project sites and buffer areas during biological surveys. Therefore, migratory avian species have no potential to nest in the proposed project sites or buffer areas.

Incidental Wildlife – Wildlife species that we recorded during our focused surveys for special-status species are listed in Table 4 below.

Special-Status Plants – No special-status plant species were identified during the course of botanical surveys within the proposed project sites and buffer areas. Surveys were conducted during the appropriate blooming period of all of the targeted special-status plant species identified in Table 2 as potentially occurring within the proposed project sites and buffer areas. The annual grassland habitat found within the proposed project sites and buffer areas is disturbed due to ongoing cattle grazing and agricultural activities, and the likelihood of special-status plant species occurring within the proposed project sites is unlikely. Additionally, non-native weedy grassland species within the proposed project sites and buffer areas likely out compete special-status species that could occur within the proposed project sites and buffer areas.

Table 3 – Blunt-Nosed Leopard Lizard Survey Results

DATE	START TIME	END TIME	START AIR TEMP	END AIR TEMP	# BNLL OBSERVED Adults/Hatchlings	NUMBER OF BIOLOGIST
4/17/12	1230	1500	80	87	0/0	2
4/19/12	1141	1349	77	80	0/0	2
4/20/12	1019	1245	80	87	0/0	2
4/21/12	0945	1150	84	93	0/0	2
5/28/12	1105	1400	78	83	0/0	2
5/29/12	1115	1345	81	87	0/0	4
5/30/12	1050	1250	81	87	0/0	2
5/31/12	1105	1310	88	95	0/0	2
6/25/12	1340	1428	90	92	0/0	4
6/26/12	1020	1320	81	89	0/0	3
6/27/12	0800	1140	77	95	0/0	2
6/28/12	0745	0850	77	82	0/0	4
8/30/12	0740	1000	77	89	0/0	2
9/4/12	0740	0900	78	85	0/0	4
9/5/12	0740	1015	78	90	0/0	2
9/6/12	0730	1015	77	95	0/0	2
9/7/12	0745	1012	77	92	0/0	2

Habitat Types – Habitat types observed during field surveys are described further below:

Ruderal/Disturbed

This habitat type was observed within and along the edges of the existing access road from which the proposed access roads to the proposed well sites would be constructed. Common plant species found in this community were composed primarily of weedy non-native and native species. Vegetative species observed included slender wild oats (*Avena barbata*), wild oat (*Avena fatua* L.), black mustard (*Brassica nigra* [L.] Koch), soft chess brome (*Bromus hordeaceus*), rip-gut brome (*Bromus rigidus* Roth), common mallow (*Malva neglecta* Wallr.), pineapple-weed (*Matricaria matricariodes*), perennial sowthistle (*Sonchus arvensis* L.), spiny sowthistle (*Sonchus asper* [L.] Hill), and annual sowthistle (*Sonchus oleraceus* L.).

Wildlife use of this community is limited due to the monocultural and weedy nature of plant species present. Although the diversity of wildlife is limited, species that do occur in the habitat type are often abundant and well adapted to the presence of humans.

Table 4
Wildlife Species Observed within Proposed Project Area

Birds

Turkey vulture (*Cathartes aura*)
Common raven (*Corvus corax*)
Western meadowlark (*Sturnella neglecta*)
American crow (*Corvus brachyrhynchos*)
House sparrow (*Passer domesticus*)
Mourning dove (*Zenaida macroura*)

Mammals

Black-tailed jackrabbit (*Lepus californicus*)
Desert cottontail (*Sylvilagus audubonni*)
California ground squirrel (*Otospermophilus beecheyi*)

Reptiles

Western whiptail (*Aspidoscelis tigris*)
Western fence lizard (*Sceloporus occidentalis*)
Pacific gopher snake (*Pituophis catenifer*)
Common side-blotched lizard (*Uta stansburiana*)

Table 5
Plants Observed within the Project Area

Blow wives - *Achyrachaena mollis*	Fiddleneck - *Amsinckia intermedia*
Ranchers fireweed - *Amsinckia menziesii*	Mt. Diablo locoweed - *Astragalus oxyphysus*
Saltbush – *Atriplex polycarpa*	Slender wild oats - *Avena barbata*
Wild oat - *Avena fatua* L.	Black mustard - *Brassica nigra* (L.) Koch
Soft chess brome - *Bromus hordeaceus*	Red brome - *Bromus madritensis ssp. rubens*
Rip-gut brome - *Bromus rigidus* Roth	Red maids - *Calandrinia ciliata*
Shepherd's-purse - *Capsella bursa-pastoris*	Turkey mullein - *Croton setigerus*
Redstem filaree - *Erodium cicutarium*	Broadleaf filaree - *Erodium botrys*
California poppy - *Eschscholzia californica*	Hare barley - *Hordeum leporinum*
Common mallow - *Malva neglecta* Wallr.	Horehound - *Marrubium vulgare*
Pineapple-weed - *Matricaria matricariodes*	Perennial sowthistle - *Sonchus arvensis* L.
Spiny sowthistle - *Sonchus asper* (L.) Hill	Annual sowthistle - *Sonchus oleraceus* L.
Vinegar weed - *Trichostema lanceolatum*	Red clover - *Trifolium pratense*

Non-Native Annual Grassland

Non-native annual grassland was observed covering all six (6) proposed well sites, the proposed access roads to the six (6) proposed well sites, proposed flow lines, and the buffer areas of the proposed well sites, access roads, and flow lines. Common species found in this vegetative community were composed of introduced grasses and broadleaf weedy species. Plant species observed during field surveys included fiddleneck (*Amsinckia intermedia*), ranchers fireweed (*Amsinckia menziesii*), Mt. Diablo locoweed (*Astragalus oxyphysus*), saltbush (*Atriplex polycarpa*), slender wild oats (*Avena barbata*), wild oat (*Avena fatua* L.), black mustard (*Brassica nigra* [L.] Koch), soft chess brome (*Bromus hordeaceus*), red brome (*Bromus madritensis ssp. rubens*), rip-gut brome (*Bromus rigidus* Roth), red maids (*Calandrinia ciliata*), shepherd's-purse (*Capsella bursa-pastoris*), turkey mullein (*Croton setigerus*), redstem filaree (*Erodium cicutarium*), broadleaf filaree (*Erodium botrys*), California poppy (*Eschscholzia californica*), hare barley (*Hordeum leporinum*), horehound (*Marrubium vulgare*), vinegar weed (*Trichostema lanceolatum*), and red clover (*Trifolium pratense*).

Wildlife species observed in this community during field surveys included western whiptail (*Aspidoscelis tigris*), turkey vulture (*Cathartes aura*), American crow (*Corvus brachyrhynchos*),

common raven (*Corvus corax*), black-tailed jackrabbit (*Lepus californicus*), California ground squirrel (*Otospermophilus beecheyi*), house sparrow (*Passer domesticus*), Pacific gopher snake (*Pituophis catenifer*), western fence lizard (*Sceloporus occidentalis*), western meadowlark (*Sturnella neglecta*), desert cottontail (*Sylvilagus audubonni*), common side-blotched lizard (*Uta stansburiana*), and mourning dove (*Zenaida macroura*).

Habitat Conservation and Natural Community Conservation Plans – There are no adopted Habitat Conservation Plans, Natural Community Conservation Plans or other approved local, regional, or state habitat conservation plans in the project area.

ANALYSIS OF POTENTIAL IMPACTS

The biological assessment conducted for the proposed project found that no special-status animal or plant species were present within the proposed project sites or buffer areas. However, suitable habitat for sensitive plant and animal species was observed within both the project sites and buffer areas during biological surveys. No riparian, wetland, stream, vernal pool, or other sensitive community types were observed during the biological assessment.

Direct mortality or injury to common wildlife and plant populations could occur during ground disturbance activities associated with implementation of the proposed project. Small vertebrate, invertebrate, and plant species are particularly prone to impact during project implementation because they are much less to non-mobile, and cannot easily move out of the path of project activities. Other more mobile wildlife species, such as most birds and larger mammals, can avoid project-related activities by moving to other adjacent areas temporarily. Increased human activity and vehicle traffic in the vicinity may disturb some wildlife species. However, common wildlife species have likely become acclimated to on-going ranching and oil and gas exploration and production activities. Because common wildlife species found in the project area are locally and regionally common, potential impacts to these resources are considered less than significant. Therefore, no avoidance or minimization measures are proposed at this time.

Implementation of the proposed project could potentially impact individual and nesting burrowing owls should they become established within the proposed project sites and buffer areas prior to project implementation. RAB Consulting would like to note that this species was not observed during biological surveys. Impacts to this species could occur through crushing by construction equipment during the construction of the proposed well sites and the proposed access roads. Actively nesting burrowing owls could also be affected due to noise and vibration from project activities if nests are located closer than 500 meters to the proposed well sites and proposed access roads; project related noise and vibration could cause the abandonment of active nest sites. Impacts to this species would be considered significant. Avoidance and minimization measures to protect these species from potential impacts are described further in the ***Proposed Avoidance and Minimization Measures*** section.

No evidence of San Joaquin kit fox or American badgers, or any potential/known burrows was observed within areas proposed for project activities during biological surveys. However, San Joaquin kit foxes and American badgers have the potential to become established in the proposed project sites and buffer areas prior to project implementation. Implementation of the proposed

project could potentially result in significant impacts on individual American badgers and San Joaquin kit foxes should they take up residence in the proposed project sites and buffer areas prior to project implementation. Impacts to these species would likely occur through one of the following ways:

- Through crushing or injury of individual San Joaquin kit foxes or American badgers if they are present within proposed project work areas during project implementation. This could result in direct mortality to live individuals or small populations of these species.

- Through the destruction of burrows if they are excavated by San Joaquin kit foxes or American badgers within disturbance areas prior to proposed project implementation. As stated previously, no potential or known dens were identified within proposed disturbance areas or buffer areas during biological surveys. No signs were observed that would indicate the presence of this species within the proposed project sites or buffer areas.

- Through visual, noise, and vibration impacts. If San Joaquin kit foxes or American badgers become established in burrows adjacent to the proposed project sites, the presence of construction personnel, and the noise and vibration caused by construction activities could lead to the abandonment of actively used burrows/dens. As discussed previously, no potential or known burrows were identified within the proposed project sites and buffer areas. No "signs" (tracks, scats, active digging, etc.) of either species were documented. Proposed project activities could cause the abandonment of occupied burrows if they become established prior to project implementation.

Impacts to American badgers and San Joaquin kit foxes and their potential burrows/dens would be considered a potentially significant impact. Minimization and avoidance measures to protect these species from potential impacts are described further in the ***Recommended Minimization and Avoidance Measures*** section.

Implementation of the proposed project has the potential to impact Tipton kangaroo rat, Tulare grasshopper mice, and San Joaquin pocket mice by causing direct mortality of individuals of these species by crushing due to use of construction equipment. Individuals of this species could also be crushed or buried in potential burrows within the proposed project sites and buffer areas. Potential burrows (California ground squirrel burrows) were observed throughout the proposed project sites and buffer areas during biological surveys. These burrows could provide potential refuge burrows for these species. It should be noted that no evidence was observed of any of these species presence during biological surveys, and these species are expected to be absent from the proposed project sites and buffer areas. However, the potential exists that these species could become established within the proposed project sites prior to project implementation. Impacts to these species would be considered a significant impact. Avoidance and minimization measures to protect nesting avian species from potential impacts are described further in the ***Recommended Avoidance and Minimization Measures*** section.

BNLL are not expected to be impacted by the proposed project. Potential habitat for these species was observed in annual grassland habitat within the proposed project sites and buffer

areas during biological surveys. Protocol-level biological surveys were conducted within these areas; however, no BNLL were observed during these surveys. Therefore, this species is expected to be absent from the proposed project sites and buffer areas, and no impacts to this species are anticipated as a result of proposed project implementation.

Traffic, consisting predominantly of ranching and oil and gas exploration and production vehicles and equipment within the project area is moderate. A short-term increase in vehicle traffic is anticipated during project implementation and less so after drilling and completion activities are complete. This will result in a short-term increase in associated noise, which may cause temporary disturbance to wildlife species. More tolerant species may adapt to and even take advantage of close human contact. Increased vehicular traffic could cause direct mortality to these species or impede normal activities such as dispersal (Luckenbach 1975, Weinstein 1978). Species intolerant of human activities may use the project sites less when humans are regularly present in the area (Bushnel 1978, Lee and Griffith 1977). Those species observed at or near the project sites appear to have acclimated to ongoing activities, and are expected to do so after the proposed project is implemented.

Direct mortality or injury to sensitive animal populations could occur during construction, drilling, and completion activities if these activities are not confined to approved construction areas, access roads, and staging areas (assuming that sensitive animal populations are established in the construction zone during project implementation).

The project would not interfere with movements of wildlife species or with established native resident or migratory wildlife corridors. Native resident and/or migratory fish and known native wildlife nursery sites are not present within the project sites or areas.

PROPOSED AVOIDANCE AND MINIMIZATION MEASURES

Implementation of proposed avoidance and minimization measures included in this report are recommended to reduce potential impacts to wildlife and plants. Avoidance and minimization measures presented below are what can be expected for the proposed project. These measures have been adapted here from the programmatic biological opinion issued by the USFWS (USFWS 2001) as well as other sources. It should be noted that the proposed project is not covered by the programmatic biological opinion, as the proposed project is located on land with privately owned surface and minerals. As such, these measures are only recommended:

1. As close to beginning of construction as possible, but not more than 14 days prior to construction, a qualified biologist shall conduct a final pre-construction survey of the construction zone to insure that no special-status wildlife species have recently occupied the proposed project sites. A qualified biologist shall be present immediately prior to construction activities that have potential to impact sensitive species (i.e., well site preparation, access road grading, etc.) to identify and protect potentially sensitive resources.

2. Proposed project sites boundaries shall be clearly delineated by stakes, flagging and /or rope or cord to minimize inadvertent degradation or loss of adjacent habitat during construction and drilling operations. Staff and/or its contractors shall post signs and/or place fence

around the sites to restrict access of vehicles and equipment unrelated to construction, drilling, and completion operations.

3. A qualified biologist monitor will be present during initial ground disturbance and site construction activities.

4. If San Joaquin kit foxes become established within the proposed project sites or buffer areas prior to project implementation, Naftex will implement the measures contained in the USFWS's "Standardized recommendations for protection of the San Joaquin kit fox prior to or during ground disturbance" (USFWS 2011). Naftex will implement the following measures:

   - If kit fox dens have become established within 200 feet of a construction area prior to project implementation that may be indirectly impacted by construction activities, exclusion zones shall be established prior to construction by a qualified biologist and dens shall not be disturbed in any way. Exclusion zone fencing should include untreated wood particle-board, silt fencing, orange construction fencing or other fencing as approved by the USFWS and CDFW. Exclusion zones shall be roughly circular with a radius of the following distances measured outward from entrance; potential den 50 feet, and known den 100 feet. Fencing must contain openings for kit fox ingress/egress and keeps humans and equipment out. If a natal/pupping den is discovered within a project site or within 200 feet of the project site, the USFWS and CDFW shall be immediately notified and under no circumstances should the den be disturbed or destroyed without prior authorization. If the preconstruction survey reveals an active natal pupping or new information, the project applicant should contact the USFWS and CDFW immediately to obtain the necessary take authorization/permit. If the take authorization/permit has already been issued, then the biologist may proceed with den destruction within the project boundary, except natal/pupping den which may not be destroyed while occupied. A take authorization/permit is required to destroy these dens even after they are vacated. Protective exclusion zones can be placed around all known and potential dens which occur outside the project footprint.

   - San Joaquin Kit fox exclusion zone barriers shall be maintained until all construction and drilling activities have been completed, and then removed. If specified exclusion zones cannot be observed for any reason, USFWS and CDFW shall be contacted for guidance prior to ground disturbing activities at or near the subject den. In the event that USFWS and CDFW concur that an occupied San Joaquin kit fox den would be unavoidably destroyed by a planned project action, procedures detailed in the USFWS Standardized Recommendations for protection of the San Joaquin Kit Fox (USFWS 2011) shall be implemented. Den excavation shall be undertaken only by a qualified biologist pursuant to USFWS and CDFW authorization and direction for excavation of kit fox dens.

   - In the event that a San Joaquin kit fox is injured or killed, the incident shall immediately be reported to the project biologist. The project biologist shall contact CDFW immediately in the case of a dead, injured or entrapped kit fox. The CDFW

contact for immediate assistance is State Dispatch at (916)445-0045. They will contact the local warden or the CDFW Central Region office at (559) 243-4014. The USFWS should be contacted at Endangered Species Division, (916) 414-6620 or (916) 414-6600. The USFWS and CDFW shall be notified in writing within three (3) working days of the accidental death or injury to a San Joaquin kit fox during project related activities. Notification must include the date, time, and location of the incident or of the finding of a dead or injured animal and any other pertinent information. The USFWS contact is the Chief of the Division of Endangered Species, 2800 Cottage Way, Suite W2605, Sacramento, California 95825-1846. The CDFW contact is the Central Region office at (559) 243-4014. New sightings of kit fox shall be reported to the CNDDB. A copy of the reporting form and a topographic map clearly marked with the location of where the kit fox was observed should also be provided to the USFWS as well.

- Kit foxes are attracted to den-like structures such as pipes and may enter stored pipes and become trapped or injured. All construction pipes, culverts, or similar structures with a diameter of 4 inches or greater that are stored at a construction site for one or more overnight periods should be thoroughly inspected for kit foxes before the pipe is subsequently buried, capped, or otherwise used or moved in any way. If a kit fox is discovered inside a pipe, that section of pipe should not be moved until the USFWS and CDFW has been consulted. If necessary, and under the direct supervision of the biologist, the pipe may be moved only once to remove it from the path of construction activity, until the fox has escaped.

- Limited destruction of kit fox dens may be allowed, if avoidance is not a reasonable alternative, provided the following procedures are observed. Destruction of any known or natal/pupping kit fox den requires take authorization/permit from the USFWS and CDFW. Destruction of the den should be accomplished by careful excavation until it is certain that no kit foxes are inside. The den should be fully excavated, filled with dirt and compacted to ensure that kit foxes cannot reenter or use the den during the construction period. If at any point during excavation, a kit fox is discovered inside the den, the excavation activity shall cease immediately and monitoring of the den as described above should be resumed. Destruction of the den may be completed when in the judgment of the biologist, the animal has escaped, without further disturbance, from the partially destroyed den. Natal or pupping dens which are occupied cannot be destroyed until the pups and adults have vacated and then only after consultation with the USFWS and CDFW. Known dens occurring within the footprint of the activity must be monitored for three (3) days with tracking medium or an infra-red beam camera to determine the current use. If no kit fox activity is observed during this period, the den should be destroyed immediately to preclude subsequent use. If kit fox activity is observed at the den during this period, the den should be monitored for at least five (5) consecutive days from the time of the observation to allow any resident animal to move to another den during its normal activity. Use of the den can be discouraged during this period by partially plugging its entrances(s) with soil in such a manner that any resident animal can escape easily. Only when the den is determined to be unoccupied may the den be excavated under

the direction of the biologist. If the animal is still present after five (5) or more consecutive days of plugging and monitoring, the den may have to be excavated when, in the judgment of a biologist, it is temporarily vacant, for example during the animal's normal foraging activities. The USFWS and CDFW encourage hand excavation, but realize that soil conditions may necessitate the use of excavating equipment. However, extreme caution must be exercised. For potential dens, if a take authorization/permit has been obtained, den destruction may proceed without monitoring, unless other restrictions were issued with the take authorization/permit. If no take authorization/permit has been issued, then potential dens should be monitored as if they were known dens. If any den was considered to be a potential den, but is later determined during monitoring or destruction to be currently, or previously used by kit fox (e.g., if kit fox sign is found inside), then all construction activities shall cease and the USFWS and CDFW shall be notified immediately.

5. The burrowing owl nesting season begins as early as February 1 and continues through August 31. If burrowing owls are located or become established within the proposed project sites or buffer areas at the time of the final pre-activity biological survey and are using burrows within the project sites or buffer areas, a qualified biologist will consult with CDFW; the following measures shall be implemented:

   (a) Naftex will follow recommendations included in CDFW's *Staff Report on Burrowing Owl Mitigation* (CDFW 2012a) including avoidance of occupied burrows by implementation of a no-construction buffer zone of a minimum distance of 500 meters, unless a qualified biologist approved by CDFW verifies through non-invasive methods that either: 1) the birds have not begun egg laying and incubation; or 2) that juveniles from the occupied burrows are foraging independently and are capable of independent survival.

   (b) On-site passive relocation of burrowing owls should be implemented if owls are using the burrows after August 31. Passive relocation is defined as encouraging owls to move from occupied burrows to alternate natural or artificial burrows that are beyond 150 feet from the impact zone and that are within or contiguous to a minimum of 6.5 acres of foraging habitat for each pair of relocated owls. Relocation of owls should only be implemented during the non-breeding season.

   (c) Owls should be excluded from burrows in the immediate impact zone and within a 150 feet buffer zone by installing one-way doors in burrow entrances. One-way doors should be left in place 48 hours to insure owls have left the burrow before excavation. One alternate natural or artificial burrow should be provided for each burrow that will be excavated in the project impact zone. The project area should be monitored daily for one week to confirm owl use of alternate burrows before excavating burrows in the immediate impact zone.

   (d) The project area shall be monitored daily for one week to confirm owl use of alternate burrows before excavating burrows in the immediate impact zone. Whenever possible, burrows shall be excavated using hand tools and refilled to prevent

reoccupation. Sections of flexible plastic pipe or burlap bags shall be inserted into burrow tunnels to prevent tunnel collapse while soil is excavated around that portion of a tunnel.

6. A project representative shall establish restrictions on construction-related traffic to approved construction areas, storage areas, staging and parking areas via signage. Off-road traffic outside of designated project areas shall be prohibited. Project-related traffic shall observe a 15 mph speed limit in all project areas except on County roads and State and federal highways to avoid impacts to special-status wildlife species.

7. Project activities during the drilling phase of the proposed project shall be scheduled to avoid evening hours, as feasible, to avoid special-status wildlife species that are active in the nighttime.

8. All vehicle operators shall check under vehicles and equipment before moving them if they have remained parked and shut off for 10 minutes or longer.

9. Hazardous materials, fuels, lubricants, and solvents that spill accidentally during project-related activities shall be cleaned up and removed from the project sites as soon as possible according to applicable federal, state and local regulations.

10. All equipment storage and parking during site development, drilling, and operation shall be confined to the proposed project sites or to previously disturbed off site areas that are not suitable habitat for listed species.

11. An Environmental Awareness Program shall be conducted to orient all employees involved in construction and drilling operations. The program shall consist of a brief presentation in which biologists knowledgeable of endangered species biology and legislative protection shall explain endangered species concerns. The program shall include a discussion of special-status plants and sensitive wildlife species. Species biology, habitat needs, status under the Endangered Species Act, and measures being taken for the protection of these species and their habitats as a part of the project shall be discussed.

12. If wildlife proof barricade fencing is not used at the proposed well sites, all excavated steep-walled holes or trenches in excess of three feet in depth shall be provided with one or more escape ramps constructed of earth fill to prevent entrapment of endangered species or other animals during the construction phase. Ramps shall be located at no greater than 1,000-foot intervals and at not less than 45-degree angles. Trenches shall be inspected for entrapped wildlife each morning prior to onset of construction activities and immediately prior to the end of each working day. Before such holes or trenches are filled they shall be inspected thoroughly for entrapped animals. Any animals discovered shall be allowed to escape voluntarily without harassment before construction activities resume, or removed from the trench or hole by a qualified biologist and allowed to escape unimpeded.

13. All construction pipes, culverts, or similar structures stored at a project site overnight having a diameter of four inches or greater shall be inspected thoroughly for wildlife species before

being buried, capped, or otherwise used or moved in any way. Pipes laid in trenches overnight shall be capped. If during construction a wildlife species is discovered inside a pipe, that section of pipe shall not be moved or, if necessary, moved only once to remove it from the path of construction activity, until the wildlife species has escaped.

14. All food-related trash items such as wrappers, cans, bottles or food scraps generated during construction or during subsequent stages of the project shall be disposed of only in closed containers and regularly removed from the proposed project sites. Food items may attract wildlife species onto a project site, consequently exposing such animals to increased risk of injury or mortality. No deliberate feeding of wildlife shall be allowed.

15. To prevent harassment or mortality of wildlife species via predation, or destruction of their dens or nests, no domestic pets shall be permitted on the proposed project sites.

16. Use of rodenticides and herbicides on the proposed project sites shall be permitted only as part of a USFWS and CDFW approved management plan unless such use is otherwise approved on a case-by-case basis. This is necessary to prevent primary or secondary poisoning of endangered species using adjacent habitats or depletion of prey upon which sensitive wildlife may depend.

CONCLUSION

Special-status species and their habitat have been documented in the general vicinity of the proposed project sites. No sensitive plant or wildlife species were observed during the biological survey and assessment. If the proposed avoidance and minimization measures recommended in this report are implemented during the proposed project, impacts to sensitive wildlife and special-status plant species and/or their habitats will be less than significant.

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APPENDIX A
REPRESENTATIVE PHOTOGRAPHS

Photograph 1
Proposed project sites. View looking south from north side of proposed project sites.

Photograph 2
Proposed project sites. View looking north from south side of proposed project sites.

ATTACHMENT D

ARCHAEOLOGICAL SURVEY

June 18, 2012

Mr. Robert Booher
Robert A. Booher Consulting
3221 Quail Hollow Drive
Fairfield, California 94533

Subject: Cultural Resources Assessment of the Naftex Operating Company Bloemer and Kirschenman Exploratory Oil and Gas Well Project, Kern County, California (BCR Consulting Project No. SYN1215)

Dear Mr. Booher:

Brunzell Cultural Resource Consulting (BCR Consulting) was retained by Robert A. Booher Consulting (RAB Consulting) to conduct a cultural resources records search, Native American consultation, and pedestrian field survey of the Naftex Operating Company Bloemer and Kirschenman Exploratory Oil and Gas Well Project (the proposed project) located in unincorporated Kern County, California. This letter report presents those results. The purpose of this study was to identify prehistoric or historic resources within the proposed project that may be impacted by project activities, pursuant to the California Environmental Quality Act (CEQA). The lead agency under CEQA for the project is the California Division of Oil, Gas, and Geothermal Resources (Division).

An archaeological record search and pedestrian field survey of the proposed project site did not reveal the presence of any cultural resources. Based on these results the proposed project is not anticipated to affect any historical resources. Therefore, no significant impact related to archaeological or historical resources is anticipated and no further investigations are recommended for the proposed project unless:

- The proposed project is changed to include areas not subject to this study;
- The proposed project is changed to include additional construction;
- Project activities reveal the presence of cultural materials.

Project Description and Location

Naftex Operating Company (Naftex) proposes to construct six (6) oil and gas well sites, and drill one (1) exploratory oil and gas well from each pad. The proposed project is located 2.9 miles northeast of Edison in central Kern County, California (Figure 1). The proposed project is located in Section 26, Township 29 South, Range 29 East, Mount Diablo Baseline and Meridian (MDBM), in unincorporated Kern County, California. It is depicted on the U.S. Geological Survey (USGS) *Rio Bravo Ranch* (1995) and *Edison* (1992) 7.5-minute quadrangle (see Attachment A). The proposed oil and gas well sites are located at the following coordinates (WGS84):

Well Name	Latitude	Longitude
Bloemer 1	35.374949	-118.834100
Bloemer 2	35.376241	-118.8340937
Bloemer 3	35.3755525	-118.8337385
Bloemer 4	35.3749549	-118.8330825
Kirschenman 1	35.3742796	-118.8335941
Kirschenman 2	35.3735667	-118.8340511

Archaeological Records Search

BCR Consulting Principal Archaeologist David Brunzell completed the archaeological records search at the Southern San Joaquin Valley Information Center located at California State University Bakersfield. The records search included a review of all recorded historic and prehistoric archaeological sites, as well as recorded built environment resources within one mile of the proposed project site. The research also reviewed known cultural resources reports completed in the vicinity. In addition, BCR Consulting examined the California State Historic Property Data File (HPD), which includes the National Register of Historic Places (National Register), California Historical Landmarks (CHL), California Points of Historical Interest (CPHI), and various local historic registers. The records search revealed that five cultural resource studies were previously conducted, resulting in the recording of one historic-period cultural resource within one mile of the proposed project site. The following are the results of the records search:

California USGS 7.5 Minute Quadrangle	Archaeological Sites	Built Environment Resources	Reports
Rio Bravo Ranch, CA (1995)	CA-KER-4740	None	KE-641, 1066, 1726, 1806, 3559
Edison, CA (1992)	None	None	KE-641, 1726, 3559

Native American Consultation

BCR Consulting requested a search of the Sacred Lands File maintained by the Native American Heritage Commission (NAHC) on June 6, 2012. The request included a brief project description and location map sent by email to David Singleton of the NAHC. Mr. Singleton performed the Sacred Lands File search, which has failed to reveal any record of Native American cultural resources within one-half mile of the proposed project. Mr. Singleton has also provided names of potentially interested tribes and individuals to BCR Consulting. BCR Consulting has communicated with those tribes and individuals via certified letters and emails. A record of all communications is provided in Attachment B of this report.

Pedestrian Field Survey

BCR Consulting Principal Archaeologist David Brunzell conducted a reconnaissance pedestrian inventory of the proposed project site on June 11, 2012. During the survey, Mr. Brunzell walked 15-meter transects across the proposed project site. Rodent back dirt and other natural soil exposures were inspected for cultural remains. Vegetation within the proposed project site included seasonal grasses, Russian thistle, and mustard seed, exhibiting approximately 75 percent surface visibility. Soils consisted of fine silts containing intermittent granitic cobbles and gravels, and some quartz outcrops. A concentration of

modern construction debris and related disturbances were also noted within the project boundaries. No historic or prehistoric cultural resources were recorded during the survey.

Recommendations

The records search and field survey did not identify any cultural resources within the proposed project site. Based on these results the proposed project is not anticipated to affect any archaeological or historical resources. Therefore, no significant impact related to archaeological or historical resources is anticipated and no further investigations are recommended for the proposed project unless:

- The proposed project is changed to include areas not subject to this study;
- The proposed project is changed to include additional construction;
- Project activities reveal the presence of cultural materials.

The current study attempted to determine whether archaeological deposits were present on the proposed project site. Although none were yielded during the records search and field survey, ground-disturbing activities have the potential to reveal buried deposits not observed on the surface. Prior to the initiation of ground-disturbing activities, field personnel should be alerted to the possibility of buried prehistoric or historic cultural deposits. In the event that field personnel encounter buried cultural materials, work in the immediate vicinity of the find should cease and a qualified archaeologist should be retained to assess the significance of the find. The qualified archaeologist shall have the authority to stop or divert construction excavation as necessary. If the qualified archaeologist finds that any cultural resources present meet National or California Register eligibility requirements, plans for the treatment, evaluation, and mitigation of impacts to the find will need to be developed.

If human remains are encountered, State Health and Safety Code Section 7050.5 states that no further disturbance shall occur until the County Coroner has made a determination of origin and disposition pursuant to Public Resources Code Section 5097.98. The County Coroner must be notified of the find immediately. If the remains are determined to be prehistoric, the Coroner will notify the NAHC, which notify a Most Likely Descendant. With the permission of the landowner or authorized representative, the MLD may inspect the discovery site. The MLD shall complete the inspection within 48 hours of notification.

Please contact me by phone at 909/525-7078 or e-mail at david.brunzell@yahoo.com with any questions or comments.

Sincerely,

David Brunzell, M.A./RPA
Principal Investigator/Archaeologist

Attachment A: Regional and Project Location Maps
Attachment B: Native American Heritage Commission Consultation Correspondence
Attachment C: Photographic Documentation

ATTACHMENT A:
REGIONAL AND PROJECT LOCATION MAPS

Reference: Topo! 2010 National Geographic; USGS Quad: Rio Bravo Ranch (1995), and Edison (1992), CA

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Project Location Site **Figure 1**
Bloemer and Kirschenman Exploratory Oil and Gas Project

Naftex Operating Company
1900 Avenue of the Stars. Suite 2450
Los Angeles, CA. 90067

ATTACHMENT B:

NATIVE AMERICAN HERITAGE COMMISSION CONSULTATION CORRESPONDENCE

Subject:	SLF/Tribe List Request for Naftex Project, Kern County
From:	joseph brunzell (joebrunzell@gmail.com)
To:	ds_nahc@pacbell.net;
Cc:	david.brunzell@yahoo.com;
Date:	Wednesday, June 6, 2012 11:17 AM

Hi Dave,

I'd like to request a Sacred Lands File search and list of potentially interested tribes and individuals for a cultural resource study of a proposed oil and gas exploration project in Kern County, California. The project is located in Section 26 of Township 29 South, Range 29 East, MDBM. It is depicted on the USGS Edison (1992), and Rio Bravo Ranch (1995) California 7.5 Minute Topographic Quadrangles (see attached project location map).

Please send the list to my email or the below fax number, and please get in touch with any questions.
Can you also reference the Naftex Project in the subject line of your letter?

Please note that our address has changed (see below).

Joseph Brunzell
Staff Archaeologist
BCR Consulting
1420 Guadalajara Place
Claremont, Ca. 91711
Phone: 909/210-7452
Fax: 909/621-7678

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Project Location Site **Figure 1**
Bloemer and Kirschenman Exploratory Oil and Gas Project

Naftex Operating Company
1900 Avenue of the Stars. Suite 2450
Los Angeles, CA. 90067

STATE OF CALIFORNIA Edmund G. Brown, Jr., Governor

NATIVE AMERICAN HERITAGE COMMISSION
915 CAPITOL MALL, ROOM 364
SACRAMENTO, CA 95814
(916) 653-6251
Fax (916) 657-5390
Web Site www.nahc.ca.gov
ds_nahc@pacbell.net

June 8 2012

Mr. Joseph Brunzell, Staff Archaeologist
BCR Consulting
1420 Guadalajara Place
Claremont, CA 91711

Sent by FAX to: 909-621-7678
No. of Pages: 5

Re. Sacred Lands File Search and Native American Contacts list for the proposed **"Oil and Gas Exploration Well Development Project;"** located northeast of the City of Bakersfield in the Rio Bravo area; Kern County, California

Dear Mr. Brunzell:

The Native American Heritage Commission (NAHC) conducted a Sacred Lands File searches of the 'area of potential effect,' (APE) based on the USGS coordinates provided and **Native American cultural resources were not identified** in the project area of potential effect (e.g. APE): you specified. . Also, please note, the NAHC Sacred Lands Inventory is not exhaustive and does not preclude the discovery of cultural resources during any project groundbreaking activity.

California Public Resources Code §§5097.94 (a) and 5097.96 authorize the NAHC to establish a Sacred Land Inventory to record Native American sacred sites and burial sites. These records are exempt from the provisions of the California Public Records Act pursuant to. California Government Code §6254 (r). The purpose of this code is to protect such sites from vandalism, theft and destruction.

In the 1985 Appellate Court decision (170 Cal App 3rd 604), the court held that the NAHC has jurisdiction and special expertise, as a state agency, over affected Native American resources, impacted by proposed projects including archaeological, places of religious significance to Native Americans and burial sites.

The California Environmental Quality Act (CEQA – CA Public Resources Code §§ 21000-21177, amendments effective 3/18/2010) requires that any project that causes a substantial adverse change in the significance of an historical resource, that includes archaeological resources, is a 'significant effect' requiring the preparation of an Environmental Impact Report (EIR) per the CEQA Guidelines defines a significant impact on the environment as 'a substantial, or potentially substantial, adverse change in any of physical conditions within an area affected by the proposed project, including ... objects of historic or aesthetic significance." In order to comply with this provision, the lead agency is required to assess whether the project will have an adverse impact on these resources within the 'area of potential effect (APE), and if so, to mitigate that effect. CA Government Code §65040.12(e) defines "environmental justice" provisions and is applicable to the environmental review processes.

Early consultation with Native American tribes in your area is the best way to avoid unanticipated discoveries once a project is underway. Local Native Americans may have knowledge of the religious and cultural significance of the historic properties of the proposed project for the area (e.g. APE). Consultation with Native American communities is also a matter of environmental justice as defined by California Government Code §65040 12(e). We urge consultation with those tribes and interested Native Americans on the list that the NAHC has provided in order to see if your proposed project might impact Native American cultural resources. Lead agencies should consider avoidance as defined in §15370 of the CEQA Guidelines when significant cultural resources as defined by the CEQA Guidelines §15064.5 (b)(c)(f) may be affected by a proposed project. If so, Section 15382 of the CEQA Guidelines defines a significant impact on the environment as "substantial," and Section 2183.2 which requires documentation, data recovery of cultural resources.

The 1992 *Secretary of the Interiors Standards for the Treatment of Historic Properties* were revised so that they could be applied to all historic resource types included in the National Register of Historic Places and including cultural landscapes. Also, federal Executive Orders Nos. 11593 (preservation of cultural environment), 13175 (coordination & consultation) and 13007 (Sacred Sites) are helpful, supportive guides for Section 106 consultation. The aforementioned Secretary of the Interior's *Standards* include recommendations for all 'lead agencies' to consider the historic context of proposed projects and to "research" the cultural landscape that might include the 'area of potential effect.'

Partnering with local tribes and interested Native American consulting parties, on the NAHC list, should be conducted in compliance with the requirements of federal NEPA (42 U.S.C 4321-43351) and Section 106 4(f), Section 110 and (k) of the federal NHPA (16 U.S.C. 470 *et seq*). Section 4(f) of the Department of Transportation Act of 1966 (23 CFR 774); 36 CFR Part 800.3 (f) (2) & .5, the President's Council on Environmental Quality (CSQ, 42 U.S.C 4371 *et seq.* and NAGPRA (25 U.S.C. 3001-3013) as appropriate. The 1992 *Secretary of the Interiors Standards for the Treatment of Historic Properties* were revised so that they could be applied to all historic resource types included in the National Register of Historic Places and including cultural landscapes. Also, federal Executive Orders Nos. 11593 (preservation of cultural environment), 13175 (coordination & consultation) and 13007 (Sacred Sites) are helpful, supportive guides for Section 106 consultation. The NAHC remains concerned about the limitations and methods employed for NHPA Section 106 Consultation.

Also, California Public Resources Code Section 5097.98, California Government Code §27491 and Health & Safety Code Section 7050.5 provide for provisions for accidentally discovered archeological resources during construction and mandate the processes to be followed in the event of an accidental discovery of any human remains in a project location other than a 'dedicated cemetery', another important reason to have Native American Monitors on board with the project.

To be effective, consultation on specific projects must be the result of an ongoing relationship between Native American tribes and lead agencies, project proponents and their contractors, in the opinion of the NAHC. An excellent way to reinforce the relationship between a project and local tribes is to employ Native American Monitors in all phases of proposed projects including the planning phases.

Confidentiality of "historic properties of religious and cultural significance" may also be protected under Section 304 of he NHPA or at the Secretary of the Interior discretion if not eligible for listing on the National Register of Historic Places. The Secretary may also be advised by the federal Indian Religious Freedom Act (cf. 42 U.S.C., 1996) in issuing a decision

on whether or not to disclose items of religious and/or cultural significance identified in or near the APE and possibility threatened by proposed project activity.

If you have any questions about this response to your request, please do not hesitate to contact me at (916) 653-6251.

Sincerely,

Dave Singleton

Attachment: Native American Contact List

Native American Contacts
Kern County
June 8, 2012

Santa Rosa Rancheria
Rueben Barrios, Chairperson
P.O. Box 8 — Tache
Lemoore , CA 93245 — Tachi
(559) 924-1278 — Yokut
(559) 924-3583 Fax

Tejon Indian Tribe
Katherine Montes- Morgan, Chairperson
2234 4th Street — Yowlumne
Wasco , CA 93280 — Kitanemuk
kmorgan@bak.rr.com — Kawaiisu
661-758-2303

Tule River Indian Tribe
Neil Peyron, Chairperson
P.O. Box 589 — Yokuts
Porterville , CA 93258
chairman@tulerivertribe-nsn.
(559) 781-4271
(559) 781-4610 FAX

Kawaiisu Tribe of Tejon Reservation
David Laughinghorse Robinson
PO Box 1547 — Kawaiisu
Kernville , CA 93238
(661) 664-3098 - work
(661) 664-7747 - home
horse.robinson@gmail.com

Ron Wermuth
P.O. Box 168 — Tubatulabal
Kernville , CA 93238 — Kawaiisu
warmoose@earthlink.net — Koso
(760) 376-4240 - Home — Yokuts
(916) 717-1176 - Cell

Kern Valley Indian Council
Robert Robinson, Co-Chairperson
P.O. Box 401 — Tubatulabal
Weldon , CA 93283 — Kawaiisu
brobinson@iwvisp.com — Koso
(760) 378-4575 (Home) — Yokuts
(760) 549-2131 (Work)

Kitanemuk & Yowlumne Tejon Indians
Delia Dominguez, Chairperson
115 Radio Street — Yowlumne
Bakersfield , CA 93305 — Kitanemuk
deedominguez@juno.com
(626) 339-6785

Tubatulabals of Kern Valley
Dr. Donna Begay, Tribal Chairwoman
P.O. Box 226 — Tubatulabal
Lake Isabella, CA 93240
drbegay@aol.com
(760) 379-4590
(760) 379-4592 FAX

This list is current only as of the date of this document.

Distribution of this list does not relieve any person of the statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resources Code and Section 5097.98 of the Public Resources Code.

This list is applicable for contacting local Native Americans with regard to cultural resources for the proposed Oil and Gas Well Exploration Project; located in the Rio Bravo area; Kern County, California for which a Sacred Lands File search and Native American Contacts list were requested.

Native American Contacts
Kern County
June 8, 2012

Santa Rosa Tachi Rancheria
Lalo Franco, Cultural Coordinator
P.O. Box 8 Tachi
Lemoore , CA 93245 Tache
(559) 924-1278 - Ext. 5 Yokut
(559) 924-3583 - FAX

This list is current only as of the date of this document.

Distribution of this list does not relieve any person of the statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resources Code and Section 5097.98 of the Public Resources Code.

This list is applicable for contacting local Native Americans with regard to cultural resources for the proposed Oil and Gas Well Exploration Project; locaated in the Rio Bravo area; Kern County, California for which a Sacred Lands File search and Native American Contacts list were requested.

Native American Consultation Summary for the Naftex Operating Company Proposed 20 Acre Oil and Gas Exploration Project, Kern County, California.* Native American Heritage Commission replied to BCR Consulting Request on June 8, 2012. Results of Sacred Land File Search did not indicate presence of Native American cultural resources, and recommended that the below groups/individuals be contacted.

Groups Contacted	Letter/Email Date	Response from Tribes
Rueben Barrios, Chairperson Santa Rosa Rancheria	Letter: 6/8/12 Email: N/A	None
Katherine Montes-Morgan, Chairperson Tejon Indian Tribe	Letter: 6/8/12 Email: 6/8/12	6/20/12: Ms. Montes Morgan responded by email that the Tejon Indian Tribe has no knowledge of cultural resources t this site, but did request copies of the NAHC report, and the results of the archaeological records search. She also wishes to be notified of any finds (email attached).
Neil Peyron, Chairperson Tule River Indian Tribe	Letter: 6/8/12 Email: 6/8/12	None
David Laughinghorse Robinson Kawaiisu Tribe of Tejon Reservation	Letter: 6/8/12 Email: 6/8/12	None
Ron Wermuth	Letter: 6/8/12 Email: 6/8/12	None
Robert Robinson, Co-Chairperson Kern Valley Indian Council	Letter: 6/8/12 Email: 6/8/12	None
Delia Dominguez, Chairperson Kitanemuk & Yowlumne Tejon Indians	Letter: 6/8/12 Email: 6/8/12	None
Dr. Donna Begay, Tribal Chairperson Tubatulabals of Kern Valley	Letter: 6/8/12 Email: 6/8/12	None
Lalo Franco, Cultural Coordinator Santa Rosa Tachi Rancheria	Letter: 6/8/12 Email: N/A	None

*Original 20 acres encompassed six well sites depicted in project location map.

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June 8, 2012

Rueben Barrios
Chairperson
Santa Rosa Rancheria
P.O. Box 8
Lemoore, California 93245

Subject: Tribal Consultation for the Naftex Operating Company Proposed 20 Acre Oil and Gas Exploration Project, Kern County, California.

Dear Rueben:

This is an invitation to consult on a proposed development project at locations with which you have tribal cultural affiliation. The purpose of the consultation is to ensure the protection of Native American cultural resources on which the proposed undertaking may have an impact. In the tribal consultation process, early consultation is encouraged in order to provide for full and reasonable public input from Native American Groups and Individuals, as consulting parties, on potential effect of the development project and to avoid costly delays. Further, we understand that much of the content of the consultation will be confidential and will include, but not be limited to, the relationship of proposed project details to Native American Cultural Historic Properties, such as burial sites, known or unknown, architectural features and artifacts, ceremonial sites, sacred shrines, and cultural landscapes. The proposed oil and gas exploration project is located within Section 26 of Township 29 South, Range 29 East, Mt. Diablo Baseline and Meridian, and is depicted on the *Edison* (1992*),* and *Rio Bravo Ranch* (1995), *California* USGS 7.5 Minute Topographic Quadrangle (see attached).

If you know of any cultural resources in the vicinity that may be of religious and/or cultural significance to your community or if you would like more information, please contact me at 909-525-7078 or david.brunzell@yahoo.com. Correspondence can also be sent to BCR Consulting, Attn: David Brunzell, 1420 Guadalajara Place, Claremont, California 91711. I request a response by June 22, 2012. If you require more time, please let me know. Thank you for your involvement in this process.

Sincerely,

BCR Consulting

David Brunzell, M.A./RPA
Principal Investigator/Archaeologist
Attachment: USGS Map

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Project Location Site **Figure 1**
Bloemer and Kirschenman Exploratory Oil and Gas Project

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1900 Avenue of the Stars. Suite 2450
Los Angeles, CA. 90067

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June 8, 2012

Katherine Montes-Morgan
Chairperson
Tejon Indian Tribe
2234 4th Street
Wasco, California 93280

Subject: Tribal Consultation for the Naftex Operating Company Proposed 20 Acre Oil and Gas Exploration Project, Kern County, California.

Dear Katherine:

This is an invitation to consult on a proposed development project at locations with which you have tribal cultural affiliation. The purpose of the consultation is to ensure the protection of Native American cultural resources on which the proposed undertaking may have an impact. In the tribal consultation process, early consultation is encouraged in order to provide for full and reasonable public input from Native American Groups and Individuals, as consulting parties, on potential effect of the development project and to avoid costly delays. Further, we understand that much of the content of the consultation will be confidential and will include, but not be limited to, the relationship of proposed project details to Native American Cultural Historic Properties, such as burial sites, known or unknown, architectural features and artifacts, ceremonial sites, sacred shrines, and cultural landscapes. The proposed oil and gas exploration project is located within Section 26 of Township 29 South, Range 29 East, Mt. Diablo Baseline and Meridian, and is depicted on the *Edison* (1992*),* and *Rio Bravo Ranch* (1995), *California* USGS 7.5 Minute Topographic Quadrangle (see attached).

If you know of any cultural resources in the vicinity that may be of religious and/or cultural significance to your community or if you would like more information, please contact me at 909-525-7078 or david.brunzell@yahoo.com. Correspondence can also be sent to BCR Consulting, Attn: David Brunzell, 1420 Guadalajara Place, Claremont, California 91711. I request a response by June 22, 2012. If you require more time, please let me know. Thank you for your involvement in this process.

Sincerely,

BCR Consulting

David Brunzell, M.A./RPA
Principal Investigator/Archaeologist
Attachment: USGS Map

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Project Location Site **Figure 1**
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Naftex Operating Company
1900 Avenue of the Stars. Suite 2450
Los Angeles, CA. 90067

Subject:	Tribal Consultation for the Naftex Operating Company Proposed 20 Acre Oil and Gas Exploration Project, Kern County, California
From:	Julie Gonzalez (office@tejontribe.net)
To:	david.brunzell@yahoo.com;
Cc:	kmorgan@bak.rr.com;
Date:	Wednesday, June 20, 2012 10:17 AM

Dear David Brunzell,

Thank you, for the letter dated June 8, 2012 and the opportunity to comment on this project. Tejon Indian Tribe has no conflict with this project nor do we know of any cultural resources that might be impacted at this site. However, I am asking you to please forward me copies of both the Native American Heritage Commission and the South San Joaquin Information Center record searches for this site. I would also like for you notify me immediately if any site(s) and/or artifacts are discovered during your project in the area.

Sincerely,

Kathryn Montes Morgan

Tribal Chair

Tejon Indian Tribe

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June 8, 2012

Neil Peyron
Chairperson
Tule River Indian Tribe
P.O. Box 589
Porterville, California 93258

Subject: Tribal Consultation for the Naftex Operating Company Proposed 20 Acre Oil and Gas Exploration Project, Kern County, California.

Dear Neil:

This is an invitation to consult on a proposed development project at locations with which you have tribal cultural affiliation. The purpose of the consultation is to ensure the protection of Native American cultural resources on which the proposed undertaking may have an impact. In the tribal consultation process, early consultation is encouraged in order to provide for full and reasonable public input from Native American Groups and Individuals, as consulting parties, on potential effect of the development project and to avoid costly delays. Further, we understand that much of the content of the consultation will be confidential and will include, but not be limited to, the relationship of proposed project details to Native American Cultural Historic Properties, such as burial sites, known or unknown, architectural features and artifacts, ceremonial sites, sacred shrines, and cultural landscapes. The proposed oil and gas exploration project is located within Section 26 of Township 29 South, Range 29 East, Mt. Diablo Baseline and Meridian, and is depicted on the *Edison* (1992*),* and *Rio Bravo Ranch* (1995), *California* USGS 7.5 Minute Topographic Quadrangle (see attached).

If you know of any cultural resources in the vicinity that may be of religious and/or cultural significance to your community or if you would like more information, please contact me at 909-525-7078 or david.brunzell@yahoo.com. Correspondence can also be sent to BCR Consulting, Attn: David Brunzell, 1420 Guadalajara Place, Claremont, California 91711. I request a response by June 22, 2012. If you require more time, please let me know. Thank you for your involvement in this process.

Sincerely,

BCR Consulting

David Brunzell, M.A./RPA
Principal Investigator/Archaeologist
Attachment: USGS Map

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Tehachapi

June 8, 2012

David Laughinghorse Robinson
Kawaiisu Tribe of Tejon Resrvation
P.O. Box 1547
Kernville, California 93238

Subject: Tribal Consultation for the Naftex Operating Company Proposed 20 Acre Oil and Gas Exploration Project, Kern County, California.

Dear David:

This is an invitation to consult on a proposed development project at locations with which you have tribal cultural affiliation. The purpose of the consultation is to ensure the protection of Native American cultural resources on which the proposed undertaking may have an impact. In the tribal consultation process, early consultation is encouraged in order to provide for full and reasonable public input from Native American Groups and Individuals, as consulting parties, on potential effect of the development project and to avoid costly delays. Further, we understand that much of the content of the consultation will be confidential and will include, but not be limited to, the relationship of proposed project details to Native American Cultural Historic Properties, such as burial sites, known or unknown, architectural features and artifacts, ceremonial sites, sacred shrines, and cultural landscapes. The proposed oil and gas exploration project is located within Section 26 of Township 29 South, Range 29 East, Mt. Diablo Baseline and Meridian, and is depicted on the *Edison* (1992*),* and *Rio Bravo Ranch* (1995), *California* USGS 7.5 Minute Topographic Quadrangle (see attached).

If you know of any cultural resources in the vicinity that may be of religious and/or cultural significance to your community or if you would like more information, please contact me at 909-525-7078 or david.brunzell@yahoo.com. Correspondence can also be sent to BCR Consulting, Attn: David Brunzell, 1420 Guadalajara Place, Claremont, California 91711. I request a response by June 22, 2012. If you require more time, please let me know. Thank you for your involvement in this process.

Sincerely,

BCR Consulting

David Brunzell, M.A./RPA
Principal Investigator/Archaeologist
Attachment: USGS Map

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Project Location Site **Figure 1**
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Tehachapi

June 8, 2012

Ron Wermuth
P.O. Box 168
Kernville, California 93238

Subject: Tribal Consultation for the Naftex Operating Company Proposed 20 Acre Oil and Gas Exploration Project, Kern County, California.

Dear Ron:

This is an invitation to consult on a proposed development project at locations with which you have tribal cultural affiliation. The purpose of the consultation is to ensure the protection of Native American cultural resources on which the proposed undertaking may have an impact. In the tribal consultation process, early consultation is encouraged in order to provide for full and reasonable public input from Native American Groups and Individuals, as consulting parties, on potential effect of the development project and to avoid costly delays. Further, we understand that much of the content of the consultation will be confidential and will include, but not be limited to, the relationship of proposed project details to Native American Cultural Historic Properties, such as burial sites, known or unknown, architectural features and artifacts, ceremonial sites, sacred shrines, and cultural landscapes. The proposed oil and gas exploration project is located within Section 26 of Township 29 South, Range 29 East, Mt. Diablo Baseline and Meridian, and is depicted on the *Edison* (1992*),* and *Rio Bravo Ranch* (1995), *California* USGS 7.5 Minute Topographic Quadrangle (see attached).

If you know of any cultural resources in the vicinity that may be of religious and/or cultural significance to your community or if you would like more information, please contact me at 909-525-7078 or david.brunzell@yahoo.com. Correspondence can also be sent to BCR Consulting, Attn: David Brunzell, 1420 Guadalajara Place, Claremont, California 91711. I request a response by June 22, 2012. If you require more time, please let me know. Thank you for your involvement in this process.

Sincerely,

BCR Consulting

David Brunzell, M.A./RPA
Principal Investigator/Archaeologist
Attachment: USGS Map

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June 8, 2012

Robert Robinson
Co-Chairperson
Kern Valley Indian Council
P.O. Box 401
Weldon, California 93283

Subject: Tribal Consultation for the Naftex Operating Company Proposed 20 Acre Oil and Gas Exploration Project, Kern County, California.

Dear Robert:

This is an invitation to consult on a proposed development project at locations with which you have tribal cultural affiliation. The purpose of the consultation is to ensure the protection of Native American cultural resources on which the proposed undertaking may have an impact. In the tribal consultation process, early consultation is encouraged in order to provide for full and reasonable public input from Native American Groups and Individuals, as consulting parties, on potential effect of the development project and to avoid costly delays. Further, we understand that much of the content of the consultation will be confidential and will include, but not be limited to, the relationship of proposed project details to Native American Cultural Historic Properties, such as burial sites, known or unknown, architectural features and artifacts, ceremonial sites, sacred shrines, and cultural landscapes. The proposed oil and gas exploration project is located within Section 26 of Township 29 South, Range 29 East, Mt. Diablo Baseline and Meridian, and is depicted on the *Edison* (1992*),* and *Rio Bravo Ranch* (1995), *California* USGS 7.5 Minute Topographic Quadrangle (see attached).

If you know of any cultural resources in the vicinity that may be of religious and/or cultural significance to your community or if you would like more information, please contact me at 909-525-7078 or david.brunzell@yahoo.com. Correspondence can also be sent to BCR Consulting, Attn: David Brunzell, 1420 Guadalajara Place, Claremont, California 91711. I request a response by June 22, 2012. If you require more time, please let me know. Thank you for your involvement in this process.

Sincerely,

BCR Consulting

David Brunzell, M.A./RPA
Principal Investigator/Archaeologist
Attachment: USGS Map

BCRCONSULTING
ARCHAEOLOGY·HISTORICAL PRESERVATION·PALEONTOLOGY
Claremont Naga Tehachapi
www.bcrconsulting.net
909-525-7078

Project Location Site **Figure 1**
Bloemer and Kirschenman Exploratory Oil and Gas Project

Naftex Operating Company
1900 Avenue of the Stars. Suite 2450
Los Angeles, CA. 90067

BCRCONSULTING ARCHAEOLOGY HISTORIC PRESERVATION PALEONTOLOGY
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Tehachapi

June 8, 2012

Delia Dominguez
Chairperson
Kitanemuk & Yowlumne Tejon Indians
115 Radio Street
Bakersfield, California 93305

Subject: Tribal Consultation for the Naftex Operating Company Proposed 20 Acre Oil and Gas Exploration Project, Kern County, California.

Dear Delia:

This is an invitation to consult on a proposed development project at locations with which you have tribal cultural affiliation. The purpose of the consultation is to ensure the protection of Native American cultural resources on which the proposed undertaking may have an impact. In the tribal consultation process, early consultation is encouraged in order to provide for full and reasonable public input from Native American Groups and Individuals, as consulting parties, on potential effect of the development project and to avoid costly delays. Further, we understand that much of the content of the consultation will be confidential and will include, but not be limited to, the relationship of proposed project details to Native American Cultural Historic Properties, such as burial sites, known or unknown, architectural features and artifacts, ceremonial sites, sacred shrines, and cultural landscapes. The proposed oil and gas exploration project is located within Section 26 of Township 29 South, Range 29 East, Mt. Diablo Baseline and Meridian, and is depicted on the *Edison* (1992*),* and *Rio Bravo Ranch* (1995), *California* USGS 7.5 Minute Topographic Quadrangle (see attached).

If you know of any cultural resources in the vicinity that may be of religious and/or cultural significance to your community or if you would like more information, please contact me at 909-525-7078 or david.brunzell@yahoo.com. Correspondence can also be sent to BCR Consulting, Attn: David Brunzell, 1420 Guadalajara Place, Claremont, California 91711. I request a response by June 22, 2012. If you require more time, please let me know. Thank you for your involvement in this process.

Sincerely,

BCR Consulting

David Brunzell, M.A./RPA
Principal Investigator/Archaeologist
Attachment: USGS Map

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909.525.7078
Claremont
Napa
Tehachapi

June 8, 2012

Dr. Donna Begay
Tribal Chairwoman
Tubatulabals of Kern Valley
P.O. Box 226
Lake Isabella, California 93240

Subject: Tribal Consultation for the Naftex Operating Company Proposed 20 Acre Oil and Gas Exploration Project, Kern County, California.

Dear Donna:

This is an invitation to consult on a proposed development project at locations with which you have tribal cultural affiliation. The purpose of the consultation is to ensure the protection of Native American cultural resources on which the proposed undertaking may have an impact. In the tribal consultation process, early consultation is encouraged in order to provide for full and reasonable public input from Native American Groups and Individuals, as consulting parties, on potential effect of the development project and to avoid costly delays. Further, we understand that much of the content of the consultation will be confidential and will include, but not be limited to, the relationship of proposed project details to Native American Cultural Historic Properties, such as burial sites, known or unknown, architectural features and artifacts, ceremonial sites, sacred shrines, and cultural landscapes. The proposed oil and gas exploration project is located within Section 26 of Township 29 South, Range 29 East, Mt. Diablo Baseline and Meridian, and is depicted on the *Edison* (1992*),* and *Rio Bravo Ranch* (1995), *California* USGS 7.5 Minute Topographic Quadrangle (see attached).

If you know of any cultural resources in the vicinity that may be of religious and/or cultural significance to your community or if you would like more information, please contact me at 909-525-7078 or david.brunzell@yahoo.com. Correspondence can also be sent to BCR Consulting, Attn: David Brunzell, 1420 Guadalajara Place, Claremont, California 91711. I request a response by June 22, 2012. If you require more time, please let me know. Thank you for your involvement in this process.

Sincerely,

BCR Consulting

David Brunzell, M.A./RPA
Principal Investigator/Archaeologist
Attachment: USGS Map

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909-525-7078

Project Location Site **Figure 1**
Bloemer and Kirschenman Exploratory Oil and Gas Project

Naftex Operating Company
1900 Avenue of the Stars. Suite 2450
Los Angeles, CA. 90067

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909.525.7078
Claremont
Napa
Tehachapi

June 8, 2012

Lalo Franco
Cultural Coordinator
Santa Rosa Tachi Rancheria
P.O. Box 8
Lemoore, California 93245

Subject: Tribal Consultation for the Naftex Operating Company Proposed 20 Acre Oil and Gas Exploration Project, Kern County, California.

Dear Lalo:

This is an invitation to consult on a proposed development project at locations with which you have tribal cultural affiliation. The purpose of the consultation is to ensure the protection of Native American cultural resources on which the proposed undertaking may have an impact. In the tribal consultation process, early consultation is encouraged in order to provide for full and reasonable public input from Native American Groups and Individuals, as consulting parties, on potential effect of the development project and to avoid costly delays. Further, we understand that much of the content of the consultation will be confidential and will include, but not be limited to, the relationship of proposed project details to Native American Cultural Historic Properties, such as burial sites, known or unknown, architectural features and artifacts, ceremonial sites, sacred shrines, and cultural landscapes. The proposed oil and gas exploration project is located within Section 26 of Township 29 South, Range 29 East, Mt. Diablo Baseline and Meridian, and is depicted on the *Edison* (1992*),* and *Rio Bravo Ranch* (1995), *California* USGS 7.5 Minute Topographic Quadrangle (see attached).

If you know of any cultural resources in the vicinity that may be of religious and/or cultural significance to your community or if you would like more information, please contact me at 909-525-7078 or david.brunzell@yahoo.com. Correspondence can also be sent to BCR Consulting, Attn: David Brunzell, 1420 Guadalajara Place, Claremont, California 91711. I request a response by June 22, 2012. If you require more time, please let me know. Thank you for your involvement in this process.

Sincerely,

BCR Consulting

David Brunzell, M.A./RPA
Principal Investigator/Archaeologist
Attachment: USGS Map

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www.bcrconsulting.net
909-525-7078

Project Location Site **Figure 1**
Bloemer and Kirschenman Exploratory Oil and Gas Project

Naftex Operating Company
1900 Avenue of the Stars. Suite 2450
Los Angeles, CA. 90067

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City, State, ZIP+4 Wasco, CA. 93280

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Street, Apt. No.; or PO Box No. P.O. Box 8
City, State, ZIP+4 Lemoore, CA. 93245

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Street, Apt. No.; or PO Box No. P.O. Box 1547
City, State, ZIP+4 Kernville, CA. 93238

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Sent To Neil Peyron
Street, Apt. No.; or PO Box No. P.O. Box 589
City, State, ZIP+4 Porterville, CA. 93258

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Street, Apt. No.; or PO Box No. P.O. Box 401
City, State, ZIP+4 Weldon, CA. 93283

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Sent To Ron Wermuth
Street, Apt. No.; or PO Box No. P.O. Box 168
City, State, ZIP+4 Kernville, CA. 93238

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Sent To Delia Dominguez
Street, Apt. No.; or PO Box No. 115 Radio Street
City, State, ZIP+4 Bakersfield, CA 93305

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Street, Apt. No.; or PO Box No. P.O. Box 226
City, State, ZIP+4 Lake Isabella, CA 93240

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Total Postage & Fees	$ $3.40	06/08/2012

Sent To Lalo Franco
Street, Apt. No.; or PO Box No. P.O. Box 8
City, State, ZIP+4 Lemoore, CA 93245

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ATTACHMENT C:
PHOTOGRAPHIC DOCUMENTATION

Photo 1: Project Site Overview (E View)

Photo 2: Project Site Overview (SE View)

SENATE RULES COMMITTEE	SB 390
Office of Senate Floor Analyses	
1020 N Street, Suite 524	
(916) 445-6614 Fax: (916)	
327-4478	

THIRD READING

Bill No: SB 390
Author: Alpert (D), et al
Amended: 5/28/99
Vote: 21

SENATE ENVIRONMENTAL QUALITY COMMITTEE : 6-3, 4/19/99
AYES: Sher, Alpert, Alarcon, Chesbro, Hayden, O'Connell
NOES: McPherson, Rainey, Wright
NOT VOTING: Solis

SENATE APPROPRIATIONS COMMITTEE : 9-4, 5/27/99
AYES: Johnston, Alpert, Bowen, Burton, Escutia, Karnette, McPherson, Perata, Vasconcellos
NOES: Johnson, Kelley, Leslie, Mountjoy

SUBJECT : Water quality

SOURCE : San Francisco BayKeeper

DIGEST : This bill:

1. Revises the authority of regional water quality control boards to waive waste discharge requirements of the Porter-Cologne Water Quality Control act as to a specific discharge if the waiver is not against the public interest and is not for a period to exceed five years.

2. Requires regional boards and the State Water Resources Control Board to enforce the conditions under which a waiver was granted.

CONTINUED

3. Requires the regional boards, prior to renewing any waiver, to review the terms of the waiver at a public hearing.

4. Revises liability provisions where a person violates prescribed orders or discharges waste in violation of a waste discharge requirement or other order or prohibition to include waivers or conditions.

ANALYSIS : Existing law, the Porter-Cologne Water Quality Control Act:

1. Requires anyone who discharges waste anywhere in the State, except into a community sewer system, to:

   A. Report the discharge to the regional water quality control board if the discharge "could affect the quality of the waters of the State."

   B. Obtain waste discharge requirements (a water quality permit) from the regional board that ensure that the requirements of the basin water quality control plan are met, that water quality objectives are achieved and that the beneficial uses of water are not impaired by the discharge.

2. Requires dischargers that have obtained a water

quality permit to report new discharges and material changes in existing waste discharges and prohibits them from initiating those changes until one of the following occurs:

A. A revised water quality permit is issued.

B. The regional board waives the requirement to revise the permit.

C. 120 days expire and one of the following applies:

(1) The change is not subject to the California Environmental Quality Act (CEQA).

(2) The change is subject to CEQA but (a) the regional board fails to act on a required negative declaration within 105 days, (b) the regional board as lead agency for evaluating the change doesn't issue the revised permit within one year, or (c) the regional board, as responsible agency, doesn't issue the revised permit within 90 days of receiving adequate environmental documentation.

3. Authorizes a regional board to waive the requirements that a discharge be reported, that a water quality permit be obtained and that changes in a discharge be reported and the permit be revised, if the regional boards find that the waiver is not against the public interest.

4. Makes anyone who violates prescribed orders or discharges waste in violation of a waste discharge requirement or other order or prohibition liable civilly.

This bill:

1. Additionally specifies that a regional board may waive the requirements set forth in #3 above if the term of the waiver does not exceed five years.

2. Requires the regional boards and the State Water Resources Control Board (SWRCB) to enforce the conditions under which a waiver is granted.

3. Requires the regional board, prior to renewing a waiver, to review the terms at a public hearing. At that time the regional board would determine whether the discharge should be subject to general or individual waste discharge requirements.

4. Revises the liability provisions where someone violates prescribed orders or discharges waste in violation of a waste discharge requirement or other order or prohibition to include waiver, condition or certification.

History of the Waiver Authority and General Permits . According to the Senate Environmental Quality Committee analysis, the waiver authority was granted to regional boards almost 30 years ago and has evolved into a complicated system. When waivers are granted for specific discharges and to specific dischargers, these individual waiver cases are known to the regional boards. Over the years, however, each regional board has also adopted a "waiver policy," a specific list of classes of waste

discharges that neither have to be reported to the regional board nor require permits. The waiver policy is incorporated into each regional board's basin water quality control plan and covers a myriad of classes of discharges, each of which may or may not be subject to waiver limitations. The Central Valley regional board, for example, waives stormwater runoff without condition unless it is subject to federal permit requirements; inert waste discharges are waived if good disposal practices are followed: reporting and permitting of irrigation return flows are waived if sediment and concentrations of materials toxic to fish and wildlife in the flows are minimized.

Limitations on class waivers are probably not enforceable. They are, in most cases, so nonspecific that they can not be made operational. The Porter-Cologne Act is silent on the question of whether violations of waiver limitations are subject to fines or other sanctions. The default sanction seems to be that if waiver limitations are violated, the waiver may be withdrawn. In the case of individual waivers, this may have some effect. In the case of class waivers it is probably useless. Even if regional boards knew where discharges were occurring, it is hard to see how the termination of the class waiver could be used against an individual member of the class without destroying its usefulness.

In 1995, SB 572 (Kelley) authorized the State and regional boards to issue general permits for classes of discharge activities. While the intent was to substitute a general permit for individual ones, general permits could also be used as a substitute for class waivers. The general permit has two overwhelming advantages over class waivers. First, it can require dischargers subject to it to report their

activities to the regional boards. Second, a general permit is subject to the same conditions as a water quality permit, namely, that it must implement the requirements of the basin water quality control plan in order to protect the beneficial uses of water. An operational measure of the validity of the general permit is therefore available. Contrast this with the measure of the validity of a waiver: a regional board simply must find that it is not against the "public interest" (a philosophical, not an operational, concept).

FISCAL EFFECT : Appropriation: No Fiscal Com.: Yes Local: Yes

According to the Senate Appropriations Committee:

Fiscal Impact (in thousands)

Major Provisions	1999-2000	2000-01	2001-02	Fund
Revision of waste discharge permit waiver process	Unknown major cost, offset by unknown amount by waste discharge permit fees			General/ Special*

*Waste Discharge Permit Fund

Regional boards have been issuing waste discharge permit waivers for nearly 30 years. Each regional board has a waiver policy governing classes of waste discharges that neither have to be reported to the regional board or

require permits. As a result, it is difficult to determine costs associated with reviewing and monitoring waivers. In any event, there will be major costs associated with requiring the State Water Resources Control Board and the regional boards to perform increased oversight over the waivers. Further, these entities must operate under statutorily imposed fee caps that are not reflective of workload. As a result, the work of the boards to administer the act, which has grown in complexity, is increasingly underfunded and will require General Fund support to implement the provisions of this bill.

SUPPORT : (Verified 5/28/99)

San Francisco BayKeeper, DeltaKeeper (source)
California League of Conservation Voters
Santa Monica BayKeeper
Golden Gate Audubon Society
Sierra Club
Natural Resources Defense Council
Planning and Conservation League
Surfers Tired of Pollution
Redwood Coast Watershed Alliance
Salmon Steelhead Recovery Coalition
Friends of Schooner Gulch
Coast Action Group
Albion River Watershed Protection Association
Friends of Salmon Creek
Russian River Watershed Protection Committee
Center for Marine Conservation
California Coastal Commission (committee analysis)
California Assn. of Environmental Health Officers (committee analysis)

OPPOSITION : (Verified 6/2/99)

California Association of Port Authorities
California Farm Bureau Federation
California Municipal Utilities Association
California Building Industry Association
California Mining Association
Agricultural Council of California
California Cattlemen's Association
California League of Food Processors

Western United Dairymen
California Manufacturers Association
Ingomar Packing Company
California Licensed Foresters Association
Western Crop Protection Association
Western State Petroleum

ARGUMENTS IN SUPPORT : According to the San Francisco BayKeeper, an environmental organization, and its affiliate, the DeltaKeeper, the water quality of over 500 water bodies in the State is impaired to the point that they cannot sustain the beneficial uses which have been designated for them in their respective basin water quality control plans. The BayKeeper believes that while the federal and state water quality permit programs have reduced water pollution substantially over the years, waivers for specific discharges and types (classes) of discharges have prevented more progress from being made in cleaning up the State's rivers, lakes, bays, estuaries and ocean waters.

ARGUMENTS IN OPPOSITION : The opponents oppose the language pertaining to waste discharge fees.

SUPPORT/OPPOSITION: SEE ABOVE

**** END ****

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

ENVIRONMENTAL ASSESSMENT
FOR
WAIVING WASTE DISCHARGE REQUIREMENTS
FOR SPECIFIC TYPES OF DISCHARGE

Although Water Code Section 13263 requires that the Board prescribe waste discharge requirements for all discharges of which it has knowledge, Water Code Section 13269 allows the Board to waive waste discharge requirements for specific discharges or types of discharges where such action is in the public interest. Because the Board has limited resources, it must concentrate on the most important water quality problems. It is not, therefore, appropriate to regulate the thousands of waste dischargers which have little or no impact on water quality.

The Board has chosen to regulate many agricultural dischargers through development of Best Management Practices rather than waste discharge requirements. In many cases, the state-of-the-art precludes more extensive regulation.

The staff proposes that the Board waive requirements for 22 categories of discharge. These discharges are generally small in volume and non-toxic. Thus there will be no adverse water quality impacts. Many thousands of these discharges exist in the region and many are added each year. The Board has not requested Reports of Waste Discharge for these and does not plan to do so. Many projects which will be covered by the waiver resolution - - such as applications for water quality certification and proposed subdivisions - - are now reviewed by staff and will continue to be. If staff expects adverse water quality impacts, or if they occur in spite of compliance with the waiver limitations, staff will recommend that the Board adopt waste discharge requirements.

Staff has carefully reviewed the consequences of waiving requirements for these 22 categories and concluded that there will be no adverse water quality impacts. Projects for which requirements are waived may have other environmental impacts. These will be considered, and mitigated if necessary, by the lead agency for the project at the time of the project. Waiving waste discharge requirements as discussed above has no effect on other potential environmental impacts of the project.

If you have any questions or comments regarding this assessment please contact:

J. Lawrence Pearson, P.E.
California Regional Water Quality Control Board
Central Valley Region
3201 'S' Street
Sacramento, CA 95816
(916) 445-0270

Persons Providing Assistance in the Preparation of this Assessment:

W. H. Crooks, W. S. Johnson, J. L. Pearson, F. S. Nevins, S. J. Green and R. E. Merrill of the Regional Water Quality Control Board; S. Vassey and E. Miller of the State Water Resources Control Board.

NEGATIVE DECLARATION

TO WHOM IT MAY CONCERN:

The staff of the California Regional Water Quality Control Board, Central Valley Region (Board) has made an assessment of environmental impacts in accordance with the California Environmental Quality Act (CEQA) and appropriate regulations for the resolution discussed below. The resolution and assessment are attached.

Project Sponsor: California Regional Water Quality Control Board Central Valley Region

Title of Project: Resolution No. _____ Waiving Waste Discharge Requirements for Specific Types of Discharges

Location: Various Places in the Central Valley Region

Description of Proposed Project: The resolution allows dischargers of specific types waste (within stated limitations) to operate in conformance with the Water Code without receiving waste discharge requirements from the Board.

Mitigation Measures: The waiver of requirements is conditional and may be terminated at any time by the Board

Findings: The specific types of waste discharge for which requirements are waived are limited to those for which no adverse water quality impacts are foreseen. Therefore an Environmental Impact Report is not required by CEQA.

Any person may object to the Board's forgoing an EIR for this action by calling or writing the Board's office.

Dated this 23 day of December, 1981.

California Regional Water Quality Control Board
Central Valley Region
3201 'S' Street
Sacramento, CA 95816
(916) 445-0270

J. Lawrence Pearson

J. Lawrence Pearson, P.E.
Authorized Signature

Supervising Engineer
Position/Title

JLP/ajp 12/23/81

NEGATIVE DECLARATION/ENVIRONMENTAL ASSESSMENT SENT TO THE FOLLOWING:

U. S. Bureau of Reclamation
U. S. Fish and Wildlife Service
U. S. Department of Agriculture, Soil Conservation Service
Department of Food and Agriculture
Department of Health Services, Sacramento
Department of Health Services, Fresno
Department of Health Services, Stockton
Department of Health Services, Redding
Mr. Walt Pettit, State Water Resources Control Board
Ms. Elizabeth Miller, State Water Resources Control Board
Department of Water Resources, Red Bluff
Department of Water Resources, Sacramento
Department of Water Resources,, Fresno
Department of Fish and Game
Division of Oil and Gas
Mr. Steve Carlson, University of California Cooperative Extension Service (Davis)
Office of Planning and Research, State Clearinghouse
Central Valley Region U. C. Cooperative Extension County Directors
Central Valley Region County Planning Departments
Central Valley Region County Health Departments
Central Valley Region County Agricultural Commissioners
California Farm Bureau Federation
California Association of Resource Conservation Districts
California Association of Water Agencies
California Central Valley Flood Control Association
SACOG
Fresno COG
Bakersfield COG
ABAG
Sierra Club, San Francisco

12/23/81

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

RESOLUTION NO. 82-036

WAIVING WASTE DISCHARGE REQUIREMENTS
FOR SPECIFIC TYPES OF DISCHARGE

WHEREAS, Water Code Section 13260(a) requires that any person discharging wastes or proposing to discharge wastes within the region, other than to a community sewer system, that could affect the quality of the waters of the state, shall file a report of waste discharge; and

WHEREAS, the Regional Water Quality Control Board, Central Valley Region, (hereafter Board), has a statutory obligation to prescribe waste discharge requirements except where a waiver is not against the public interest; and

WHEREAS, waiving requirements for certain specific type of waste discharge is not against the public interest because it avoids unnecessary expenditures of Board resources; and

WHEREAS, many types of waste discharges have no adverse effect on the waters of the state; and

WHEREAS, many waste dischargers are willing to self-regulate their discharges and thereby protect the waters of the state; and

WHEREAS, many waste dischargers are effectively regulated by local government or other state agencies; and

WHEREAS, state-of-the-art makes significant improvements in specific types of discharges unreasonable; and

WHEREAS, staff has prepared a Negative Declaration in accordance with the California Environmental Quality Act and appropriate regulations and finds that there are no significant adverse water quality impacts; and

WHEREAS, the Board has reviewed the Negative Declaration and concurs with the staff findings; and

WHEREAS, the Board, on 26 March 1982, held a hearing in Bakersfield, California and considered all evidence concerning this matter: Therefore be it

RESOLVED, That the California Regional Water Quality Board, Central Valley Region, waives waste discharge requirements for the following specific types of waste discharges except for those dischargers for which waste discharge requirements have been adopted; and be it further

RESOLVED, That this action waiving waste discharge requirements is conditional and may be terminated for any type of discharge or any specific discharger at any time.

Type of Waste Discharge	Limitations
1. Air conditioner, cooling and elevated temperature waters	Small volumnes which will not change temperature of receiving water more than 1°C.
2. Drilling muds	Discharged to sump with two feet of freeboard. Sump must be dried by evaporation or pumping. Drill-mud may remain in sump only if discharger demonstrates that it is nontoxic. Sump area shall be restored to pre-construction state within 60 days of completion or abandonment of well.
3. Clean oil containing no toxic materials	Used for beneficial purposes such as dust control, weed control and mosquito abatement where it cannot reach state waters.
4. Minor dredger operations	When spoil is nontoxic and discharged to land.
5. Group 3 solid wastes	Good disposal practices.
6. Test pumpings of fresh water wells	When assurances are provided that pollutants are neither present nor added.
7. Storm water runoff	Where no water quality problems are contemplated and no federal NPDES permit is required.
8. Erosion from development	Where Best Manangement Practices (BMP) plans have been formulated and implemented.
9. Pesticide rinse waters from applicators	Where discharger complies with Board guidelines.
10. Confined animal wastes	Where discharger complies with Board guidelines.

RESOLUTION NO. 82-00

WAIVING WASTE DISCHARGE REQUIREMENTS
FOR SPECIFIC TYPES OF DISCHARGE

Type of Waste Discharge	Limitations
11. Minor stream channel alterations and suction dredging	Where regulated by Department of Fish and Game agreements.
12. Small, short-term sand and gravel operations	All operations and wash waters confined to land.
13. Small metals mining operations	All operations confined to land, no toxic materials utilized in recovery operations.
14. Swimming pool discharges	Where adequate dilution exists or where beneficial uses are not affected.
15. Food processing wastes spread on land	Where an operating/maintenance plan has been approved.
16. Construction	Where BMPs used.
17. Agricultural commodity wastes	Small, seasonal and confined to land.
18. Industrial wastes utilized for soil amendments	Where industry certifies its nontoxic content and BMP Ag applications used.
19. Timber harvesting	Operating under approved plan.
20. Minor hydro projects	Operating under water rights permit from State Water Resources Control Board or Fish and Game agreement and no water quality impacts anticipated.
21. Irrigation return water	Operating to minimize sediment to meet Basin Plan turbidity objectives and to prevent concentrations of materials toxic to fish or wildlife.
22. Projects where application for Water Quality Certification is required	Where project (normally minor construction) is not expected to have a significant water quality effect and project complies with Fish and Game agreements.

Type of Waste Discharge	Limitations
23. Septic tank/leachfield systems	Where project has county permit and county uses Board Guidelines.

I, JAMES A. ROBERTSON, Executive Officer, do hereby certify the foregoing is a full, true and correct copy of a Resolution adopted by the California Regional Water Quality Control Board, Central Valley Region, on 26 March 1982.

JAMES A. ROBERTSON, Executive Officer

Amended 26 March 1982

California Regional Water Quality Control Board
Central Valley Region

Peter M. Rooney
Secretary for Environmental Protection

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Ed J. Schnabel
Chair

15 September 1998

To: Basin Plan Recipients

FOURTH EDITION OF THE WATER QUALITY CONTROL PLAN (BASIN PLAN) FOR THE SACRAMENTO RIVER AND SAN JOAQUIN RIVER BASINS

The Third Edition of the Basin Plan was adopted by the Regional Water Board on 9 December 1994, approved by the State Water Board on 16 February 1995 and approved by the Office of Administrative Law on 9 May 1995. Since then, the Basin Plan has been amended twice. One amendment (Regional Water Board Resolution 95-142) dealt with compliance schedules in National Pollutant Discharge Elimination System permits and the other (Regional Water Board Resolution 96-147) addressed agricultural subsurface drainage discharges. The Basin Plan has now been reprinted, incorporating these amendments. This will be the **Fourth Edition - 1998**.

The Basin Plan is in a loose-leaf format to facilitate the addition of amendments. The Basin Plan can be kept up-to-date by inserting any updated pages that you receive in the future. The date subsequent amendments are adopted by the Regional Water Board will appear at the bottom of the page. Otherwise, all pages will be dated 1 September 1998.

Copies of the Basin Plan are also available on the Regional Water Board's internet web site at the following address: http://www.swrcb.ca.gov/~rwqcb5/home.html.

The Basin Plan refers to objectives in the State Water Board's May 1991 *Water Quality Control Plan for Salinity* (Salinity Plan). The objectives are also reproduced in Table III-5. In May 1995, the State Water Board adopted *the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary* which supersedes the Salinity Plan. Therefore, the reader should refer to the May 1995 Plan rather than the Salinity Plan. Reference to State Water Board's May 1995 Plan will be reflected in a future Basin Plan amendment.

Appendix 38 of the Basin Plan is a Water Quality Limited Segment List that was in effect in 1994. In 1998, the Regional Water Board and State Water Board approved an updated list and submitted it to the US EPA for its consideration (as required by the Clean Water Act).

If you have any questions, please call me at (916)255-3093.

JERROLD A. BRUNS, Chief
Standards, Policies and Special Studies

Amendments to the 1994 Water Quality Control Plan for the
Sacramento River and San Joaquin River Basins

	Subject	Date Adopted By Reg. Bd.	Regional Board Resolution No.	Date in Effect
1.	Amendment Specifically Authorizing Compliance Schedules in NPDES Permits for Achieving Water Quality Objectives or Effluent Limits Based on Objectives	5/26/95	95-142	5/26/95*
2.	Adoption of Water Quality Objectives and an Implementation Plan Regulation of Agricultural Subsurface Drainage in the Grassland Area	5/3/96	96-147	1/10/97*
3.	Adoption of Site Specific Water Quality Objectives for pH and Turbidity for Deer Creek in El Dorado County	7/19/02	R5-2002-0127	10/21/03
4.	Adoption of Corrective Language	9/6/02	R5-2002-0151	1/27/04
5.	Adoption of a Control Program for Mercury in Clear Lake, including COMM use for Clear Lake and Mercury Objectives for Fish Tissue	12/6/02	R5-2002-0207	10/2/03
6.	Adoption of a Control Program for Orchard Pesticide Runoff and Diazinon Runoff into the Sacramento and Feather Rivers, including Site-Specific Water Quality Objectives for Diazinon	10/16/03	R5-2003-0148	8/11/04
7.	Adoption of Site Specific Temperature Objectives for Deer Creek in El Dorado And Sacramento Counties	1/31/03 9/16/05	R5-2003-0006 R5-2005-0119	5/17/06

* The amendment is not in effect until it is approved by the State Water Resources Control Board and Office of Administrative Law. If the amendment involves adopting or revising a standard which relates to surface waters it must also be approved by the U.S. Environmental Protection Agency (USEPA) [40 CFR Section 131(c)]. If the standard revision is disapproved by USEPA, the revised standard remains in effect until it is revised by the basin planning process, or USEPA promulgates its own rule which supersedes the standard revision [40 CFR Section 131.21(c)]

Amendments to the 1994 Water Quality Control Plan for the
Sacramento River and San Joaquin River Basins

Subject	Date Adopted By Reg. Bd.	Regional Board Resolution No.	Date in Effect
8. Amendment for the Control of Salt and Boron Discharges into the Lower San Joaquin River	9/10/04	R5-2004-0108	7/28/06
9. Amendment to De-Designate Four Beneficial Uses of Old Alamo Creek, Solano County	4/28/05	R5-2005-0053	8/7/06
10. Amendment for the Control Program for Factors Contributing to the Dissolved Oxygen Impairment in the Stockton Deep Water Ship Channel	1/27/05	R5-2005-0005	8/23/06
11. Amendment for the Control of Diazinon and Chlorpyrifos Runoff into the San Joaquin River	10/21/05	R5-2005-0138	12/20/06
12. Amendment for the Control of Mercury in Cache creek, Bear Creek, Sulphur Creek and Harley Gulch	10/21/05	R5-2005-0146	2/6/07
13. Amendment for the Control of Nutrients in Clear Lake	6/23/06	R5-2006-0060	7/12/07
14. Amendment for the Control of Diazinon and Chlorpyrifos Runoff into the Sacramento-San Joaquin Delta	6/23/06	R5-2006-0061	10/10/07
15. Amendment for the Control of Diazinon and Chlorpyrifos Runoff into the Sacramento and Feather Rivers	5/3/07	R5-2007-0034	8/11/08
16. Amendment to Revise Water Quality Objectives for pH and Turbidity	10/25/07	R5-2007-0136	7/7/09
17. Amendment to Determine Certain Beneficial Uses are not Applicable and Establish Water Quality Objectives in Sulphur Creek, Colusa County	3/16/07	R5-2007-0021	9/4/09

Amendments to the 1994 Water Quality Control Plan for the
Sacramento River and San Joaquin River Basins

Subject	Date Adopted By Reg. Bd.	Regional Board Resolution No.	Date in Effect
18. Non-Regulatory Amendments to Correct Editing Errors and Update Language	8/13/09	R5-2009-0069	5/18/11
19. Amendments to Control Methylmercury And Total Mercury in the Sacramento-San Joaquin Delta Estuary	4/22/2010	R5-2010-0043	10/20/11

THE WATER QUALITY CONTROL PLAN (BASIN PLAN)

FOR THE

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD

CENTRAL VALLEY REGION

FOURTH EDITION

Revised October 2011 (with Approved Amendments)

THE SACRAMENTO RIVER BASIN AND THE SAN JOAQUIN RIVER BASIN

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD CENTRAL VALLEY REGION

Katherine Hart, Chair
Lyle Hoag, Member
Karl Longley, Member
Sandra Meraz, Member
Dan Odenweller, Member

Pamela C. Creedon, Executive Officer

COVER PHOTO ACKNOWLEDGMENTS:

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Yosemite: David Rosen/ Ducks Unlimited
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Sugar Beets: Brenda Grewell/ Dept. of Water Resources

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APPENDIX

MAPS

FOREWORD TO THE FOURTH EDITION (1998)

The preparation and adoption of water quality control plans (Basin Plans) is required by the California Water Code (Section 13240) and supported by the Federal Clean Water Act. Section 303 of the Clean Water Act requires states to adopt water quality standards which "consist of the designated uses of the navigable waters involved and the water quality criteria for such waters based upon such uses." According to Section 13050 of the California Water Code, Basin Plans consist of a designation or establishment for the waters within a specified area of beneficial uses to be protected, water quality objectives to protect those uses, and a program of implementation needed for achieving the objectives. State law also requires that Basin Plans conform to the policies set forth in the Water Code beginning with Section 13000 and any state policy for water quality control. Since beneficial uses, together with their corresponding water quality objectives, can be defined per federal regulations as water quality standards, the Basin Plans are regulatory references for meeting the state and federal requirements for water quality control (40 CFR 131.20). One significant difference between the state and federal programs is that California's basin plans establish standards for ground waters in addition to surface waters.

Basin Plans are adopted and amended by Regional Water Boards under a structured process involving full public participation and state environmental review. Basin Plans and amendments thereto, do not become effective until approved by the State Water Resources Control Board (State Water Board). Regulatory provisions must be approved by the Office of Administrative Law. Adoption or revision of surface water standards are subject to the approval of the U.S. Environmental Protection Agency.

Basin Plans complement water quality control plans adopted by the State Water Board, such as the Water Quality Control Plans for Temperature Control and Ocean Waters. It is the intent of the State and Regional Water Boards to maintain the Basin Plans in an updated and readily available edition that reflects the current water quality control program.

This Basin Plan covers the entire Sacramento and San Joaquin River Basins. A separate Basin Plan covers the Tulare Lake Basin. The Basin Plan was first adopted in 1975. In 1989, a second edition was published. The second edition incorporated all the amendments which were adopted and approved since 1975, updated the Basin Plan to include new state policies and programs, restructured and edited the Basin Plan for clarity, and incorporated the results of triennial reviews conducted in 1984 and 1987. The Third Edition - 1994 incorporated all amendments approved between 1989 and 1994, included new state policies and programs, edited and restructured the Basin Plan to make it consistent with other regional and state plans, and substantively amended sections dealing with beneficial uses, objectives, and implementation programs.. The current edition (Fourth Edition - 1998) incorporates two new amendments approved since 1994. One amendment deals with compliance schedules in permits and the other addresses agricultural subsurface drainage discharges.

In this Basin Plan, "Regional Water Board" refers to the Central Valley Regional Water Quality Control Board and "State Water Board" refers to the State Water Resources Control Board.

BASIN DESCRIPTION

This Basin Plan covers the entire area included in the Sacramento and San Joaquin River drainage basins (see maps in pocket* and Figure II-1). The basins are bound by the crests of the Sierra Nevada on the east and the Coast Range and Klamath Mountains on the west. They extend some 400 miles from the California - Oregon border southward to the headwaters of the San Joaquin River.

*NOTE: The planning boundary between the San Joaquin River Basin and the Tulare Lake Basin follows the southern watershed boundaries of the Little Panoche Creek, Moreno Gulch, and Capita Canyon to boundary of the Westlands Water District. From here, the boundary follows the northern edge of the Westlands Water District until its intersection with the Firebuagh Canal Company's Main Lift Canal. The basin boundary then follows the Main Lift Canal to the Mendota Pool and continues eastward along the channel of the San Joaquin River to Millerton Lake in the Sierra Nevada foothills, and then follows along the southern boundary of the San Joaquin River drainage basin.

The Sacramento River and San Joaquin River Basins cover about one fourth of the total area of the State and over 30% of the State's irrigable land. The Sacramento and San Joaquin Rivers furnish roughly 51% of the State's water supply. Surface water from the two drainage basins meet and form the Delta, which ultimately drains to San Francisco Bay. Two major water projects, the Federal Central Valley Project and the State Water Project, deliver water from the Delta to Southern California, the San Joaquin Valley, Tulare Lake Basin, the San Francisco Bay area, as well as within the Delta boundaries.

The Delta is a maze of river channels and diked islands covering roughly 1,150 square miles, including 78 square miles of water area. The legal boundary of the Delta is described in Section 12220 of the Water Code (also see Figure III-1 of this Basin Plan).

Ground water is defined as subsurface water that occurs beneath the ground surface in fully saturated zones within soils and other geologic formations. Where ground water occurs in a saturated geologic unit that contains sufficient permeability and thickness to yield significant quantities of water to wells or springs, it can be defined as an aquifer (USGS, Water Supply Paper 1988, 1972). A ground water basin is defined as a hydrogeologic unit containing one large aquifer or several connected and interrelated aquifers (Todd, *Groundwater Hydrology*, 1980).

Major ground water basins underlie both valley floors, and there are scattered smaller basins in the foothill areas and mountain valleys. In many parts of the Region, usable ground waters occur outside of these currently identified basins. There are water-bearing geologic units within ground water basins in the Region that do not meet the definition of an aquifer. Therefore, for basin planning and regulatory purposes, the term "ground water" includes all subsurface waters that occur in fully saturated zones and fractures within soils and other geologic formations, whether or not these waters meet the definition of an aquifer or occur within identified ground water basins.

Sacramento River Basin

The Sacramento River Basin covers 27,210 square miles and includes the entire area drained by the Sacramento River. For planning purposes, this includes all watersheds tributary to the Sacramento River that are north of the Cosumnes River watershed. It also includes the closed basin of Goose Lake and drainage sub-basins of Cache and Putah Creeks.

The principal streams are the Sacramento River and its larger tributaries: the Pit, Feather, Yuba, Bear, and American Rivers to the east; and Cottonwood, Stony, Cache, and Putah Creeks to the west. Major reservoirs and lakes include Shasta, Oroville, Folsom, Clear Lake, and Lake Berryessa.

DWR Bulletin 118-80 identifies 63 ground water basins in the Sacramento watershed area. The Sacramento Valley floor is divided into 2 ground water basins. Other basins are in the foothills or mountain valleys. There are areas other than those identified in the DWR Bulletin with ground waters that have beneficial uses.

San Joaquin River Basin

The San Joaquin River Basin covers 15,880 square miles and includes the entire area drained by the San Joaquin River. It includes all watersheds tributary to

the San Joaquin River and the Delta south of the Sacramento River and south of the American River watershed. The southern planning boundary is described in the first paragraph of the previous page.

The principal streams in the basin are the San Joaquin River and its larger tributaries: the Cosumnes, Mokelumne, Calaveras, Stanislaus, Tuolumne, Merced, Chowchilla, and Fresno Rivers. Major reservoirs and lakes include Pardee, New Hogan, Millerton, McClure, Don Pedro, and New Melones.

DWR Bulletin 118-80 identifies 39 ground water basins in the San Joaquin watershed area. The San Joaquin Valley floor is divided into 15 separate ground water basins, largely based on political considerations. Other basins are in the foothills or mountain valleys. There are areas other than those identified in the DWR Bulletin with ground waters that have beneficial uses.

Grassland Watershed

The Grassland watershed is a valley floor sub-basin of the San Joaquin River Basin. The portion of the watershed for which agricultural subsurface drainage policies and regulations apply covers an area of approximately 370,000 acres and is bounded on the north by the alluvial fan of Orestimba Creek and by the Tulare Lake Basin to the south. The San Joaquin River forms the eastern boundary and Interstate Highway 5 forms the approximate western boundary. The San Joaquin River forms a wide flood plain in the region of the Grassland watershed.

The hydrology of the watershed has been irreversibly altered due to water projects and is presently governed by land uses. These uses are primarily, managed wetlands and agriculture. The wetlands form important waterfowl habitat for migratory waterfowl using the Pacific Flyway. The alluvial fans of the western and southern portions of the watershed contain salts and selenium which can be mobilized through irrigation practices and can impact beneficial uses of surface waters and wetlands if not properly regulated.

Lower San Joaquin River Watershed and Subareas

Technical descriptions of the Lower San Joaquin River (LSJR) and its component subareas are contained in Appendix 41. General descriptions follow: The LSJR watershed encompasses approximately 4,580 square miles in Merced County and portions of Fresno, Madera, San Joaquin, and Stanislaus counties. For planning purposes, the LSJR watershed is defined as the area draining to the San Joaquin River downstream of the Mendota Dam and upstream of the Airport Way Bridge near Vernalis, excluding the areas upstream of dams on the major Eastside reservoirs: New Don Pedro, New Melones, Lake McClure, and similar Eastside reservoirs in the LSJR system. The LSJR watershed excludes all lands within Calaveras, Tuolumne, San Benito, and Mariposa Counties. The LSJR watershed has been subdivided into seven major sub areas. In some cases major subareas have been further subdivided into minor subareas to facilitate more effective and focused water quality planning (Table I-1).

Table I-1 Lower San Joaquin River Subareas

Major Subareas		Minor Subareas	
1	LSJR upstream of Salt Slough	1a	Bear Creek
		1b	Fresno-Chowchilla
2	Grassland	-- --	
3	East Valley Floor	3a	Northeast Bank
		3b	North Stanislaus
		3c	Stevinson
		3d	Turlock Area
4	Northwest Side	4a	Greater Orestimba
		4b	Westside Creeks
		4c	Vernalis North
5	Merced River	-- --	
6	Tuolumne River	-- --	
7	Stanislaus River	-- --	

1. Lower San Joaquin River upstream of Salt Slough
This subarea drains approximately 1,480 square miles on the east side of the LSJR upstream of the Salt Slough confluence. The subarea includes the portions of the Bear Creek, Chowchilla River and Fresno River watersheds that are contained within Merced and Madera Counties. The northern boundary of the subarea generally abuts the Merced River Watershed. The western and southern boundaries follow the San Joaquin River from the Lander Avenue Bridge to Friant, except for the lands within the Columbia Canal Company, which are excluded. Columbia Canal Company lands are included in the Grassland Subarea. This subarea is composed of the following drainage areas:

1a. Bear Creek (effective drainage area)
This minor subarea is a 620 square mile subset of lands within the LSJR upstream of Salt Slough Subarea. The Bear Creek Minor Subarea is predominantly comprised of the portion of the Bear Creek Watershed that is contained within Merced County.

1b. Fresno-Chowchilla
The Fresno-Chowchilla Minor Subarea is comprised of approximately 860 square miles of land within the southern portion of the LSJR upstream of Salt Slough Subarea. This minor subarea is located in southeastern Merced County and western Madera County and contains the land area that drains into the LSJR between Sack Dam and the Bear Creek confluence, including the drainages of the Fresno and Chowchilla Rivers.

2. Grassland
The Grassland Subarea drains approximately 1,370 square miles on the west side of the LSJR in portions of Merced, Stanislaus, and Fresno Counties. This subarea includes the Mud Slough, Salt Slough, and Los Banos Creek watersheds. The eastern boundary of this subarea is generally formed by the LSJR between the Merced River confluence and the Mendota Dam. The Grassland Subarea extends across the LSJR, into the east side of the San Joaquin Valley, to include the lands within the Columbia Canal Company. The western boundary of the subarea generally follows the crest of the Coast Range with the exception of lands within San Benito County, which are excluded.

3. East Valley Floor
This subarea includes approximately 413 square miles of land on the east side of the LSJR that drains directly to the LSJR between the Airport Way Bridge near Vernalis and the Salt Slough confluence. The subarea is largely comprised of the land between the major east-side drainages of the Tuolumne, Stanislaus, and Merced Rivers. This subarea lies within central Stanislaus County and north-central Merced County. Numerous drainage canals, including the Harding Drain and natural drainages, drain this subarea. The subarea is comprised of the following minor subareas:

3a. Northeast Bank
This minor subarea of the East Valley Floor contains all of the land draining the east side of the San Joaquin River between the Maze Boulevard Bridge and the Crows Landing Road Bridge, except for the Tuolumne River subarea. The Northeast Bank covers approximately 123 square miles in central Stanislaus County.

3b. North Stanislaus
The North Stanislaus minor subarea is a subset of lands within the East Valley Floor Subarea. This minor subarea drains approximately 68 square miles of land between the Stanislaus and Tuolumne River watersheds that flows into the San Joaquin River between the Airport Way Bridge near Vernalis and the Maze Boulevard Bridge.

3c. Stevinson
This minor subarea of the East Valley Floor contains all of the land draining to the LSJR between the Merced River confluence and the Lander Avenue (Highway 165) Bridge. The Stevinson Minor Subarea occupies approximately 44 square miles in north-central Merced County.

3d. Turlock Area
This minor subarea of the East Valley Floor contains all of the land draining to the LSJR between the Crows Landing Road Bridge and the Merced River confluence. The Turlock Area Minor Subarea occupies approximately 178 square miles in south-central Stanislaus County and northern Merced County.

4. Northwest Side
This 574 square mile area generally includes the lands on the West side of the LSJR between the Airport Way Bridge near Vernalis and the Newman Waste way confluence. This subarea includes the entire drainage area of Orestimba, Del Puerto, and Hospital/Ingram Creeks. The subarea is primarily located in Western Stanislaus County except for a small area that extends into Merced County near the town of Newman and the Central California Irrigation District Main Canal.

4a. Greater Orestimba
The Greater Orestimba Minor Subarea is a 285 square mile subset of the Northwest Side Subarea located in southwest Stanislaus County and a small portion of western Merced County. It contains the entire Orestimba Creek watershed and the remaining area that drains into the LSJR from the west between the Crows Landing Road Bridge and the confluence of the Merced River, including Little Salad and Crow Creeks.

4b. Westside Creeks
This Minor Subarea is comprised of 277 square miles of the Northwest Side Subarea in western Stanislaus County. It consists of the areas that drain into the west side of the San Joaquin River between Maze Boulevard and Crows Landing Road, including the drainages of Del Puerto, Hospital, and Ingram Creeks.

4c. Vernalis North
The Vernalis North Minor Subarea is a 12 square mile subset of land within the most northern portion of the Northwest Side Subarea. It contains the land draining to the San Joaquin River from the west between the Maze

Boulevard Bridge and the Airport Way Bridge near Vernalis.

5. Merced River

This 294 square mile subarea is comprised of the Merced River watershed downstream of the Merced-Mariposa county line and upstream of the River Road Bridge. The Merced River subarea includes a 13-square-mile "island" of land (located between the East Valley Floor and the Tuolumne River Subareas) that is hydrologically connected to the Merced River by the Highline Canal.

6. Tuolumne River

This 294 square mile subarea is comprised of the Tuolumne River watershed downstream of the Stanislaus-Tuolumne county line, including the drainage of Turlock Lake, and upstream of the Shiloh Road Bridge.

7. Stanislaus River

This 157 square mile subarea is comprised of the Stanislaus River watershed downstream of the Stanislaus-Calaveras county line and upstream of Caswell State Park.

II. EXISTING AND POTENTIAL BENEFICIAL USES

Beneficial uses are critical to water quality management in California. State law defines beneficial uses of California's waters that may be protected against quality degradation to include (and not be limited to) "...domestic; municipal; agricultural and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves" (Water Code Section 13050(f)). Protection and enhancement of existing and potential beneficial uses are primary goals of water quality planning.

Significant points concerning the concept of beneficial uses are:

1. All water quality problems can be stated in terms of whether there is water of sufficient quantity or quality to protect or enhance beneficial uses.

2. Beneficial uses do not include all of the reasonable uses of water. For example, disposal of wastewaters is not included as a beneficial use. This is not to say that disposal of wastewaters is a prohibited use of waters of the State; it is merely a use which cannot be satisfied to the detriment of beneficial uses. Similarly, the use of water for the dilution of salts is not a beneficial use although it may, in some cases, be a reasonable and desirable use of water.

3. The protection and enhancement of beneficial uses require that certain quality and quantity objectives be met for surface and ground waters.

4. Fish, plants, and other wildlife, as well as humans, use water beneficially.

Beneficial use designation (and water quality objectives, see Chapter III) must be reviewed at least once during each three-year period for the purpose of modification as appropriate (40 CFR 131.20).

The beneficial uses, and abbreviations, listed below are standard basin plan designations.

Municipal and Domestic Supply (MUN) - Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.

Agricultural Supply (AGR) - Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation (including leaching of salts), stock watering, or support of vegetation for range grazing.

Industrial Service Supply (IND) - Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well repressurization.

Industrial Process Supply (PRO) - Uses of water for industrial activities that depend primarily on water quality.

Ground Water Recharge (GWR) - Uses of water for natural or artificial recharge of ground water for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.

Freshwater Replenishment (FRSH) - Uses of water for natural or artificial maintenance of surface water quantity or quality.

Navigation (NAV) - Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.

Hydropower Generation (POW) - Uses of water for hydropower generation.

Water Contact Recreation (REC-1) - Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

Non-contact Water Recreation (REC-2) - Uses of water for recreational activities involving proximity to water, but where there is generally no body contact with water, nor any likelihood of ingestion of water. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing,

or aesthetic enjoyment in conjunction with the above activities.

Commercial and Sport Fishing (COMM) - Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.

Aquaculture (AQUA) - Uses of water for aquaculture or mariculture operations including, but not limited to, propagation, cultivation, maintenance, or harvesting of aquatic plants and animals for human consumption or bait purposes.

Warm Freshwater Habitat (WARM) - Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Cold Freshwater Habitat (COLD) - Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Estuarine Habitat (EST) - Uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).

Wildlife Habitat (WILD) - Uses of water that support terrestrial or wetland ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats or wetlands, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

Preservation of Biological Habitats of Special Significance (BIOL) - Uses of water that support designated areas or habitats, such as established refuges, parks, sanctuaries, ecological reserves, or Areas of Special Biological Significance (ASBS), where the preservation or enhancement of natural resources requires special protection.

Rare, Threatened, or Endangered Species (RARE) - Uses of water that support aquatic habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened or endangered.

Migration of Aquatic Organisms (MIGR) - Uses of water that support habitats necessary for migration or other temporary activities by aquatic organisms, such as anadromous fish.

Spawning, Reproduction, and/or Early Development (SPWN) - Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.

Shellfish Harvesting (SHELL) - Uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters, and mussels) for human consumption, commercial, or sports purposes.

Surface Waters

Existing and potential beneficial uses which currently apply to surface waters of the basins are presented in Figure II-1 and Table II-1. The beneficial uses of any specifically identified water body generally apply to its tributary streams, except as provided below:

- MUN, COLD, MIGR and SPWN do not apply to Old Alamo Creek (Solano County) from its headwaters to the confluence with New Alamo Creek

- MUN and the human consumption of aquatic organisms do not apply to Sulphur Creek (Colusa County) from Schoolhouse Canyon to the confluence with Bear Creek

In some cases a beneficial use may not be applicable to the entire body of water. In these cases the Regional Water Board's judgment will be applied.

It should be noted that it is impractical to list every surface water body in the Region. For unidentified water bodies, the beneficial uses will be evaluated on a case-by-case basis.

Water Bodies within the basins that do not have beneficial uses designated in Table II-1 are assigned MUN designations in accordance with the provisions of State Water Board Resolution No. 88-63 which is, by reference, a part of this Basin Plan, except as provided below:

- Old Alamo Creek (Solano County) from its headwaters to the confluence with New Alamo Creek

- Sulphur Creek (Colusa County) from Schoolhouse Canyon to the confluence with Bear Creek

These MUN designations in no way affect the presence or absence of other beneficial use designations in these water bodies.

In making any exemptions to the beneficial use designation of MUN, the Regional Board will apply the exceptions listed in Resolution 88-63 (Appendix Item 8).

Ground Waters

Beneficial uses of ground waters of the basins are presented below. For the purposes of assigning beneficial uses, the term ground water is defined in Chapter I.

Unless otherwise designated by the Regional Water Board, all ground waters in the Region are considered as suitable or potentially suitable, at a minimum, for municipal and domestic water supply (MUN), agricultural supply (AGR), industrial service supply (IND), and industrial process supply (PRO).

In making any exceptions to the beneficial use designation of municipal and domestic supply (MUN), the Regional Water Board will apply the criteria in State Water Board Resolution No. 88-63, 'Sources of Drinking Water Policy'. The criteria for exceptions are:

- "The total dissolved solids (TDS) exceed 3,000 mg/l (5,000 &mhos/cm, electrical conductivity) and it is not reasonably expected by the Regional Water Board [for the ground water] to supply a public water system, or

- "There is contamination, either by natural processes or by human activity (unrelated to a specific pollution incident), that cannot reasonably be treated for domestic use using either Best Management Practices or best economically achievable treatment practices, or

- "The water source does not provide sufficient water to supply a single well capable of producing an average, sustained yield of 200 gallons per day, or

- "The aquifer is regulated as a geothermal energy producing source or has been exempted administratively pursuant to 40 CFR, Section 146.4 for the purpose of underground injection of fluids associated with the production of hydrocarbon or geothermal energy, provided that these fluids do not constitute a hazardous waste under 40 CFR Section 261.3."

To be consistent with State Water Board Resolution No. 88-63 in making exceptions to beneficial use designations other than municipal and domestic supply (MUN), the Regional Water Board will consider criteria for exceptions, parallel to Resolution No. 88-63 exception criteria, which would indicate limitations on those other beneficial uses as follows:

In making any exceptions to the beneficial use designation of agricultural supply (AGR), the Regional Water Board will consider the following criteria:

- There is pollution, either by natural processes or by human activity (unrelated to a specific pollution incident), that cannot reasonably be treated for agricultural use using either Best Management Practices or best economically achievable treatment practices, or

- The water source does not provide sufficient water to supply a single well capable of producing an average, sustained yield of 200 gallons per day, or

- The aquifer is regulated as a geothermal energy producing source or has been exempted administratively pursuant to 40 CFR, Section 146.4 for the purpose of underground injection of fluids associated with the production of hydrocarbon or geothermal energy, provided that these fluids do not constitute a hazardous waste under 40 CFR Section 261.3.

In making any exceptions to the beneficial use designation of industrial supply (IND or PRO), the Regional Water Board will consider the following criteria:

- There is pollution, either by natural processes or by human activity (unrelated to a specific pollution incident), that cannot reasonably be treated for industrial use using either Best Management Practices or best economically achievable treatment practices, or

- The water source does not provide sufficient water to supply a single well capable of producing an average, sustained yield of 200 gallons per day.

FIGURE II-1

SURFACE WATER BODIES AND BENEFICIAL USES

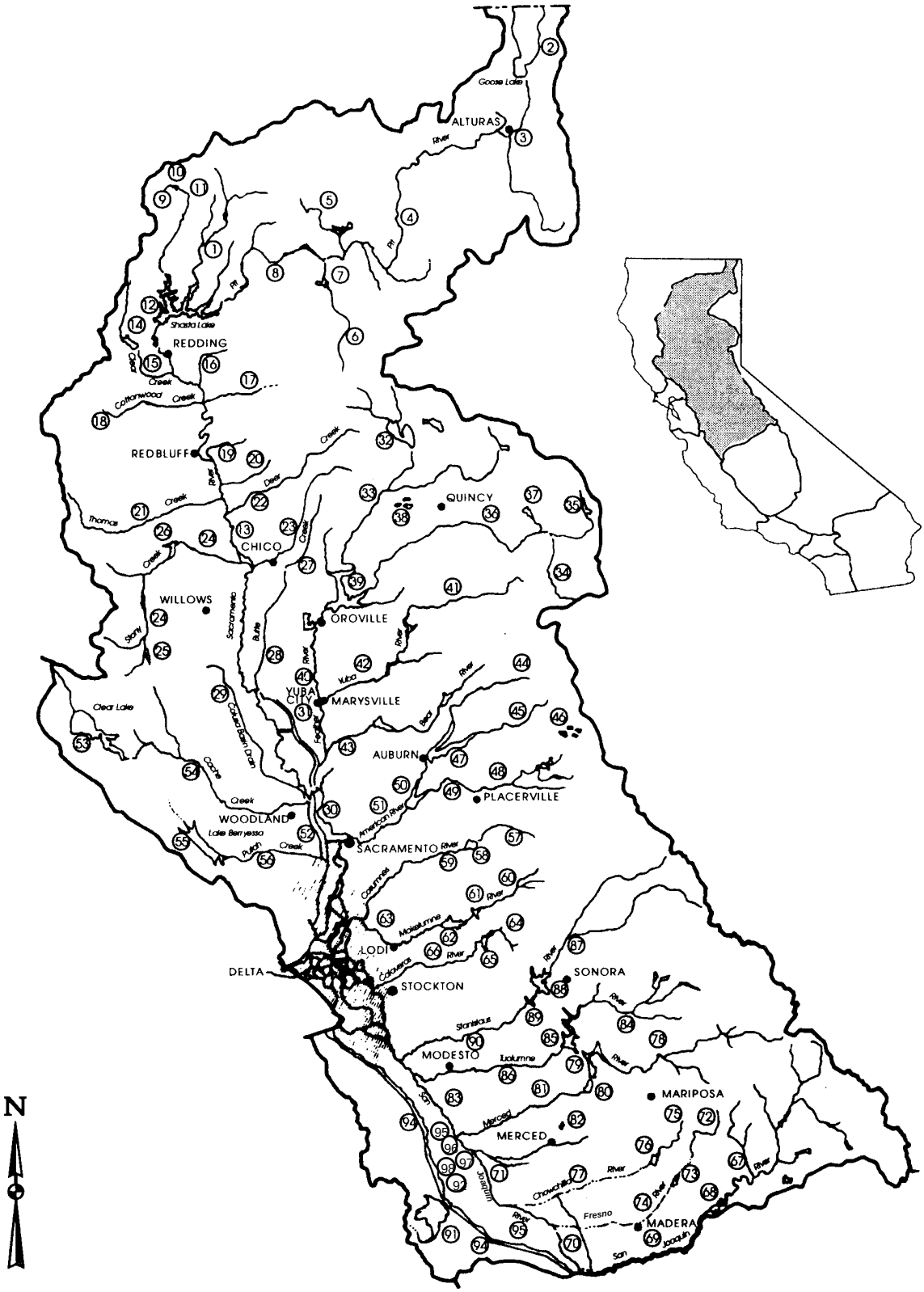

TABLE II-1

SURFACE WATER BODIES AND BENEFICIAL USES

	SURFACE WATER BODIES (1)	HYDRO UNIT NUMBER	MUN	AGRI-CULTURE		INDUSTRY			RECREATION			FRESHWATER HABITAT (2)		MIGRATION		SPAWNING		WILD	NAV
				AGR		PROC	IND	POW	REC-1		REC-2	WARM	COLD	MIGR		SPWN		WILD	NAV
			MUNICIPAL AND DOMESTIC SUPPLY	IRRIGATION	STOCK WATERING	PROCESS	SERVICE SUPPLY	POWER	CONTACT	CANOEING (1) AND RAFTING	OTHER NONCONTACT	WARM	COLD	WARM (3)	COLD (4)	WARM (3)	COLD (4)	WILDLIFE HABITAT	NAVIGATION
1	McCLOUD RIVER	505.	E					E	E	P	E		E				E	E	
2	GOOSE LAKE	527.20		E	E				E		E	E	E					E	
	PIT RIVER																		
3	NORTH FORK, SOUTH FORK, PIT RIVER	526.00	E	E	E				E	P	E	E	E			E	E	E	
4	CONFLUENCE OF FORKS TO HAT CREEK	526.35	E	E	E			E	E	E	E	E	E			E		E	
5	FALL RIVER	526.41	E	E	E			E	E	E	E	E	E					E	
6	HAT CREEK	526.30		E				E	E		E	E	E				E	E	
7	BAUM LAKE	526.34						E	E		E		E				P	E	
8	MOUTH OF HAT CREEK TO SHASTA LAKE	526.	E	E	E			E	E	E	E	P	E			E	E	E	
	SACRAMENTO RIVER																		
9	SOURCE TO BOX CANYON RESERVOIR	525.22		E	E				E		E		E					E	
10	LAKE SISKIYOU	525.22							E		E	E	E				P	E	
11	BOX CANYON DAM TO SHASTA LAKE	525.2		E	E				E	E	E		E				E	E	
12	SHASTA LAKE	506.10	E	E				E	E		E	E	E			E	E	E	
13	SHASTA DAM TO COLUSA BASIN DRAIN		E	E	E		E	E	E	E	E	E	E	E	E	E	E	E	E
14	WHISKEY TOWN RESERVOIR	524.61	E	E	E			E	E		E	E	E			E		E	
15	CLEAR CREEK BELOW WHISKEYTOWN RESERVOIR	524.62	E	E	E				E	E	E	E	E		E	E	E	E	
16	COW CREEK	507.3	P	E	E			E	E	P	E		E		E	E	E	E	
17	BATTLE CREEK	507.12		E	E			E	E	E	E	E	E		E	E	E	E	
18	COTTONWOOD CREEK	524.3	E	E	E	P	P	P	E	E	E	E	E		E	E	E	E	
19	ANTELOPE CREEK	509.63	E	E	E				E		E	E	E		E	E	E	E	
20	MILL CREEK	509.42	E	E	E				E		E	E	E		E	E	E	E	
21	THOMES CREEK	523.10		E	E			P	E		E	E	E		E	E	E	E	
22	DEER CREEK	509.20	E	E	E				E	E	E	E	E		E	E	E	E	
23	BIG CHICO CREEK	509.14		E	E				E	E	E	E	E		E	E	E	E	
24	STONY CREEK	522.00		E	E				E	E	E	E	P		E	E	E	E	
25	EAST PARK RESERVOIR	522.33							E		E	E	P			E		E	
26	BLACK BUTTE RESERVOIR	522.12		E	E				E		E	E				E		E	
	BUTTE CREEK																		
27	SOURCES TO CHICO	521.30	E	E	E			E	E			E	E		E	E	E	E	
28	BELOW CHICO, INCLUDING BUTTE SLOUGH	520.40		E	E				E	E		E	E		E	E		E	
29	COLUSA BASIN DRAIN	520.21		E	E				E	E		E	P	E		E		E	

LEGEND
E = EXISTING BENEFICIAL USES
P = POTENTIAL BENEFICIAL USES
L = EXISTING LIMITED BENEFICIAL USE

NOTE:
Surface waters with the beneficial uses of Groundwater Recharge (GWR), Freshwater Replenishment (FRSH), and Preservation of Rare and Endangered Species (RARE) have not been identified in this plan. Surface waters of the Sacramento and San Joaquin River Basins falling within these beneficial use categories will be identified in the future as part of the continuous planning process to be conducted by the State Water Resources Control Board.

SURFACE WATER BODIES AND BENEFICIAL USES

	SURFACE WATER BODIES (1)	HYDRO UNIT NUMBER	MUN	AGRI-CULTURE		INDUSTRY			RECREATION			FRESHWATER HABITAT (2)		MIGRATION		SPAWNING		WILD	NAV
			MUN	AGR		PROC	IND	POW	REC-1		REC-2	WARM	COLD	MIGR		SPWN		WILD	NAV
			MUNICIPAL AND DOMESTIC SUPPLY	IRRIGATION	STOCK WATERING	PROCESS	SERVICE SUPPLY	POWER	CONTACT	CANOEING (1) AND RAFTING	OTHER NONCONTACT	WARM	COLD	WARM (3)	COLD (4)	WARM (3)	COLD (4)	WILDLIFE HABITAT	NAVIGATION
30	COLUSA BASIN DRAIN TO EYE ["I"] STREET BRIDGE	520.00	E	E					E	E	E	E	E	E	E	E	E	E	E
31	SUTTER BYPASS	520.3		E					E			E			E		E	E	
	FEATHER RIVER																		
32	LAKE ALMANOR	518.41						E	E			E	E			E		E	
33	NORTH FORK, FEATHER RIVER	518.4	E					E	E	E	E		E				E	E	
	MIDDLE FORK, FEATHER RIVER	518.3																	
34	SOURCE TO LITTLE LAST CHANCE CREEK	518.35		E	E				E	E	E	E	E				E	E	
35	FRENCHMAN RESERVOIR	518.36							E		E	P	E				E	E	
36	LITTLE LAST CHANCE CREEK TO LAKE OROVILLE	518.3	E						E	E	E	E	E				E	E	
37	LAKE DAVIS	518.34							E		E	P	E				E	E	
38	LAKES BASIN LAKES	518.5							E		E		E				E	E	
39	LAKE OROVILLE	518.12	E	E				E	E		E	E	E			E	E	E	
40	FISH BARRIER DAM TO SACRAMENTO RIVER	515.	E	E					E	E	E	E	E	E	E	E	E	E	
	YUBA RIVER																		
41	SOURCES TO ENGLEBRIGHT RESERVOIR	517.	E	E	E			E	E	E	E		E				E	E	
42	ENGLEBRIGHT DAM TO FEATHER RIVER	515.3		E	E			E	E	E	E	E	E	E	E	E	E	E	
43	BEAR RIVER	515.1	E	E	E			E	E	E	E	E	E	P	P	P	P	E	
	AMERICAN RIVER																		
44	NORTH FORK, SOURCE TO FOLSOM LAKE	514.5	E	E					E	E	E	P	E				E	E	
45	MIDDLE FORK, SOURCE TO FOLSOM LAKE	514.4	E	E	E			E	E	E	E	P	E				E	E	
46	DESOLATION VALLEY LAKES	514.4							E		E		E				E	E	
	SOUTH FORK	514.3																	
48	SOURCE TO PLACERVILLE	514.3	E					E	E	E	E	P	E				E	E	
49	PLACERVILLE TO FOLSOM LAKE	514.32	E	E				E	E	E	E	E	E					E	
50	FOLSOM LAKE	514.23	E	E			P	E	E		E	E	E			E		E	
51	FOLSOM DAM TO SACRAMENTO RIVER	519.21	E	E			E	E	E	E	E	E	E	E	E	E	E	E	
52	YOLO BYPASS (8)	510.		E	E				E		E	E	P	E	E	E		E	
	CACHE CREEK																		
53	CLEAR LAKE (a)	513.52	E	E	E				E		E	E	P			E		E	
54	CLEAR LAKE TO YOLO BYPASS (d)	511/513	E	E	E	E	E		E	E	E	E	P			E	E	E	

(1) Shown for streams and rivers only with the implication that certain flows are required for this beneficial use.
(2) Resident does not include anadromous. Any Segments with both COLD and WARM beneficial use designations will be considered COLD water bodies for the application of water quality objectives.
(3) Striped bass, sturgeon, and shad.
(4) Salmon and steelhead
(5) As a primary beneficial use.

(a) The following beneficial uses EXIST in addition to those noted in Table II-1

Mud Slough (north): COMM and SHELL
Salt Slough: COMM, BIOL, and SHELL
Wetland Water Supply Channels: BIOL
Clear Lake: COMM

(6) The indicated beneficial uses are to be protected for all waters except in specific cases where evidence indicates the appropriateness of additional or alternative beneficial use designations.
(7) Sport fishing is the only recreation activity permitted.
(8) Beneficial uses vary throughout the Delta and will be evaluated on a case-by-case basis. COMM is a designated beneficial use for the Sacramento San Joaquin Delta and Yolo Bypass waterways listed in Appendix 43 and not any tributaries to the listed waterways or portions of the listed waterways outside of the legal Delta boundary unless specifically designated.

(d) In addition to the beneficial uses noted in Table II-1, COMM exists for Cache Creek from Clear Lake to Yolo Bypass and in the following tributaries only: North Fork Cache Creek and Bear Creek.

(9) Per State Water Board Resolution No. 90-28, Marsh Creek and Marsh Creek Reservoir in Contra Costa County are assigned the following beneficial uses: REC1 and REC2 (potential uses), WARM, WILD and RARE. COMM is a designated beneficial use for Marsh Creek and its tributaries listed in Appendix 43 within the legal Delta boundary.

A/ Hidden Reservoir = Hensley Lake
B/ Buchanan Reservoir = Eastman Lake

SURFACE WATER BODIES AND BENEFICIAL USES

	SURFACE WATER BODIES (1)	HYDRO UNIT NUMBER	MUN	AGRI-CULTURE		INDUSTRY			RECREATION			FRESHWATER HABITAT (2)		MIGRATION		SPAWNING		WILD	NAV
				AGR		PROC	IND	POW	REC-1		REC-2	WARM	COLD	MIGR		SPWN		WILD	NAV
			MUNICIPAL AND DOMESTIC SUPPLY	IRRIGATION	STOCK WATERING	PROCESS	SERVICE SUPPLY	POWER	CONTACT	CANOEING (1) AND RAFTING	OTHER NONCONTACT	WARM	COLD	WARM (3)	COLD (4)	WARM (3)	COLD (4)	WILDLIFE HABITAT	NAVIGATION
	PUTAH CREEK																		
55	LAKE BERRYESSA	512.21	E	E	E			P	E		E	E	E			E		E	
56	LAKE BERRYESSA TO YOLO BYPASS	510/511	E	E	E				E	E	E	E	P			E		E	
	OTHER LAKES AND RESERVOIRS IN SACRAMENTO R. BASIN 5A (6)		E	E	E	E		E	E		E	E	E				E	E	
	COSUMNES RIVER																		
57	SOURCES TO NASHVILLE RESERVOIR (PROPOSED)	532.	E	E					E		E		E				E	E	
58	NASHVILLE RESERVOIR (PROPOSED)	532.	P					P	P		P	P	P	P		P	P	P	
59	SOURCE TO DELTA	531/532	E	E	E				E	E	E	E	E	E	E	E	E	E	
	MOKELUMNE RIVER																		
60	SOURCES TO PARDEE RESERVOIR	532.6	E					E	E	E	E	E	E	E		E	E	E	
61	PARDEE RESERVOIR (7)	532.6	E					E	E		E	E	E			E	E	E	
62	CAMANCHE RESERVOIR	531.2	E	E	E				E		E	E	E	E		E	E	E	
63	CAMANCHE RESERVOIR TO DELTA	531.2		E	E				E	E	E	E	E	E	E	E	E	E	
	CALAVERAS RIVER																		
64	SOURCE TO NEW HOGAN RESERVOIR	533.							E	E	E	E	E	E		E	E	E	
65	NEW HOGAN RESERVOIR	533.1							E		E	E	E	E		E	E	E	
66	NEW HOGAN RESERVOIR TO DELTA	531.3	E	E	E	P	P		E	E	E	E	E	E	E	E	E	E	
	OTHER LAKES AND RESERVOIRS IN HYDRO UNIT NOS. 531, 532, 533, 543, 544 (6)		E	E	E	E		E	E		E	E	E				E	E	
	SAN JOAQUIN RIVER																		
67	SOURCES TO MILLERTON LAKE	540.	E	E	E			E	E	E	E	E	E					E	
68	MILLERTON LAKE	540.12	P	E	E				E		E	E	P					E	
69	FRIANT DAM TO MENDOTA POOL	545.	E	E	E	E			E	E	E	E	E	E	E	E	P	E	
70	MENDOTA DAM TO SACK DAM	545.1	P	E	E	E			E	E	E	E		E	E	E	P	E	
71	SACK DAM TO MOUTH OF MERCED RIVER	535.7	P	E	E	E			E	E	E	E		E	E	E	P	E	
	FRESNO RIVER																		
72	SOURCE TO HIDDEN RESERVOIR A/	539.31	E	E	E				E		E	E	E					E	
73	HIDDEN RESERVOIR A/	539.32	E		E				E		E	E						E	
74	HIDDEN RESERVOIR TO SAN JOAQUIN RIVER	545.	P	E	E				E	P	E	E						E	
	CHOWCHILLA RIVER																		
75	SOURCE TO BUCHANAN RESERVOIR B/	539.11							E		E	E	E					E	
76	BUCHANAN RESERVOIR B/	539.12	E	E	E				E		E	E						E	
77	BUCHANAN DAM TO SAN JOAQUIN RIVER	535/545	P	E		E			E	P	E	E						E	

(1) Shown for streams and rivers only with the implication that certain flows are required for this beneficial use.
(2) Resident does not include anadromous. Any Segments with both COLD and WARM beneficial use designations will be considered COLD water bodies for the application of water quality objectives.
(3) Striped bass, sturgeon, and shad.
(4) Salmon and steelhead
(5) As a primary beneficial use.

(6) The indicated beneficial uses are to be protected for all waters except in specific cases where evidence indicates the appropriateness of additional or alternative beneficial use designations.
(7) Sport fishing is the only recreation activity permitted.
(8) Beneficial uses vary throughout the Delta and will be evaluated on a case-by-case basis. COMM is a designated beneficial use for the Sacramento San Joaquin Delta and Yolo Bypass waterways listed in Appendix 43 and not any tributaries to the listed waterways or portions of the listed waterways outside of the legal Delta boundary unless specifically designated.

(9) Per State Water Board Resolution No. 90-28, Marsh Creek and Marsh Creek Reservoir in Contra Costa County are assigned the following beneficial uses: REC1 and REC2 (potential uses), WARM, WILD and RARE. COMM is a designated beneficial use for Marsh Creek and its tributaries listed in Appendix 43 within the legal Delta boundary.

A/ Hidden Reservoir = Hensley Lake
B/ Buchanan Reservoir = Eastman Lake

SURFACE WATER BODIES AND BENEFICIAL USES

	SURFACE WATER BODIES (1)	HYDRO UNIT NUMBER	MUN	AGRI-CULTURE		INDUSTRY			RECREATION			FRESHWATER HABITAT (2)		MIGRATION		SPAWNING		WILD	NAV
				AGR		PROC	IND	POW	REC-1		REC-2	WARM	COLD	MIGR		SPWN		WILD	NAV
			MUNICIPAL AND DOMESTIC SUPPLY	IRRIGATION	STOCK WATERING	PROCESS	SERVICE SUPPLY	POWER	CONTACT	CANOEING (1) AND RAFTING	OTHER NONCONTACT	WARM	COLD	WARM (3)	COLD (4)	WARM (3)	COLD (4)	WILDLIFE HABITAT	NAVIGATION
	MERCED RIVER																		
78	SOURCE TO McCLURE LAKE	537.	P	E				E	E	E	E	E	E					E	
79	McCLURE LAKE	537.22	P	E				E	E		E	E	E					E	
80	McSWAIN RESERVOIR	537.1	P	E				E	E		E	E	E					E	
81	McSWAIN RESERVOIR TO SAN JOAQUIN RIVER	535.	E		E	E	E	E	E	E	E	E	E	E	E	E	E	E	
82	YOSEMITE LAKE	535.9							E		E	E	E					E	
83	MOUTH OF MERCED RIVER TO VERNALIS	535/541	P	E	E	E			E	E	E	E		E	E	E		E	
	TUOLUMNE RIVER																		
84	SOURCE TO [NEW] DON PEDRO RESERVOIR	536.	E	E	E			E	E	E	E	E	E					E	
85	NEW DON PEDRO RESERVOIR	536.32	P					E	E		E	E	E					E	
86	NEW DON PEDRO DAM TO SAN JOAQUIN RIVER	535.	P	E	E				E	E	E	E	E		E	E	E	E	
	STANISLAUS RIVER																		
87	SOURCE TO NEW MELONES RESERVOIR (PROPOSED)	534.	E	E	E			E	E	E	E	E	E					E	
88	NEW MELONES RESERVOIR	534.21	E	E	E			E	E		E		E					E	
89	TULLOCH RESERVOIR	534.22	P	E	E			E	E		E	E						E	
90	GOODWIN DAM TO SAN JOAQUIN RIVER	535.	P	E	E	E	E	E	E	E	E	E	E		E	E	E	E	
91	SAN LUIS RESERVOIR	542.32	E	E	E		E	E	E		E	E						E	
92	O'NEILL RESERVOIR	541.2	E	E	E				E		E	E							
93	OTHER LAKES AND RESERVOIRS IN SAN JOAQUIN R. BASIN, (EXCLUDING HYDRO UNIT NOS. 531-533, 543, 544) (6)		E					E	E		E	E	E				E	E	
94	CALIFORNIA AQUEDUCT	541.	E	E	E	E	E	E	E		E							E	
95	DELTA-MENDOTA CANAL	541/543	E	E	E				E		E	E						E	
	GRASSLAND WATERSHED [a]	541.2																	
96	MUD SLOUGH (NORTH)			L (b)	E				E		E	E				E		E	
97	SALT SLOUGH			E	E				E		E	E				E		E	
98	WETLAND WATER SUPPLY CHANNELS (10)			L (b)	E							L (c)						E	
C	SACRAMENTO SAN JOAQUIN DELTA (8, 9)	544.	E	E	E	E	E		E		E	E	E	E	E	E		E	E

(1) Shown for streams and rivers only with the implication that certain flows are required for this beneficial use.
(2) Resident does not include anadromous. Any Segments with both COLD and WARM beneficial use designations will be considered COLD water bodies for the application of water quality objectives.
(3) Striped bass, sturgeon, and shad.
(4) Salmon and steelhead
(5) As a primary beneficial use.

(6) The indicated beneficial uses are to be protected for all waters except in specific cases where evidence indicates the appropriateness of additional or alternative beneficial use designations.
(7) Sport fishing is the only recreation activity permitted.
(8) Beneficial uses vary throughout the Delta and will be evaluated on a case-by-case basis. COMM is a designated beneficial use for the Sacramento San Joaquin Delta and Yolo Bypass waterways listed in Appendix 43 and not any tributaries to the listed waterways or portions of the listed waterways outside of the legal Delta boundary unless specifically designated.

(9) Per State Water Board Resolution No. 90-28, Marsh Creek and Marsh Creek Reservoir in Contra Costa County are assigned the following beneficial uses: REC1 and REC2 (potential uses), WARM, WILD and RARE. COMM is a designated beneficial use for Marsh Creek and its tributaries listed in Appendix 43 within the legal Delta boundary.
(10) Wetland water supply channels for which beneficial uses are designated are defined in Appendix 40

(a) The following beneficial uses EXIST in addition to those noted in Table II-1

Mud Slough (north): COMM and SHELL
Salt Slough: COMM, BIOL, and SHELL
Wetland Water Supply Channels: BIOL
Clear Lake: COMM

(b) Elevated natural salt and boron concentrations may limit this use to irrigation of salt and boron tolerant crops. Intermittent low flow conditions may also limit this use.

(c) Wetland channels can sustain aquatic life, but due to fluctuating flow regimes and habitat limitations, may not be suitable for nesting and/or propagation.

III. WATER QUALITY OBJECTIVES

The Porter-Cologne Water Quality Control Act defines water quality objectives as "...the limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area" [Water Code Section 13050(h)]. It also requires the Regional Water Board to establish water quality objectives, while acknowledging that it is possible for water quality to be changed to some degree without unreasonably affecting beneficial uses. In establishing water quality objectives, the Regional Water Board must consider, among other things, the following factors:

- Past, present, and probable future beneficial uses;
- Environmental characteristics of the hydrographic unit under consideration, including the quality of water available thereto;
- Water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area;
- Economic considerations;
- The need for developing housing within the region;
- The need to develop and use recycled water. (Water Code Section 13241)

The Federal Clean Water Act requires a state to submit for approval of the Administrator of the U.S. Environmental Protection Agency *(USEPA)* all new or revised water quality standards which are established for surface and ocean waters. As noted earlier, California water quality standards consist of both beneficial uses (identified in Chapter II) and the water quality objectives based on those uses.

There are **seven important points** that apply to water quality objectives.

The **first point** is that water quality objectives can be revised through the basin plan amendment process. Objectives may apply region-wide or be specific to individual water bodies or parts of water bodies. Site-specific objectives may be developed whenever the Regional Water Board believes they are appropriate. As indicated previously, federal regulations call for each state to review its water quality standards at least every three years. These Triennial Reviews provide one opportunity to evaluate changing water quality objectives, because they begin with an identification of potential and actual water quality problems, i.e., beneficial use impairments. Since impairments may be associated with water quality objectives being exceeded, the Regional Water Board uses the results of the Triennial Review to implement actions to assess, remedy, monitor, or otherwise address the impairments, as appropriate, in order to achieve objectives and protect beneficial uses. If a problem is found to occur because, for example, a water quality objective is too weak to protect beneficial uses, the Basin Plan should be amended to make the objective more stringent. (Better enforcement of the water quality objectives or adoption of certain policies or redirection of staff and resources may also be proper responses to water quality problems. See the Implementation chapter for further discussion.)

Changes to the objectives can also occur because of new scientific information on the effects of specific constituents. A major source of information is the USEPA which develops data on the effects of chemical and other constituent concentrations on particular aquatic species and human health. Other information sources for data on protection of beneficial uses include the National Academy of Science which has published data on bioaccumulation and the Federal Food and Drug Administration which has issued criteria for unacceptable levels of chemicals in fish and shellfish used for human consumption. The Regional Water Board may make use of those and other state or federal agency information sources in assessing the need for new water quality objectives.

The **second point** is that achievement of the objectives depends on applying them to controllable water quality factors. *Controllable water quality factors* are those actions, conditions, or circumstances resulting from human activities that may influence the quality of the waters of the State, that are subject to the authority of the State Water Board or the Regional Water Board, and that may be reasonably controlled. Controllable factors are not allowed to cause further degradation of water quality in instances where uncontrollable factors have

already resulted in water quality objectives being exceeded. The Regional Water Board recognizes that man made changes that alter flow regimes can affect water quality and impact beneficial uses.

The **third point** is that objectives are to be achieved primarily through the adoption of waste discharge requirements (including permits) and cleanup and abatement orders. When adopting requirements and ordering actions, the Regional Water Board considers the potential impact on beneficial uses within the area of influence of the discharge, the existing quality of receiving waters, and the appropriate water quality objectives. It can then make a finding as to the beneficial uses to be protected within the area of influence of the discharge and establish waste discharge requirements to protect those uses and to meet water quality objectives. The objectives contained in this plan, and any State or Federally promulgated objectives applicable to the basins covered by the plan, are intended to govern the levels of constituents and characteristics in the main water mass unless otherwise designated. They may not apply at or in the immediate vicinity of effluent discharges, but at the edge of the *mixing zone* if areas of dilution or criteria for diffusion or dispersion are defined in the waste discharge specifications.

The **fourth point** is that the Regional Water Board recognizes that immediate compliance with water quality objectives adopted by the Regional Water Board or the State Water Board, or with water quality criteria adopted by the USEPA, may not be feasible in all circumstances. Where the Regional Water Board determines it is infeasible for a discharger to comply immediately with such objectives or criteria, compliance shall be achieved in the shortest practicable period of time (determined by the Regional Water Board), not to exceed ten years after the adoption of applicable objectives or criteria. This policy shall apply to water quality objectives and water quality criteria adopted after the effective date of this amendment to the Basin Plan [25 September 1995].

The **fifth point** is that in cases where water quality objectives are formulated to preserve historic conditions, there may be insufficient data to determine completely the temporal and hydrologic variability representative of historic water quality. When violations of such objectives occur, the Regional Water Board judges the reasonableness of achieving those objectives through regulation of the controllable factors in the areas of concern.

The **sixth point** is that the State Water Board adopts policies and plans for water quality control which can specify water quality objectives or affect their implementation. Chief among the State Water Board's policies for water quality control is State Water Board Resolution No. 68-16 (Statement of Policy with Respect to Maintaining High Quality of Waters in California). It requires that wherever the existing quality of surface or ground waters is better than the objectives established for those waters in a basin plan, the existing quality will be maintained unless as otherwise provided by Resolution No. 68-16 or any revisions thereto. This policy and others establish general objectives. The State Water Board's water quality control plans applicable to the Sacramento and San Joaquin River Basins are the Thermal Plan and Water Quality Control Plan for Salinity. The Thermal Plan and its water quality objectives are in the Appendix. The Water Quality Control Plan for Salinity water quality objectives are listed as Table III-5. The State Water Board's plans and policies that the Basin Plan must conform to are addressed in Chapter IV, Implementation.

The **seventh point** is that water quality objectives may be in numerical or narrative form. The enumerated milligram-per-liter (mg/l) limit for copper is an example of a numerical objective; the objective for color is an example of a narrative form.

Information on the application of water quality objectives is contained in the section, *Policy for Application of Water Quality Objectives*, in Chapter IV.

WATER QUALITY OBJECTIVES FOR INLAND SURFACE WATERS

The objectives below are presented by categories which, like the Beneficial Uses of Chapter II, were standardized for uniformity among the Regional Water Boards. The water quality objectives apply to all surface waters in the Sacramento and San Joaquin River Basins, including the Delta, or as noted. *(The legal boundary of the Delta is contained in Section 12220 of the Water Code and identified in Figure III-1.)* The numbers in parentheses following specific water bodies are keyed to Figure II-1.

Bacteria

In waters designated for contact recreation (REC-1), the fecal coliform concentration based on a minimum of not less than five samples for any 30-day period shall not exceed a geometric mean of 200/100 ml, nor shall more than ten percent of the total number of samples taken during any 30-day period exceed 400/100 ml.

For Folsom Lake (50), the fecal coliform concentration based on a minimum of not less than five samples for any 30-day period, shall not exceed a geometric mean of 100/100 ml, nor shall more than ten percent of the total number of samples taken during any 30-day period exceed 200/100 ml.

Biostimulatory Substances

Water shall not contain biostimulatory substances which promote aquatic growths in concentrations that cause nuisance or adversely affect beneficial uses.

Chemical Constituents

Waters shall not contain chemical constituents in concentrations that adversely affect beneficial uses. The chemical constituent objectives in Table III-1 apply to the water bodies specified. Metal objectives in the table are dissolved concentrations. Selenium, molybdenum, and boron objectives are total concentrations. Water quality objectives are also contained in the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta, adopted by the State Water Board in May 1995 and revised in 2006.

At a minimum, water designated for use as domestic or municipal supply (MUN) shall not contain concentrations of chemical constituents in excess of the maximum contaminant levels (MCLs) specified in the following provisions of Title 22 of the California Code of Regulations, which are incorporated by reference into this plan: Tables 64431-A (Inorganic Chemicals) and 64431-B (Fluoride) of Section 64431, Table 64444-A (Organic Chemicals) of Section 64444, and Tables 64449-A (Secondary Maximum Contaminant Levels-Consumer Acceptance Limits) and 64449-B (Secondary Maximum Contaminant Levels-Ranges) of Section 64449. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect. At a minimum, water designated for use as domestic or municipal supply (MUN) shall not contain lead in excess of 0.015 mg/l. The Regional Water Board acknowledges that specific treatment requirements are imposed by state and federal drinking water regulations on the consumption of surface waters under specific circumstances. To protect all beneficial uses the Regional Water Board may apply limits more stringent than MCLs.

TABLE III-1
TRACE ELEMENT WATER QUALITY OBJECTIVES

CONSTITUENT	MAXIMUM CONCENTRATION [a] (mg/l)	APPLICABLE WATER BODIES
Arsenic	0.01	Sacramento River from Keswick Dam to the I Street Bridge at City of Sacramento (13, 30); American River from Folsom Dam to the Sacramento River (51); Folsom Lake (50); and the Sacramento-San Joaquin Delta.
Barium	0.1	As noted above for Arsenic.
Boron	2.0 (15 March through 15 September) 0.8 (monthly mean, 15 March through 15 September)	San Joaquin River, mouth of the Merced River to Vernalis
	2.6 (16 September through 14 March) 1.0 (monthly mean, 16 September through 14 March)	
	1.3 (monthly mean, critical year[b])	
	5.8 2.0 (monthly mean, 15 March through 15 September)	Salt Slough, Mud Slough (north), San Joaquin River from Sack Dam to the mouth of Merced River
Cadmium	0.00022 [c]	Sacramento River and its tributaries above State Hwy 32 bridge at Hamilton City

TABLE III-1 TRACE ELEMENT
WATER QUALITY OBJECTIVES (Continued)

CONSTITUENT	MAXIMUM CONCENTRATION [a] (mg/l)	APPLICABLE WATER BODIES
Copper	0.0056 [c]	As noted above for Cadmium.
	0.01 [d]	As noted above for Arsenic. [d]
Cyanide	0.01	As noted above for Arsenic.
Iron	0.3	As noted above for Arsenic.
Manganese	0.05	As noted above for Arsenic.
Molybdenum	0.015 0.010 (monthly mean)	San Joaquin River, mouth of the Merced River to Vernalis
	0.050 0.019 (monthly mean)	Salt Slough, Mud Slough (north), San Joaquin River from Sack Dam to the mouth of Merced River
Selenium	0.012 0.005 (4-day average)	San Joaquin River, mouth of the Merced River to Vernalis
	0.020 0.005 (4-day average)	Mud Slough (north), and the San Joaquin River from Sack Dam to the mouth of Merced River
	0.020 0.002 (monthly mean)	Salt Slough and constructed and re-constructed water supply channels in the Grassland watershed listed in Appendix 40.
Silver	0.01	As noted above for Arsenic.
Zinc	0.1 [d]	As noted above for Arsenic. [d]
	0.016 [c]	As noted above for Cadmium.

a Metal objectives in this table are dissolved concentrations. Selenium, molybdenum, and boron objectives are total concentrations.

b See Table IV-3.

c The effects of these concentrations were measured by exposing test organisms to dissolved aqueous solutions of 40 mg/l hardness that had been filtered through a 0.45 micron membrane filter. Where deviations from 40 mg/l of water hardness occur, the objectives, in mg/l, shall be determined using the following formulas:

$$Cu = e^{(0.905)(\ln \text{hardness}) - 1.612} \times 10^{-3}$$

$$Zn = e^{(0.830)(\ln \text{hardness}) - 0.289} \times 10^{-3}$$

$$Cd = e^{(1.160)(\ln \text{hardness}) - 5.777} \times 10^{-3}$$

d Does not apply to Sacramento River above State Hwy. 32 bridge at Hamilton City. See relevant objectives (*) above.

Color

Water shall be free of discoloration that causes nuisance or adversely affects beneficial uses.

Dissolved Oxygen

Within the legal boundaries of the Delta, the dissolved oxygen concentration shall not be reduced below:

> 7.0 mg/l in the Sacramento River (below the I Street Bridge) and in all Delta waters west of the Antioch Bridge; 6.0 mg/l in the San Joaquin River (between Turner Cut and Stockton, 1 September through 30 November); and 5.0 mg/l in all other Delta waters except for those bodies of water which are constructed for special purposes and from which fish have been excluded or where the fishery is not important as a beneficial use.

For surface water bodies outside the legal boundaries of the Delta, the monthly median of the mean daily dissolved oxygen *(DO)* concentration shall not fall below 85 percent of saturation in the main water mass, and the 95 percentile concentration shall not fall below 75 percent of saturation. The dissolved oxygen concentrations shall not be reduced below the following minimum levels at any time:

Waters designated WARM 5.0 mg/l
Waters designated COLD 7.0 mg/l
Waters designated SPWN 7.0 mg/l

The more stringent objectives in Table III-2 apply to specific water bodies in the Sacramento and San Joaquin River Basins:

TABLE III-2
SPECIFIC DISSOLVED OXYGEN WATER QUALITY OBJECTIVES

AMOUNT	TIME	PLACE
9.0 mg/l *	1 June to 31 August	Sacramento River from Keswick Dam to Hamilton City (13)
8.0 mg/l	1 September to 31 May	Feather River from Fish Barrier Dam at Oroville to Honcut Creek (40)
8.0 mg/l	all year	Merced River from Cressy to New Exchequer Dam (78)
8.0 mg/l	15 October to 15 June	Tuolumne River from Waterford to La Grange (86)

* When natural conditions lower dissolved oxygen below this level, the concentrations shall be maintained at or above 95 percent of saturation.

Floating Material

Water shall not contain floating material in amounts that cause nuisance or adversely affect beneficial uses.

Mercury

For Sulphur Creek (Colusa County), waters shall be maintained free of mercury from anthropogenic sources such that beneficial uses are not adversely affected. During low flow conditions, defined as flows less than 3 cfs, the instantaneous maximum total mercury concentration shall not exceed 1,800 ng/l. During high flow conditions, defined as flows greater than 3 cfs, the instantaneous maximum ratio of mercury to total suspended solids shall not exceed 35 mg/kg. Both objectives apply at the mouth of Sulphur Creek.

Methylmercury

For Clear Lake (53), the methylmercury concentration in fish tissue shall not exceed 0.09 and 0.19 mg methylmercury/kg wet weight of tissue in trophic level 3 and 4 fish, respectively.

For Cache Creek (Clear Lake to Yolo Bypass) (54), North Fork Cache Creek, and Bear Creek (tributary to Cache Creek), the average methylmercury concentration shall not exceed 0.12 and 0.23 mg methylmercury/ kg wet weight of muscle tissue in trophic level 3 and 4 fish, respectively. For Harley Gulch (tributary to Cache Creek), the average methylmercury concentration shall not exceed 0.05 mg methylmercury/ kg wet weight in whole, trophic level 2 and 3 fish.

For the Sacramento-San Joaquin Delta and Yolo Bypass waterways listed in Appendix 43, the average methylmercury concentrations shall not exceed 0.08 and 0.24 mg methylmercury/kg, wet weight, in muscle tissue of trophic level 3 and 4 fish, respectively (150-500 mm total length). The average methylmercury concentrations shall not exceed 0.03 mg methylmercury/kg, wet weight, in whole fish less than 50 mm in length.

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Compliance with the methylmercury fish tissue objectives shall be determined by analysis of fish tissue as described in Chapter V, Surveillance and Monitoring.

Oil and Grease

Waters shall not contain oils, greases, waxes, or other materials in concentrations that cause nuisance, result in a visible film or coating on the surface of the water or on objects in the water, or otherwise adversely affect beneficial uses.

pH

The pH shall not be depressed below 6.5 nor raised above 8.5.

The following site-specific objectives replace the general pH objective, above, in its entirety for the listed water bodies.

For Goose Lake (2), pH shall be less than 9.5 and greater than 7.5 at all times.

Pesticides

- No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses.

- Discharges shall not result in pesticide concentrations in bottom sediments or aquatic life that adversely affect beneficial uses.

- Total identifiable persistent chlorinated hydrocarbon pesticides shall not be present in the water column at concentrations detectable within the accuracy of analytical methods approved by the Environmental Protection Agency or the Executive Officer.

- Pesticide concentrations shall not exceed those allowable by applicable antidegradation policies (see State Water Resources Control Board Resolution No. 68-16 and 40 C.F.R. Section 131.12.).

- Pesticide concentrations shall not exceed the lowest levels technically and economically achievable.

- Waters designated for use as domestic or municipal supply (MUN) shall not contain concentrations of pesticides in excess of the Maximum Contaminant Levels set forth in California Code of Regulations, Title 22, Division 4, Chapter 15.

- Waters designated for use as domestic or municipal supply (MUN) shall not contain concentrations of thiobencarb in excess of 1.0 µg/l.

Pesticide concentrations shall not exceed the levels identified in Table III-2A. Where more than one objective may be applicable, the most stringent objective applies.

For the purposes of this objective, the term pesticide shall include: (1) any substance, or mixture of substances which is intended to be used for defoliating plants, regulating plant growth, or for preventing, destroying, repelling, or mitigating any pest, which may infest or be detrimental to vegetation, man, animals, or households, or be present in any agricultural or nonagricultural environment whatsoever, or (2) any spray adjuvant,

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TABLE III-2A

SPECIFIC PESTICIDE OBJECTIVES

PESTICIDE	MAXIMUM CONCENTRATION AND AVERAGING PERIOD	APPLICABLE WATER BODIES
Chlorpyrifos	0.025 µ g/L ; 1-hour average (acute) 0.015 µ g/L ; 4-day average (chronic) Not to be exceeded more than once in a three year period.	San Joaquin River from Mendota Dam to Vernalis (Reaches include Mendota Dam to Sack Dam (70), Sack Dam to Mouth of Merced River (71), Mouth of Merced River to Vernalis (83)), Delta Waterways listed in Appendix 42. Sacramento River from Shasta Dam to Colusa Basin Drain (13) and the Sacramento River from the Colusa Basin Drain to I Street Bridge (30). Feather River from Fish Barrier Dam to Sacramento River (40).
Diazinon	0.16 µ g/L ; 1-hour average (acute) 0.10 µ g/L ; 4-day average (chronic) Not to be exceeded more than once in a three year period.	San Joaquin River from Mendota Dam to Vernalis (Reaches include Mendota Dam to Sack Dam (70), Sack Dam to Mouth of Merced River (71), Mouth of Merced River to Vernalis (83)), Delta Waterways listed in Appendix 42, Sacramento River from Shasta Dam to Colusa Basin Drain (13) and the Sacramento River from the Colusa Basin Drain to I Street Bridge (30). Feather River from Fish Barrier Dam to Sacramento River (40).

or (3) any breakdown products of these materials that threaten beneficial uses. Note that discharges of "inert" ingredients included in pesticide formulations must comply with all applicable water quality objectives.

Radioactivity

Radionuclides shall not be present in concentrations that are harmful to human, plant, animal or aquatic life nor that result in the accumulation of radionuclides in the food web to an extent that presents a hazard to human, plant, animal or aquatic life.

At a minimum, waters designated for use as domestic or municipal supply (MUN) shall not contain concentrations of radionuclides in excess of the maximum contaminant levels (MCLs) specified in Table 64442 of Section 64442 and Table 64443 of Section 64443 of Title 22 of the California Code of Regulations, which are incorporated by reference into this plan. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect.

Salinity

Electrical Conductivity and Total Dissolved Solids– Special Cases in the Sacramento and San Joaquin River Basins Other Than the Delta

The objectives for electrical conductivity and total dissolved solids in Table III-3 apply to the water bodies specified. To the extent of any conflict with the general Chemical Constituents water quality objectives, the more stringent shall apply.

Electrical Conductivity, Total Dissolved Solids, and Chloride--Delta Waters

See the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary, 2006, for salinity objectives applicable in the Delta.

Table III-3

ELECTRICAL CONDUCTIVITY AND TOTAL DISSOLVED SOLIDS

PARAMETER	WATER QUALITY OBJECTIVES	APPLICABLE WATER BODIES
Electrical Conductivity (at 25°C)	Shall not exceed 230 micromhos/cm (50 percentile) or 235 micromhos/cm (90 percentile) at Knights Landing above Colusa Basin Drain; or 240 micromhos/cm (50 percentile) or 340 micromhos/cm (90 percentile) at I Street Bridge, based upon previous 10 years of record.	Sacramento River (13, 30)
	Shall not exceed 150 micromhos/cm (90 percentile) in well-mixed waters of the Feather River.	North Fork of the Feather River (33); Middle Fork of the Feather River from Little Last Chance Creek to Lake Oroville (36); Feather River from the Fish Barrier Dam at Oroville to Sacramento River (40)
	Shall not exceed 150 micromhos/cm from Friant Dam to Gravelly Ford (90 percentile).	San Joaquin River, Friant Dam to Mendota Pool (69)
Total Dissolved Solids	Shall not exceed 125 mg/l (90 percentile)	North Fork of the American River from the source to Folsom Lake (44); Middle Fork of the American River from the source to Folsom Lake (45); South Fork of the American River from the source to Folsom Lake (48, 49); American River from Folsom Dam to Sacramento River (51)
	Shall not exceed 100 mg/l (90 percentile)	Folsom Lake (50)
	Shall not exceed 1,300,000 tons	Goose Lake (2)

Sediment

The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.

Settleable Material

Waters shall not contain substances in concentrations that result in the deposition of material that causes nuisance or adversely affects beneficial uses.

Suspended Material

Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.

Tastes and Odors

Water shall not contain taste- or odor-producing substances in concentrations that impart undesirable tastes or odors to domestic or municipal water supplies or to fish flesh or other edible products of aquatic origin, or that cause nuisance, or otherwise adversely affect beneficial uses.

Temperature

The natural receiving water temperature of intrastate waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Water Board that such alteration in temperature does not adversely affect beneficial uses.

Temperature objectives for COLD interstate waters, WARM interstate waters, and Enclosed Bays and Estuaries are as specified in the *Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays of California* including any revisions. There are also temperature objectives for the Delta in the State Water Board's *2006 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary*.

At no time or place shall the temperature of COLD or WARM intrastate waters be increased more than 5°F above natural receiving water temperature. Temperature changes due to controllable factors shall be limited for the water bodies specified as described in Table III-4. To the extent of any conflict with the above, the more stringent objective applies.

In determining compliance with the water quality objectives for temperature, appropriate averaging periods may be applied provided that beneficial uses will be fully protected.

TABLE III-4
SPECIFIC TEMPERATURE OBJECTIVES

DATES	APPLICABLE WATER BODY
From 1 December to 15 March, the maximum temperature shall be 55°F. From 16 March to 15 April, the maximum temperature shall be 60°F. From 16 April to 15 May, the maximum temperature shall be 65°F. From 16 May to 15 October, the maximum temperature shall be 70°F. From 16 October to 15 November, the maximum temperature shall be 65°F. From 16 November to 30 November, the maximum temperature shall be 60°F.	Sacramento River from its source to Box Canyon Reservoir (9); Sacramento River from Box Canyon Dam to Shasta Lake (11)
The temperature in the epilimnion shall be less than or equal to 75°F or mean daily ambient air temperature, whichever is greater.	Lake Siskiyou (10)
The temperature shall not be elevated above 56°F in the reach from Keswick Dam to Hamilton City nor above 68°F in the reach from Hamilton City to the I Street Bridge during periods when temperature increases will be detrimental to the fishery.	Sacramento River from Shasta Dam to I Street Bridge (13, 30)

The following site-specific objective replaces the general temperature objective, above, in its entirety for the listed water body:

For Deer Creek, source to Cosumnes River, temperature changes due to controllable factors shall not cause creek temperatures to exceed the objectives specified in Table III-4A.

TABLE III-4A
DEER CREEK TEMPERATURE OBJECTIVES

Date	Daily Maximum (ºF)[a]	Monthly Average (ºF)[b]
January and February	63	58
March	65	60
April	71	64
May	77	68
June	81	74
July through Sept.	81	77
October	77	72
November	73	65
December	65	58

a Maximum not to be exceeded.
b Defined as a calendar month average.

Toxicity

All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life. This objective applies regardless of whether the toxicity is caused by a single substance or the interactive effect of multiple substances. Compliance with this objective will be determined by analyses of indicator organisms, species diversity, population density, growth anomalies, and biotoxicity tests of appropriate duration or other methods as specified by the Regional Water Board.

The Regional Water Board will also consider all material and relevant information submitted by the discharger and other interested parties and numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate

organizations to evaluate compliance with this objective.

The survival of aquatic life in surface waters subjected to a waste discharge or other controllable water quality factors shall not be less than that for the same water body in areas unaffected by the waste discharge, or, when necessary, for other control water that is consistent with the requirements for "experimental water" as described in *Standard Methods for the Examination of Water and Wastewater*, latest edition. As a minimum, compliance with this objective as stated in the previous sentence shall be evaluated with a 96-hour bioassay.

In addition, effluent limits based upon acute biotoxicity tests of effluents will be prescribed where appropriate; additional numerical receiving water quality objectives for specific toxicants will be established as sufficient data become available; and source control of toxic substances will be encouraged.

Turbidity

Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses. Increases in turbidity attributable to controllable water quality factors shall not exceed the following limits:

- Where natural turbidity is less than 1 Nephelometric Turbidity Unit (NTU), controllable factors shall not cause downstream turbidity to exceed 2
- Where natural turbidity is between 1 and 5 NTUs, increases shall not exceed 1 NTU.
- Where natural turbidity is between 5 and 50 NTUs, increases shall not exceed 20 percent.
- Where natural turbidity is between 50 and 100 NTUs, increases shall not exceed 10 NTUs.
- Where natural turbidity is greater than 100 NTUs, increases shall not exceed 10 percent.

In determining compliance with the above limits, appropriate averaging periods may be applied provided that beneficial uses will be fully protected.

Exceptions to the above limits will be considered when a dredging operation can cause an increase in turbidity. In those cases, an allowable zone of dilution within which turbidity in excess of the limits may be tolerated will be defined for the operation and prescribed in a discharge permit.

For Folsom Lake (50) and American River (Folsom Dam to Sacramento River) (51), except for periods of storm runoff, the turbidity shall be less than or equal 10 NTUs. To the extent of any conflict with the general turbidity objective, the more stringent applies.

For Delta waters, the general objectives for turbidity apply subject to the following: except for periods of storm runoff, the turbidity of Delta waters shall not exceed 50 NTUs in the waters of the Central Delta and 150 NTUs in other Delta waters. Exceptions to the Delta specific objectives will be considered when a dredging operation can cause an increase in turbidity. In this case, an allowable zone of dilution within which turbidity in excess of limits can be tolerated will be defined for the operation and prescribed in a discharge permit.

For Deer Creek, source to Cosumnes River:

- When the dilution ratio for discharges is less than 20:1 and where natural turbidity is less that 1 Nephelometric Turbidity Unit (NTU), discharges shall not cause the receiving water daily average turbidity to exceed 2 NTUs or daily maximum turbidity to exceed 5 NTUs. Where natural turbidity is between 1 and 5 NTUs, dischargers shall not cause receiving water daily average turbidity to increase more than 1 NTU or daily maximum turbidity to exceed 5 NTUs
- Where discharge dilution ratio is 20:1 or greater, or where natural turbidity is greater than 5 NTUs, the general turbidity objectives shall apply.

WATER QUALITY OBJECTIVES FOR GROUND WATERS

The following objectives apply to all ground waters of the Sacramento and San Joaquin River Basins, as the objectives are relevant to the protection of designated beneficial uses. These objectives do not require improvement over naturally occurring background concentrations. The ground water objectives contained in this plan are not required by the federal Clean Water Act.

Bacteria

In ground waters used for domestic or municipal supply (MUN) the most probable number of coliform organisms over any seven-day period shall be less than 2.2/100 ml.

Chemical Constituents

Ground waters shall not contain chemical constituents in concentrations that adversely affect beneficial uses.

At a minimum, ground waters designated for use as domestic or municipal supply (MUN) shall not contain concentrations of chemical constituents in excess of the maximum contaminant levels (MCLs) specified in the following provisions of Title 22 of the California Code of Regulations, which are incorporated by reference into this plan: Tables 64431-A (Inorganic Chemicals) and 64431-B (Fluoride) of Section 64431, Table 64444-A (Organic Chemicals) of Section 64444, and Tables 64449-A (Secondary Maximum Contaminant Levels-Consumer Acceptance Limits) and 64449-B (Secondary Maximum Contaminant Levels-Ranges) of Section 64449. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect. At a minimum, water designated for use as domestic or municipal supply (MUN) shall not contain lead in excess of 0.015 mg/l. To protect all beneficial uses, the Regional Water Board may apply limits more stringent than MCLs.

Radioactivity

At a minimum, ground waters designated for use as domestic or municipal supply (MUN) shall not contain concentrations of radionuclides in excess of the maximum contaminant levels (MCLs) specified in Table 4 (MCL Radioactivity) of Section 64443 of Title 22 of the California Code of Regulations, which are incorporated by reference into this plan. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect.

Tastes and Odors

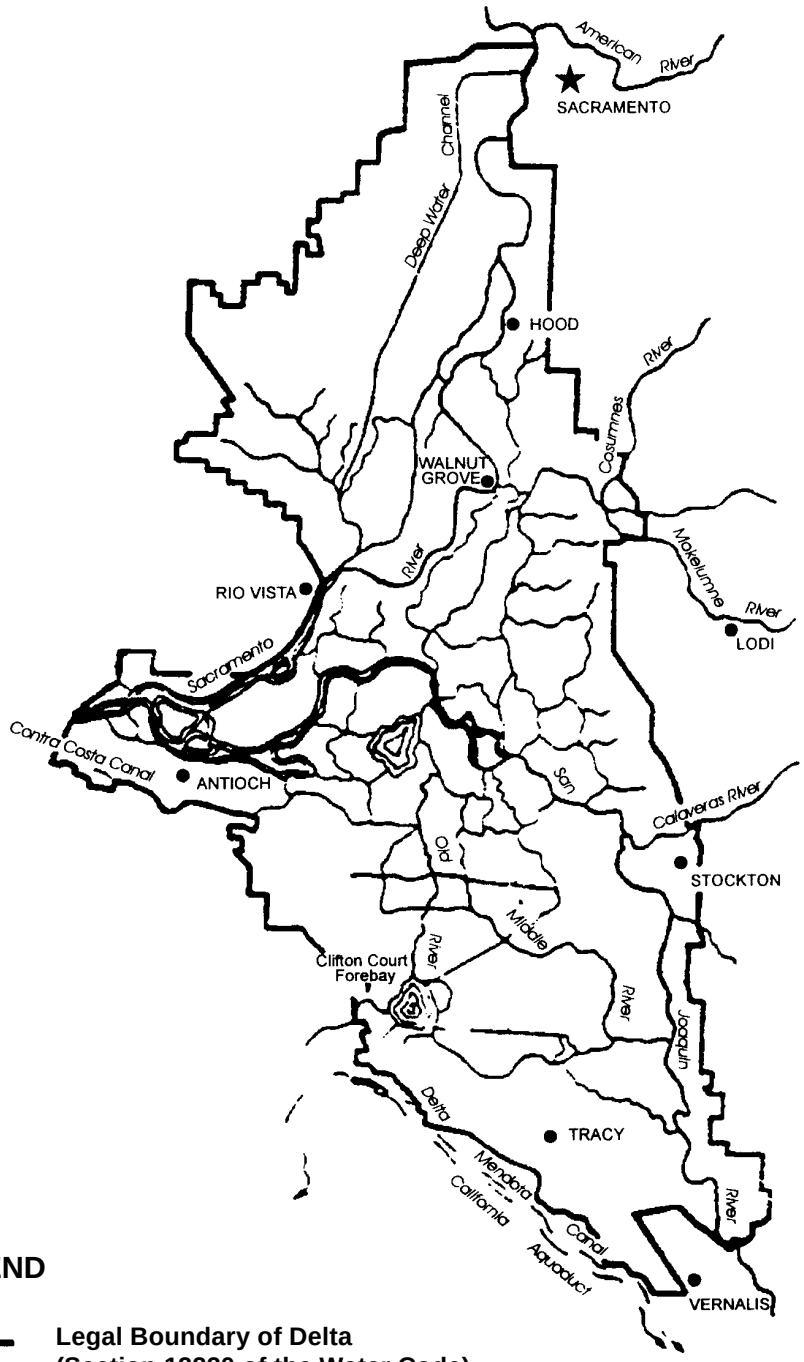
Ground waters shall not contain taste- or odor-producing substances in concentrations that cause nuisance or adversely affect beneficial uses.

Toxicity

Ground waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life associated with designated beneficial use(s). This objective applies regardless of whether the toxicity is caused by a single substance or the interactive effect of multiple substances.

FIGURE III-1

BOUNDARY OF THE SACRAMENTO - SAN JOAQUIN DELTA



N

LEGEND

Legal Boundary of Delta (Section 12220 of the Water Code)

The Porter-Cologne Water Quality Control Act states that basin plans consist of beneficial uses, water quality objectives and a program of implementation for achieving their water quality objectives [Water Code Section 13050(j)]. The implementation program shall include, but not be limited to:

1. A description of the nature of actions which are necessary to achieve the objectives, including recommendations for appropriate action by any entity, public or private;

2. A time schedule for the actions to be taken; and,

3. A description of surveillance to be undertaken to determine compliance with the objectives (Water Code Section 13242).

In addition, State law requires that basin plans indicate estimates of the total cost and identify potential sources of funding of any agricultural water quality control program prior to its implementation. (Water Code Section 13141). This chapter of the Basin Plan responds to all but the surveillance requirement. That is described in Chapter V.

This chapter is organized as follows: The first section contains a general description of water quality concerns. These are organized by discharger type (e.g., agriculture, silviculture, mines, etc.). The second section lists programs, plans and policies which should result in the achievement of most of the water quality objectives in this plan. This section includes descriptions of State Water Board policies, statewide plans, statewide programs dealing with specific waste discharge problems (e.g., underground tanks, storm water, solid waste disposal sites, etc.), memoranda of understanding, management agency agreements, memoranda of agreement, Regional Water Board policies, a listing of Regional Water Board prohibition areas, and Regional Water Board guidelines addressing specific water quality problems. The third section contains recommendations for appropriate action by entities other than the Regional Water Board. The fourth section describes how; within the framework of the programs, plans and policies discussed in the second section; the Regional Water Board integrates water quality control activities into a continuing planning process. The fifth section identifies the current actions and the time schedule for future actions of the Regional Water Board to achieve compliance with water quality objectives where the programs, plans and policies in the second section are not adequate. The last section lists the estimated costs and funding sources for agricultural water quality control programs that are implemented by the Regional Water Board.

WATER QUALITY CONCERNS

Water quality concerns are existing or potential water quality problems, i.e., impairments of beneficial uses or degradations of water quality. At any given time, water quality problems generally reflect the intensity of activities of key discharge sources and the volume, quality, and uses of the receiving waters affected by the discharges.

Historic and ongoing point and nonpoint source discharges impact surface waters. Significant portions of major rivers and the Delta are impaired, to some degree, by discharges from agriculture, mines, urban areas and industries. Upstream, small streams and tributaries to the Rivers are impaired or threatened because of discharges from mines, silviculture activities, and urban development activities. Control approaches may differ depending on the source of the problem.

A variety of historic and ongoing point and non-point industrial, urban, and agricultural activities degrade the quality of ground water. Discharges to ground water associated with these activities include industrial and agricultural chemical use and spills; underground and above ground tank and sump leaks; landfill leachate and gas releases; septic tank failures; improper animal waste management; and chemical seepage via shallow drainage wells and abandoned wells. The resulting impacts on ground water quality from these discharges are often long-term and costly to treat or remediate. Consequently, as discharges are identified, containment and cleanup of source areas and plumes must be undertaken as quickly as possible. Furthermore, activities that may potentially impact ground water must be managed to ensure that ground water quality is protected.

Improper management of waste materials and spillage of industrial fluids have degraded or polluted ground water resources beneath military bases, rail yards, wood treating facilities, aerospace manufacturing and testing operations, municipal gas

plants, fuel tank farms, pesticide formulators, dry cleaners, and other industrial facilities. Many of the sites contain high concentrations of contaminants in soils, which continue to be sources of ground water degradation and pollution, until remediated.

Our knowledge of amounts and types of problems associated with discharge activities change over time. Early federal and state control efforts tended to focus on the most understood or visible problems such as the discharge of raw sewage to rivers and streams. As these problems were controlled and as pollutant detection and measurement methods improved, regulatory emphasis shifted. For example, control of toxic discharges is now a major concern. Toxicity can be associated with many discharge activities. Its effects may be first expressed as acute or chronic reductions in the number of organisms in receiving waters. Minute amounts of toxic materials may also impair beneficial uses from accumulation in tissues or sediments.

Discharges are sometimes sorted into *point source* and *nonpoint source* categories. A point source discharge usually refers to waste emanating from a single, identifiable place. A nonpoint source discharge usually refers to waste emanating from diffused locations. The Regional Water Board may control either type of discharge, but the control approaches may differ.

Salt management is becoming increasingly important in the San Joaquin Valley for urban and agricultural interests. If current practices for discharging waters containing elevated levels of salt continue unabated, the San Joaquin Valley can have a large portion of its ground water severely degraded within a few decades. Therefore, the Regional Water Board will pursue strategies that will achieve the availability of a valley-wide drain for the discharge of agricultural wastewaters and drain waters degraded by elevated levels of salt and in which nutrient and toxic material concentrations meet applicable standards.
Following is a brief description of the water quality impacts associated with basin discharge activities along with some general control considerations.

Agriculture

Agricultural activities affect water quality in a number of ways. There are unique problems associated with irrigated agriculture, agricultural support activities, and animal confinement operations because of the volume of water used and the diffused nature of many of the discharges.

Irrigated Agriculture

Irrigated agriculture accounts for most water use in the two sub-basins. Both the San Joaquin and the Sacramento Rivers carry substantial amounts of agricultural return water or drainage. Agricultural drainage contributes salts, nutrients, pesticides, trace elements, sediments, and other by-products that affect the water quality of the rivers and the Delta.

There is a Memorandum of Understanding between the State Water Board and Department of Pesticide Regulation describing the role of each agency with regard to pesticide regulation.

Salt management is critical to agriculture in the Central Valley. Evaporation and crop transpiration remove water from soils which can result in an accumulation of salts in the root zone of the soils at levels that retard or inhibit plant growth. Additional amounts of water often are applied to leach the salts below the root zones. The leached salts can reach ground or surface water. The movement of the salts to surface waters may be a natural occurrence of subsurface flows or it can result from the surface water discharge of subsurface collection systems (often called tile drains) which are routinely employed in areas of the Central Valley where farm lands have poor drainage capabilities. The tile drainage practice consists of installing collection systems below the root zone of the crops to drain soils that would otherwise stay saturated because of subsurface conditions that restrict drainage. Tile drain installation may result in TDS concentrations in drainage water many times greater than in the irrigation water that was applied to the crops. Tile drain water can also contain pesticides, trace elements, and nutrients.

Pesticides and nutrients are also major ingredients of surface agricultural drainage. They have found their way to ground and surface waters in many areas of the basins. Fish and aquatic wildlife deaths attributable to pesticide contamination of surface water occur periodically.

Nitrate and DBCP (1,2-Dibromo-3-chloropropane) levels exceeding the State drinking water standards occur extensively in ground water in the basins and public and domestic supply wells have been closed because of DBCP, EDB, nitrates, and other contaminants in several locations.

Discharge of sediment is another problem encountered with agriculture. Sedimentation impairs fisheries and, by virtue of the characteristics of many

organic and inorganic compounds to bind to soil particles, it serves to distribute and circulate toxic substances through the riparian, estuarine, and marine systems. Sedimentation also increases the costs of pumping and treating water for municipal and industrial use. An additional significant impact of sediment in runoff is the sediment's direct smothering effect on bottom dwelling communities.

The Regional Water Board approaches problems related to irrigated agriculture as it does other categories of problems. Staff are assigned to identify and evaluate beneficial use impairments associated with agricultural discharges. Control actions are developed and implemented as appropriate per the schedules identified through the continuous planning process (see section titled, "ACTIONS AND SCHEDULE TO ACHIEVE WATER QUALITY OBJECTIVES").

Agricultural Support Activities

These are the activities associated with the application of pesticides, disposal of pesticide rinse waters, and formulation of pesticides and fertilizers. Major water quality problems connected with all of these operations stem from the discharge of waters used to clean equipment or work areas. The Region has confirmed cases of ground water contamination as a result of improper containment and disposal of rinse water.

Many of the application facilities fall under Regional Water Board regulatory programs. When appropriate, best management practices are recommended. Regional Water Board staff also inspects high risk sites to evaluate compliance. Enforcement strategies are implemented as warranted.

Animal Confinement Operations

Runoff from animal confinement facilities (e.g., stockyards, dairies, poultry ranches) can impair both surface and ground water beneficial uses. The animal wastes may produce significant amounts of coliform, ammonia, nitrate, and TDS contamination. The greatest potential for water quality problems has historically stemmed from the overloading of the facilities' waste containment and treatment ponds during the rainy season and inappropriate application of wastewater and manure. Most of these facilities are not operating under waste discharge requirements (WDRs). However, waste management at all confined animal facilities must comply with specific regulations and large facilities must obtain an NPDES storm water permit.

Silviculture

Forest management activities, principally timber harvesting and application of herbicides, have the potential to impact beneficial uses. Timber harvest activities annually take place on tens of thousands of acres of private and federal land in the Central Valley Region and they may affect water quality throughout the area being harvested. Erosion can result from road construction, logging, and post-logging operations. Logging debris may be deposited in streams. Landslides and other mass soil movements can also occur as a result of timber operations.

Herbicides may be used in silviculture to reduce commercial timber competition from weeds, grasses, and other plants or to prepare a site for planting of commercial species by eliminating existing vegetation. Use of herbicides has caused concern among regulatory agencies and the public because of the possibility of transport from target sites to streams by wind and water runoff.

The State and Regional Water Boards entered into agreements with both the U.S. Forest Service and the California Department of Forestry and Fire Protection which require these agencies to control nonpoint source discharges by implementing control actions certified by the State Water Board as best management practices (*BMPs*). The Regional Water Board enforces compliance with BMP implementation and may impose control actions above and beyond what is specified in the agreements if the practices are not applied correctly or do not protect water quality. Point source discharges on federal and state and private forest lands are regulated through waste discharge limits.

Municipalities and Industries

Municipal and industrial point source discharges to surface waters are generally controlled through National Pollutant Discharge Elimination System (*NPDES*) permits. Although the NPDES program was established by the Clean Water Act, the permits are prepared and enforced by the Regional Water Boards per California's authority for the Act. The number of cases of ground water pollution attributable to industrial or municipal sources has increased steadily. For example, the Region's inventory of underground storage tanks indicates the number of leaking tanks is high. Ground water contamination from other industrial sources generally occurs from practices of disposing of fluids or other materials used in production processes. Waste

compounds have been discharged directly to unlined sumps, pits, or depressions and spread on soils. In some cases, these disposal practices went on many years before they were discovered or discontinued. Leaking municipal or industrial sewer lines also contribute to ground water pollution.

The promulgation of EPA sludge regulations under section 503 of the Clean Water Act and the adoption of water quality objectives for toxic pollutants pursuant to section 303(c)(2)(B) will require that NPDES permits, upon renewal, be updated to reflect these new regulations. Once effluent limitations sufficient to comply with sludge requirements and water quality objectives for toxic pollutants have been placed into NPDES permits, POTWs subject to pretreatment program requirements will be required to update their local limits consistent with EPA pretreatment program regulations and guidance.

Storm Water

Runoff from residential and industrial areas also contributes to water quality degradation. Urban storm water runoff contains pesticides, oil, grease, heavy metals, polynuclear aromatic hydrocarbons, other organics, and nutrients. Because these pollutants accumulate during the dry summer months, the first major autumn storm can flush a highly concentrated load to receiving waters and catch basins. Combined storm and sanitary systems may result in some runoff to sewage treatment plants. In other cases, storm water collection wells can produce direct discharges to ground water. Impacts of storm water contaminants on surface and ground waters are an important concern.

The "Control Action Considerations of the State Water Board" section in Chapter IV provides more detail on how the Regional Water Board regulates storm water.

Mineral Exploration and Extraction

Mineral exploration and extraction discharges are associated with several ore, geothermal, and petroleum/natural gas activities. The discharge of greatest concern in the Sacramento and San Joaquin River Basins is the result of ore exploration and extraction.
Drainage and runoff from mines and various operations associated with mining can result in serious impacts to ground and surface water beneficial uses, if not properly managed. Along much of the east side of the Coast Range, runoff, drainage, and erosion from old mercury mines is a problem that has resulted in high levels of mercury in aquatic environments and fish tissue. There are also major metal and acid discharges associated with abandoned copper mines in the Sierra/ Cascades drainages. Sedimentation can be a problem in the construction and operation of many mines.

Within the past decade there has been a significant increase in the amount of gold extraction and processing in the Sierra foothills and in the Coast Ranges. Most of these operations have been made possible by advances in technology, permitting the economical extraction of minute quantities of gold from large volumes of ore with the use of cyanide and other reagents by heap and vat leach methods, and by the current high price of gold on world markets. Advances in ore and waste rock handling techniques have made open pit mining more profitable and common. These mining operations involve the handling and management of large quantities of ore, potentially-toxic chemical reagents, tailings, waste rock, and spent leaching solutions in piles, tailings ponds, and impoundments. If not carefully managed, these operations have the potential to leach toxic reagents, heavy metals, salts, and acidic drainage waters into surface and ground water resources. Mining waste management facilities and associated mining operations are regulated through the issuance of waste discharger requirements under the State and Regional Water Boards' hazardous and solid waste regulatory program (Title 23, California Code of Regulations (CCR), Division 3, Chapter 15 and Title 27, CCR, Division 2, Subdivision 1).

Efforts to control drainage have gradually expanded over the years. Staff assessments of mine water quality problems done in 1979 and 1992 helped direct the Regional Water Board's approach to the problems. When other options were exhausted, the Regional Water Board has used public funds to abate pollution from these mines.

Geothermal operations in the basins are centered in the Geysers Area of Lake County. Potential impacts to water quality are caused by soil erosion from road construction and site preparation, high pressure steam blowouts, and accidental spills of materials from drilling operations, power plants, steam condensate lines, and waste transport accidents. Bentonite clay, boron, ammonia, sodium hydroxide, sulfur compounds, heavy metals, and petroleum products are found in various concentrations in mud sumps, steam condensate lines, and sulfide abatement sludge.

Operational failures can release these substances into waterways.

Hazardous and Non-Hazardous Waste Disposal

Discharges of solid, semi-solid, and liquid wastes to landfills, waste piles, surface impoundments, pits, trenches, tailings ponds, natural depressions and land treatment facilities (collectively called "waste management units") have the potential to create sources of pollution affecting the quality of waters of the State. Unlike surface waters which often have the capacity to assimilate discharged waste constituents, ground waters have little or no assimilative capacity, due to their slow migration rate, lack of aeration, lower biological activity, and laminar flow patterns. If the concentrations of constituents in the land-discharged waste are sufficiently high to prevent the waste from being classified as "inert waste" under 27 CCR, Section 20230, discharges of such wastes to waste management units require long term containment or active treatment following the discharge in order to prevent waste or waste constituents from migrating to and impairing the beneficial uses of waters of the State. Pollutants from such discharges may continue to affect water quality long after the discharge of new waste *to* the unit has ceased, either because of continued leachate or gas discharges *from* the unit, or because pollutants have accumulated in underlying soils from which they are gradually released to ground water.

Landfills for disposal of municipal or industrial solid waste (solid waste disposal sites) are the major categories of waste management units in the region, but there are also surface impoundments used for storage or evaporative treatment of liquid wastes, waste piles for the storage of solid wastes, and land treatment units for the biological treatment of semi-solid sludges from wastewater treatment facilities and liquid wastes from cannery and other industrial operations. Sumps, trenches, and soil depressions have been used in the past for liquid waste disposal. Mining waste management units (tailings ponds, surface impoundments, and waste piles) also represent a significant portion of the waste management units in the Region. The Regional Water Board issues waste discharge requirements to ensure that these discharges are properly contained to protect the Region's water resources from degradation, and to ensure that dischargers undertake effective monitoring to verify continued compliance with requirements.

These discharges, and the waste management units at which the wastes are discharged, are subject to concurrent regulation by other State and local agencies responsible for land use planning, solid waste management, and hazardous waste management. "Local Enforcement Agencies" (mainly cities and counties) implement the State's solid waste management laws and local ordinances governing the siting, design, and operation of solid waste disposal facilities (usually landfills) with the concurrence of the California Integrated Waste Management Board (CIWMB). The CIWMB also has direct responsibility for review and approval of plans for closure and post-closure maintenance of solid waste landfills. The Department of Toxic Substance Control (DTSC) issues permits for all hazardous waste treatment, storage, and disposal facilities (which include hazardous waste incinerators, tanks, and warehouses where hazardous wastes are stored in drums as well as landfills, waste piles, surface impoundments, and land treatment units). The State Water Board, Regional Water Boards, CIWMB, and DTSC have entered into a Memoranda of Understanding to coordinate their respective roles in the concurrent regulation of these discharges. In addition, the Toxic Pits Cleanup Act of 1984 precludes the storage or disposal of liquid hazardous wastes or hazardous wastes containing free liquids. The Regional Water Board is responsible for enforcing this Act under the authority of the Health and Safety Code, Section 25208 et seq. (See page IV-13 for further description).

The statutes and regulations governing the discharges of both hazardous and non-hazardous wastes have been revised and strengthened in the last few years. The discharge of municipal solid wastes to land are closely regulated and monitored; however, some water quality problems have been detected and are being addressed. Recent monitoring efforts under the State and Regional Water Boards' Title 23, CCR Division 3, Chapter 15; Title 27 CCR, Division 2, Subdivision 1; and SWAT programs have revealed that discharges of municipal solid wastes to unlined and single clay lined landfills have resulted in ground water degradation and pollution by volatile organic constituents (VOCs) and other waste constituents. VOCs are components of many household hazardous wastes and certain industrial wastes that are present within municipal solid waste streams. VOCs can easily migrate from landfills either in leachate or by vapor-phase transport. Clay liners and natural clay formations between discharged wastes and ground waters are largely ineffective in preventing water quality impacts from municipal solid waste constituents. In a recently adopted policy for water

quality control, the State Water Board found that "[r]esearch on liner systems for landfills indicates that (a) single clay liners will only delay, rather than preclude, the onset of leachate leakage, and (b) the use of composite liners represents the most effective approach for reliably containing leachate and landfill gas" (State Water Board Resolution No. 93-62, *Policy for Regulation of Discharges of Municipal Solid Waste*).

As a result of similar information on a national scale, the U. S. Environmental Protection Agency (USEPA) has adopted new regulations under Subtitle D of the Resource Conservation and Recovery Act (RCRA) which require the containment of municipal solid wastes by composite liners and leachate collection systems. Composite liners consist of a flexible synthetic membrane component placed above and in intimate contact with a compacted low-permeability soil component. This liner system enhances the effectiveness of the leachate collection and removal system and provides a barrier to vapor-phase transport of VOCs from the unit. Regional Water Boards and the CIWMB are implementing these new regulations in California under a policy for water quality control from the State Water Board (Resolution No. 93-62, discussed above) and new regulations from CIWMB. While a single composite liner of the type that can be approved under Subtitle D regulations is a significant improvement over past municipal solid waste containment systems, it should be noted, however, that single composite liners will not necessarily provide complete protection for ground water resources.

Contaminated Sites Threatening Ground Water Quality

The Regional Water Board has identified over 7000 sites with confirmed releases of constituents of concern which have adversely impacted or threaten to impact the quality of ground water resources. Sources of pollution at these sites include: leaking underground storage tanks and sumps; leaking above ground tanks; leaking pipelines; leaking waste management units, such as landfills, disposal pits, trenches and ponds; surface spills from chemical handling, transfer or storage; poor housekeeping; and illegal disposal. A policy for investigation and cleanup of such sites is contained in the section of this chapter titled “Policy for Investigation and Cleanup of Contaminated Sites.”

Other Discharge Activities

Some remaining discharges of major concern include sedimentation from land development activities in the foothills and mountains, leachate from septic tank/individual wastewater disposal systems, and dredging and dredging spoils runoff.

Many of the foothill/mountain counties in the sub-basins face high growth rates. Sedimentation from the land disturbances associated with residential and commercial development is an increasing problem that, when added to the sedimentation resulting from farming and silvicultural operation, may require establishment of a region-wide erosion control program. The Regional Water Board's current practice is to emphasize local government control of erosion caused by residential development. Erosion control guidelines are included in the erosion/sedimentation action plan which is in the Appendix.

Improperly located, designed, constructed and/or maintained on-site wastewater treatment and disposal systems can result in ground and surface water degradation and public health hazards. The Regional Water Board's approach is that the control of individual wastewater treatment and disposal systems is best accomplished by local environmental health departments enforcing county ordinances designed to provide protection to ground and surface waters. To help the counties with enforcement, the Regional Water Board adopted guidelines which contain criteria for proper installation of conventional systems (see Guidelines section of this chapter and Appendix). Although the Regional Water Board has also prohibited septic tank usage in certain areas, it has formal and informal agreements with counties to evaluate field performance of alternative and special design systems.

The energy crisis of the 1970s resulted in a surge of small hydroelectric facility development in the mountains and foothills. Impairments to beneficial uses may occur because of erosion from construction and changes in water temperature. The Regional Water Board has published guidelines for small hydro-electric facilities (see Guidelines section of this chapter and Appendix) to help address some of the problems associated with small hydroelectric plants.

Dredging is a problem because the process can result in turbidity and the reintroduction and resuspension of harmful metal or organic materials. This latter effect occurs directly as a result of the displacement

of sediment at the dredging site and indirectly as a result of erosion of dredge spoil to surface waters at the deposition site. Another major concern is water quality problems associated with the dredge spoils disposal site. There is much dredging of the Sacramento and San Joaquin Rivers and the Delta because of the need to maintain the ship channels to the Ports of Sacramento and Stockton. The Regional Water Board regulates dredging operations on a case-by-case basis. Operational criteria may result from permits or the water quality certification requirements stemming from Section 401(a) of the Clean Water Act.

In addition to the problems described above, the Regional Water Board responds to spontaneous discharges such as spills, leaks and overflows. These can have cumulatively or individually significant effects on beneficial uses of ground and surface waters.

Water Bodies with Special Water Quality Problems

Water quality management may require the identification and ranking of water bodies with regard to certain quality parameters. Water Quality Limited Segments (*WQLSs*) are one example of expressing water quality problems by water bodies. WQLSs are those sections of lakes, streams, rivers or other fresh water bodies where water quality does not meet (or is not expected to meet) water quality standards even after the application of appropriate effluent limitations for point sources (40 CFR 130, et seq.).

Additional treatment beyond minimum federal requirements will be imposed on dischargers to WQLSs. Dischargers will be assigned or allocated a maximum allowable load of critical pollutants so that water quality objectives can be met in the segment.

The Regional Water Board's list of WQLSs is updated biennially as required by Clean Water Act Section 303(d). The current list may be obtained by contacting the Regional Water Board office.

THE NATURE OF CONTROL ACTIONS IMPLEMENTED BY THE REGIONAL WATER BOARD

The nature of actions to achieve water quality objectives consists of Regional Water Board efforts:

1. to identify potential water quality problems;
2. to confirm and characterize water quality problems through assessments for source, frequency, duration, extent, fate, and severity;
3. to remedy water quality problems through imposing or enforcing appropriate measures; and
4. to monitor problem areas to assess effectiveness of the remedial measures.

Generally, the actions associated with the first step consist of surveys or reviews of survey information and other data sources to isolate possible impairments of beneficial uses or water quality.

The characterization step usually involves studies that attempt to answer questions about a water quality problem's source, extent, duration, frequency, and severity. Information on these parameters is essential to confirm a problem and prepare for remedy. The Regional Water Board may gain this information through its own work or through data submittals requested of actual or potential dischargers under Section 13267 of the California Water Code.

Problem remedy calls for the Regional Water Board to prevent or clean up problems. A common means of prevention is through the issuance of National Pollutant Discharge Elimination System (NPDES) permits, waste discharge requirements (WDRs), discharge prohibitions, and other discharge restrictions. Cleanup is implemented through enforcement measures such as Cease and Desist (*C&D*) and Cleanup and Abatement (*C&A*) orders. The NPDES is a requirement of the Federal Clean Water Act (Section 402) and California has implementing responsibility. The national permit system only applies to certain surface water discharges. WDRs, which encompass permits, are called for by State law, Water Code Section 13260, et seq. The WDRs system is not as restricted as the Federal NPDES. As practical, WDRs may be used to control any type of discharge to ground or surface waters. C&D and C&A orders are two of the enforcement tools available to the Regional Water Board to correct actual or potential violations of WDRs, NPDES permits, prohibitions, and other water quality control obligations.

The details of the monitoring step are explained in Chapter V. In general, the Regional Water Board has wide latitude to require actual and potential dischargers to submit monitoring and surveillance

information, in addition to using State Water Board data or collecting its own.

Whatever actions the Regional Water Board implements must be consistent with the Basin Plan's beneficial uses and water quality objectives, as well as certain State and Regional Water Boards' policies, plans, agreements, prohibitions, guidance, and other restrictions or requirements. These considerations are described below and included in the Appendix when noted.

Control Action Considerations of the State Water Board

Policies and Plans

The State Water Board adopts water quality control policies and water quality control plans to which Regional Water Board actions must conform. Sections 13146 and 13247 of the California Water Code generally require that, in carrying out activities which affect water quality, all state agencies, departments, boards and offices must comply with all policies for water quality control and with applicable water quality control plans approved or adopted by the State Water Board. Two of the plans, the Ocean Plan and the Tahoe Plan, do not affect the Sacramento and San Joaquin River Basins. The policies and plans that are applicable are described below.

1. *The State Policy for Water Quality Control*

   This policy declares the State Water Board's intent to protect water quality through the implementation of water resources management programs and serves as the general basis for subsequent water quality control policies. The policy was adopted by the State Water Board in 1972. See Appendix Item 1.

2. *State Water Board Resolution No. 68-16, Statement of Policy with Respect to Maintaining High Quality of Water in California*

   The State Water Board adopted this policy on 28 October 1968. The policy generally restricts the Regional Water Board and dischargers from reducing the water quality of surface or ground waters even though such a reduction in water quality might still allow the protection of the beneficial uses associated with the water prior to the quality reduction. The goal of the policy is to maintain high quality waters. Changes in water quality are allowed only if the change is consistent with maximum benefit to the people of the State; does not unreasonably affect present and anticipated beneficial uses; and, does not result in water quality less than that prescribed in water quality control plans or policies.

   USEPA water quality standards regulations require each state to adopt an “antidegradation” policy and specify the minimum requirements for the policy (40 CFR 131.12). The State Water Board has interpreted State Water Board Resolution No. 68-16 to incorporate the federal antidegradation policy. The Regional Water Board implements Resolution No. 68-16 consistent with the federal antidegradation policy where the federal regulations apply. Resolution No. 68-16 applies to both ground and surface waters of the state. Resolution No. 68-16 is Appendix Item 2; the federal policy is Appendix Item 39.

3. *State Water Board Resolution No. 74-43, The Water Quality Control Policy for the Enclosed Bays and Estuaries of California*

   This policy was adopted by the State Water Board on 16 May 1974 and provides water quality principles and guidelines for the prevention of water quality degradation in enclosed bays and estuaries to protect the beneficial uses of such waters. The Regional Water Board must enforce the policy and take actions consistent with its provisions. (This policy does not apply to wastes from boats or land runoff except as specifically indicated for siltation and combined sewer flows.) See Appendix Item 3.

4. *State Water Board Resolution No. 75-58, Water Quality Control Policy on the Use and Disposal of Inland Waters Used for Powerplant Cooling*

   This policy was adopted by the State Water Board in June 1975. Its purpose is to provide consistent principles and guidance for supplementary waste discharge requirements or other water quality control actions for thermal powerplants using inland waters for cooling. The Regional Water Board is responsible for its enforcement. See Appendix Item 4.

5. *State Water Board Resolution No. 77-1, Policy and Action Plan for Water Reclamation in California*
The policy was adopted 6 January 1977. Among other things, the policy requires the Regional Water Boards to conduct reclamation surveys and specifies reclamation actions to be implemented by the State and Regional Water Boards and other agencies. The policy and action plan are contained in the State Water Board report titled, *Policy and Action Plan for Water Reclamation in California*. See Appendix Item 5.

6. *State Water Board Resolution No. 87-22, Policy on the Disposal of Shredder Waste*

This State Water Board Resolution, adopted 19 March 1987, permits the disposal into certain landfills of wastes, produced by the mechanical destruction of car bodies, old appliances and similar castoffs, under specific conditions designated and enforced by the Regional Water Boards. See Appendix Item 6.

7. *State Water Board Resolution No. 88-23, Policy Regarding the Underground Storage Tanks Pilot Program*

The State Water Board adopted this policy on 18 February 1988. The policy implements a pilot program to fund oversight of remedial action at leaking underground storage tank sites, in cooperation with the California Department of Health Services. Oversight may be deferred to the Regional Water Boards. See Appendix Item 7.

8. *State Water Board Resolution No. 88-63, Sources of Drinking Water Policy*

This policy for water quality control, adopted on 19 May 1988, is essential to the designation of beneficial uses. The policy specifies that, except under specifically defined exceptions, all surface and ground waters of the state are to be protected as existing or potential sources of municipal and domestic supply. The specific exceptions include waters with existing high total dissolved solids concentrations (greater than 3000 mg/l), low sustainable yield (less than 200 gallons per day for a single well), waters with contamination that cannot be treated for domestic use using best management practices or best economically achievable treatment practices, waters within particular municipal, industrial and agricultural wastewater conveyance and holding facilities, and regulated geothermal ground waters. Where the Regional Water Board finds that one of the exceptions applies, it may remove the municipal and domestic supply beneficial use designation for the particular body of water through a formal Basin Plan amendment and a public hearing, followed by approval of such an amendment by the State Water Board and the Office of Administrative Law. See Appendix Item 8.

9. *State Water Board Resolution No. 90-67, Pollutant Policy Document (PPD)*

The PPD was adopted by the State Water Board in 1990, as part of their overall Delta water rights proceedings. The PPD establishes state policy for water quality control to be used by the San Francisco Bay Regional Water Board and the Central Valley Regional Water Board in updating basin plans. The PPD requires the Central Valley Regional Water Board to develop a mass emission strategy for limiting loads of heavy metals, PAHs and selenium entering the Delta. It also requires that specific actions be taken to eliminate the discharge of chlorinated dibenzodioxins and dibenzofurans to the Delta. The PPD describes other actions for controlling antifouling compounds used on boats and for regulating dredging.

10. *State Water Board Resolution No. 92-49, Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code Section 13304*

This resolution contains policies and procedures for Regional Water Boards to follow for the oversight and regulation of investigations and cleanup and abatement activities from all types of discharge or threat of discharge subject to Section 13304 of the Water Code. It directs Regional Water Boards to ensure that dischargers are required to cleanup and to abate the effect of discharges. This cleanup and abatement shall be done in a manner that promotes attainment of background water quality, or the highest water quality which is reasonable if background levels of water quality cannot be restored. Any cleanup less stringent than background water quality shall be consistent with maximum benefit to the people of the state and not unreasonably affect present and anticipated beneficial uses of such water. See Appendix Item 9.

11. *State Water Board Resolution No. 93-62, Policy for Regulation of Discharges of Municipal Solid Waste*

The policy for water quality control, adopted by State Water Board on 17 June 1993, directs Regional Water Boards to amend waste discharge requirements for municipal solid waste landfills to incorporate pertinent provisions of the federal "Subtitle D" regulations under the Resource Conservation and Recovery Act (40 CFR Parts 257 & 258). The majority of the provisions of the Subtitle D regulations become effective on 9 October 1993. Landfills which are subject to the Subtitle D regulations and the Policy are those which have accepted municipal solid waste on or after 9 October 1991. See Appendix Item 10.

12. *The Thermal Plan*

The Water Quality Control Plan for the Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California was adopted by the State Water Board on 18 May 1972 and amended 18 September 1975. The plan specifies water quality objectives, effluent quality limits, and discharge prohibitions related to thermal characteristics of interstate waters and waste discharges. See Appendix Item 11. (Note: the State Water Board adopted Resolution No. 92-82 on 22 October 1992, approving an exception to the Thermal Plan for Sacramento Regional County Sanitation District. See Appendix Item 12.)

13. *The Delta Plan, Water Right Decision 1485, and the Water Quality Control Plan for Salinity*

In August 1978, the State Water Board adopted the Delta Plan and Water Right Decision 1485 (D-1485). The Delta Plan contained water quality standards, Delta outflow requirements and export constraints for the Delta. These standards, requirements, and constraints were then implemented in D-1485 by making them conditions of the water right permits for the Central Valley Project and the State Water Project.

When the Delta Plan and accompanying D-1485 were originally issued, the State Water Board committed itself to review the Delta Plan in about ten years. In 1986, the State Court of Appeal issued a decision addressing legal challenges to the Delta Plan and D-1485. The Court directed the State Water Board to take a global view toward its dual responsibilities (water quality and water rights) to the State's water resources.

In response to the Court's decision, the State Water Board adopted the Water Quality Control Plan for Salinity in May 1991. The May 1991 Plan was superceded in May 1995 when the State Water Board adopted the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. This Plan was revised in 2006. The State Water Board's Plan includes water quality objectives for salinity, temperature and dissolved oxygen that are applicable in the Delta.

In December 1999 the State Water Board adopted, and in March 2000 per Order WR 2000-02 revised, Water Right Decisions 1641. This decision amended certain water rights by assigning responsibilities to water right holders to help meet flow objectives intended to implement certain water quality objectives contained in the 1995 Bay-Delta Plan.

Rather than taking any water right action to meet the dissolved oxygen objectives in the 1995 Bay-Delta Plan, the State Water Board directed the Regional Water Board to first prepare a TMDL to achieve the dissolved oxygen objectives and implement it.

14. *Nonpoint Source Management Plan and the Nonpoint Source Implementation and Enforcement Policy*

In December 1999, the State Water Board, in its continuing efforts to control nonpoint source (NPS) pollution in California, adopted the *Plan for California's Nonpoint Source Pollution Control Program* (NPS Program Plan). The NPS Program Plan upgraded the State's first *Nonpoint Source Management Plan* adopted by the State Water Board in 1988 (1988 Plan). Upgrading the 1988 Plan with the NPS Program Plan brought the State into compliance with the requirements of Section 319 of the Clean Water Act and Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990.

The NPS Implementation and Enforcement Policy, adopted by the State Water Board on 20 May 2004 (State Water Board Resolution No. 2004-0030), explains how the Porter-Cologne Act mandates and authorities, delegated to the

State Water Board and Regional Water Boards by the California Legislature, will be used to implement and enforce the NPS Program Plan. The policy also provides a bridge between the NPS Program Plan and the *SWRCB Water Quality Enforcement Policy*.

15. *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California" (a.k.a. State Implementation Plan or SIP)*

    In March 2000, the State Water Board adopted the SIP in Resolution No. 2000-015. This Policy establishes:

    (1) Implementation provisions for priority pollutant criteria promulgated by the U.S. Environmental Protection Agency (U.S. EPA) through the National Toxics Rule (40 CFR 131.36) (promulgated on 22 December 1992 and amended on 4 May 1995) and through the California Toxics Rule (40 CFR 131.38) (promulgated on 18 May 2000 and amended on 13 February 2001), and for priority pollutant objectives established by Regional Water Boards in their basin plans; and
    (2) Monitoring requirements for 2,3,7,8-TCDD equivalents; and
    (3) Chronic toxicity control provisions.

    In addition, this Policy includes special provisions for certain types of discharges and factors that could affect the application of other provisions in this Policy.

16. *Water Quality Enforcement Policy (Enforcement Policy)*

    The State Water Board adopted the Enforcement Policy on 19 February 2002. The primary goal of this Enforcement Policy is to create a framework for identifying and investigating instances of noncompliance, for taking enforcement actions that are appropriate in relation to the nature and severity of the violation, and for prioritizing enforcement resources to achieve maximum environmental benefits.

17. *Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List*

    Pursuant to California Water Code section 13191.3(a), this State policy for water quality control describes the process by which the State Water Board and the regional water boards will comply with the listing requirements of section 303(d) of the federal Clean Water Act. The objective of this policy is to establish a standardized approach for developing California's section 303(d) list in order to achieve the overall goal of achieving water quality standards and maintaining beneficial uses in all of California's surface waters.

18. *Water Quality Control Policy for Addressing Impaired Waters: Regulatory Structure and Options*

    Section 303(d) of the Clean Water Act requires states to identify waters within their borders that are not attaining water quality standards. This State policy for water quality control describes the existing tools and mechanisms that the regional water boards will use to address the water bodies listed as impaired under section 303(d) of the federal Clean Water Act.

19. *Policy for Compliance Schedules in National Pollutant Discharge Elimination System Permits*

    The Policy authorizes the Regional Water Board to include a compliance schedule in a permit for an existing discharger to implement a new, revised, or newly interpreted water quality objective or criterion in a water quality standard that results in a permit limitation more stringent than the limitation previously imposed.

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Programs

1. *Discharges of Hazardous Waste to Land, California Code of Regulations Title 23, Division 3, Chapter 15 and Consolidated Regulations for Treatment, Storage, Processing or Disposal of Solid Waste, California Code of Regulations Title 27, Division 2, Subdivision*

   Title 23, CCR, Division 3 Chapter 15 and Title 27 CCR, Division 2, Subdivision 1 includes regulations governing discharges of hazardous and solid waste to land for treatment, storage, or disposal. The regulations cover landfills, surface impoundments, waste piles, land treatment units, mining waste management units and confined animal facilities. In addition, actions to clean up and abate conditions of pollution or nuisance at contaminated sites are covered by relevant portions of the regulations where contaminated materials are taken off-site for treatment, storage, or disposal and, as feasible, where wastes are contained or remain on-site at the completion of cleanup actions. The regulations classify wastes according to their threat to water quality, classify waste management units according to the degree of

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protection that they provide for water quality, and provide siting, construction, monitoring, corrective action, closure and post closure maintenance criteria. Chapter 15 requirements are minimum standards for proper management of each waste category. These regulations require the complete containment of wastes which, if discharged to land for treatment, storage or disposal, have the potential to degrade the quality of water resources. Regional Water Boards may impose more stringent requirements to accommodate regional and site-specific conditions.

2. *Solid Waste Assessment Test (SWAT)*

Section 13273, added to the Water Code in 1985 (Assembly Bill 3525), required all owners of both active and inactive nonhazardous landfills to complete a Solid Waste Assessment (SWAT) to determine if hazardous waste constituents have migrated from the landfill into ground water. Pursuant to a list adopted by the State Water Board, 150 site owners statewide per year would complete this evaluation by 2001.

The Regional Water Board must review the SWAT report to determine whether any hazardous waste has migrated into ground water. If so, the Regional Water Board must notify the Department of Toxic Substances Control and the Integrated Waste Management Board, and take appropriate remedial action [CA Water Code Section 13273(e)].

3. *Toxic Pits Cleanup Act (TPCA)*

The Toxic Pits Cleanup Act of 1984 (Section 25208 et seq. of the Health and Safety Code) established a program to ensure that existing surface impoundments are either made safe or closed so that they do not pollute the waters of the state. The Act requires that all impoundments containing liquid hazardous wastes or hazardous wastes containing free liquids be retrofitted with a liner/leachate collection system, or closed by 1 July 1988. Surface impoundments containing hazardous wastes are prohibited within one-half mile upgradient from a potential source of drinking water. The law provided for certain exemptions.

4. *Underground Storage Tank (UST) Program*

The Central Valley UST Program is implemented under Division 20, Chapters 6.7 and 6.75 of the California Health and Safety Code and Title 23, Division 3, Chapter 16 of the California Code of Regulations. The program has two elements: leak prevention, which is implemented statewide by Local Implementing Agencies in 58 counties and 49 cities; and leak investigation and cleanup which is implemented by the Regional Water Board with assistance from the Local Implementing Agencies. Some Counties in the Central Valley Region are under contract with the State Water Board to provide investigation and cleanup oversight on some sites. These Counties are required to implement the requirements of the Basin Plan.

5. *Aboveground Petroleum Storage Act*

The Aboveground Petroleum Storage Act (Chapter 6.67, Division 20, Health and Safety Code) requires owners or operators of aboveground petroleum storage tanks to file a storage statement and pay a fee every two years (beginning 1 July 1990), to take specific actions to prevent spills, and, in certain instances, to implement a ground water monitoring program. Fees are used by staff to inspect facilities and review spill prevention plans. If a site is contaminated, staff oversee cleanup and the tank owner or operator is required to reimburse the Regional Water Board for reasonable costs for that oversight. There are approximately 8000 tank facilities in the region which have filed storage statements.

6. *Storm Water Regulations*

The 1987 Clean Water Act amendments required the USEPA to establish regulations to control storm water discharges associated with industrial activity; discharges from large (serving a population of 250,000 or more) and medium (serving a population of greater than 100,000 but less than 250,000) municipal separate storm sewer systems; and discharges from construction sites.

Federal regulations for storm water discharges were promulgated by the USEPA on 16 November 1990 (40 CFR Parts 122, 123, and 124). The regulations require large and medium size municipalities and specific categories of facilities, which discharge storm water associated with industrial activity, to obtain NPDES permits and to implement Best Available Technology Economically Achievable (BAT) and Best Conventional Pollutant Control

Technology (BCT) to reduce or eliminate industrial storm water pollution. Municipal permits establish controls to reduce/eliminate pollutants to the maximum extent possible (MEP) and to effectively prohibit illicit discharges to storm sewer systems.

In 1991 (amended in 1992), the State Water Board adopted a statewide general NPDES permit (Order No. 91-13-DWQ, General Permit No. CAS000001) for storm water discharges associated with industrial activities. The Order applies to facilities which discharge storm water to surface waters, either directly or through a storm drain system, excluding construction activities.

The State Water Board also adopted a statewide general NPDES permit (Order No. 92-08-DWQ, General Permit No. CAS000002) in 1992, which applies to construction projects resulting in land disturbance of five acres or greater.

7. *U.S. Department of Defense (DOD) Program*

The State and Regional Water Board's DOD Program provides regulatory oversight for the restoration and protection of surface and ground water quality during environmental cleanup of military facilities listed in the DOD/State Memorandum of Agreement (DSMOA). The State Water Board will enter into an interagency agreement with the Department of Toxic Substances Control (DTSC) which, in turn, will enter into the DSMOA with DOD for cleanup oversight reimbursement. The State and Regional Water Boards provide regulatory oversight by their authority pursuant to Division 7 of the Water Code and Section 120(f) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Title 42, U.S.C., Section 9620 (f). The DOD enters into a two-year cooperative agreement with DTSC to support DTSC's mandated mission to protect public health and the environment. The DOD Program should continue until DSMOA facility cleanups are completed (20 to 30 years) or Congress decides to terminate State oversight funding.

The cleanup of military facilities is required to be consistent with the applicable provisions of CERCLA (Section 120 relating to Federal Facilities), the Superfund Amendments and Reauthorization Act of 1986 (SARA), the National Contingency Plan, and State laws.

State Water Board Management Agency Agreements (MAAs), Memorandum of Agreement (MOA), and Memoranda of Understanding (MOUs)

The Regional Water Board abides by State Water Board agreements with federal and State agencies which have been formalized with either an MAA, MOA, or an MOU signed by the State Water Board.

1. *U. S. Forest Service Agreement*

On 26 February 1981 the State Water Board Executive Director signed an MAA with the U.S. Forest Service (*USFS*) which waives discharge requirements for certain USFS nonpoint source discharges provided that the Forest Service implements State Water Board approved best management practices (*BMPs*) and procedures and the provisions of the MAA. The MAA covers all USFS lands in California. Implementation of the BMPs, in conjunction with monitoring and performance review requirements approved by the State and Regional Water Boards, is the primary method of meeting the Basin Plan's water quality objectives for the activities to which the BMPs apply. The MAA does not include USFS point source discharges and in no way limits the authority of the Regional Water Board to carry out its legal responsibilities for management or regulation of water quality. See Appendix Item 13.

2. *Department of Health Services*

On 27 January 1986, the State Water Board Chairperson signed an MOA with the Department of Health Services regarding the implementation of the hazardous waste program. The agreement covers surveillance and enforcement related to water quality at landfills, surface impoundments, waste piles, and land treatment facilities that treat, store, or dispose of hazardous waste. It also covers the issuance, modification, or denial of permits to facilities, including the revision of the water quality aspects of hazardous waste management facility siting, design, closure, post-closure, and surface and ground water monitoring and protection. See Appendix Item 14.

3. *Department of Health Services*

In 1988, the Chairman of the State Water Board signed an MOA with the Department of Health Services regarding the use of reclaimed water.

The MOA outlines the basic activities of the agencies, allocates primary areas of responsibility and authority between these agencies, and provides for methods and mechanisms to assure coordination for activities related to the use of reclaimed water. See Appendix Item 15.

4. *California Department of Forestry Agreement*

In February 1988, the State Water Board signed an MAA with the California Department of Forestry and Fire Protection (*CDFFP*) and the California Board of Forestry (*BOF*), for the purpose of carrying out, pursuant to Section 208 of the Federal Clean Water Act, those portions of the State's Water Quality Management Plan (*WQMP*) related to controlling water quality impacts caused by silvicultural activities on nonfederal forest lands. As with the USFS MAA, the CDFFP agreement requires the Department to implement certain BMPs to protect water quality from timber harvest and associated activities. Approval of the MAA as a WQMP component by the USEPA results in the Regional Water Boards relinquishing some authority to issue WDRs for State timber operations (Public Resources Code Section 4514.3). However, CDF and the Regional and State Water Boards must still ensure that the operations incorporate BMPs and comply with applicable water quality standards. Appendix F of the MAA also calls for the preparation of a Memorandum of Understanding (*MOU*) for the Regional Water Boards, the State Water Board, and the CDFFP to prescribe interagency procedures for implementing BMPs. See Appendix Item 16.

5. *Department of Conservation Agreement*

In March 1988, the State Water Board amended a February 1982 MOA with the State Department of Conservation, Division of Oil and Gas (*CDOG*), to regulate oil, gas, and geothermal fields' discharges. The agreement requires CDOG to notify the Regional Water Boards of all new operators, all pollution problems associated with operators, and proposed discharges. CDOG and Regional Water Boards must also work together, within certain time-lines, to review and prepare discharge permits. See Appendix Item 17.

6. *Department of Health Services/Department of Toxic Substances Control*

In July 1990, the State Water Board and the Department of Health Services, Toxic Substances Control Program (later reorganized into the Department of Toxic Substances Control) signed an MOU which explains the roles of the agencies (and of the Regional Water Boards) in the cleanup of hazardous waste sites. The MOU describes the protocol the agencies will follow to determine which agency will act as lead and which will act as support, the responsibilities of the agencies in their respective roles, the procedures the agencies will follow to ensure coordinated action, the technical and procedural requirements which each agency must satisfy, the procedures for enforcement and settlement, and the mechanism for dispute resolution. This MOU does not alter the Board's responsibilities with respect to water quality protection. See Appendix Item 18.

7. *Soil Conservation Service, U.S. Department of Agriculture*

On 31 July 1990, the State Water Board Executive Director signed an MOU with Soil Conservation Service (SCS), a technical agency for the U.S. Department of Agriculture. Through this MOU, State Water Board seeks to utilize the personnel and expertise of SCS in the development and implementation of water quality programs and projects. The goal is to accelerate implementation of best management practices and other nonpoint source pollution prevention measures. See Appendix Item 19.

8. *Environmental Affairs Agency, Air Resources Board, and California Integrated Waste Management Board*

On 27 August 1990, the State Water Board Executive Director signed an MOU with the Environmental Affairs Agency, Air Resources Board, and California Integrated Waste Management Board to enhance program coordination and reduce duplication of effort. This MOU consists of provisions describing the scope of the agreement (including definitions of the parties and issues to which the MOU applies), the principles which will govern the conduct of the parties, and the existing statutory framework. See Appendix Item 20.

9. *California Department of Pesticide Regulation*

On 23 December 1991, the State Water Board Chairman signed a MOU with the California Department of Pesticide Regulation (DPR) to ensure that pesticides registered in California are used in a manner that protects water quality and the beneficial uses of water while recognizing the need for pest control.

The State Water Board and nine Regional Water Boards are responsible for protecting the beneficial use of water in California and for controlling all discharges of waste into waters of the state while DPR is the lead agency for pesticide regulation in California.

This will be accomplished by implementing Best Management Practices (BMPs) initially upon voluntary compliance to be followed by regulatory-based encouragement of BMPs as circumstances dictate. Mandatory compliance will be based, whenever possible, on DPR's implementation of regulations and/or pesticide use permit requirements. However, the State Water Board and Regional Water Boards retain ultimate responsibility for compliance with water quality objectives. The agreement was revised on 19 January 1993 to facilitate implementation of the original agreement. See Appendix Item 21.

10. *Implementation of the San Joaquin Valley Drainage Program's Recommended Plan*

In January 1992, the State Water Board Chairman signed a MOU with the U.S. Bureau of Reclamation, the U.S. Fish and Wildlife Service, the U.S. Soil Conservation Service, the U.S. Geological Survey, the California Department of Fish and Game, and the Department of Food and Agriculture. The MOU is an agreement by the agencies to use the management plan described in the September 1990 final report of the San Joaquin Valley Drainage Program as a guide for remedying subsurface drainage and related problems. See Appendix Item 22.

11. *California Integrated Waste Management Board*

On 16 December 1992, the State Water Board Executive Director signed a MOU to address the Regional Water Board's review of Solid Waste Assessment Test reports. See Appendix Item 23.

12. *Bureau of Land Management*

On 27 January 1993, the State Water Board Vice Chairman signed a MOU to address nonpoint source water quality issues on public lands managed by the Bureau. See Appendix Item 24.

Control Action Considerations of the Central Valley Regional Water Board

Policies and Plans

The following policies were adopted, or are hereby adopted, by the Regional Water Board. The first four policies listed were adopted as part of the 1975 Basin Plan. Items 7 through 11 are new policies:

1. *Urban Runoff Policy*

   a. Subregional municipal and industrial plans are required to assess the impact of urban runoff on receiving water quality and consider abatement measures if a problem exists.

   b. Effluent limitations for storm water runoff are to be included in NPDES permits where it results in water quality problems.

2. *Wastewater Reuse Policy*

   The Regional Water Board encourages the reclamation and reuse of wastewater, including treated ground water resulting from a cleanup action, where practicable and requires as part of a Report of Waste Discharge an evaluation of reuse and land disposal options as alternative disposal methods. Reuse options should include consideration of the following, where appropriate, based on the quality of the wastewater and the required quality for the specific reuses: industrial and municipal supply, crop irrigation, landscape irrigation, ground water recharge, and wetland restoration. Where studies show that Year-round or continuous reuse or land disposal of all of the wastewater is not practicable, the Regional Water Board will require dischargers to evaluate how reuse or land disposal can be optimized, such as consideration of reuse/disposal for part of the flow and seasonal reuse/disposal options (e.g., dry season land disposal).

3. *Controllable Factors Policy*

Controllable water quality factors are not allowed to cause further degradation of water quality in instances where other factors have already resulted in water quality objectives being exceeded. Controllable water quality factors are those actions, conditions, or circumstances resulting from human activities that may influence the quality of the waters of the State, that are subject to the authority of the State Water Board or Regional Water Board, and that may be reasonably controlled.

4. *The Water Quality Limited Segment Policy*

Additional treatment beyond minimum federal requirements will be imposed on dischargers to Water Quality Limited Segments. Dischargers will be assigned or allocated a maximum allowable load of critical pollutants so that water quality objectives can be met in the segment.

To determine an allowable load for dischargers, the "Loading Capacity" must be determined. The "Loading Capacity" is the maximum amount of pollution that can be present in a water body without violating water quality objectives. The Loading Capacity can be established to address multiple pollutants or a single pollutant. The Loading Capacity can be allocated to NPDES permitted sources (point sources) as waste load allocations and to non-NPDES permitted sources (nonpoint sources) and background as load allocations. Part of the Loading Capacity may also be set aside or not assigned to account for any uncertainty in the Loading Capacity calculation.

The Loading Capacity and allocations are established to meet Clean Water Act Section 303(d) requirements. In addition, the Loading Capacity and allocations can provide a framework for actions to be taken by the Regional Water Board for achieving pollutant reductions and attaining water quality objectives.

5. *Regional Water Board Resolution No. 70-118, Delegation of Duties and Powers to the Regional Water Board's Executive Officer*

In January 1970, the Regional Water Board adopted Resolution No. 70-118 which delegates certain duties and powers of the Board to its Executive Officer pursuant to Section 13223 of the California Water Code. See Appendix Item 25.

6. *Regional Water Board Resolution No. 96-147, San Joaquin River Agricultural Subsurface Drainage Policy*

a. The control of toxic trace elements in agriculture subsurface drainage, especially selenium, is the first priority.

b. The control of agricultural subsurface drainage will be pursued on a regional basis.

c. The reuse of agricultural subsurface drainage will be encouraged, and actions that would limit or prohibit reuse discouraged.

d. Of the two major options for disposal of salts produced by agricultural irrigation, export out of the basin has less potential for environmental impacts and, therefore, is the favored option. The San Joaquin River may continue to be used to remove salts from the basin so long as water quality objectives are met.

e. The valley-wide drain to carry the salts generated by agricultural irrigation out of the valley remains the best technical solution to the water quality problems of the San Joaquin River and Tulare Lake Basin. The Regional Water Board, at this time, feels that a valley-wide drain will be the only feasible, long-range solution for achieving a salt balance in the Central Valley. The Regional Water Board favors the construction of a valley-wide drain under the following conditions:

- All toxicants would be reduced to a level which would not harm beneficial uses of receiving waters.
- The discharge would be governed by specific discharge and receiving water limits in an NPDES permit.
- Long-term, continuous biological monitoring would be required.

f. Optimizing protection of beneficial uses on a watershed basis will guide the development of actions to regulate agricultural subsurface drainage discharges.

g. For regulation of selenium discharges, actions need to be focused on selenium load reductions.

7. *Antidegradation Implementation Policy*

The antidegradation directives of Section 13000 of the Water Code and State Water Board Resolution No. 68-16 ("Statement of Policy With Respect to Maintaining High Quality Waters in California") require that high quality waters of the State shall be maintained "consistent with the maximum benefit to the people of the State." The Regional Water Board applies these directives when issuing a permit, or in an equivalent process, regarding any discharge of waste which may affect the quality of surface or ground waters in the region.

Implementation of this policy to prevent or minimize surface and ground water degradation is a high priority for the Board. In nearly all cases, preventing pollution before it happens is much more cost-effective than cleaning up

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pollution after it has occurred. Once degraded, surface water is often difficult to clean up when it has passed downstream. Likewise, cleanup of ground water is costly and lengthy due, in part, to its relatively low assimilative capacity and inaccessibility. The prevention of degradation is, therefore, an important strategy to meet the policy's objectives.

The Regional Water Board will apply 68-16 in considering whether to allow a certain degree of degradation to occur or remain. In conducting this type of analysis, the Regional Water Board will evaluate the nature of any proposed discharge, existing discharge, or material change therein, that could affect the quality of waters within the region. Any discharge of waste to high quality waters must apply best practicable treatment or control not only to prevent a condition of pollution or nuisance from occurring, but also to maintain the highest water quality possible consistent with the maximum benefit to the people of the State.

Pursuant to this policy, a Report of Waste Discharge, or any other similar technical report required by the Board pursuant to Water Code Section 13267, must include information regarding the nature and extent of the discharge and the potential for the discharge to affect surface or ground water quality in the region. This information must be presented as an analysis of the impacts and potential impacts of the discharge on water quality, as measured by background concentrations and applicable water quality objectives. The extent of information necessary will depend on the specific conditions of the discharge. For example, use of best professional judgment and limited available information may be sufficient to determine that ground or surface water will not be degraded. In addition, the discharger must identify treatment or control measures to be taken to minimize or prevent water quality degradation.

8. *Policy for Application of Water Quality Objectives*

Water quality objectives are defined in the Water Code as "the limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area". (see Chapter III). Water quality objectives may be stated in either numerical or narrative form. Water quality objectives apply to all waters within a surface water or ground water resource for which beneficial uses have been designated, rather than at an intake, wellhead or other point of consumption.

In conjunction with the issuance of NPDES and storm water permits, the Regional Water Board may designate mixing zones within which water quality objectives will not apply provided the discharger has demonstrated to the satisfaction of the Regional Water Board that the mixing zone will not adversely impact beneficial uses. If allowed, different mixing zones may be designated for different types of objectives, including, but not limited to, acute aquatic life objectives, chronic aquatic life objectives, human health objectives, and acute and chronic whole effluent toxicity objectives, depending in part on the averaging period over which the objectives apply. In determining the size of such mixing zones, the Regional Water Board will consider the applicable procedures and guidelines in EPA's Water Quality Standards Handbook and the Technical Support Document for Water Quality-based Toxics Control. Pursuant to EPA guidelines, mixing zones designated for acute aquatic life objectives will generally be limited to a small zone of initial dilution in the immediate vicinity of the discharge.

Where the Regional Water Board determines it is infeasible to achieve immediate compliance with water quality objectives adopted by the Regional Water Board or the State Water Board, or with water quality criteria adopted by the USEPA, or with an effluent limitation based on these objectives or criteria, the Regional Water Board may establish in NPDES permits a schedule of compliance. The schedule of compliance shall include a time schedule for completing specific actions that demonstrate reasonable progress toward the attainment of the objectives or criteria and shall contain a final compliance date, based on the shortest practicable time (determined by the Regional Water Board) required to achieve compliance. In no event shall an NPDES permit include a schedule of compliance that allows more than ten years (from the date of adoption of the objective or criteria) for compliance with water quality objectives, criteria or effluent limitations based on the objectives or criteria. Schedules of compliance are authorized by this provision only for those water quality objectives or criteria adopted after the effective date of this provision [25 September 1995].

State Water Board Resolution No. 68-16 requires the maintenance of the existing high quality of water (i.e., "background") unless a change in water quality "will be consistent with maximum benefit to the people of the State....". This policy explains how the Regional Water Board applies numerical and narrative water quality objectives to ensure the reasonable protection of beneficial uses of water and how the Regional Water Board applies Resolution No. 68-16 to promote the maintenance of existing high quality waters.

The numerical and narrative water quality objectives define the least stringent standards that the Regional Water board will apply to regional waters in order to protect beneficial uses. Numerical receiving water limitations will be established in Board orders for constituents and parameters which will, at a minimum, meet all applicable water quality objectives. However, the water quality objectives do not require improvement over naturally occurring background concentrations. In cases where the natural background concentration of a particular constituent exceeds an applicable water quality objective, the natural background concentration will be considered to comply with the objective. Consistent with Resolution No. 68-16, the Regional Water Board will impose more stringent numerical limitations (or prohibitions) which will maintain the existing quality of the receiving water, unless, pursuant to Resolution No. 68-16, some adverse change in water quality is allowed. Maintenance of the existing high quality of water means maintenance of "background" water quality conditions, i.e., the water quality found upstream or upgradient of the discharge, unaffected by other discharges. Therefore, the water quality objectives will define the least stringent limits which will be imposed and background defines the most stringent limits which will be imposed on ambient water quality.

This Basin Plan contains numerical water quality objectives for various constituents and parameters in Chapter III. Where numerical water quality objectives are listed, these are the limits necessary for the reasonable protection of beneficial uses of the water. In many instances, the Regional Water Board has not been able to adopt numerical water quality objectives for constituents or parameters, and instead has adopted narrative water quality objectives (e.g., for bacteria, chemical constituents, taste and odor, and toxicity). Where compliance with these narrative objectives is required (i.e., where the objectives are applicable to protect specified beneficial uses), the Regional Water Board will, on a case-by-case basis, adopt numerical limitations in orders which will implement the narrative objectives.

To evaluate compliance with the narrative water quality objectives, the Regional Water Board considers, on a case-by-case basis, direct evidence of beneficial use impacts, all material and relevant information submitted by the discharger and other interested parties, and relevant numerical criteria and guidelines developed and/or published by other agencies and organizations (e.g., State Water Board, California Department of Health Services, California Office of Environmental Health Hazard Assessment, California Department of Toxic Substances Control, University of California Cooperative Extension, California Department of Fish and Game, USEPA, U.S. Food and Drug Administration, National Academy of Sciences, U.S. Fish and Wildlife Service, Food and Agricultural Organization of the United Nations). In considering such criteria, the Board evaluates whether the specificnumerical criteria, which are available through these sources and through other information supplied to the Board, are relevant and appropriate to the situation at hand and, therefore, should be used in determining compliance with the narrative objective. For example, compliance with the narrative objective for taste and odor may be evaluated by comparing concentrations of pollutants in water with numerical taste and odor thresholds that have been published by other agencies. This technique provides relevant numerical limits for constituents and parameters which lack numerical water quality objectives. To assist dischargers and other interested parties, the Regional Water Board staff has compiled many of these numerical water quality criteria from other appropriate agencies and organizations in the Central Valley Regional Water Board's staff report, *A Compilation of Water Quality Goals*. This staff report is updated regularly to reflect changes in these numerical criteria.

Where multiple toxic pollutants exist together in water, the potential for toxicologic interactions exists. On a case by case basis, the Regional Water Board will evaluate available receiving water and effluent data to determine whether there is a reasonable potential for interactive

toxicity. Pollutants which are carcinogens or which manifest their toxic effects on the same organ systems or through similar mechanisms will generally be considered to have potentially additive toxicity. The following formula will be used to assist the Regional Water Board in making determinations:

$$\sum_{i=1}^{n} \frac{[\text{Concentration of Toxic Substance}]_i}{[\text{Toxicologic Limit for Substance in Water}]_i} < 1.0$$

The concentration of each toxic substance is divided by its toxicologic limit. The resulting ratios are added for substances having similar toxicologic effects and, separately, for carcinogens. If such a sum of ratios is less than one, an additive toxicity problem is assumed not to exist. If the summation is equal to or greater than one, the combination of chemicals is assumed to present an unacceptable level of toxicologic risk. For example, monitoring shows that ground water beneath a site has been degraded by three volatile organic chemicals, A, B, and C, in concentrations of 0.3, 0.4, and 0.04 µg/l, respectively. Toxicologic limits for these chemicals are 0.7, 3, and 0.06 µg/l, respectively. Individually, no chemical exceeds its toxicologic limit. However, an additive toxicity calculation shows:

$$\frac{0.3}{0.7} + \frac{0.4}{3} + \frac{0.04}{0.06} = 1.2$$

The sum of the ratios is greater than unity (>1.0); therefore, the additive toxicity criterion has been violated. The concentrations of chemicals A, B, and C together present a potentially unacceptable level of toxicity.

For permitting purposes, it is important to clearly define how compliance with the narrative toxicity objectives will be measured. Staff is currently working with the State Water Board to develop guidance on this issue.

9. *Policy for Investigation and Cleanup of Contaminated Sites*

The Regional Water Board's strategy for managing contaminated sites is guided by several important principles, which are based on Water Code Sections 13000 and 13304, the Title 23, CCR, Division 3, Chapter 15 and Title 27, CCR, Division 2, Subdivision 1 regulations and State Water Board Resolution Nos. 68-16 and 92-49:

a. State Water Board Policy & Regulation

The Regional Water Board will require conformance with the provisions of State Water Board Resolution No. 68-16 in all cases and will require conformance with applicable or relevant provisions of 23 CCR, Division 3, Chapter 15 and 27 CCR, Division 2, Subdivision 1 to the extent feasible. These provisions direct the Regional Water Board to ensure that dischargers are required to clean up and abate the effect of discharges in a manner that promotes attainment of background water quality, or the highest water quality which is reasonable and protective of beneficial uses if background levels of water quality cannot be restored.

b. Site Investigation

An investigation of soil and ground water to determine full horizontal and vertical extent of pollution is necessary to ensure that cleanup plans are protective of water quality. The goal of the investigation shall be to determine where concentrations of constituents of concern exceed beneficial use protective levels (water quality objectives) and, additionally, where constituents of concern exceed background levels (the zero-impact line). Investigations shall extend off-site as necessary to determine the full extent of the impact.

c. Source Removal/Containment

Immediate removal or containment of the source, to the extent practicable, should be implemented where necessary to prevent further spread of pollution as well as being among the most cost-effective remediation actions. The effectiveness of ground water cleanup techniques often depends largely on the completeness of source removal or containment efforts (e.g., removal of significantly contaminated soil or pockets of dense non-aqueous phase liquids).

d. Cleanup Level Approval

Ground water and soil cleanup levels are approved by the Regional Water Board. The Executive Officer may approve cleanup levels as appropriately delegated by the Board.

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e. Site Specificity

Given the extreme variability of hydrogeologic conditions in the Region, cleanup levels must reflect site-specific factors.

f. Discharger Submittals

The discharger must submit the following information for consideration by the Regional Water Board in establishing cleanup levels which meet the criteria contained in 23 CCR Section 2550.4(c) through (g):

i. water quality assessment to determine impacts and threats to the quality of water resources;

ii. risk assessment to determine impacts and threats to human health and the environment; and

iii. feasibility study of cleanup alternatives which compare effectiveness, cost, and time to achieve cleanup levels. Cleanup levels covered by this study shall include, at a minimum, background levels, levels which meet all applicable water quality objectives and which do not pose significant risks to health or the environment, and an alternate cleanup level which is above background levels and which also meets the requirements as specified in paragraphs g. (*v*) and (*vi*) below.

g. Ground Water Cleanup Levels

Ground water cleanup levels shall be established based on:

i. background concentrations of individual pollutants;

ii. applicable water quality objectives to protect designated beneficial uses of the water body, as listed in Chapters II and III;

iii. concentrations which do not pose a significant risk to human health or the environment, considering risks from toxic constituents to be additive across all media of exposure and, in the absence of scientifically valid data to the contrary, additive for all constituents having similar toxicologic effects or having carcinogenic effects; and

iv. technologic and economic feasibility of attaining background concentrations and of attaining concentrations lower than defined by (*ii*) and (*iii*) above.

Factors in (*i*) through (*iv*) above are used to establish ground water cleanup levels according to the following principles:

v. Pursuant to 23 CCR Section 2550.4, the Regional Water Board establishes cleanup levels that are protective of human health, the environment and beneficial uses of waters of the state, as measured by compliance with (*ii*) and (*iii*) above, and are equal to background concentrations if background levels are technologically and economically feasible to achieve. If background levels are infeasible to achieve, cleanup levels are set between background concentrations and concentrations that meet all criteria in (*ii*) and (*iii*) above. Within this concentration range, cleanup levels must be set at the lowest concentrations that are technologically and economically achievable. In no case are cleanup levels established below natural background concentrations.

vi. Technologic feasibility is determined by assessing the availability of technologies which have been shown to be effective in reducing the concentrations of the constituents of concern to the established cleanup levels. Bench-scale and/or pilot-scale studies may be necessary to make this feasibility assessment in the context of constituent, hydrogeologic, and other site-specific factors. Economic feasibility does not refer to the subjective measurement of the ability of the discharger to pay the costs of cleanup, but rather to the objective balancing of the incremental benefit of attaining more stringent levels of constituents of concern as compared with the incremental cost of achieving

those levels. Factors to be considered in the establishment of cleanup levels greater than background are listed in 23 CCR, Section 2550.4(d). The discharger's ability to pay is one factor to be considered in determining whether the cleanup level is *reasonable*. However, availability of economic resources to the discharger is primarily considered in establishing reasonable schedules for compliance with cleanup levels.

vii. Compliance with (*iii*) above shall be determined through risk assessments performed by the discharger, using the most current procedures authorized by the Department of Toxic Substances Control, the Office of Environmental Health Hazard Assessment, or the USEPA. The Regional Water Board is not the lead agency for specifying risk assessment procedures or for reviewing risk assessments. The Board will assist the discharger, as necessary, in obtaining the appropriate, most current procedures from the above listed agencies. To prevent duplication of effort, the Board will rely on the Department of Toxic Substances Control, the Office of Environmental Health Hazard Assessment, or appropriately designated local health agencies to review and evaluate the adequacy of health and environmental risk assessments. The Board will assist the discharger, as necessary, in determining which of these agencies will review the risk assessments for a particular site. Priority will be given to those agencies that are already involved with the assessment and cleanup of the site.

h. Compliance with Ground Water Cleanup Levels

To protect potential beneficial uses of the water resource as required by Water Code Sections 13000 and 13241, compliance with ground water cleanup levels must occur throughout the pollutant plume.

i. Modifying Ground Water Cleanup Levels

The Regional Water Board may consider modifying site-specific ground water cleanup levels (that have been determined pursuant to subsection (g) above) that are more stringent than applicable water quality objectives, only when a final remedial action plan has been pursued in good faith, and all of the following conditions are met:

i. Modified cleanup levels meet the conditions listed in g(*ii*) and (*iii*) above

ii. An approved cleanup program has been fully implemented and operated for a period of time which is adequate to understand the hydrogeology of the site, pollutant dynamics, and the effectiveness of available cleanup technologies;

iii. Adequate source removal and/or isolation is undertaken to eliminate or significantly reduce future migration of constituents of concern to ground water;

iv. The discharger has demonstrated that no significant pollutant migration will occur to other underlying or adjacent aquifers;

v. Ground water pollutant concentrations have reached asymptotic levels using appropriate technology;

vi. Optimization of the existing technology has occurred and new technologies have been evaluated and applied where economically and technologically feasible; and

vii. Alternative technologies for achieving lower constituent levels have been evaluated and are inappropriate or not economically feasible.

j. Soil Cleanup Levels

For soils which threaten the quality of water resources, soil cleanup levels should be equal to background concentrations of the individual leachable/mobile constituents, unless background levels are technologically or economically infeasible to achieve. Where background levels are infeasible to achieve, soil cleanup levels are established to ensure that remaining leachable/mobile

constituents of concern will not threaten to cause ground water to exceed applicable ground water cleanup levels, and that remaining constituents do not pose significant risks to health or the environment. The Regional Water Board will consider water quality, health, and environmental risk assessment methods, as long as such methods are based on site-specific field data, are technically sound, and promote attainment of all of the above principles.

k. Verification of Soil Cleanup

Verification of soil cleanup generally requires verification sampling and follow-up ground water monitoring. The degree of required monitoring will reflect the amount of uncertainty associated with the soil cleanup level selection process. Follow-up ground water monitoring may be limited where residual concentrations of leachable/mobile constituents in soils are not expected to impact ground water quality.

l. Remaining Constituents

Where leachable/mobile concentrations of constituents of concern remain on-site in concentrations which threaten water quality, the Regional Water Board will require implementation of applicable provisions of Title 23, CCR, Division 3 Chapter 15 and Title 27, CCR, Division 2, Subdivision 1. Relevant provisions of Title 23, CCR, Division 3 Chapter 15 and Title 27, CCR, Division 2, Subdivision 1 which may not be directly applicable, but which address situations similar to those addressed at the cleanup site will be implemented to the extent feasible, in conformance with Title 23, CCR, Section 2511(d)/27 CCR, Section 20090(d). This may include, but is not limited to, surface or subsurface barriers or other containment systems, waste immobilization, toxicity reduction, and financial assurances.

10. *Policy for Obtaining Salt Balance in the San Joaquin Valley*

It is the policy of the Regional Water Board to encourage construction of facilities to convey agricultural drain water from the San Joaquin and Tulare Basins. A valley-wide conveyance facility for agricultural drain waters impaired by high levels of salt is the only feasible, long-range solution for achieving a salt balance in the Central Valley.

11. *Watershed Policy*

The Regional Water Board supports implementing a watershed based approach to addressing water quality problems. The State and Regional Water Boards are in the process of developing a proposal for integrating a watershed approach into the Board's programs. The benefits to implementing a watershed based program would include gaining participation of stakeholders and focusing efforts on the most important problems and those sources contributing most significantly to those problems.

Regional Water Board Memoranda of Understanding (MOU) and Memoranda of Agreement (MOA)

1. *U.S. Bureau of Land Management*

In September 1985, the Regional Water Board Executive Officer signed MOUs with the three U.S. Bureau of Land Management Districts in the Central Valley (i.e., the Ukiah District, the Susanville District, and the Bakersfield District). The MOUs, which are identical for each District, aim at improving coordination between the two agencies for the control of water quality problems resulting from mineral extraction activities on BLM administered lands. See Appendix Items 26 through 28.

2. *U. S. Bureau of Reclamation Agreement*

On 2 July 1969, the Regional Water Board signed an MOA with the Bureau of Reclamation to schedule water releases from the New Melones Unit of the Central Valley Project to maintain an oxygen level at or above 5 mg/l in the Stanislaus River downstream of the unit and to not exceed a mean monthly TDS concentration of 500 mg/l in the San Joaquin River immediately below the mouth of the Stanislaus River. The MOA's water quality requirements are subject to some conditions. See Appendix Item 29.

3. *California Department of Fish and Game and Mosquito Abatement and Vector Control Districts of the South San Joaquin Valley*

On 25 February 1993, the Regional Water Board Executive Officer signed an MOU with the California Department of Fish and Game and 11 mosquito abatement and vector control districts of the south

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San Joaquin valley regarding vegetation management in wastewater treatment facilities. The MOU designates the Districts as lead agencies in determining the adequacy of vegetation management operations in abating mosquito breeding sources. Included in the MOU are the definition of vegetative management operations and conditions to protect nesting birds, eggs, and nests. See Appendix Item 30.

Regional Water Board Waivers

State law allows Regional Water Boards to conditionally waive WDRs for a specific discharge or types of discharges where the waiver is consistent with any applicable state or regional water quality control plan and it is in the public interest. A waiver may not exceed five years in duration, but may be renewed by a Regional Water Board. Waiver conditions must include monitoring requirements unless the Regional Water Board determines that the discharge does not pose a significant threat to water quality. Prior to renewing any waiver for a specific type of discharge, the Regional Water Board shall review the terms of the waiver policy at a public hearing. At the hearing, the Regional Water Board shall determine whether the discharge for which the waiver policy was established should be subject to general or individual waste discharge requirements. (Water Code Section 13269)

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The Regional Water Board may, after compliance with the California Environmental Quality Act (CEQA), allow short-term variances from Basin Plan provisions, if determined to be necessary to implement control measures for vector and weed control, pest eradication, or fishery management which are being conducted to fulfill statutory requirements under California's Fish and Game, Food and Agriculture, or Health and Safety Codes. In order for the Regional Water Board to determine if a variance is appropriate, agencies proposing such activities must submit to the Regional Water Board project-specific information, including measures to mitigate adverse impacts.

Regional Water Board Prohibitions

The Porter-Cologne Water Quality Control Act allows the Regional Water Board to prohibit certain discharges (Water Code Section 13243). Prohibitions may be revised, rescinded, or adopted as necessary. The prohibitions applicable to the Sacramento and San Joaquin River Basins are identified and described below.

[NOTE: Costs incurred by any unit of local government for a new program or increased level of service for compliance with discharge prohibitions in the Basin Plan do not require reimbursement by the State per Section 2231 of the Revenue and Taxation Code, because the Basin Plan implements a mandate previously enacted by statute, Chapter 482, Statutes of 1969.]

1. *Water Bodies*

   Water bodies for which the Regional Water Board has held that the direct discharge of wastes is inappropriate as a permanent disposal method include sloughs and streams with intermittent flow or limited dilution capacity. The direct discharge of municipal and industrial wastes (excluding storm water discharges) into the following specific water bodies has been prohibited, as noted:

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American River, including Lake Natoma (from Folsom Dam to mouth)

Clear Lake

Folsom Lake

Fourteen Mile Slough at Stockton N.W. and Lincoln Village

Lake Berryessa

Middle Fork, Feather River (from Dellecker to Lake Oroville)

Lake Oroville

Sacramento River (from confluence with the Feather River to the Freeport Bridge). [Note: There are two exceptions, (1) discharges of combined municipal waste and storm runoff flow from the City of Sacramento, and (2) discharges of treated/disinfected municipal waste from the City of West Sacramento when the City's Clarksburg outfall line is at its maximum hydraulic capacity and when Sacramento River flow is greater than 80,000 cfs, are not subject to the prohibition. The discharges are to be controlled through waste discharge requirements.]

Sacramento Ship Channel and Turning Basin

Shasta Lake

Sugar Cut at Tracy

Thermalito Forebay and Afterbay

Tulloch Reservoir

Whiskeytown Reservoir

Willow Creek-Bass Lake in Madera County (the prohibition is for sewage effluent only)

2. *Leaching Systems*

Discharge of wastes from new and existing leaching and percolation systems has been prohibited by the Regional Water Board in the following areas:

Amador City, Amador County (Adopted by Regional Water Board Order No. 73-129; effective as of 12/15/72)

Martell Area, Amador County (73-129; 12/15/72)

Shasta Dam Area Public Utilities District, Shasta County (73-129; 12/15/72)

Vallecito Area, Calaveras County (73-129; 12/15/72)

West Point Area, Calaveras County (73-129; 12/15/72)

Celeste Subdivision Area, Merced County (73-129; 12/15/72)

Snelling Area, Merced County (73-129; 12/15/72, and amended 74-126; 12/14/73)

North San Juan, Nevada County (74-123; 12/14/73)

Arnold Area, Calaveras County (74-124, 75-180; 12/14/73, 6/25/75)

Contra Costa County Sanitation District No. 15, Contra Costa County (74-125; 12/14/73)

Madera County Service Area No. 2, Bass Lake (74-127; 12/14/73)

Madera County Service Area No. 3, Parksdale (74-128; 12/14/73)

Coulterville County Service Area No. 1, Mariposa County (75-070; 3/21/75)

Midway Community Services District, Merced County (75-072; 3/21/75)

Adin Community Services District, Modoc County (75-272 11/21/75)

Fall River Mills, Community Services District, Shasta County (75-273; 11/21/75)

Bell Road Community, including Panorama and Pearl, Placer County (75-274; 11/21/75)

Nice and Lucerne, Lake County (76-58; 2/27/76)

Courtland Sanitation District, Sacramento County (76-59; 2/27/76)
Six-Mile Village, Calaveras County (76-60; 2/27/76)

Communities of Clearlake Highlands and Clearlake Park, Lake County (76-89; 3/26/76)

Taylorsville County Service Area, Plumas County (76-129; 5/28/76)

Community of South Lakeshore Assessment District, Lake County (76-215; 9/24/76)

Anderson-Cottonwood Irrigation District, Community of Cottonwood, Shasta County (76-230; 10/22/76)

Daphnedale Area, Modoc County (76-231; 10/22/76)

Chico Urban Area, Butte County (90-126; 4/27/90)

3. *Petroleum*

The Regional Water Board has prohibited the discharge of oil or any residuary product of petroleum to the waters of the State, except in accordance with waste discharge requirements or other provisions of Division 7, California Water Code.

4. *Vessel Wastes*

The Regional Water Board has prohibited the discharge of toilet wastes from the vessels of all houseboat rental businesses on Shasta Lake, Clear Lake, and the Delta.

5. *Pesticides*

Effective immediately for molinate and thiobencarb and on 1 January 1991 for carbofuran, malathion and methyl parathion, the discharge of irrigation return flows containing these pesticides is prohibited unless the discharger is following a management practice approved by the Board. Proposed management practices for these pesticides will not be approved unless they are expected to meet the performance goals contained in the following table. Also, the management practices must ensure that discharges of thiobencarb to waters designated as municipal or domestic water supplies will comply with the 1.0 µg/l water quality objective for this pesticide. It is important to note that the performance goals in this timetable are interim in nature and while they are based on the best available information, they are not to be equated with concentrations that meet the water quality objectives. The intent of the performance goals is to bring concentrations being found in surface waters down to levels that approach compliance with the objectives. Future performance goals and numerical objectives will be set using the results of ongoing evaluations of the risks posed by these pesticides. Future performance goals may also be site-specific to take into consideration the additive impacts of more than one pesticide being present in a water body at the same time. The Board will reexamine the progress of the control effort for these pesticides in 1993 and will set performance goals intended to bring concentrations of these five pesticides into full compliance with all objectives by 1995.

Performance Goals[1] for Management Practices in µg/l

	YEAR			
Pesticide	1990	1991	1992	1993
Carbofuran	D	0.4	0.4	R
Malathion	I	0.1	R	R
Molinate	30.0	20.0	10.0	R
Methyl parathion	D	0.26	0.13	R
Thiobencarb	3.0	1.5	R	R

[1] Performance goals are daily maxima and apply to all waters designated as freshwater habitat.

D = No numerical goal - control practices under development

I = No numerical goal - sources of discharge to be identified by special study

R = The Regional Board will review the latest technical and economic information determine if the performance goal should be adjusted

6. *San Joaquin River Subsurface Agricultural Drainage*

a. The discharge of agricultural subsurface drainage from the Grassland watershed to the San Joaquin River or its tributaries from any on-farm subsurface drain, open drain, or similar drain system is prohibited, unless such discharge began prior to the effective date of this amendment (10 January 1997) or unless such discharge is governed by waste discharge requirements.

b. The discharge of agricultural subsurface drainage water to Salt Slough and wetland water supply channels identified in Appendix 40 is prohibited after 10 January 1997, unless water quality objectives for selenium are being met. This prohibition may be reconsidered if public or private interests prevent the implementation of a separate conveyance facility for agricultural subsurface drainage.

c. The discharge of agricultural subsurface drainage water to Mud Slough (north) and the San Joaquin River from Sack Dam to the mouth of the Merced River is prohibited after 1 October 2010, unless water quality objectives for selenium are being met. This prohibition may be reconsidered if public or private interests prevent the implementation of a separate conveyance facility for agricultural subsurface drainage to the San Joaquin River.

d. The discharge of selenium from agricultural subsurface drainage systems in the Grassland watershed to the San Joaquin River is prohibited in amounts exceeding 8,000 lbs/year for all water year types beginning 10 January 1997.

e. Activities that increase the discharge of poor quality agricultural subsurface drainage are prohibited.

7. *Diazinon and Chlorpyrifos Discharges into the Sacramento and Feather Rivers*

Beginning August 11, 2008, the direct or indirect discharge of diazinon or chlorpyrifos into the Sacramento and Feather Rivers is prohibited if, in the previous year (July-June), any exceedance of the diazinon or chlorpyrifos water quality objectives, or diaxinon and chlorpyrifos loading capacity occurred.

These prohibitions do not apply if the discharge of diazinon or chlorpyrifos is subject to a waiver of waste discharge requirements implementing the diazinon and chlorpyrifos water quality objectives and load allocations for diazinon and chlorpyrifos for the Sacramento and Feather Rivers, or governed by individual or general waste discharge requirements.

These prohibitions apply only to dischargers causing or contributing to the exceedance of the water quality objective or loading capacity.

8. *Dissolved Oxygen in the Stockton Deep Water Ship Channel(DWSC)*

The discharge of oxygen demanding substances or their precursors into waters tributary to the DWSC portion of the San Joaquin River is prohibited after 31 December 2011 when net daily flow in the DWSC portion of the San Joaquin River in the vicinity of Stockton is less than 3,000 cubic feet per second, unless dissolved oxygen objectives in the DWSC are being met.

Any increase in the discharge of oxygen demanding substances or their precursors into waters tributary to the DWSC portion of the San Joaquin River is prohibited after 23 August 2006.

These prohibitions do not apply if the discharge is regulated by a waiver of waste discharge requirements, or individual or general waste discharge requirements or NPDES permits, which implement the *Control Program for Factors Contributing to the Dissolved Oxygen Impairment in the Stockton Deep Water Ship Channel* or which include a finding that the discharge will have no reasonable potential to cause or contribute to a negative impact on the dissolved oxygen impairment in the DWSC. These prohibitions will be reconsidered by the Regional Water Board by December 2009 based on:

a) the results of the oxygen demand and precursor studies required in the *Control Program for Factors Contributing to the Dissolved Oxygen Impairment in the Stockton Deep Water Ship Channel*

b) the prevailing dissolved oxygen conditions in the DWSC

9. *Control of Diazinon and Chlorpyrifos Runoff into the San Joaquin River*

Beginning 1 December 2010, the direct or indirect discharge of diazinon or chlorpyrifos into the San Joaquin River is prohibited during the dormant season (1 December through 1 March) if any exceedance of the chlorpyrifos or diazinon water quality objectives, or diazinon and chlorpyrifos loading capacity occurred during the previous dormant season.

Beginning 2 March 2011, the direct or indirect discharge of diazinon or chlorpyrifos into the

San Joaquin River is prohibited during the irrigation season (2 March through 30 November) if any exceedance of the chlorpyrifos or diazinon water quality objectives, or diazinon and chlorpyrifos loading capacity occurred during the previous irrigation season.

These prohibitions apply only to i) dischargers who discharge the pollutant causing or contributing to the exceedance of the water quality objective or loading capacity; and ii) dischargers located in those subareas not meeting their load allocations.

These prohibitions do not apply if the discharge of diazinon or chlorpyrifos is subject to a waiver of waste discharge requirements implementing the diazinon and chlorpyrifos water quality objectives and load allocations for diazinon and chlorpyrifos for the San Joaquin River, or governed by individual or general waste discharge requirements.

10. *Control of Diazinon and Chlorpyrifos Runoff into Delta Waterways (as identified in Appendi42)*

    Beginning December 1, 2011, the direct or indirect discharge of diazinon or chlorpyrifos into Delta Waterways is prohibited during the dormant season (1 December through 1 March) if any exceedance of the chlorpyrifos or diazinon water quality objectives, or diazinon and chlorpyrifos loading capacity occurred during the previous dormant season.

    Beginning March 2, 2012, the direct or indirect discharge of diazinon or chlorpyrifos into Delta Waterways is prohibited during the irrigation season (2 March through 30 November) if any exceedance of the chlorpyrifos or diazinon water quality objectives, or diazinon and chlorpyrifos loading capacity occurred during the previous irrigation season.

    These prohibitions do not apply if the discharge of diazinon or chlorpyrifos is subject to a waiver of waste discharge requirements implementing the diazinon and chlorpyrifos water quality objectives and load allocations for diazinon and chlorpyrifos for the Delta Waterways, or governed by individual or general waste discharge requirements.

    These prohibitions apply only to dischargers causing or contributing to the exceedance of the water quality objective or loading capacity.

    These prohibitions do not apply to direct or indirect discharges to the Sacramento or San Joaquin Rivers upstream of the legal boundary of the Delta (as defined in Section 12220 of the California Water Code).

Regional Water Board Guidelines

The Regional Water Board has adopted guidance for certain types of dischargers which is designed to reduce the possibility that water quality will be impaired. The Regional Water Board may still impose discharge requirements. All of the Guidelines are contained in the Appendix (Items 33 through 37). Currently, the following Guidelines apply to the Sacramento and San Joaquin River Basins:

1. *Wineries*

   This Guideline contains criteria for protecting beneficial uses and preventing nuisance from the disposal to land of stillage wastes.

2. *Erosion and Sedimentation*

   This Guideline identifies practices to be implemented by local government to reduce erosion and sedimentation from construction activities.

3. *Small Hydroelectric Facilities*

   This Guideline specifies measures to protect water quality from temperature, turbidity, and dissolved oxygen effects from the construction and operation of small hydroelectric Facilities.

4. *Disposal from Land Developments*

   This Guideline contains criteria for the siting of septic tanks, sewer lines, leach fields, and seepage pits to protect water quality.

5. *Mining*

   This Guideline identifies actions that the Regional Water Board takes to address the water quality problems associated with mining. It requires owners and operators of active mines to prepare plans for closure and reclamation, but it does not specify any practices or criteria for mine operators.

Nonpoint Source Action Plans

Section 208 of the 1972 Amendments to the Federal Clean Water Act resulted in monies being made available to states to address nonpoint source problems. The Regional Water Board used 208 grant funds to develop its mining and erosion/sedimentation guidelines, among other things. It also encouraged local governments to make use of the 208 program. As a result, several counties in the sub-basins developed action plans to control nonpoint source problems which affected them. The Regional Water Board action plans are described in Table IV-2

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TABLE IV-2
NONPOINT SOURCE ACTION PLANS

LOCATION	RECOMMENDED ACTION
Shasta County	Best Management Practices (BMPs) for control of erosion from land development (adopted 1980)
Nevada County	BMPs for erosion and individual wastewater disposal systems (adopted 1980)
Placer County	BMPs for erosion and installation of individual wastewater disposal systems (adopted 1980)
Lake County	BMPs for erosion and creek bed management (adopted 1979)
Communities of Paradise and Magalia (Butte County)	BMPs for wastewater management (adopted 1979)
Solano County	BMPs for surface water runoff (adopted 1979)
Upper Putah Creek Watershed (Lake, Napa Counties)	Strategies and recommendations for addressing problems from geothermal development, abandoned mines, and individual wastewater disposal systems (adopted 1981)
Fall River (Shasta County)	BMPs for livestock grazing and individual wastewater disposal systems (adopted 1982)
Plumas County	BMPs for erosion control (adopted 1980)
Mariposa County	BMPs for individual wastewater disposal systems for area north of the community of Mariposa; BMPs for erosion and sedimentation in the Stockton Creek Watershed (adopted 1979)
Merced County	Lake Yosemite Area -- BMPs for individual wastewater disposal systems (adopted 1979)

ACTIONS RECOMMENDED FOR IMPLEMENTATION BY OTHER ENTITIES

Consistent with the Porter-Cologne Water Quality Control Act, the Basin Plan may identify control actions recommended for implementation by agencies other than the Regional Water Board [Water Code Section 13242(a)].

Recommended for Implementation by the State Water Board

Interbasin Transfer of Water

Before granting new permits for water storage or diversion which involves interbasin transfer of water, the State Water Board should require the applicant to evaluate the alternatives listed below. Permits should not be approved unless the alternatives have been thoroughly investigated and ruled out for social, environmental, or economic reasons.

1. In situations where wastewater is discharged to marine waters without intervening beneficial use (for example, the San Francisco Bay Area and most of Southern California), increase the

efficiency of municipal, industrial, and agricultural water use.

2. Make optimum use of existing water resource facilities.

3. Store what would otherwise be surplus wet-weather Delta outflows in off-stream reservoirs.

4. Conjunctively use surface and ground waters.

5. Give careful consideration to the impact on basin water quality of inland siting of power plants.
6. Make maximum use of reclaimed water while protecting public health and avoiding severe economic penalties to a particular user or class of users.

Trans-Delta Water Conveyance

The State Water Board should adopt the position that those proposing trans-Delta water conveyance facilities must clearly demonstrate the following, if such a facility is constructed:

1. Protection of all beneficial uses in the Delta that may be affected by such a facility;

2. Protection of all established water quality objectives that may be affected by such a facility; and,

3. Adherence to the six alternatives previously identified for Interbasin Transfer of Water.

Water Quality Planning

A core planning group has been established within the staff of the State Water Board, which has the responsibility to integrate the statewide planning of water quality and water resources management.

Water Intake Studies

The State Water Board should coordinate studies to assess the costs and benefits of moving planned diversions from the eastern side of the Central Valley to points further west, probably to the Delta, to allow east side waters to flow downstream for uses of fishery enhancement, recreation, and quality control. Specific study items should include:

1. Possible intake relocations;

2. Conveyance and treatment required to accommodate such relocations;

3. Direct and indirect (including consumer and environmental) costs and benefits of relocation; and,

4. Institutional problems.

The State Water Board should request voluntary participation in the studies by agencies planning diversions, but should take appropriate action through its water rights authority if such participation cannot be obtained. At a minimum, participation would be required of the San Francisco Water Department and East Bay Municipal Utility District.

Subsurface Agricultural Drainage

1. The Regional Board will request that the State Water Board use its water rights authority to preclude the supplying of water to specific lands, if water quality objectives are not met by the specified compliance dates and Regional Board administrative remedies fail to achieve compliance.

2. The State Water Board should work jointly with the Regional Water Board in securing compliance with the 2 µg/l selenium objective for managed- wetlands in the Grassland area.

3. The State Water Board should also consider grant funds to implement a cost share program to install a number of flow monitoring stations within the Grassland area to assist in better defining the movement of pollutants through the area.

4. The State Water Board should continue to consider the Drainage Problem Area in the San Joaquin Basin and the upper Panoche watershed (in the Tulare Basin) as priority nonpoint source problems in order to make USEPA nonpoint source control funding available to the area.

5. The State Water Board should seek funding for research and demonstration of advanced technology that will be needed to achieve final selenium loads necessary to meet selenium water quality objectives.

Salt and Boron in the Lower San Joaquin River

1. The State Water Board should consider the continued use of its water rights authority to prohibit water transfers if the transfer contributes to low flows and related salinity water quality impairment in the Lower San Joaquin River.

2. The State Water Board should consider the continued conditioning of water rights on the attainment of existing and new water quality objectives for salinity in the Lower San Joaquin River, when these objectives cannot be met through discharge controls alone.

Dissolved Oxygen in the Stockton Deep Water Ship Channel (DWSC)

1. The State Water Board should consider amending water right permits for existing activities that reduce flow through the DWSC to require that the associated impacts on excess net oxygen demand conditions in the DWSC be evaluated and their impacts reduced in accordance with the *Control Program for Factors Contributing to the Dissolved Oxygen Impairment in the DWSC*.

2. The State Water Board should consider requiring evaluation and full mitigation of the potential impacts of future water right permits or water transfer applications on reduced flow and excess net oxygen demand conditions in the DWSC.

Delta Mercury

1. The State Water Board should consider requiring methylmercury controls for new water management activities that have the potential to increase ambient methylmercury levels as a condition of approval of any water right action required to implement the project. The State Water Board Division of Water Rights should consider requiring the evaluation and implementation of feasible management practices to reduce or, at a minimum, prevent methylmercury ambient levels from increasing from those changes in water management activities and flood conveyance projects that have the potential to increase methylmercury levels. The State Water Board should consider funding or conducting studies to develop and evaluate management practices to reduce methylmercury production resulting from existing water management activities or flood conveyance projects.

2. During future reviews of the salinity objectives contained in the Bay-Delta Plan, the State Water Board Division of Water Rights should consider conducting studies to determine whether proposed changes to salinity objectives could affect methylmercury production and should consider the results of these studies in evaluating changes to the salinity objectives.

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Recommended for Implementation by Other Agencies

Water Resources Facilities

1. Consideration should be given to the construction of a storage facility to store surplus wet-weather Delta outflows. Construction should be contingent on studies demonstrating that some portion of wet-weather Delta outflow is truly surplus to the Bay-Delta system.

2. Consideration should be given to the use of excess capacity in west San Joaquin Valley conveyances, or of using a new east valley conveyance to:

   a. Augment flows and improve water quality in the San Joaquin River and southern Delta with the goal of achieving water quality as described in Table IV-3.

TABLE IV-3

	TYPE PF YEAR[1]			
TDS MG/L	CRITICAL[2]	DRY[3]	NORMAL	WET[4]
Max. 3-day (arith. avg.)	500	500	500	500
Maximum (annual avg.)	385	385	385	285
Max. May-Sep (arith. avg.)	300	250	250	250
Max. 3-Day May-Sep (arith Avg.)	450	350	350	350

1 Relative to unimpaired runoff to Delta Based on 1922 - 1971 period. See definitions in Figure III-2
2 Less than 57% , or less than 70% when preceding year critical
3 Less than 70%, or less than 90% when preceding year critical
4 Greater than 125%

   b. Prevent further ground water overdrafts and associated quality problems.

3. Agencies responsible for existing water resources facilities that reduce flow through the Stockton Deep Water Ship Channel (DWSC) should evaluate and reduce their impacts on excess net oxygen demand conditions in the DWSC in accordance with the *Control Program for Factors Contributing to the Dissolved Oxygen Impairment in the DWSC*.

4. Agencies responsible for future water resources facilities projects, which potentially reduce flow through the DWSC, should evaluate and fully mitigate the potential negative impacts on excess net oxygen demand conditions in the DWSC.

Agricultural Drainage Facilities

Facilities should be constructed to convey agricultural drain water from the San Joaquin and Tulare Basins. It is the policy of the Regional Water Board to encourage construction. The discharge must comply with water quality objectives of the receiving water body.

Subsurface Agricultural Drainage

1. The entire drainage issue is being handled as a watershed management issue. The entities in the Drainage Problem Area and entities within the remainder of the Grassland watershed need to

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establish a regional entity with authority and responsibility for drain water management.

2. The regional drainage entity and agricultural water districts should consider adopting economic incentive programs as a component of their plans to reduce pollutant loads. Economic incentives can be an effective institutional means of promoting on-farm changes in drainage and water management.

3. If fragmentation of the parties that generate, handle and discharge agricultural subsurface drainage jeopardizes the achievement of water quality objectives, the Regional Water Board will consider petitioning the Legislature for the formation of a regional drainage district.

4. The Legislature should consider putting additional bond issues before the voters to provide low interest loans for agricultural water conservation and water quality projects and incorporating provisions that would allow recipients to be private landowners, and that would allow irrigation efficiency improvement projects that reduce drainage discharges to be eligible for both water conservation funds and water quality facilities funds.

5. The San Joaquin Valley Drainage Implementation Program or other appropriate agencies should continue to investigate the alternative of a San Joaquin River Basin drain to move the existing discharge point for poor quality agricultural subsurface drainage to a location where its impact on water quality is less.

6. The selenium water quality objective for the wetland channels can not be achieved without removal of drainage water from these channels. The present use of the Grassland channels has developed over a 30-year period through agreements between the dischargers, water and irrigation districts, the U.S. Bureau of Reclamation, the California Department of Water Resources, the U.S. Fish and Wildlife Service, the California Department of Fish and Game, the Grassland Water District and the Grassland Resource Conservation District. Because each entity shared in the development of the present drainage routing system, each shares the responsibility for implementation of a wetlands bypass.

Stockton Deep Water Ship Channel (DWSC)

1. The U.S. Army Corps of Engineers should reduce the impacts of the existing DWSC geometry on excess net oxygen demand conditions in accordance with the *Control Program for Factors Contributing to the Dissolved Oxygen Impairment in the DWSC*.

Delta Mercury

1. USEPA and the California Air Resources Board should work with the State Water Board and develop a memorandum of understanding to evaluate local and statewide mercury air emissions and deposition patterns and to develop a load reduction program(s).

2. The State of California should establish the means to fund a portion of the mercury control projects in the Delta and upstream watersheds.

3. Watershed stakeholders are encouraged to identify total mercury and methylmercury reduction projects and propose and conduct projects to reduce upstream non-point sources of methylmercury and total mercury. The Regional Water Board recommends that state and federal grant programs give priority to projects that reduce upstream non-point sources of methylmercury and total mercury.

4. Dischargers may evaluate imposed administrative civil liabilities projects for total mercury and methylmercury discharge and exposure reduction projects, consistent with Supplemental Environmental Project policies.

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CONTINUOUS PLANNING FOR IMPLEMENTATION OF WATER QUALITY CONTROL

In order to effectively protect beneficial uses, the Regional Water Board updates the Basin Plan regularly in response to changing water quality conditions. The Regional Water Board is periodically apprised of water quality problems in the Sacramento and San Joaquin River Basins, but the major review of water quality is done every three years as part of the Triennial Review of water quality standards.
During the triennial review, the Regional Water Board holds a public hearing to receive comments on actual and potential water quality problems. A workplan is prepared which identifies the control actions that will be implemented over the succeeding three years to address the problems. The actions may include or result in revision of the Basin Plan's water quality standards if that is an appropriate problem remedy. Until such time that a basin plan is revised, the triennial review also serves to reaffirm existing standards.

The control actions that are identified through the triennial review process are incorporated into the Basin Plan to meet requirements to describe actions (to achieve objectives) and a time schedule of their implementation as called for in the Water Code, Section 13242(a) and (b). The actions recommended in the most recent triennial review are described in the following section.

ACTIONS AND SCHEDULE TO ACHIEVE WATER QUALITY OBJECTIVES

Agricultural Drainage Discharges in the San Joaquin River Basin

Water quality in the San Joaquin River has degraded significantly since the late 1940s. During this period, salt concentrations in the River, near Vernalis, have doubled. Concentrations of boron, selenium, molybdenum and other trace elements have also increased. These increases are primarily due to reservoir development on the east side tributaries and upper basin for agricultural development, the use of poorer quality, higher salinity, Delta water in lieu of San Joaquin River water on west side agricultural lands and drainage from upslope saline soils on the west side of the San Joaquin Valley. Point source discharges to surface waters only contribute a small fraction of the total salt and boron loads in the San Joaquin River.

The water quality degradation in the River was identified in the 1975 Basin Plan and the Lower San Joaquin River was classified as a Water Quality Limited Segment. At that time, it was envisioned that a Valley-wide Drain would be developed and these subsurface drainage water flows would then be discharged outside the Basin, thus improving River water quality. However, present day development is looking more toward a regional solution to the drainage water discharge problem rather than a valley-wide drain.

Because of the need to manage salt and other pollutants in the River, the Regional Water Board began developing a Regional Drainage Water Disposal Plan for the Basin. The development began in FY 87/88 when Basin Plan amendments were considered by the Water Board in FY 88/89. The amendment development process included review of beneficial uses, establishment of water quality objectives, and preparation of a regulatory plan, including a full implementation plan. The regulatory plan emphasized achieving objectives through reductions in drainage volumes and pollutant loads through best management practices and other on-farm methods.

The 88/89 amendment emphasized toxic elements in subsurface drainage discharges. The Regional Water Board however still recognizes salt management as the most serious long-term issue on the San Joaquin River. Salinity impairment in the Lower San Joaquin River remains a persistent problem as salinity water quality objectives continue to be exceeded. The Regional Water Board adopted the following control program for salt and boron in the Lower San Joaquin River to address salt and boron impairment and to bring the river into compliance with water quality objectives. Additionally, the Regional Water Board will continue as an active participant in the San Joaquin River Management Program implementation phase, as

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authorized by AB 3048, to promote salinity management schemes including time discharge releases, real time monitoring and source control.

Per the amendment to the Basin Plan for San Joaquin River subsurface agricultural drainage, approved by the State Water Board in Resolution No. 96-078 and incorporated herein, the following actions will be implemented.

1. In developing control actions for selenium, the Regional Board will utilize a priority system which focuses on a combination of sensitivity of the beneficial use to selenium and the environmental benefit expected from the action.

2. Control actions which result in selenium load reduction are most effective in meeting water quality objectives.

3. With the uncertainty in the effectiveness of each control action, the regulatory program will be conducted as a series of short-term actions that are designed to meet long-term water quality objectives.

4. Best management practices, such as water conservation measures, are applicable to the control of agricultural subsurface drainage.

5. Performance goals will be used to measure progress toward achievement of water quality objectives for selenium. Prohibitions of discharge and waste discharge requirements will be used to control agricultural subsurface drainage discharges containing selenium. Compliance with performance goals and water quality objectives for nonpoint sources will occur no later than the dates specified in Table IV-4.

6. Waste discharge requirements will be used to control agricultural subsurface drainage discharges containing selenium and may be used to control discharges containing other toxic trace elements.

7. Selenium load reduction requirements will be incorporated into waste discharge requirements as effluent limits as necessary to ensure that the selenium water quality objectives in the San Joaquin River downstream of the Merced River inflow is achieved. The Board intends to implement a TMDL after public review.

Table IV-4. Compliance Time Schedule for Meeting the 4-day Average and Monthly Mean Water Quality Objective for Selenium

Selenium Water Quality Objectives (in bold) and Performance Goals (in italics)

Water Body/Water Year Type [1]	1 October 1996	1 October 2002	1 October 2005	1 October 2010
Salt Slough and Wetland Water Supply Channels listed in Appendix 40	**2 µg/L monthly mean**			
San Joaquin River below the Merced River; Above Normal and Wet Water Year types [1]		*5µg/L monthly mean*	**5 µg/L 4-day avg.**	
San Joaquin River below the Merced River; Critical, Dry, and Below Normal Water Year types		*8µg/L monthly mean*	*5 µg/L monthly mean*	**5 µg/L 4-day avg.**
Mud Slough (north) and the San Joaquin River from Sack Dam to the Merced River				**5 µg/L 4-day avg.**

[1] The water year classification will be established using the best available estimate of the 60-20-20 San Joaquin Valley water year hydrologic classification (as defined in Footnote 17 for Table 3 in the State Water Resources Control Board's *Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary*, May 1995) at the 75% exceedance level using data from the Department of Water Resources Bulletin 120 series. The previous water year's classification will apply until an estimate is made of the current water year.

8. Selenium effluent limits established in waste discharge requirements will be applied to the discharge of subsurface drainage water from the Grassland watershed. In the absence of a regional entity to coordinate actions on the discharge, the Regional Board will consider setting the effluent limits at each drainage water source (discharger) to ensure that beneficial uses are protected at all points downstream.

9. Upslope irrigations and water facility operators whose actions contribute to subsurface drainage flows will participate in the program to control discharges.

10. Public and private managed-wetlands will participate in the program to achieve water quality objectives.

11. Achieving reductions in the load of selenium discharged is highly dependent upon the effectiveness of individual actions or technology not currently available; therefore, the Regional Board will review the waste discharge requirements and compliance schedule at least every 5 years.

12. All those discharging or contributing to the generation of agricultural subsurface drainage will be required to submit for approval a short-term (5-year) drainage management plan designed to meet interim milestones and a long-term drainage management plan designed to meet final water quality objectives.

13. An annual review of the effectiveness of control actions taken will be conducted by those contributing to the generation of agricultural subsurface drainage.

14. Evaporation basins in the San Joaquin Basin will be required to meet minimum design standards, have waste discharge requirements and be part of a regional plan to control agricultural subsurface drainage.

15. The Regional Board staff will coordinate with US EPA and the dischargers on a study plan to support the development of a site specific selenium water quality objective for the San Joaquin River and other effluent dominated waterbodies in the Grassland watershed.

16. The Regional Board will establish water quality objectives for salinity for the San Joaquin River.

Control program for Salt and Boron Discharges into the Lower San Joaquin River (LSJR)

The goal of the salt and boron control program is to achieve compliance with salt and boron water quality objectives without restricting the ability of dischargers to export salt out of the San Joaquin River basin.

For the purpose of this control program, nonpoint source land uses include all irrigated lands and nonpoint source discharges are discharges from irrigated lands.

Irrigated lands are lands where water is applied for producing crops and, for the purpose of this control program, includes, but is not limited to, land planted to row, field and tree crops as well as commercial nurseries, nursery stock production, managed wetlands, and rice production.

This control program is phased to allow for implementation of existing water quality objectives, while providing the framework and timeline for implementing future water quality objectives.

The salt and boron control program establishes salt load limits to achieve compliance at the Airport Way Bridge near Vernalis with salt and boron water quality objectives for the LSJR. The Regional Water Board establishes a method for determining the maximum allowable salt loading to the LSJR. Load allocations are established for nonpoint sources and waste load allocations are established for point sources.

Load allocations to specific dischargers or groups of dischargers are proportionate to the area of nonpoint source land use contributing to the discharge. Control actions that result in salt load reductions will be effective in the control of boron.

The salt and boron control program establishes timelines for: 1) developing and adopting salt and boron water quality objectives for the San Joaquin River upstream of the Airport Way Bridges near Vernalis; 2) a control program to achieve these objectives; and 3) developing and adopting a groundwater control program.

Per the amendment to the Basin Plan for control of salt and boron discharges into the lower San Joaquin River (LSJR) basin, approved by the Regional Water Board in Resolution No. 2004-0108 and incorporated herein, the Regional Water Board will take the following actions, as necessary and appropriate, to implement this control program:

1. The Regional Water Board shall use waivers of waste discharge requirements or waste discharge requirements to apportion load allocations to each of the following seven geographic subareas that comprise the LSJR:

    a. San Joaquin River Upstream of Salt Slough
    b. Grassland
    c. Northwest Side
    d. East Valley Floor
    e. Merced River
    f. Tuolumne River
    g. Stanislaus River

These subareas are described in Chapter 1 and in more detail in Appendix 41.

2. Dischargers of irrigation return flows from irrigated lands are in compliance with this control program if they meet any of the following conditions:

    a. Cease discharge to surface water

    b. Discharge does not exceed 315µS/cm electrical conductivity (based on a 30-day running average)

    c. Operate under waste discharge requirements that include effluent limits for salt

    d. Operate under a waiver of waste discharge requirements for salt and boron discharges to the LSJR

3. The Regional Water Board will adopt a waiver of waste discharge requirements for salinity management, or incorporate into an existing agricultural waiver, the conditions required to participate in a Regional Water Board approved real-time management program. Load allocations for nonpoint source dischargers participating in a Regional Water Board approved real-time management program are described in Table IV-4.4. Additional waiver conditions will include use of Regional Water Board approved methods to measure and report flow and electrical conductivity. Participation in a Regional Water Board approved real-time management program and attainment of salinity and boron water quality objectives will constitute compliance with this control program.

4. The Regional Water Board will adopt waste discharge requirements with fixed monthly base load allocations specified as effluent limits for nonpoint source discharges that do not meet conditions specified in a waiver of waste discharge requirements for salinity management. Entities operating under WDRs or that will be required to operate under WDRs in order to comply with other programs, may participate in a Regional Water Board approved real-time management program in lieu of additional WDRs for salinity if they meet the conditions specified in the waiver of WDRs for salinity management, as described in item 3.

5. Fixed monthly base load allocations and the method used to calculate real-time load allocations are specified in Table IV-4.4.

6. Waste Load Allocations are established for point sources of salt in the basin. NPDES permitted discharges will not exceed the salinity water quality objectives established for the LSJR at the Airport Way Bridge near Vernalis. The Regional Water Board will revise NPDES permits to incorporate TMDL allocations when the permits are renewed or reopened at the discretion of the Regional Water Board.

7. Supply water credits are established for irrigators that receive supply water from the Delta Mendota Canal (DMC) or the LSJR between the confluence of the Merced River and the Airport Way Bridge near Vernalis as described in Table IV-4.4.

8. Supply water Load Allocations are established for salts in irrigation water imported to the LSJR Watershed from the Sacramento/San Joaquin River Delta as described in Table IV-4.4.

    The Regional Water Board will attempt to enter into a Management Agency Agreement (MAA) with the U.S. Bureau of Reclamation to address salt imports from the DMC to the LSJR watershed. The MAA shall include provisions requiring the U.S. Bureau of Reclamation to:

    a. Meet DMC load allocations;or
    b. Provide mitigation and/or dilution flows to create additional assimilative capacity for salt in the LSJR equivalent to DMC salt loads in excess of their allocation

    The Regional Water Board shall request a report of waste discharge from the U.S. Bureau of Reclamation to address DMC discharges if a MAA is not established by 28 July 2008.

9. The Regional Water Board will review and update the load allocations and waste load allocations by 28 July 2012 and every 6 years thereafter. Any changes to waste load allocations and/or load allocations can be made through subsequent amendment to this control program.

Changes to load allocations will be implemented through revisions of the applicable waste discharge requirements or waivers of waste discharge requirements. Changes to waste load allocations will be implemented through revisions of the applicable NPDES permits.

10. The Regional Water Board encourages real-time water quality management and pollutant trading of waste load allocations, load allocations, and supply water allocations as a means for attaining salt and boron water quality objectives while maximizing the export of salts out of the LSJR watershed. This control program shall in no way preclude basin-wide stakeholder efforts to attain salinity water quality objectives in the LSJR so long as such efforts are consistent with the control program.

11. The established waste load allocations, load allocations, and supply water allocations represent a maximum allowable level. The Regional Water Board may take other actions or require additional reductions in salt and boron loading to protect beneficial uses

12. Salt loads in water discharged into the LSJR or its tributaries for the express purpose of providing dilution flow are not subject to load limits described in this control program if the discharge:

    a. complies with salinity water quality objectives for the LSJR at the Airport Way Bridge near Vernalis;
    b. is not a discharge from irrigated lands; and
    c. is not provided as a water supply to be consumptively used upstream of the San Joaquin River at the Airport Way Bridge near Vernalis.

13. Entities providing dilution flows, as described in item 12, will obtain an allocation equal to the salt load assimilative capacity provided by this flow. This dilution flow allocation can be used to: 1) offset salt loads discharged by this entity in excess of any allocation or; 2) trade, as described in item 10. The additional dilution flow allocation provided by dilution flows will be calculated as described in Table IV-4.4.

14. It is anticipated that salinity and boron water quality objectives for the San Joaquin River from Mendota Dam to the Airport Way Bridge near Vernalis will be developed and considered for adoption in the second phase of this TMDL, according to time schedule in Table IV-4.1.

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Table IV-4.1: Schedule for developing water quality objectives for salt and boron in the LSJR from Mendota Dam to the Airport Way Bridge near Vernalis

Milestone	Date
Staff report on criteria needed to protect beneficial uses	October 2004
Staff report and Regional Water Board workshop on water quality objectives that can reasonably be achieved	June 2005
Draft second phase TMDL with water quality objectives and program of implementation for LSJR from Mendota Dam to Airport Way Bridge near Vernalis	September 2005
Board Hearing for consideration of adoption	June 2006

15. Salinity and boron water quality objectives for the San Joaquin River from Mendota Dam to the Airport Way Bridge near Vernalis will be implemented using the implementation framework described in this 'Control Program for Salt and Boron Discharges into the Lower San Joaquin River' or other implementation mechanisms, as appropriate.

16. A groundwater control program for sources of salt discharges into the LSJR will be developed by June 2020 if water quality objectives in the LSJR are not being attained.

Implementation Priority

17. The Regional Water Board will focus control actions on the most significant sources of salt and boron discharges to the LSJR. Priority for implementation of load allocations to control salt and boron discharges will be given to subareas with the greatest unit area salt loading (tons per acre per year) to the LSJR (Table IV-4.2).

    The priorities established in Table IV-4.2 will be reviewed by 28 July 2012 and every 6 years thereafter.

Table IV-4.2: Priorities for implementing load allocations[1]

Subarea	Priority
San Joaquin River Upstream of Salt Slough	Low
Grassland	High
Northwest Side	High
East Valley Floor	Low
Merced River	Low
Tuolumne River	Medium
Stanislaus River	Low
Delta Mendota Canal[2]	High

[1] Priorities based on the unit area salt loading from each subarea and mass load from the DMC
[2] Delta Mendota Canal is not a subarea

Time Schedules for Implementation

18. The Regional Water Board will incorporate base load allocations into waste discharge requirements and real-time load allocations into conditions of waiver of waste discharge requirements by 28 July 2008. Dischargers regulated under a waiver of waste discharge requirements for dischargers participating in a real-time management program for the control of salt and boron in the LSJR shall comply with the waiver conditions within 1 year of the date of adoption of the waiver.

19. Existing NPDES point source dischargers are low priority and subject to the compliance schedules for low priority discharges in Table IV-4.3. New point source discharges that begin discharging after the date of the adoption of this control program must meet waste load allocations upon the commencement of the discharge.

Table IV-4.3: Schedule for Compliance with the load allocations for salt and boron discharges into the LSJR

Priority	Year to implement[1]	
	Wet through Dry Year Types	Critical Year Types
High	8	12
Medium	12	16
Low	16	20

[1]number of years from the effective date [28 July 2006] of this control program

Table IV-4.4 Summary of Allocations and Credits

BASE SALT LOAD ALLOCATIONS

Base Load Allocations (thousand tons of salt)

Year-type[1]	Month / Period												
	Jan	Feb	Mar	Apr 1 to Apr. 14	Pulse Period [2]	May 16 to May 31	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	41	84	116	23	72	31	0	0	5	45	98	44	36
Abv. Norm	44	84	64	26	71	14	0	0	0	44	58	35	32
Blw. Norm	22	23	31	11	45	8	0	0	0	38	41	34	30
Dry	28	39	25	5	25	1	0	0	0	25	31	27	28
Critical	18	15	11	0	0	0	0	0	0	19	30	26	23

REAL-TIME SALT LOAD ALLOCATIONS

Nonpoint source dischargers operating under waiver of waste discharge requirements must participate in a Regional Water Board approved real-time management program and meet real-time load allocations. Loading capacity and real-time load allocations are calculated for a monthly time step. The following method is used to calculate real-time load allocations. Flows are expressed in thousand acre-feet per month and loads are expressed in thousand tons per month.

Loading Capacity (LC) in thousand tons per month is calculated by multiplying flow in thousand acre-ft per month by the salinity water quality objective in µS/cm, a unit conversion factor of 0. 8293, and a coefficient of 0.85 to provide a 15 percent margin of safety to account for any uncertainty.

$$LC = Q * WQO * 0.8293 * 0.85$$

where:
LC = total loading capacity in thousand tons per month
Q = flow in the San Joaquin River at the Airport way Bridge near Vernalis in thousand acre-feet per month
WQO = salinity water quality objective for the LSJR at Airport Way Bridge near Vernalis in µS/cm

The sum of the real-time Load Allocations (LA) for nonpoint source dischargers are equal to a portion of the LSJR's total Loading Capacity (LC) as described by the following equation:

$$LA = LC - L_{BG} - L_{CUA} - L_{GW} - \Sigma WLA$$

Where:
LA = sum of the real-time Load Allocations for nonpoint source dischargers
L_{BG} = loading from background sources
L_{CUA} = consumptive use allowance
L_{GW} = loading from groundwater
ΣWLA = sum of the waste load allocations for all point sources

Background loading in thousand tons is calculated using the following equation:

$$L_{BG} = Q * 85\ \mu S/cm * 0.8293$$

Table IV-4.4 Summary of Allocations and Credits (continued)

Consumptive use allowance loading is calculated with the following equation:

L_{CUA} = Q * 230 µS/cm * 0.8293

Monthly groundwater Loading (L_{GW}) (in thousand tons)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
15	15	30	32	36	53	46	27	16	13	14	15

Waste load allocations for individual point sources are calculated using the following equation:

$WLA=Q_{PS}*WQO*0.8293$

where:
WLA = waste load allocation in thousand tons per month
Q_{PS} = effluent flow to surface waters from the NPDES permitted point source discharger (in thousand acre-feet per month)
WQO = salinity water quality objective for the LSJR at Airport Way Bridge near Vernalis in µS/cm

APPORTIONING OF SALT LOAD ALLOCATION

An individual discharger or group of dischargers can calculate their load allocation by multiplying the nonpoint source acreage drained by the load allocation per acre.

$$\text{LA per acre} = \frac{\text{LA}}{\text{Total nonpoint source acreage}}$$

As of 1 August 2003, the total nonpoint source acreage of the LSJR Basin is 1.21-million acres. Nonpoint source land uses include all irrigated agricultural lands (including managed wetlands). Agricultural land includes all areas designated as agricultural or semi-agricultural land uses in the most recent land use surveys published by the California Department of Water Resources. California Department of Water Resources land use surveys are prepared and published on a county-by-county basis. Multiple counties or portions of counties may overlay a given subarea. The land use surveys must be used in combination with a Geographic Information System to quantify the agricultural land use in each subarea. Nonpoint source land areas will be updated every 6 years though an amendment to the Basin Plan if updated California Department of Water Resources land use surveys have been published. The following land use surveys (or portions thereof) are used to quantify agricultural land use in the LSJR watershed.

County	Year of most recent land use survey[1]
Merced	1995
Madera	1995
San Joaquin	1996
Fresno	1994
Stanislaus	1996

[1]-as of 1 August 2003

Acreage of managed wetlands is based on the boundaries of the federal, private and state owned wetlands that comprise the Grassland Ecological Area in Merced County. Agricultural lands (as designated in DWR land uses surveys) within the Grassland Ecological Area are counted as a agricultural land use and not as managed wetlands. All other lands within the Grassland Ecological Area are considered to be managed wetlands.

CONSUMPTIVE USE ALLOWANCE

In addition to the base load allocations or real-time load allocations shown above, a consumptive use allowance (L_{CUA}) is provided to each discharger:

L_{CUA} in tons per month = discharge volume in acre-feet per month * 230 µS/cm * 0.8293

Table IV-4.4 Summary of Allocations and Credits (continued)

SUPPLY WATER CREDITS

A supply water credit is provided to irrigators in the Grassland and Northwest Side Subareas that receive water from the DMC. This DMC supply water credit is equal to 50 percent of the added salt load, in excess of background, delivered to Grassland and Northwest Side subareas. The following fixed DMC supply water credits apply to dischargers operating under base load allocations:

DMC supply water credits (thousand tons)

Year-type[1]	Month / Period												
	Jan	Feb	Mar	Apr 1 to Apr. 14	Pulse Period [2]	May 16 to May 31	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NORTHWEST SIDE SUBAREA													
Wet	0.0	0.2	0.0	0.7	1.4	0.7	2.0	2.6	2.6	1.0	0.9	0.6	0.0
Abv. Norm	0.0	0.0	0.0	0.8	1.9	1.0	2.3	2.3	2.6	1.2	0.8	0.3	0.0
Blw. Norm	0.0	0.0	0.0	1.0	2.6	1.5	3.4	4.2	3.3	2.5	1.9	0.8	0.0
Dry	0.0	0.0	0.0	0.1	0.3	0.2	0.3	0.5	0.5	0.2	0.2	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GRASSLAND SUBAREA													
Wet	2.1	5.9	13.9	7.8	17.3	8.8	22.6	20.8	23.2	17.2	16.0	10.4	3.7
Abv. Norm	1.2	4.8	9.4	10.4	24.7	13.6	27.6	20.3	24.5	23.9	16.6	7.5	2.6
Blw. Norm	1.4	5.7	13.8	12.5	29.5	15.9	32.6	29.2	29.8	32.9	25.3	12.8	4.5
Dry	2.2	6.7	15.9	11.1	23.4	11.2	22.9	23.1	24.0	28.0	23.7	13.0	5.3
Critical	3.3	8.9	17.2	10.2	24.1	13.3	33.3	32.5	31.8	27.5	28.7	13.6	5.9

The following method is used to calculate real-time DMC supply water credits in thousand tons per month and applies to dischargers operating under real-time load allocations.

Real-time CVP Supply Water Credit = $Q_{CVP} * (C_{CVP} - C_{BG}) * 0.8293 * 0.5$

Where:
Q_{CVP} = volume of water delivered from CVP in thousand acre-feet per month[3]
C_{CVP} = electrical conductivity of water delivered from CVP in µS/cm[3]
C_{BG} = background electrical conductivity of 85 µS/cm

For irrigators in the Northwest Side Subarea an additional supply water credit is provided to account for salts contained in supply water diverted directly from the LSJR (LSJR diversion water credit). The LSJR diversion credit is equal to 50 percent of the added salt load (in excess of background) in supply water diverted from the San Joaquin River between the confluence of the Merced River and the Airport Way Bridge near Vernalis. The following fixed LSJR supply water credits apply to dischargers operating under base load allocations:

LSJR supply water credits (thousand tons)

Year-type[1]	Month / Period												
	Jan	Feb	Mar	Apr 1 to Apr. 14	Pulse Period [2]	May 16 to May 31	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	0.0	0.6	9.2	6.2	9.4	11.0	17.2	23.5	20.5	9.5	1.3	0	0
Abv. Norm	0.0	0.8	5.0	7.4	12.3	11.2	21.8	24.9	20.3	10.7	1.5	0	0
Blw. Norm	0.0	0.6	5.5	7.0	14.4	13.4	27.3	33.1	24.9	13.9	2.4	0	0
Dry	0.0	0.7	5.3	6.4	11.1	10.7	27.5	34.0	20.3	11.4	2.4	0	0
Critical	0.0	0.8	4.5	5.1	14.8	10.6	25.2	28.5	22.3	8.7	2.5	0	0

Table IV-4.4 Summary of Allocations and Credits (continued)

The following method is used to calculate Real-time LSJR supply water credits in thousand tons per month and applies to dischargers operating under real-time load allocations.

Real-time LSJR Supply Water Credit = $Q_{LSJR\ DIV} * (C_{LSJR\ DIV} - C_{BG}) * 0.8293 * 0.5$

Where:
$Q_{LSJR\ DIV}$ = volume of water diverted from LSJR between the Merced River Confluence and the Airport Way Bridge near Vernalis in thousand acre-feet per month[4]
$C_{LSJR\ DIV}$ =electrical conductivity of water diverted from the LSJR in µS/cm[4]
C_{BG} = background electrical conductivity of 85 µS/cm

SUPPLY WATER ALLOCATIONS

The U.S. Bureau of Reclamation DMC load allocation (LA_{DMC}) is equal to the volume of water delivered from the DMC (Q_{DMC}) to the Grassland and Northwest side Subareas at a background Sierra Nevada quality of 85 µS/cm.

$LA_{DMC} = Q_{DMC} * 85\ \mu S/cm * 0.8293$

DILUTION FLOW ALLOCATIONS

Entities providing dilution flows obtain an allocation equal to the salt load assimilative capacity provided by this flow, calculated as follows:

$A_{dil} = Q_{dil} * (C_{dil-} - WQO) * 0.8293$

Where:
A_{dil} = dilution flow allocation in thousand tons of salt per month
Q_{dil} = dilution flow volume in thousand acre-feet per month
C_{dil} = dilution flow electrical conductivity in µS/cm
WQO = salinity water quality objective for the LSJR at Airport Way Bridge near Vernalis in µS/cm

[1] The water year classification will be established using the best available estimate of the 60-20-20 San Joaquin Valley water year hydrologic classification (as defined in Footnote 17 for Table 3 in the State Water Resources Control Board's *Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary*, May 1995) at the 75% exceedance level using data from the Department of Water Resources Bulletin 120 series. The previous water year's classification will apply until an estimate is made of the current water year.

[2] Pulse period runs from 4/15-5/15. Period and distribution of base load allocation and supply water credits between April 1 and May 31 may change based on scheduling of pulse flow as specified in State Water Board Water Rights Decision 1641. Total base load allocation for April 1 through May 31 does not change but will be redistributed based on any changes in the timing of the pulse period

[3] Methods used to measure and report the volume and electrical conductivity of water delivered from the CVP to irrigated lands must be approved by the Regional Water Board as part of the waiver conditions required to participate in a Regional Water Board approved real-time management program

[4] Methods used to measure and report the volume and electrical conductivity of water diverted from the SJR between the confluence of the Merced and the Airport Way Bridge near Vernalis must be approved by the Regional Water Board as part of the waiver conditions required to participate in a Regional Water Board approved real-time management program

Assessment of Biotoxicity of Major Point and Nonpoint Source Discharges in the Sacramento River and San Joaquin River Basins

In addition to numerical water quality objectives for toxicity, the Basin Plan contains a narrative water quality objective that requires all surface waters to "...be maintained free of toxic substances in concentrations that are toxic to or that produce detrimental physiological responses to human, plant, animal, and aquatic life." To check for compliance with this objective, the Regional Water Board initiated a biotoxicity monitoring program to assess toxic impacts from point and nonpoint sources in FY 86-87.

Toxicity testing monitoring requirements have been placed in NPDES permits, as appropriate. Since 1986-87, ambient toxicity testing (coupled with water quality chemistry to identify toxic constituents) has been concentrated in the Delta and major tributaries. The Regional Water Board will continue to impose toxicity testing monitoring requirements in NPDES permits. The focus of ambient toxicity testing will continue to be the Delta and major tributaries.

Heavy Metals From Point and Nonpoint Sources

Heavy metals such as copper, zinc, mercury, lead, and cadmium impair beneficial uses of surface streams. These metals result from various point and nonpoint sources throughout the region, including mines, urban runoff, agriculture, and wastewater treatment plants. Discharges from abandoned or inactive mines, particularly in the Sacramento River watershed, severely impair local receiving waters. Available information suggests that such mines are by far the largest contributors of copper, zinc, and cadmium to surface waters in the Sacramento and San Joaquin River Basins.

Because the Delta and San Francisco Bay receive all upstream inputs, the effects of heavy metals may be focused on these water bodies. Although the relationship between cause and effect remains unclear, heavy metals have been implicated as a cause of problems in Delta biota (e.g., there is a health advisory limiting the consumption of striped bass because of elevated levels of mercury) and copper objectives have been exceeded in the Bay. Problems in the Bay and Delta are related to the

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effects of total metals loadings and dissolved metals concentrations.

The Regional Water Board plans to develop a mass emission strategy to control the loads of metals entering receiving waters and the Delta. Although the strategy will focus on control of discharges from inactive and abandoned mines, reasonable steps will also be taken to limit loads of metals from other significant sources. The Regional Water Board also plans to continue to monitor for metals in the Delta and principal tributaries to the Delta to assess compliance with water quality objectives, to assess impacts on beneficial uses, and to coordinate monitoring and metal reduction programs with the San Francisco Regional Water Quality Control Board.

Where circumstances warrant, the Regional Water Board will support action to clean up and abate pollution from identified sources. Funds from the State Water Pollution Cleanup and Abatement Account have been and are being used to clean up and abate discharges from selected abandoned or inactive mines. Abatement projects are underway at Iron Mountain Mine, Walker Mine, Mammoth Mine, Balaklala Mine, Keystone Mine, Stowell Mine, and Penn Mine, as data show that these mines are the most significant sources in terms of total metals discharged to receiving waters.

However, recent judicial decisions have imposed liability on the Regional Water Board for its cleanup actions at the Penn Mine. As long as the risk of such liability exists, the Regional Water Board will likely choose not to perform cleanup at any additional sites. Action by the State Legislature or the Congress will probably be required to resolve concerns of liability and facilitate the State's role in site remediation.

The Regional Water Board also will seek additional resources to update the Regional Abandoned Mines Inventory, to establish a monitoring program to track metals across the Delta and into the Bay, and to determine what loads the Delta can assimilate without resulting in adverse impacts. Although most of the significant mine portal discharges are in the process of being controlled, others need studies to determine their potential for cleanup. Since a major uncharacterized source of metals are the tailings piles associated with the mines, studies are needed to define the loads from these sources in order to establish priorities for abatement activities.

Mercury Discharges in the Sacramento River and San Joaquin River Basins

Mercury problems are evident region-wide. The main concern with mercury is that, like selenium, it bioaccumulates in aquatic systems to levels that are harmful to fish and their predators. Health advisories have been issued which recommend limiting consumption of fish taken from the Bay/Delta, Clear Lake, Lake Berryessa, Black Butte Reservoir, Lake Pilsbury,and Marsh Creek Reservoir. Concentrations of mercury in other water bodies approach or exceed National Academy of Science (NAS), U.S. Environmental Protection Agency (EPA), and/or U.S. Food and Drug Administration (FDA) guidelines for wildlife and human protection. In addition to these concerns, fish-eating birds taken from some bodies of water in the Basins have levels of mercury that can be expected to cause toxic effects. Bird-kills from mercury also have been documented in Lake Berryessa. (There is also concern for birds in the Delta, but no studies have been completed.) The Regional Water Board has done a preliminary assessment of the mercury situation in the Central Valley Region and concluded that the problem is serious and remedies will be complex and expensive.

The short-term strategy is to concentrate on correcting problems at upstream sites while monitoring the Delta to see whether upstream control activities measurably benefit the Delta. The Regional Water Board will support efforts to fund the detailed studies necessary to define assimilative capacity and to fully define uptake mechanisms in the biota.

In the next few years monitoring is scheduled to be done in the Delta and at upstream sources. The Regional Water Board will continue to support efforts to study how mercury is cycled through the Delta and to further characterize upstream sources.

Clear Lake Mercury

The Regional Water Board has a goal to reduce methylmercury concentrations in Clear Lake fish by reducing total mercury loads from various sources within the Clear Lake watershed.

Sources of mercury include past and present discharges from the Sulphur Bank Mercury Mine (SBMM) site, small mercury mines and geothermal sources, natural and anthropogenic erosion of soils with naturally occurring mercury, and atmospheric deposition. The goal of the Clear Lake mercury management strategy is to reduce fish tissue methylmercury concentrations by 60% of existing

levels. This will be accomplished by reducing the concentration of total mercury in the surficial layer of lakebed sediment by 70% of existing levels and by further investigation and reduction of other mercury sources believed to have a high potential for mercury methylation. Through a complex process, total mercury is methylated and becomes bioavailable to organisms in the food web. The linkage between (1) the total mercury in the sediments derived from various sources and other sources of total mercury and (2) the concentration of methylmercury in ecological receptors, is complicated and subject to uncertainty. As additional information about these relationships becomes available, the Regional Water Board will revise and refine as appropriate the load allocation and implementation strategy to achieve fish tissue objectives.

Mercury Load Allocations

The strategy for meeting the fish tissue objectives is to reduce the inputs of mercury to the lake from tributaries and the SBMM site, combined with active and passive remediation of contaminated lake sediments. The load allocations for Clear Lake will result in a reduction in the overall mercury sediment concentration by 70% of existing concentrations. The load allocations are assigned to the active sediment layer of the lakebed, the SBMM terrestrial site, the tributary creeks and surface water runoff to Clear Lake, and atmospheric deposition. Table IV-5 summarizes the load allocations. The load allocation to the active sediment layer is expressed as reducing concentrations of total mercury in the active sediment layer to 30% of current concentrations. The load allocation to the SBMM terrestrial site is 5% of the ongoing loads from the terrestrial mine site. The load allocation for the mine also includes reducing mercury concentrations in surficial sediment to achieve the sediment compliance goals for Oaks Arm shown in Table IV-6. The load allocation to tributary and surface water runoff is 80% of existing loads. These load allocations account for seasonal variation in mercury loads, which vary with water flow and rainfall. The analysis includes an implicit margin of safety in the reference doses for methylmercury that were used to develop the fish tissue objectives. It also includes an explicit margin of safety of 10% to account for uncertainty in the relationship between fish tissue concentrations and loads of total mercury. The reductions in loads of total mercury from all sources are expected to result in attainment of water quality objectives.

TABLE IV-5
MERCURY LOAD ALLOCATIONS

Mercury Source	Allocation
Clear Lake Sediment	30% of existing concentration
Sulphur Bank Mine	5% of existing load
Tributaries	80% of existing load
Atmosphere	No change

Sulphur Bank Mercury Mine

Reducing mercury concentrations in surficial sediment by 70% is an overall goal for the entire lake. To achieve water quality objectives, extremely high levels of mercury in the eastern end of Oaks Arm near SBMM must be reduced by more than 70%. To evaluate progress in lowering sediment concentrations, the following sediment compliance goals are established at sites that have been sampled previously.

Current and past releases from the Sulphur Bank Mercury Mine are a significant source of total mercury loading to Clear Lake. Ongoing annual loads from the terrestrial mine site to the lakebed sediments occur through groundwater, surface water, and atmospheric routes. Loads from ongoing releases from the terrestrial mine site should be reduced to 5% of existing inputs. Because of its high potential for methylation relative to mercury in lakebed sediments, mercury entering the lake through groundwater from the mine site should be reduced to 0.5 kg/year.

Past releases from the mine site are a current source of exposure through remobilization of mercury that exists in the lakebed sediments as a result of past releases to the lake from the terrestrial mine site. Past active mining operations, erosion and other mercury transport processes at SBMM have contaminated sediment in Oaks Arm. The load allocation assigned to SBMM includes reducing surficial sediment concentrations in Oaks Arm by 70% (more at sites nearest the mine site) to meet the sediment compliance goals in Table IV-6.

In 1990, the U.S. Environmental Protection Agency (USEPA) placed Sulphur Bank Mercury Mine on the National Priorities List under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). The USEPA has already performed remediation actions to stabilize waste rock piles, reduce erosion, and control surface water on the site.

TABLE IV-6
SEDIMENT COMPLIANCE GOALS FOR MERCURY IN CLEAR LAKE

Site Designation	Location	Sediment Mercury Goal (a) (mg/kg dry weight)
Upper Arm UA-03	Center of Upper Arm on transect from Lakeport to Lucerne	0.8
Lower Arm LA-03	Center of Lower Arm, North and west of Monitor Point	1
Oaks Arm		
OA-01 (c)	0.3 km from SBMM	16 (b)
OA-02 (c)	0.8 km from SBMM	16 (b)
OA-03 (c)	1.8 km from SBMM	16
OA-04 (c)	3 km from SBMM	10
Narrows O1	7.7 km from SBMM	3

(a) Sediment goals are 30% of existing concentrations. Existing concentrations are taken as the average mercury concentrations in samples collected in 1996-2000 (Clear Lake Basin Plan Amendment Staff Report).

(b) Due to the exceptionally high concentrations existing at the eastern end of Oaks Arm, sediment goals at OA-01 and OA-02 are not 70% of existing concentrations. These goals are equal to the sediment goal established for OA-03.

(c) Sediment goal is part of the load allocation for SBMM.

Estimates of the current annual loads from the terrestrial mine site to the surficial lakebed sediment are under investigation. Existing data indicate that loads of total mercury from the terrestrial mine site are within a broad range of 1 to 568 kg mercury per year. New data may be used to refine the load estimates as discussed below. As part of verifying compliance with the load allocations, remediation activities to address current and past releases from SBMM should be conducted to meet the sediment compliance goals listed in Table IV-6 for sediments within one kilometer of the mine site, specifically at sites OA-01 and OA-02.

The Regional Water Board anticipates that fish tissue objectives for mercury will not be met unless the load reductions from Sulphur Bank Mercury Mine are attained.

The Regional Water Board will request that USEPA continue remediation activities on the mine site and prepare an implementation plan or plans that address the following: reduction of ongoing releases of mercury from the SBMM site through surface water, groundwater, and the atmosphere; necessary remediation for mercury in lakebed sediments previously deposited through mining, erosion, and other processes at the mine site; and monitoring and review activities. The implementation plans should provide interim sediment goals and explain how control actions will assist in achieving fish tissue objectives for mercury in Clear Lake. The Regional Water Board will request that USEPA submit remediation plans for Regional Board approval for the SBMM site within eight years after the effective date of this amendment and implement the plan two years thereafter. USEPA should complete remediation activities at the mine site and active lakebed sediment remediation within ten years of plan implementation.

USEPA anticipates implementing additional actions to address the ongoing surface and groundwater releases from the SBMM over the next several years. These actions are expected to lead to significant reductions in the ongoing releases from the mine pit, the mine waste piles and other ongoing sources of mercury releases from the terrestrial mine site. USEPA also currently plans to investigate what steps are appropriate under CERCLA to address the existing contamination in the lakebed sediments due to past releases from the SBMM. Regional Water Board staff will continue to work closely with the USEPA on these important activities. In addition, Regional Water Board staff will coordinate monitoring activities to investigate other sources of mercury loads to Clear Lake. These investigations by USEPA and the Regional Water Board should reduce the uncertainty that currently exists regarding the annual load of total mercury to the lake, the contribution of each source to that load, and the degree to which those sources lead to methylmercury exposure to and mercury uptake by fish in the lake. This information should lead to more refined decisions about what additional steps are appropriate and feasible to achieve the applicable water quality criteria.

The sediment compliance goals for Oaks Arm will require USEPA to address both (1) the ongoing releases from the terrestrial mine site and (2) the load of total mercury that currently exists in the active lakebed sediment layer as a result of past releases. Potential options to control the ongoing releases of mercury from the terrestrial mine site include: remediation of onsite waste rock, tailings and ore piles to minimize the erosion of mercury contaminated sediments into the lake; diversion of surface water run-on away from waste piles and the inactive mine

pit; control and containment or treatment of surface water runoff; control of groundwater flow into Clear Lake; and reduction of mercury flux from the mine waste piles into the atmosphere.

Meeting the load allocation for the lakebed sediment will require remediation of contaminated sediment. Potential options to address the mercury that currently exists in the lakebed as a result of past releases and is being remobilized may include dredging the contaminated sediment, capping with clean sediments, facilitating natural burial of highly contaminated sediments, or reducing the transport of highly contaminated sediments from the Oaks Arm into the rest of the lake. Monitoring to assess progress toward meeting the load reduction goals from Sulphur Bank Mercury Mine should be planned and conducted as part of specific remediation activities. Baselines for mercury loads from the various ongoing inputs from the mine site should be established in order to evaluate successes of the remediation activities.

In order to refine the load estimates from SBMM, the Regional Water Board recommends that USEPA determine the following information: mercury concentrations and sediment deposition rates for sediment cores collected near the mine site; characterization of porewater in sediments near the mine site to determine sources, magnitude and impacts of mercury-containing fluids/groundwater entering the lake; estimates of total surface water and groundwater fluxes of mercury from SBMM, including transport through the wetlands north of the site; and patterns of sediment transport and deposition within the lake.

If additional information reveals that reaching the 95% reduction in mercury loads from the terrestrial mine site is technically infeasible or cost prohibitive, or otherwise not technically justified, the Regional Water Board will consider internal adjustments to the SBMM load allocation. It may be possible to adjust the allocation among the terrestrial site and the contaminated sediments associated with the SBMM, provided the internal reallocation achieves the same overall reduction in loads from mine-related sources (terrestrial mine site and ongoing contributions from highly contaminated sediments). Any internal adjustment must achieve the sediment compliance goals in the east end of Oaks Arm.

Although USEPA is currently spending public funds to address the releases from the SBMM, the owner of SBMM is the party that is legally responsible for addressing the past, current and future releases from the SBMM and for developing implementation plans, implementing control activities that result in achievement of the load reduction, and performing monitoring to verify the load reduction.

Tributaries and Surface Water Runoff

Past and current loads of total mercury from the tributaries and direct surface water runoff are also a source of mercury loading to the lake and to the active sediment layer in the lakebed. This section excludes loads from surface water runoff associated with the SBMM because those are addressed separately above. The loads of total mercury from the tributaries and surface water runoff to Clear Lake should be reduced by 20% of existing levels. In an average water year, existing loads are estimated to be 18 kg/year. Loads range from 1 to 60 kg/year, depending upon water flow rates and other factors. The load allocation applies to tributary inputs as a whole, instead of to individual tributaries. Efforts should be focused on identifying and controlling inputs from hot spots. The U.S. Bureau of Land Management, U.S. Forest Service, other land management agencies in the Clear Lake Basin, and Lake County shall submit plans for monitoring and implementation to achieve the necessary load reductions. The Regional Water Board will coordinate with the above named agencies and other interested parties to develop the monitoring and implementation plans. The purpose of the monitoring shall be to refine load estimates and identify potential hot spots of mercury loading from tributaries or direct surface runoff into Clear Lake. Hot spots may include erosion of soils with concentrations of mercury above the average for the rest of the tributary. If significant sources are identified, the Regional Water Board will coordinate with the agencies to develop and implement load reductions. The implementation plans shall include a summation of existing erosion control efforts and a discussion of feasibility and proposed actions to control loads from identified hot spots. The agencies will provide monitoring and implementation plans within five years after the effective date of this amendment and implement load reduction plans within five years thereafter. The goal is to complete the load reductions within ten years of implementation plan approval.

Regional Water Board staff will work with the Native American Tribes in the Clear Lake watershed on mercury reduction programs for the tributaries and surface water runoff. Staff will solicit the Tribe's participation in the development of monitoring and implementation plans.

Wetlands

The Regional Water Board is concerned about the potential for wetland areas to be significant sources of methylmercury. Loads and fate of methylmercury from wetlands that drain to Clear Lake are not fully understood. The potential for production of methylmercury should be assessed during the planning of any wetlands or floodplain restoration projects within the Clear Lake watershed. The Regional Water

Board establishes a goal of no significant increases of methylmercury to Clear Lake resulting from such activities. As factors contributing to mercury methylation are better understood, the possible control of existing methylmercury production within tributary watersheds should be examined.

Atmospheric Deposition
Atmospheric loads of mercury originating outside of the Clear Lake watershed and depositing locally are minimal. Global and regional atmospheric inputs of mercury are not under the jurisdiction of the Regional Water Board. Loads of mercury from outside of the Clear Lake watershed and depositing from air onto the lake surface are established at the existing input rate, which is estimated to be 1 to 2 kg/year.

Public Education
An important component of the Clear Lake mercury strategy is public education. Until the effects of all mercury reduction efforts are reflected in fish tissue levels, the public needs to be continually informed about safe fish consumption levels. The Lake County Public Health Department will provide outreach and education to the community, emphasizing portions of the population that are at risk, such as pregnant women and children. Education efforts may include recommendations to eat smaller fish and species having lower mercury concentrations.

Monitoring and Review
The monitoring plan for Clear Lake will determine whether mercury loads have been reduced to meet sediment compliance goals and fish tissue objectives. Monitoring will include fish tissue, water and sediment sampling. The Regional Water Board will oversee the preparation of detailed monitoring plans and resources to conduct monitoring of sediment, water and fish to assess progress toward meeting the water quality objectives. Chapter V, Surveillance and Monitoring, provides details for monitoring in Clear Lake.

The Regional Water Board will review the progress toward meeting the fish tissue objectives for Clear Lake every five years. The review will be timed to coincide with the five-year review to be conducted by USEPA for the Record of Decision for the Sulphur Bank Mercury Mine Superfund Site. The Clear Lake mercury management strategy was developed with existing information. The Regional Water Board recognizes that there are uncertainties with the load estimates and the correlation between reductions in loads of total mercury, methylmercury uptake by biota, and fish tissue concentrations. Regional Water Board staff will consider any new data to refine load estimates and allocations from sources within the Clear Lake watershed. Estimates of existing loads from SBMM or the tributaries will be refined during the review process. If new data indicate that the linkage analysis or load allocations will not result in attainment of the fish tissue objectives, or the fish tissue objectives or load allocations require adjustment, revisions to the Basin Plan will be proposed.

Cache Creek Watershed Mercury Program

The Cache Creek watershed methylmercury and total mercury implementation program applies to Cache Creek (from Clear Lake to the Settling Basin outflow and North Fork Cache Creek from Indian Valley Reservoir Dam to the main stem Cache Creek), Bear Creek, Sulphur Creek, and Harley Gulch. This implementation program is intended to reduce loads of methylmercury and total mercury to achieve all applicable water quality standards for mercury and methylmercury, including the site-specific water quality objectives for methylmercury in fish tissue. Guidance for monitoring mercury in fish, water, and sediment is provided in Chapter V, Surveillance and Monitoring.

Historic mining activities in the Cache Creek watershed have discharged and continue to discharge large volumes of inorganic mercury (termed total mercury) to creeks in the watershed. Much of the mercury discharged from the mines is now distributed in the creek channels and floodplain downstream from the mines. Natural erosion processes can be expected to slowly move the mercury downstream out of the watershed over the next several hundred years. However, current and proposed activities in and around the creek channel can enhance mobilization of this mercury. Activities in upland areas, such as road maintenance and grazing and timber activities can add to the mercury loads reaching Cache Creek, particularly when the activities take place in areas that have elevated mercury levels.

Total mercury in the creeks is converted to methylmercury by bacteria in the sediment. The concentration of methylmercury in fish tissue is directly related to the concentration of methylmercury in the water. The concentration of methylmercury in the water column is controlled in part by the concentration of total mercury in the sediment and the rate at which the total mercury is converted to methylmercury. The rate at which total mercury is converted to methylmercury is variable from site to site, with some sites (i.e., wetlands and marshes) having greatly enhanced rates of methylation.

Since methylmercury in the water column is directly related to mercury levels in fish, the following methylmercury load allocations are assigned to tributaries and the main stem of Cache Creek.

Methylmercury Load Allocations
Tables IV-6.1 and 6.2 provide methylmercury load allocations for Cache Creek, its tributaries, and instream methylmercury production. Allocations are expressed as a percent of existing methylmercury loads. The methylmercury allocations will be achieved by reducing the annual average methylmercury (unfiltered) concentrations to site-specific, aqueous methylmercury goals, which are 0.14 ng/L in Cache Creek, 0.06 ng/L in Bear Creek, and 0.09 ng/L in Harley Gulch. The allocations in Tables IV-6.1 and IV-6.2 apply to sources of methylmercury entering each tributary or stream segment. In aggregate, the sources to each tributary or stream segment shall have reductions of methylmercury loads as shown below.

Table IV-6.2 provides the load allocation within Bear Creek and its tributaries to attain the allocation for Bear Creek described in Table IV-6.1. The inactive mines listed in Table IV-6.4 are assigned a 95% total mercury load reduction. Reductions in mercury loads from mines, erosion, and other sources in the Sulphur Creek watershed are expected to reduce in channel production of methylmercury to meet the Sulphur Creek methylmercury allocation.

To achieve the water quality objectives and the methylmercury allocations listed in Tables IV-6.1 and IV-6.2, the following actions are needed: 1) reduce loads of total mercury from inactive mines, 2) where feasible, implement projects to reduce total mercury inputs from existing mercury-containing sediment deposits in creek channels and creek banks downstream from historic mine discharges, 3) reduce erosion of soils with enriched total mercury concentrations, 4) limit activities in the watershed that will increase methylmercury discharges to the creeks and, where feasible, reduce discharges of methylmercury from existing sources, and 5) evaluate other remediation actions that are not directly linked to activities of a discharger. Because methylmercury is a function of total mercury, reductions in total mercury loads are needed to achieve the methylmercury load allocations. Methylmercury allocations will be achieved in part by natural erosion processes that remove mercury that has deposited in creek beds and banks since the start of mining.

Table IV-6.3 summarizes implementation actions, affected watersheds, and agencies or persons assigned primary responsibility for mercury load reduction projects, and required completion dates for the projects. For purposes of this Basin Plan Implementation Program, the term "project" refers to actions or activities that result in a discharge of mercury to Cache Creek or are conducted within the 10-year floodplain.

Inactive Mines
By 6 February 2009, the Regional Water Board shall adopt cleanup and abatement orders or take other appropriate actions to control discharges from the inactive mines (Table IV-6.4) in the Cache Creek watershed. Responsible parties shall develop and submit for Executive Officer approval plans, including a time schedule, to reduce loads of mercury from mining or other anthropogenic activities by 95% of existing loads consistent with State Water Resources Control Board Resolution 92-49. The goal of the cleanup is to restore the mines to pre-mining conditions with respect to the discharge of mercury. Mercury and methylmercury loads produced by interaction of thermal springs with mine wastes from the Turkey Run and Elgin mines are considered to be anthropogenic loading. The responsible parties shall be deemed in compliance with this requirement if cleanup actions and maintenance activities are conducted in accordance with the approved plans. Cleanup actions at the mines shall be completed by 2011.

The wetland immediately downstream from the Abbott and Turkey Run mines in Harley Gulch contains mercury and is a source of methylmercury. After mine cleanup has been initiated, the responsible parties and owners of the wetland shall develop and submit for Executive Officer approval a cleanup and abatement plan to reduce the wetland's methylmercury loads to meet the Harley Gulch aqueous methylmercury allocation. The wetland cleanup and abatement shall be completed by 2011. Cleanup and abatement at the wetland should not be implemented prior to cleanup actions at the upstream mines.

The Sulphur Creek streambed and flood plain directly below the Central, Cherry Hill, Empire, Manzanita, West End and Wide Awake Mines contains mine waste. After mine cleanup has been initiated, the responsible parties and owners of the streambed and floodplain shall develop and submit for Executive Officer approval a cleanup and abatement plan to reduce anthropogenic mercury loading in the creek.

TABLE IV-6.1
CACHE CREEK METHYLMERCURY ALLOCATIONS

Source	Existing Annual Load (g/yr)	Acceptable Annual Load (g/yr)	Allocation (% of existing load)
Cache Creek (Clear Lake to North Fork confluence)	36.8	11	30%
North Fork Cache Creek	12.4	12.4	100%
Harley Gulch	1.0	0.04	4%
Davis Creek	1.3	0.7	50%
Bear Creek @ Highway 20	21.1	3	15%
Within channel production and ungauged tributaries	49.5	32	65%
		7 (a)	10% (a)
Total of loads	122	66	54%
Cache Creek at Yolo (b)	72.5	39	54%
Cache Creek Settling Basin Outflow (c)	87	12	14%

a. The allocation includes a margin of safety, which is set to 10% of the acceptable loads. In terms of acceptable annual load estimates, the margin of safety is 7 g/yr.
b. Cache Creek at Yolo is the compliance point for the tributaries and Cache Creek channel for meeting the allocations and aqueous goals. Agricultural water diversions upstream of Yolo remove methylmercury (50 g/year existing load).
c. The Settling Basin Outflow is the compliance point for methylmercury produced in the Settling Basin.

TABLE IV-6.2
BEAR CREEK METHYLMERCURY ALLOCATIONS

Source	Existing Annual Load (g/yr)	Acceptable Annual Load (g/yr)	Allocation (% of existing load)
Bear Creek @ Bear Valley Road	1.7	0.9	50%
Sulphur Creek	8	0.8	10%
In channel production and ungauged tributaries	11.4	1	10%
		0.3 (a)	10% (a)
Total of loads	21.1	3	15%
Bear Creek at Hwy 20 (b)	21.1	3	15%

a. The allocation includes a margin of safety, which is set to 10% of the acceptable loads. In terms of acceptable annual load estimates, the margin of safety is 0.3 g/yr.
b. Bear Creek at Highway 20 is the compliance point for Bear Creek and its tributaries.

TABLE IV-6.3
IMPLEMENTATION SUMMARY

Implementation Activity	Affected Watersheds	Assigned Responsibility	Action	Completion Date
Inactive Mines	Bear Creek, Harley Gulch, Sulphur Creek	Mine owners and other responsible parties, USBLM	Cleanup mines, sediment, and wetlands	2011
Creek Sediments-Harley Gulch Delta	Harley Gulch	USBLM	Conduct additional studies Submit report on engineering options Conduct projects, as required	2006 2008 2011
Creek Sediments-Upper Watershed	Bear Creek, Davis Creek, Harley Gulch, Sulphur Creek, and Cache Creek (Harley Gulch to Camp Haswell)	USBLM, SLC, CDFG, Colusa, Lake, and Yolo Counties, private landowners	Conduct additional studies Feasibility studies Conduct Projects (as required)	2007 (Scope and time schedule for plan and reports determined as needed)
Erosion Control-Upper Watershed	Sub-watersheds with "enriched" mercury. Includes areas of Bear Creek, Sulphur Creek, and Cache Creek (Harley Gulch to Camp Haswell)	USBLM, SLC, CDFG, Colusa, Lake, and Yolo Counties, private landowners	Conduct additional studies Identify activities that increase erosion Submit erosion control plans, as required Implement erosion control plans, as required	2006 2007 2009 2011
Erosion Control from New Projects, 10-yr Floodplains	Cache Creek (Harley Gulch to Settling Basin), Bear and Sulphur Creeks, Harley Gulch	Yolo County, Reclamation Board, private landowners, US Army Corps of Engineers	Implement management practices and monitoring for erosion control	During and after project construction
New Reservoirs, Ponds, and Wetlands	Cache Creek watershed	Yolo County or project proponents	Submit plans to control methylmercury discharges	Prior to project construction
Anderson Marsh	Cache Creek at Clear Lake	California Department of Parks and Recreation	Conduct additional studies Submit report on management options Conduct Project (as required)	2006 2008 2011

TABLE IV-6.4
CACHE CREEK WATERSHED INACTIVE MINES (a)

Mine	Average Annual Load Estimate, kg mercury/year (b)
Abbott and Turkey Run Mines	7
Rathburn and Rathburn-Petray Mines	20
Petray North and South Mines	5
Wide Awake Mine	0.8
Central, Cherry Hill, Empire, Manzanita, and West End Mines	5
Elgin Mine	3
Clyde Mine	0.4

a. The mines are grouped by current landowner. Although cleanup requirements apply to each mine, a single owner or responsible party having adjacent mines may apply the 95% reduction to the total discharge from their mines.
b. Estimates of average annual loads are preliminary, based on data collected by the California Geological Survey (Rathburn, Rathburn-Petray, Petray North, and Petray South mines) and Regional Water Board staff (other mines). Load estimates do not include mercury that would be discharged in extreme erosional events. Responsible parties may be required to refine the load estimates.

Creek Sediment – Upper Watershed
There are areas downstream from mines in Harley Gulch, Bear Creek, Sulphur Creek, Davis Creek and Cache Creek that have significant deposits of mercury-containing sediment that were derived, at least in part, from historic discharges from the mines. Where feasible, sediment discharges from these deposits need to be reduced or eliminated.

The Regional Water Board and the USBLM will conduct additional studies to determine the extent of mercury in sediment at the confluence of Harley Gulch and Cache Creek. The Regional Water Board will require the USBLM to evaluate engineering options to reduce erosion of this material to Cache Creek. If feasible projects are identified, the Regional Water Board will require USBLM to cleanup the sediment.

At other sites, further assessments are needed to determine whether responsible parties should be required to conduct feasibility studies to evaluate methods to control sources of mercury and methylmercury. The Executive Officer will, to the extent appropriate, prioritize the need for feasibility studies and subsequent remediation actions based on mercury concentrations and masses, erosion potential, and accessibility. Staff intends to complete the assessments by 6 February 2009. Where applicable, the Executive Officer will notify responsible parties to submit feasibility studies. Following review of the feasibility studies, the Executive Officer will determine whether cleanup actions will be required. Responsible parties that could be required to conduct feasibility studies include the US Bureau of Land Management (USBLM); State Lands Commission (SLC), California Department of Fish and Game (CDFG); Yolo, Lake, and Colusa Counties, mine owners, and private landowners. Assessments are needed of stream beds and banks in the following areas: Cache Creek from Harley Gulch to Camp Haswell, Harley Gulch, Sulphur Creek, and Bear Creek south of the Bear Valley Road crossing.

Erosion Control – Upper Watershed
Activities in upland parts of the watershed (i.e., outside the active floodplain), such as road construction and maintenance, grazing, timber management and other activities, can result in increased erosion and transport of mercury to the creeks, especially in parts of the watershed where the soils have enriched levels of mercury. Enriched soil and sediment is defined as having an average concentration of mercury of 0.4 mg/kg, dry weight in the silt/clay fraction (less than 63 microns). Provisions described below are applicable in the following areas: the Cache Creek watershed (Harley Gulch to Camp Haswell), Harley Gulch and Sulphur Creek watersheds, and the Bear Creek watershed south of the Bear Valley Road crossing. Some projects subject to this implementation plan may be subject to permits, including general stormwater permits. This implementation plan does not preclude the requirement to obtain any applicable federal, state, or local permit applicable to such projects.

<u>Road Construction and Maintenance</u>
Management practices shall be implemented to control erosion from road construction and maintenance activities in parts of the watershed identified above. All California Department of Transportation (Caltrans) road construction projects or maintenance activities that result in soil disturbance shall comply with the Caltrans statewide Storm Water Management Plan and implement best

management practices to control erosion, including pre-project assessments to identify areas with enriched mercury and descriptions of additional management practices that will be implemented in these areas. Water quality and sediment monitoring may be required to ensure compliance with these requirements. For paved roads, entities maintaining or constructing road shall implement the Caltrans or equivalent management practices to comply with these requirements. For unpaved roads, entities maintaining or constructing road shall implement all reasonable management practices to control erosion during construction and maintenance activities. By 6 February 2009, county and agency road departments shall submit information describing the management practices that will be implemented to control erosion.

Other Activities

A goal of the Regional Water Board is to minimize erosion from areas with enriched mercury concentrations. Further studies are needed to identify specific upland sites within the watershed areas described above that have enriched mercury concentrations and to evaluate whether activities at these sites could result in increased erosion (i.e., grazing, timber harvest activities, etc.) or contribute to increases in methylmercury production. Staff will identify areas with enriched mercury concentrations by 6 February 2008. After the studies are complete, the Executive Officer will require affected landowners and/or land managers to 1) submit reports that identify anthropogenic activities on their lands that could result in increased erosion and 2) implement management practices to control erosion. As necessary, erosion control plans will be required no later than 6 February 2011. Entities responsible for controlling erosion include the US Bureau of Land Management (USBLM); State Lands Commission (SLC); California Department of Fish and Game (CDFG); Yolo, Lake, and Colusa Counties; and private landowners.

Landowners implementing new projects or proposing change in land use on land in the enriched areas shall implement practices to control erosion and minimize discharges of mercury and methylmercury. If the dischargers are not implementing management practices to control erosion or methylmercury discharges, the Regional Water Board may consider individual prohibitions of waste discharge. For proposed changes in land use or new projects, landowners shall submit a plan including erosion estimates from the new project, erosion control practices, and, if a net increase in erosion is expected to occur, a remediation plan.

Erosion Control in the 10-Year Floodplains

Sediment and soil in the depositional zone of creeks downstream of mines in the Cache Creek watershed contains mercury. A goal of this plan is to minimize erosion of the mercury-containing sediment and soil due to human activities in order to protect beneficial uses in Cache Creek and to reduce loads of mercury moving downstream to the Settling Basin and the Delta. Some projects subject to this implementation plan may be subject to permits, including general stormwater permits. This implementation plan does not preclude the requirement to obtain any applicable federal, state, or local permit applicable to such projects.

The following requirements for erosion control apply to all projects conducted within the 10 year floodplains of Cache Creek (from Harley Gulch to the Settling Basin outflow), Bear Creek (from tributaries draining Petray and Rathburn Mines to Cache Creek), Sulphur Creek, and Harley Gulch.

Project proponents are required to: 1) implement management practices to control erosion and 2) conduct monitoring programs that evaluate compliance with the turbidity objective, and submit monitoring results to the Regional Water Board. The monitoring program must include monitoring during the next wet season in which the project sites are inundated. In general, there must be monitoring for each project. However, in cases where projects are being implemented as part of a detailed resource management plan that includes erosion control practices, monitoring is not required as a condition of this amendment for individual projects. Instead, the project proponent may conduct monitoring at designated sites up and downstream of the entire management plan area.

Upon written request by project proponents, the Executive Officer may waive the turbidity monitoring requirements for a project, or group of projects, if the project proponents submit an alternative method for assessing compliance with the turbidity objective.

Whenever practicable, proponents should maximize removal of mercury enriched sediment from the floodplain. Sediment removed from the channel or the Settling Basin must be placed so that it will not erode into the creek. For projects related to habitat restoration or erosion control consistent with a comprehensive resource management plan, the project proponent may relocate sediment within the

channel if the proponent uses the sediment to enhance habitat and provides appropriate erosion controls.

Some projects may not be able to meet the turbidity objectives even when all reasonable management practices will be implemented to control erosion. These projects may still be implemented if project proponents implement actions (offset projects) in some other part of the watershed that would reduce or otherwise prevent discharges of sediment containing mercury in an amount at least equivalent to the incremental increases expected from the original project. Removal of sediment from the Settling Basin would be an acceptable offset project.

All bridge, culvert, or road construction or maintenance activities that may cause erosion within the 10-year flood plains must follow the Caltrans management practices or equivalent to control erosion.

The Executive Officer may waive, consistent with State and federal law, the requirement for erosion control from a project conducted in the 10-year floodplain for habitat conservation or development activities for bank swallows that are proposed under the State's adopted Bank Swallow Recovery Plan (Department of Fish and Game, 1992).

New Reservoirs, Ponds, and Wetlands
Reservoirs, ponds, impoundments and wetlands generally produce more methylmercury than streams or rivers. Building new impoundments and wetlands that discharge to creeks in the Cache Creek watershed can add to the existing loads of methylmercury in Cache Creek and its tributaries. New impoundments, including reservoirs and ponds, and constructed wetlands shall be constructed and operated in a manner that would preclude an increase in methylmercury concentrations in Cache Creek, Bear Creek, Harley Gulch, or Sulphur Creek. This requirement applies to all new projects in the watershed, including gravel mining pits in lower Cache Creek that are being reclaimed as ponds and wetlands, for which physical construction is started after the approval of this implementation plan. "Preclude an increase in methylmercury concentrations" shall be defined as a measurable increase in aqueous concentration of methylmercury downstream of the discharge relative to upstream of the discharge.

Any entity creating an impoundment or constructed wetland that has the potential through its design to discharge surface water to Cache Creek, Bear Creek, Harley Gulch, or Sulphur Creek (uncontrollable discharge after inundation by winter storm flows is excepted) must submit plans to the Regional Water Board that describe design and management practices that will be implemented to limit the concentration of methylmercury in discharges to the creek.

The Executive Officer will consider granting exceptions to the no net increase requirement in methylmercury concentration if: 1) dischargers provide information that demonstrates that all reasonable management practices to limit discharge concentrations of methylmercury are being implemented and 2) the projects are being developed for the primary purpose of enhancing fish and wildlife beneficial uses. In granting exceptions to the no net increase requirement, the Executive Officer will consider the merits of the project and whether to require the discharger to propose other activities in the watershed that could offset the incremental increases in methylmercury concentration in the creek. The Regional Water Board will periodically review the progress towards achieving the objectives and may consider prohibitions of methylmercury discharge if the plan described above is ineffective.

The Cache Creek Nature Preserve (CCNP), which includes a wetland restored from a gravel excavation, currently minimizes any methylmercury discharges to Cache Creek by holding water within the wetlands. If water management in the CCNP wetlands is changed significantly, the operator must submit plans describing management practices that will be implemented to limit methylmercury discharge to Cache Creek.

Anderson Marsh Methylmercury
The Regional Water Board, in coordination with California Department of Parks and Recreation (DPR), will continue to conduct methylmercury studies in Anderson Marsh. If the Regional Water Board finds that Anderson Marsh is a significant methylmercury source to Cache Creek, the Regional Water Board will require DPR to evaluate potential management practices to reduce methylmercury loads. The Regional Water Board will then consider whether to require DPR to implement a load reduction project.

Cache Creek Settling Basin
Although the Cache Creek settling basin retains about one half of the total mercury attached to sediment that enters the basin, there is a net increase in methylmercury discharged from the settling basin. Methylmercury loads are expected to decrease as inflow mercury concentrations decline. The Regional Water Board will continue to conduct methylmercury studies in the basin and work with the

Reclamation Board and the US Army Corps of Engineers to develop settling basin improvements to retain more sediment and reduce methylmercury loads. The Sacramento-San Joaquin Delta mercury implementation plan will include total mercury load reduction requirements for the settling basin.

Geothermal and Spring Sources
In general, geothermal springs that discharge mercury and sulfate may not be controllable. However, geothermal discharges adjacent to Sulphur Creek are potential candidates for remediation or mercury offset projects. As needed, the Executive Officer will make a determination of the suitability of geothermal source controls for offset or remediation projects.

Thermal springs used by the Wilbur Hot Springs resort are a source of mercury and methylmercury to Sulphur Creek. Discharges of mercury or methylmercury from springs used or developed by the Wilbur Hot Springs resort shall not exceed current loads.

Potential Actions
This control plan focuses on reducing mercury discharges from mercury mines, controlling activities that mobilize past discharges from the mines, controlling activities that enhance methylation of mercury, and implementing cleanup and abatement activities at sites where sediment rich in mercury has accumulated. Responsibility for these actions may be assigned to responsible parties. There are a number of other actions that may be considered that would reduce loads of mercury in the creek that are not directly the responsibility of a discharger. The following actions are recommended for further evaluation:

- Construction of a settling basin upstream of Rumsey. The facility could trap mercury enriched sediment, reduce downstream loads and preserve space in the existing settling basin in Yolo Bypass.
- Methylmercury reduction plans for Bear Creek
- Load reductions from Davis Creek

Mercury Offset Program and Alternative Load Allocations
The Regional Water Board recognizes that cleanup of mines and non-point sources will require substantial financial resources. The Regional Water Board, therefore, will allow entities participating in approved mercury offset programs to conduct offset projects in the Cache Creek watershed. Offset programs shall be focused on projects where funding is not otherwise available. Subject to approval by the Executive Officer, entities participating in an offset program may partner with agencies in mercury control actions. The framework for offset programs will be developed in future Basin Plan amendments.

The methylmercury load allocations in Tables IV-6.1 and 6.2 are assigned to watersheds. To allow offset program proponents to conduct projects within the watersheds to reduce loads, the Regional Water Board may consider alternative load allocations that will achieve the water quality objectives.

Public Education
The local county health departments should provide outreach and education regarding the risks of consuming fish containing mercury, emphasizing portions of the population that are at risk, such as pregnant women and children.

Adaptive Implementation
The Regional Water Board will review the progress toward meeting the water quality objectives and the Basin Plan requirements at least every five years. The Regional Water Board recognizes that it may take hundreds of years to achieve the fish tissue objectives. The Regional Water Board considers entities to be in compliance with this mercury reduction plan if they comply with the above requirements for mercury, methylmercury, and erosion controls. The Regional Water Board recognizes that there are uncertainties with the load estimates and the correlation between reductions in loads of total mercury, methylmercury uptake by biota, and fish tissue concentrations. Using an adaptive management approach, however, the Regional Water Board will evaluate new data and scientific information to determine the most effective control program and allocations to reduce methylmercury and total mercury sources in the watershed.

Monitoring and Review
The monitoring guidance for Cache Creek is described in Chapter V, Surveillance and Monitoring. Regional Water Board staff will oversee the preparation of detailed monitoring plans and resources to conduct monitoring of sediment, water, and fish to assess progress toward meeting the water quality objectives. Regional Water Board staff will take the lead in determining compliance with fish tissue objectives for Cache Creek. Monitoring for

cleanup of mines or compliance with the erosion control requirements is the responsibility of the entity performing the cleanup or erosion control.

Delta Mercury Control Program

The Delta Mercury Control Program applies specifically to the Delta and Yolo Bypass waterways listed in Appendix 43.

This amendment was adopted by the Regional Water Quality Control Board on 22 April 2010, and approved by the U.S. Environmental Protection Agency on 20 October 2011. The Effective Date of the Delta Mercury Control Program shall be 20 October 2011, the date of U.S. EPA approval.

Program Overview
The Delta Mercury Control Program is designed to protect people eating one meal/week (32 g/day) of trophic levels 3 and 4 Delta fish, plus some non-Delta (commercial market) fish. The Regional Water Board recognizes that some consumers eat four to five meals per week (128-160 g/day) of a variety of Delta fish species. The fish tissue objectives will be re-evaluated during the Phase 1 Delta Mercury Control Program Review and later program reviews to determine whether objectives protective of a higher consumption rate can be attained as methylmercury reduction actions are developed and implemented.

Additional information about methylmercury source control methods must be developed to determine how and if Dischargers can attain load and waste load allocations set by the Board. Information is also needed about the methylmercury control methods' potential benefits and adverse impacts to humans, wildlife, and the environment. Therefore, the Delta Mercury Control Program will be implemented through a phased, adaptive management approach.

Phase 1 spans from 20 October 2011 through the Phase I Delta Mercury Control Program Review, expected to be by 20 October 2020. Phase 1 emphasizes studies and pilot projects to develop and evaluate management practices to control methylmercury. Phase 1 includes provisions for: implementing pollution minimization programs and interim mass limits for inorganic (total) mercury point sources in the Delta and Yolo Bypass; controlling sediment-bound mercury in the Delta and Yolo Bypass that may become methylated in agricultural lands, wetland, and open-water habitats; and reducing total mercury loading to San Francisco Bay, as required by the Water Quality Control Plan for the San Francisco Bay Basin.

Phase 1 also includes: the development of upstream mercury control programs for major tributaries; the development and implementation of a mercury exposure reduction program to protect humans; and the development of a mercury offset program.

At the end of Phase 1, the Regional Water Board shall conduct a Phase 1 Delta Mercury Control Program Review that considers: modification of methylmercury goals, objectives, allocations and/or the Final Compliance Date; implementation of management practices and schedules for methylmercury controls; and adoption of a mercury offset program for dischargers who cannot meet their load and waste load allocations after implementing all reasonable load reduction strategies. The review also shall consider other potential public and environmental benefits and negative impacts (e.g., habitat restoration, flood protection, water supply, fish consumption) of attaining the allocations. The fish tissue objectives, the linkage analysis between objectives and sources, and the attainability of the allocations will be re-evaluated based on the findings of Phase 1 control studies and other information. The linkage analysis, fish tissue objectives, allocations, and time schedules shall be adjusted at the end of Phase 1, or subsequent program reviews, if appropriate.

Phase 2 begins after the Phase 1 Delta Mercury Control Program Review or 20 October 2022, whichever occurs first, and ends in 2030. During Phase 2, dischargers shall implement methylmercury control programs and continue inorganic (total) mercury reduction programs. Compliance monitoring and implementation of upstream control programs also shall occur in Phase 2.

Load and Waste Load Allocations
Final methylmercury waste load allocations for point sources and load allocations for non-point sources are listed in Tables IV-7A through IV-7D. For each subarea listed in Table IV-7A, the sum of allocations for agricultural drainage, atmospheric wet deposition, open water, urban (nonpoint source), and wetlands and the individual allocations for tributary inputs (Table IV-7D), NPDES facilities and NPDES facilities future growth (Table IV-7B), and NPDES MS4 (Table IV-7C) within that subarea equals that subarea's assimilative capacity. New or expanded methylmercury discharges that begin after 20 October 2011 may necessitate adjustments to the allocations.

Load allocations are specific to Delta subareas, which are shown on Figure A43. The load allocations for each Delta subarea apply to the sum of annual methylmercury loads produced by different types of nonpoint sources: agricultural lands, wetlands, and open-water habitat in each subarea, as well as atmospheric wet deposition to each subarea (Table IV-7A), and runoff from urban areas outside of Municipal Separate Storm Sewer System (MS4) service areas. The subarea allocations apply to both existing and future discharges.

Waste load allocations apply to point sources, which include individual NPDES permitted facility discharges and runoff from urban areas within MS4 service areas within the Delta and Yolo Bypass (Tables IV-7B and IV-7C, respectively).

Methylmercury allocations are assigned to tributary inputs to the Delta and Yolo Bypass (Table IV-7D). Future upstream control programs are planned for tributaries to the Delta through which management practices will be implemented to meet load allocations for tributary inputs assigned by the Delta Mercury Control Program.

Load allocations for the tributary inputs, urban areas outside of MS4 service areas, open-water habitat, and atmospheric deposition, and waste load allocations for the MS4s, are based on water years 2000 through 2003, a relatively dry period. Annual loads are expected to fluctuate with rainfall volume and other factors. As a result, attainment of these allocations shall be assessed as a five-year average annual load. Allocations for these sources will be re-evaluated during review of the Phase 1 Delta Mercury Control Program as wet year data become available.

Margin of Safety
The Delta Mercury Control program includes an explicit margin of safety of 10%.

Final Compliance Date
Methylmercury load and waste load allocations for dischargers in the Delta and Yolo Bypass shall be met as soon as possible, but no later than 2030, unless the Regional Water Board modifies the implementation schedule and Final Compliance Date.

During Phase 1, all dischargers shall implement reasonable, feasible controls for inorganic (total) mercury.

All dischargers should implement methylmercury management practices identified during Phase 1 that are reasonable and feasible. However, implementation of methylmercury management practices identified in Phase 1 is not required for the purposes of achieving methylmercury load allocations for nonpoint sources until the beginning of Phase 2.

The Regional Water Board will, as necessary, include schedules of compliance in NPDES permits for compliance with water quality-based effluent limits based on the waste load allocations. The compliance schedules must be consistent with the requirements of federal laws and regulations, including, USEPA regulations 40 CFR 122.47, State laws and regulations, including State Water Board Policy for Compliance Schedules in National Pollutant Discharge Elimination System Permits, and the Final Compliance Date. The Regional Board will review the feasibility of meeting wasteload allocations based on reliable data and information regarding variability in methylmercury concentrations and treatment efficiencies and time needed to comply with the wasteload allocations. The Phase 1 Control Studies are designed to provide this information. As needed, the Regional Board shall incorporate the Phase 1 Control Studies into compliance schedules. When Phase 1 studies are complete, the Regional Board will review the need for additional time during Phase 2 for NPDES permittees to comply with the final wasteload allocations.

Implementation Program

Point Sources
The regulatory mechanism to implement the Delta Mercury Control Program for point sources shall be through NPDES permits.

Requirements for NPDES Permitted Facilities
By 20 April 2012, all facilities listed in Table IV-7B shall submit individual pollutant minimization program workplans to the Regional Water Board. The dischargers shall implement their respective pollutant minimization programs within 30 days after receipt of written Executive Officer approval of the workplans. Until the NPDES permitted facility achieves compliance with its waste load allocation, the discharger shall submit annual progress reports on pollution minimization activities implemented and evaluation of their effectiveness, including a summary of mercury and methylmercury monitoring results.

During Phase 1, all facilities listed in Table IV-7B shall limit their discharges of inorganic (total) mercury to facility performance-based levels. The interim inorganic (total) mercury effluent mass limit is to be derived using current, representative data and shall not exceed the 99.9th percentile of 12-month running effluent inorganic (total) mercury loads (lbs/year). For intermittent dischargers, the interim inorganic (total) mercury effluent mass limit shall consider site-specific discharge conditions. The limit shall be assigned in permits and reported as an annual load based on a calendar year. At the end of Phase 1, the interim inorganic (total) mercury mass limit will be re-evaluated and modified as appropriate.

NPDES permitted facilities that begin discharging to the Delta or Yolo Bypass during Phase 1 shall comply with the above requirements.

Requirements for NPDES Permitted Urban Runoff Discharges

MS4 dischargers listed in Table IV-7C shall implement best management practices (BMPs) to control erosion and sediment discharges consistent with their existing permits and orders with the goal of reducing mercury discharges.

The Sacramento MS4 (CAS082597), Contra Costa County MS4 (CAS083313), and Stockton MS4 (CAS083470) permittees shall implement pollution prevention measures and BMPs to minimize total mercury discharges. This requirement shall be implemented through mercury reduction strategies required by their existing permits and orders. Annually, the dischargers shall report on the results of monitoring and a description of implemented pollution prevention measures and their effectiveness.

The Sacramento MS4 (CAS082597), Contra Costa County MS4 (CAS083313), and Stockton MS4 (CAS083470) shall continue to conduct mercury control studies to monitor and evaluate the effectiveness of existing BMPs per existing requirements in permits and orders, and to develop and evaluate additional BMPs as needed to reduce their mercury and methylmercury discharges into the Delta and Yolo Bypass.

Nonpoint Sources

Nonpoint sources shall be regulated through the authority contained in State and federal laws and regulations, including State Water Board's Nonpoint Source Implementation and Enforcement Policy.

Table IV-7A contains methylmercury load allocations for non-point sources in the Delta and Yolo Bypass waterways listed in Appendix 43.

During Phase 1, all nonpoint sources in the Delta and Yolo Bypass shall implement reasonable, feasible actions to reduce sediment in runoff with the goal of reducing inorganic mercury loading to the Yolo Bypass and Delta, in compliance with existing Basin Plan objectives and requirements, and Irrigated Lands Regulatory Program requirements.

Attainment of methylmercury load allocations at the end of 2030 will be determined by comparing monitoring data and documentation of methylmercury management practice implementation for each subarea with loads specified in Table IV-7A and Table IV-7D.

For subareas not in compliance with allocations by 2030, the Regional Water Board may develop load allocations for individual sources and require individual monitoring and waste discharge requirements.

In subareas needing reductions in methylmercury, proponents of new wetland and wetland restoration projects scheduled for construction after 20 October 2011 shall (a) participate in Control Studies as described below, or shall implement site-specific study plans, that evaluate practices to minimize methylmercury discharges, and (b) implement methylmercury controls as feasible. New wetland projects may include pilot projects and associated monitoring to evaluate management practices that minimize methylmercury discharges.

Phase 1 Control Studies

Point and nonpoint source dischargers, working with other stakeholders, shall conduct methylmercury control studies (Control Studies) to evaluate existing control methods and, as needed, develop additional control methods that could be implemented to achieve their methylmercury load and waste load allocations. The Regional Water Board will use the Phase 1 Control Studies' results and other information to consider amendments to the Delta Mercury Control Program during the Phase 1 Delta Mercury Control Program Review. A Technical Advisory Committee, described below, will review the Control Studies' designs and results.

Study Participants

Control Studies can be developed through a stakeholder group approach or other collaborative mechanism, or by individual dischargers. Individual dischargers are not required to do individual studies

if the individual dischargers join a collaborative study group(s).

Control Studies are required for:

a. Irrigated agricultural lands that discharge to the Yolo Bypass and Delta subareas that require methylmercury source reductions.
b. Managed wetlands and wetland restoration projects that discharge to the Yolo Bypass and Delta subareas that require methylmercury source reductions.
c. Existing NPDES permitted facilities in the Delta and the Yolo Bypass (listed in Table IV-7B).
d. Sacramento Area MS4, Stockton MS4, and Contra Costa County MS4 service areas within and upstream of the legal Delta boundary.
e. State and Federal agencies whose activities affect the transport of mercury and the production and transport of methylmercury through the Yolo Bypass and Delta, or which manage open water areas in the Yolo Bypass and Delta, including but not limited to Department of Water Resources, State Lands Commission, Central Valley Flood Protection Board, U.S. Army Corps of Engineers, and U.S. Bureau of Reclamation. If appropriate during Phase 1, the Executive Officer will require other water management agencies whose activities affect methylmercury levels in the Delta and Yolo Bypass to participate in the Control Studies.
f. Other significant sources of methylmercury not listed above, as identified and deemed appropriate by the Executive Officer.

Dischargers in the Central Valley that are not subject to the Delta Mercury Control Program but may be subject to future mercury control programs in upstream tributary watersheds are encouraged to participate in the coordinated Delta Control Studies. Dischargers in and upstream of the Delta who participate in the Control Studies will be exempt from conducting equivalent Control Studies required by future upstream mercury control programs.

Study Objectives

The Control Studies shall evaluate existing control methods and, as needed, additional control methods that could be implemented to achieve methylmercury load and waste load allocations. The Control Studies shall evaluate the feasibility of reducing sources more than the minimum amount needed to achieve allocations.

Phase 1 studies also may include an evaluation of innovative actions, watershed approaches, offsets projects, and other short and long-term actions that result in reducing inorganic (total) mercury and methylmercury to address the accumulation of methylmercury in fish tissue and to reduce methylmercury exposure.

Dischargers may evaluate the effectiveness of using inorganic (total) mercury controls to control methylmercury discharges.

Dischargers may conduct characterization studies to inform and prioritize the Control Studies. Characterization studies may include, but not be limited to, evaluations of methylmercury and total mercury concentrations and loads in source waters, receiving waters, and discharges, to determine which discharges act as net sources of methylmercury, and which land uses result in the greatest net methylmercury production and loss.

Final reports for Control Studies shall include a description of methylmercury and/or inorganic (total) mercury management practices identified in Phase 1; an evaluation of the effectiveness, and costs, potential environmental effects, and overall feasibility of the control actions. Final reports shall also include proposed implementation plans and schedules to comply with methylmercury allocations as soon as possible.

If the Control Study results indicate that achieving a given methylmercury allocation is infeasible, then the discharger, or an entity representing a discharger, shall provide detailed information on why full compliance is not achievable, what methylmercury load reduction is achievable, and an implementation plan and schedule to achieve partial compliance.

Control Study Workplans

Control Studies shall be implemented through Control Study Workplan(s). The Control Study Workplan(s) shall provide detailed descriptions of how methylmercury control methods will be identified, developed, and monitored, and how effectiveness, costs, potential environmental effects, and overall feasibility will be evaluated for the control methods.

The Control Study Workplan(s) shall include details for organizing, planning, developing, prioritizing, and implementing the Control Studies.

The Control Studies will be governed using an Adaptive Management approach.

Technical Advisory Committee and Adaptive Management Approach

The Regional Water Board commits to supporting an Adaptive Management approach. The adaptive management approach includes the formation of a Stakeholder Group(s) and a Technical Advisory Committee (TAC). Regional Water Board staff, working with the TAC and Stakeholder Group(s), will provide a Control Study Guidance Document for stakeholders to reference.

The TAC shall be comprised of independent experts who would convene as needed to provide scientific and technical peer review of the Control Study Workplan(s) and results, advise the Board on scientific and technical issues, and provide recommendations for additional studies and implementation alternatives developed by the dischargers. The Board shall form and manage the TAC with recommendations from the dischargers and other stakeholders, including tribes and community organizations.

Board staff shall work with the TAC and Stakeholder Group(s) to review the Control Study Workplan(s) and results. As new information becomes available from the Control Studies or outside studies that result in redirection and/or prioritization of existing studies, dischargers may amend the Control Study Workplan(s) with Executive Officer approval.

Mercury Control Studies Schedule

1. By 20 April 2012, entities required to conduct Control Studies shall submit for Executive Officer approval either: (1) a report(s) describing how dischargers and stakeholders plan to organize to develop a coordinated, comprehensive Control Study Workplan(s), or (2) a report describing how individual dischargers will develop individual Control Study Workplans. For dischargers conducting coordinated studies, the report shall include a list of participating dischargers, stakeholders, tribes, and community groups. Dischargers shall be considered in compliance with this reporting requirement upon written commitment to either be part of a group developing a Control Study Workplan or develop an individual Control Study Workplan.

2. Control Study Workplans shall be submitted to the Regional Water Board by 20 July 2012. With Executive Officer approval, an additional nine months may be allowed for Workplans being developed by a collaborative stakeholder approach. The Control Study Workplan(s) shall contain a detailed plan for the Control Studies and the work to be accomplished during Phase 1. Regional Water Board staff and the TAC will review the Workplans and provide recommendations for revising Workplans if necessary.

   Within four months of submittal, the Executive Officer must determine if the Workplans are acceptable. After four months, Workplans are deemed approved and ready to implement if no written approval is provided by the Executive Officer, unless the Executive Officer provides written notification to extend the approval process.

   Dischargers shall be considered in compliance with this reporting requirement upon timely submittal of workplans and revisions.

3. By 20 October 2015, entities responsible for Control Studies shall submit report(s) to the Regional Water Board documenting progress towards complying with the Control Study Workplan(s). The report shall include amended workplans for any additional studies needed to address methylmercury reductions. The TAC will review the progress reports and may recommend what additional or revised studies should be undertaken to complete the objectives of the Control Studies. Staff will review the progress reports and recommendations of the TAC and provide a progress report to the Regional Water Board.

4. By 20 October 2018, entities responsible for Control Studies shall complete the studies and submit to the Regional Water Board Control Studies final reports that present the results and descriptions of methylmercury control options, their preferred methylmercury controls, and proposed methylmercury management plan(s) (including implementation schedules), for achieving methylmercury allocations. In addition, final report(s) shall propose points of compliance for non-point sources.

If the Executive Officer determines that dischargers are making significant progress towards developing, implementing and/or completing the Phase 1 Control Studies but that more time is needed to finish the studies, the Executive Officer may consider extending a study's deadlines.

The Executive Officer may, after public notice, extend time schedules up to two years if the dischargers demonstrate reasonable attempts to

secure funding for the Phase 1 studies but experience severe budget shortfalls.

Annually, staff shall publicly report to the Regional Water Board progress of upstream mercury program development, discharger and stakeholder coordination, Control Study Workplan status, implementation of Control Studies, actions implemented or proposed to meet load and waste load allocations, and the status of the formation and activities of the TAC.

By 20 October 2015, the Executive Officer shall provide a comprehensive report to the Regional Water Board on Phase 1 progress, including progress of upstream mercury control program development, Control Studies, actions implemented or proposed to meet Delta Mercury Control Program load and waste load allocations, and the status and progress of the TAC.

If dischargers do not comply with Control Study implementation schedules, the Executive Officer shall consider issuing individual waste discharge requirements or ordering the production of technical reports and/or management plans.

Phase 1 Delta Mercury Control Program Review

By 20 October 2020, at a public hearing, and after a scientific peer review and public review process, the Regional Water Board shall review the Delta Mercury Control Program and may consider modification of objectives, allocations, implementation provisions and schedules, and the Final Compliance Date.

If the Executive Officer allows an extension for the Control Studies' schedule, then the Delta Mercury Control Program Review may be delayed up to two years. If the Delta Mercury Control Program Review is delayed more than one year, the Regional Water Board should consider extending the schedule for Phase 2 implementation of methylmercury controls, and the Final Compliance Date.

The Regional Water Board shall assess: (a) the effectiveness, costs, potential environmental effects, and technical and economic feasibility of potential methylmercury control methods; (b) whether implementation of some control methods would have negative impacts on other project or activity benefits; (c) methods that can be employed to minimize or avoid potentially significant negative impacts to project or activity benefits that may result from control methods; (d) implementation plans and schedules proposed by the dischargers; and (e) whether methylmercury allocations can be attained.

The Regional Water Board shall use any applicable new information and results of the Control Studies to adjust the relevant allocations and implementation requirements as appropriate. Interim limits established during Phase 1 and allocations will not be reduced as a result of early actions that result in reduced inorganic (total) mercury and/or methylmercury in discharges.

As part of the Phase 1 Delta Mercury Control Program Review and subsequent program reviews, the Regional Water Board may consider adjusting the allocations to allow methylmercury discharges from existing and new wetland restoration and other aquatic habitat enhancement projects if dischargers provide information that demonstrates that 1) all reasonable management practices to limit methylmercury discharges are being implemented and 2) implementing additional methylmercury management practices would negatively impact fish and wildlife habitat or other project benefits. The Regional Water Board will consider the merits of the project(s) and whether to require the discharger(s) to propose other activities in the watershed that could offset the methylmercury. The Regional Water Board will periodically review the progress towards achieving the allocations and may consider additional conditions if the plan described above is ineffective.

The Regional Water Board shall conduct the Phase 1 Delta Mercury Program Review based on information received in Phase 1. If the Regional Water Board does not receive timely information to review and update the Delta Mercury Control Program, then allocations shall not be raised but may be lowered and the 2030 Final Compliance Date shall not be changed for those individual dischargers who did not complete the Phase 1 requirements.

The Regional Water Board shall require implementation of appropriate management practices. The methylmercury management plan(s) developed in Phase 1 shall be initiated as soon as possible, but no later than one (1) year after Phase 2 begins.

The Regional Water Board shall review this control program two years prior to the end of Phase 2, and at intervals no more than 10 years thereafter.

Compliance Monitoring

Within two years after the start of Phase 2, entities responsible for meeting load and waste load allocations shall monitor methylmercury loads and concentrations and submit annual reports to the Regional Water Board. The points of compliance for waste load allocations for NPDES facilities shall be the effluent monitoring points described in individual NPDES permits. The points of compliance for MS4s required to conduct methylmercury monitoring are those locations described in the individual MS4 NPDES permits or otherwise determined to be representative of the MS4 service areas and approved by the Executive Officer on an MS4-specific basis. The points of compliance and monitoring plans for non-point sources shall be determined during the Control Studies. Compliance with the load allocations for nonpoint sources and waste load allocations for MS4s may be documented by monitoring methylmercury loads at the compliance points or by quantifying the annual average methylmercury load reduced by implementing pollution prevention activities and source and treatment controls.

Entities will be allowed to comply with their mercury receiving water monitoring requirements by participating in a regional monitoring program, when such a program is implemented.

Chapter V, Surveillance and Monitoring, contains additional monitoring guidance.

Requirements for State and Federal Agencies

Open water allocations are assigned jointly to the State Lands Commission, the Department of Water Resources, and the Central Valley Flood Protection Board as applicable. Other agencies that are identified in Phase 1 that implement actions and activities that have the potential to contribute to methylmercury production and loss in open water will be required to take part in the studies. In the Phase 1 review, the Regional Water Board will modify, as appropriate, the list of entities that are responsible for meeting the open water allocations. Open water allocations apply to the methylmercury load that fluxes to the water column from sediments in open-water habitats within channels and floodplains in the Delta and Yolo Bypass.

The State Lands Commission, Central Valley Flood Protection Board, Department of Water Resources, and other identified agencies shall conduct Control Studies and evaluate options to reduce methylmercury in open waters under jurisdiction of the State Lands Commission and floodplain areas inundated by flood flows. These agencies shall evaluate their activities to determine whether operational changes or other practices or strategies could be implemented to reduce ambient methylmercury concentrations in Delta open water areas and floodplain areas inundated by managed floodplain flows. Evaluations shall include inorganic mercury reduction projects. By 20 April 2012, these agencies shall demonstrate how the agencies have secured adequate resources to fund the Control Studies. Regional Water Board staff will work with the agencies to develop the Control Studies and evaluate potential mercury and methylmercury reduction actions.

Activities including water management and impoundment in the Delta and Yolo Bypass, maintenance of and changes to salinity objectives, dredging and dredge materials disposal and reuse, and management of flood conveyance flows are subject to the open water methylmercury allocations. Agencies responsible for these activities in the Delta and Yolo Bypass include, but are not limited to, Department of Water Resources, State Lands Commission, Central Valley Flood Protection Board, U.S. Bureau of Reclamation, U.S. Army Corps of Engineers (USACE), and the State Water Resources Control Board. Control Studies shall be completed for the activities that have the potential to increase ambient methylmercury levels. These agencies may conduct their own coordinated Control Studies or may work with the other stakeholders in comprehensive, coordinated Control Studies.

The agencies should coordinate with wetland and agricultural landowners during Phase 1 to characterize existing methylmercury discharges to open waters from lands immersed by managed flood flows and develop methylmercury control measures.

New wetland, floodplain, and other aquatic habitat restoration and enhancement projects, including but not limited to projects developed, planned, funded, or approved by individuals, private businesses, non-profit organizations, and local, State, and federal agencies such as USACE, U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration Fisheries, U.S. Environmental Protection Agency, U.S. Bureau of Reclamation, State Water Resources Control Board, California Department of Water Resources, and California Department of Fish and Game, shall comply with all applicable requirements of this program, including conducting or participating in Control Studies and complying with allocations. To the

extent allowable by their regulatory authority, Federal, State, and local agencies that fund, approve, or implement such new projects shall direct project applicants/grantees/loanees to apply to or consult with the Regional Water Board to ensure full compliance with the water quality requirements herein.

Dredging and Dredge Material Reuse

Dredging activities and activities that reuse dredge material in the Delta should minimize increases in methyl and total mercury discharges to Delta waterways (Appendix 43). The following requirements apply to dredging and excavating projects in the Delta and Yolo Bypass where a Clean Water Act 401 Water Quality Certification or other waste discharge requirements are required. The Clean Water Act 401 Water Quality Certifications shall include the following conditions:

1. Employ management practices during and after dredging activities to minimize sediment releases into the water column.

2. Ensure that under normal operational circumstances, including during wet weather, dredged and excavated material reused at upland sites, including the tops and dry-side of levees, is protected from erosion into open waters.

In addition to the above requirements, the following requirements apply to the California Department of Water Resources, USACE, the Port of Sacramento, the Port of Stockton, and other State and federal agencies conducting dredging and excavating projects in the Delta and Yolo Bypass:

1. Characterize the total mercury mass and concentration of material removed from Delta waterways (Appendix 43) by dredging activities.

2. Conduct monitoring and studies to evaluate management practices to minimize methylmercury discharges from dredge return flows and dredge material reuse sites. Agencies shall:

    - By 20 October 2013, project proponents shall submit a study workplan(s) to evaluate methylmercury and mercury discharges from dredging and dredge material reuse, and to develop and evaluate management practices to minimize increases in methyl and total mercury discharges. The proponents may submit a comprehensive study workplan rather than conduct studies for individual projects. The comprehensive workplan may include exemptions for small projects. Upon Executive Officer approval, the plan shall be implemented.

    - By 20 October 2018, final reports that present the results and descriptions of mercury and methylmercury control management practices shall be submitted to the Regional Water Board.

    Studies should be designed to achieve the following aims for all dredging and dredge material reuse projects. When dredge material disposal sites are utilized to settle out solids and return waters are discharged into the adjacent surface water, methylmercury concentrations in return flows should be equal to or less than concentrations in the receiving water. When dredge material is reused at aquatic locations, such as wetland and riparian habitat restoration sites, the reuse should not add mercury-enriched sediment to the site or result in a net increase of methylmercury discharges from the reuse site.

The results of the management practices studies should be applied to future projects.

Cache Creek Settling Basin Improvement Plan and Schedule

Department of Water Resources, Central Valley Flood Protection Board, and USACE, in conjunction with any landowners and other interested stakeholders, shall implement a plan for management of mercury contaminated sediment that has entered and continues to enter the Cache Creek Settling Basin (Basin) from the upstream Cache Creek watershed. The agencies shall:

1. By 20 October 2012, the agencies shall take all necessary actions to initiate the process for Congressional authorization to modify the Basin, or other actions as appropriate, including coordinating with the USACE.

2. By 20 October 2013, the agencies shall develop a strategy to reduce total mercury from the Basin for the next 20 years. The strategy shall include a description of, and schedule for, potential studies and control alternatives, and an evaluation of funding options. The agencies shall work with the landowners within the Basin and local communities affected by Basin improvements.

3. By 20 October 2015, the agencies shall submit a report describing the long term environmental benefits and costs of sustaining the Basin's mercury trapping abilities indefinitely.

4. By 20 October 2015, the agencies shall submit a report that evaluates the trapping efficiency of the Cache Creek Settling Basin and proposes, evaluates, and recommends potentially feasible alternative(s) for mercury reduction from the Basin. The report shall evaluate the feasibility of decreasing mercury loads from the basin, up to and including a 50% reduction from existing loads.

5. By 20 October 2017, the agencies shall submit a detailed plan for improvements to the Basin to decrease mercury loads from the Basin.

The agencies shall submit the strategy and planning documents described above to the Regional Water Board for approval by the Executive Officer. During Phase 1, the agencies should consider implementing actions to reduce mercury loads from the Basin. Beginning in Phase 2, the agencies shall implement a mercury reduction plan.

Tributary Watersheds

Table IV-7D identifies methylmercury allocations for tributary inputs to the Delta and Yolo Bypass.

The sum total of 20-year average total mercury loads from the tributary watersheds identified in Table IV-7D needs to be reduced by 110 kg/yr. Initial reduction efforts should focus on watersheds that contribute the most mercury-contaminated sediment to the Delta and Yolo Bypass, such as the Cache Creek, American River, Putah Creek, Cosumnes River, and Feather River watersheds.

Future mercury control programs will address the tributary watershed methylmercury allocations and total mercury load reductions assigned to tributary inputs to the Delta and Yolo Bypass. Additional methylmercury and total mercury load reductions may be required within those watersheds to address any mercury impairment within those watersheds.

Mercury control programs will be developed for tributary inputs to the Delta by the following dates:

2012: American River;
2016: Feather, Sacramento, San Joaquin, and Mokelumne Rivers, and Marsh and Putah Creeks; and
2017: Cosumnes River and Morrison Creek.

Mercury Offsets

The intent of an offset program is to optimize limited resources to maximize environmental benefits. The overall objectives for an offset program are to (1) provide more flexibility than the current regulatory system provides to improve the environment while meeting regulatory requirements (i.e., load and wasteload allocations) at a lower overall cost and (2) promote watershed-based initiatives that encourage earlier and larger load reductions to the Delta than would otherwise occur.

On or before 20 October 2020, the Regional Water Board will consider adoption of a mercury (inorganic and/or methyl) offsets program. During Phase 1, stakeholders may propose pilot offset projects for public review and Regional Water Board approval. The offsets program and any Phase 1 pilot offset projects shall be based on the following key principles:

- Offsets shall be consistent with existing USEPA and State Board policies and with the assumptions and requirements upon which this and other mercury control programs are established.
- Offsets should not include requirements that would leverage existing discharges as a means of forcing dischargers to bear more than their fair share of responsibility for causing or contributing to any violation of water quality standards. In this context "fair share" refers to the dischargers' proportional contribution of methylmercury load.
- Offset credits should only be available to fulfill a discharger's responsibility to meet its (waste) load allocation after reasonable load reduction and pollution prevention strategies have been implemented.
- Offsets should not be allowed in cases where local human or wildlife communities bear a disparate or disproportionate pollution burden as a result of the offset.

- Offset credits should be available upon generation and last long enough (i.e., not expire quickly) to encourage feasible projects.
- Creditable load reductions achieved should be real, quantifiable, verifiable, and enforceable by the Regional Water Board.

Alternatives to direct load credits may be developed.

Exposure Reduction Program

While methylmercury and mercury source reductions are occurring, the Regional Water Board recognizes that activities should be undertaken to protect those people who eat Delta fish by reducing their methylmercury exposure and its potential health risks. The Exposure Reduction Program (ERP) is not intended to replace timely reduction of mercury and methylmercury loads to Delta waters.

The Regional Water Board will investigate ways, consistent with its regulatory authority, to address public health impacts of mercury in Delta fish, including activities that reduce actual and potential exposure of and mitigate health impacts to those people and communities most likely to be affected by mercury in Delta caught fish, such as subsistence fishers and their families (State Water Board Resolution No. 2005-0060).

By 20 October 2012, Regional Water Board staff shall work with dischargers (either directly or through their representatives), State and local public health agencies (including California Department of Public Health, California Office of Health Hazard Assessment, and county public health and/or environmental health departments), and other stakeholders, including community-based organizations, tribes, and Delta fish consumers, to complete an Exposure Reduction Strategy. The purposes of the Strategy will be to recommend to the Executive Officer how dischargers will be responsible for participating in an ERP, to set performance measures, and to propose a collaborative process for developing, funding and implementing the program. The Strategy shall take into account the proportional share of methylmercury contributed by individual dischargers. If dischargers (either directly or through their representatives) do not participate in the collaborative effort to develop the ERP, the Regional Water Board will evaluate and implement strategies, consistent with the Regional Water Board's regulatory authority, to assure participation from all dischargers or their representatives.

The objective of the Exposure Reduction Program is to reduce mercury exposure of Delta fish consumers most likely affected by mercury.

The Exposure Reduction Program must include elements directed toward:

- Developing and implementing community-driven activities to reduce mercury exposure;
- Raising awareness of fish contamination issues among people and communities most likely affected by mercury in Delta-caught fish such as subsistence fishers and their families;
- Integrating community-based organizations that serve Delta fish consumers, tribes, and public health agencies in the design and implementation of an exposure reduction program;
- Identifying resources, as needed, for community-based organizations and tribes to participate in the Program;
- Utilizing and expanding upon existing programs and materials or activities in place to reduce mercury, and as needed, create new materials or activities; and
- Developing measures for program effectiveness.

The dischargers, either individually or collectively, or based on the Exposure Reduction Strategy, shall submit an exposure reduction workplan for Executive Officer approval by 20 October 2013. The workplan shall address the Exposure Reduction Program objective, elements, and dischargers' coordination with other stakeholders. Dischargers shall integrate or, at a minimum, provide good-faith opportunities for integration of community-based organizations, tribes, and consumers of Delta fish into planning, decision making, and implementation of exposure reduction activities.

The dischargers shall implement the workplan by six months after Executive Officer approval of workplan. Every three years after workplan implementation begins, the dischargers, individually or collectively, shall provide a progress report to the Executive Officer. Dischargers shall participate in the Exposure Reduction Program until they comply with all requirements related to their individual or subarea methylmercury allocation.

The California Department of Public Health, the California Office of Environmental Health Hazard Assessment, and the local county public health and/or environmental health departments should collaborate with dischargers and community and tribal members to develop and implement exposure

reduction programs and provide guidance to dischargers and others that are conducting such activities. The California Department of Public Health and/or other appropriate agency should seek funds to contribute to the Exposure Reduction Program and to continue it beyond 2030, if needed, until fish tissue objectives are attained.

The State Water Board should develop a statewide policy that defines the authority and provides guidance for exposure reduction programs, including guidance on addressing public health impacts of mercury, activities that reduce actual and potential exposure of, and mitigating health impacts to those people and communities most likely to be affected by mercury.

Exceptions for Low Threat Discharges

Discharges subject to a waiver of waste discharge requirements based on a finding that the discharges pose a low threat to water quality, except for discharges subject to water quality certifications, are exempt from the mercury requirements of this Delta Mercury Control Program.

Discharges subject to waste discharge requirements for dewatering and other low threat discharges to surface waters are exempt from the mercury requirements of this Delta Mercury Control Program.

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Table IV-7A

Methylmercury Load and Waste load Allocations for Each Delta Subarea by Source Category

Source Type	DELTA SUBAREA													
	Central Delta		**Marsh Creek**		**Mokelumne River**		**Sacramento River**		**San Joaquin River**		**West Delta**		**Yolo Bypass**	
	Current Load (g/yr)	Allocation (g/yr)	Current Load (g/yr)	Allocation (g/yr)	Current Load (g/yr)	Allocation (g/yr)	Current Load (g/yr)	Allocation (g/yr)	Current Load (g/yr)	Allocation (g/yr)	Current Load (g/yr)	Allocation (g/yr)	Current Load (g/yr)	Allocation (g/yr)
Methylmercury Load Allocations														
Agricultural drainage [(d)]	37	37	2.2	0.4	1.6	0.57	36	20	23	8.3	4.1	4.1	19	4.1
Atmospheric wet deposition	7.3	7.3	0.23	0.23	0.29	0.29	5.6	5.6	2.7	2.7	2.4	2.4	4.2	4.2
Open water	370	370	0.18	0.032	4	1.4	140	78	48	17	190	190	100	22
Tributary Inputs [(a)]	37	37	1.9	0.34	110	39	2,034	1,129	367	133			462	100
Inputs from Upstream Subareas	(b)	(b)	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	(b)	(b)	- - -	- - -
Urban (nonpoint source)	0.14	0.14	---	---	0.018	0.018	0.62	0.62	0.0022	0.0022	0.066	0.066	---	---
Wetlands [(d)]	210	210	0.34	0.061	30	11	94	52	43	16	130	130	480	103
Methylmercury Waste Load Allocations														
NPDES facilities [(a)]	1.3	1.3	0.086	0.086	0	0	162	90	40	15	0.0019	0.0019	1	0.42
NPDES facilities future growth [(a)]	---	0.32 [(b)]	---	0.21	---	0	---	8.6	---	2.1	---	0.25 [(b)]	---	0.6
NPDES MS4 [(a)]	5.4	5.4	1.2	0.3	0.045	0.016	2.8	1.6	4.8	1.7	3.2	3.2	1.5	0.38
Total Loads [(c)] (g/yr)	**668**	**668**	**6.14**	**1.66**	**146**	**52.6**	**2,475**	**1,385**	**528**	**195**	**330**	**330**	**1,068**	**235**

Table IV-7A Footnotes:

(a) Values shown for Tributary Inputs, NPDES Facilities, NPDES Facilities Future Growth, and NPDES MS4 represent the sum of several individual discharges. See Tables IV-7B, IV-7C, and IV-7D for allocations for the individual discharges that should be used for compliance purposes.

(b) The Central Delta subarea receives flows from the Sacramento, Yolo Bypass, Mokelumne, and San Joaquin subareas. The West Delta subarea receives flows from the Central Delta and Marsh Creek subareas. These within-Delta flows have not yet been quantified because additional data are needed for loss rates across the subareas. Federal and state agencies whose activities affect methylmercury loss and production processes in the Delta and Yolo Bypass are assigned joint responsibility for the open water allocation. These subarea inflows are expected to decrease substantially (e.g., 40-80%) as upstream mercury management practices take place. As a result, reductions for sources within the Central and West subareas and tributaries that drain directly to these subareas are not required.

(c) For each Delta subarea, the allocations in Table IV-7A for agricultural drainage, atmospheric wet deposition, open water, urban (nonpoint source), and wetlands plus the individual allocations for tributary inputs (Table IV-7D), NPDES facilities and NPDES facilities future growth (Table IV-7B), and NPDES MS4 (Table IV-7C) within that subarea equal the Delta subarea's TMDL (assimilative capacity).

(d) The load allocations apply to the net methylmercury loads, where the net loads equal the methylmercury load in outflow minus the methylmercury loads in source water (e.g., irrigation water and precipitation).

TABLE IV-7B
MUNICIPAL AND INDUSTRIAL WASTEWATER METHYLMERCURY (MeHg) ALLOCATIONS

PERMITTEE [a]	NPDES Permit No.	MeHg Waste Load Allocation [b] (g/yr)
Central Delta		
Discovery Bay WWTP	CA0078590	0.37
Lincoln Center Groundwater Treatment Facility	CA008255	0.018
Lodi White Slough WWTP	CA0079243	0.94
Metropolitan Stevedore Company	CA0084174	[c]
Unassigned allocation for NPDES facility discharges	[d]	0.31
Marsh Creek		
Brentwood WWTP	CA0082660	0.14
Unassigned allocation for NPDES facility discharges	[d]	0.16
Sacramento River		
Rio Vista Northwest WWTP	CA0083771	0.069
Rio Vista WWTP	CA0079588	0.056
Sacramento Combined WWTP	CA0079111	0.53
SRCSD Sacramento River WWTP	CA0077682	89
Unassigned allocation for NPDES facility discharges	[d]	8.5
San Joaquin River		
Deuel Vocational Inst. WWTP	CA0078093	0.021
Manteca WWTP	CA0081558	0.38
Mountain House Community Services District WWTP	CA0084271	0.37
Oakwood Lake Subdivision Mining Reclamation [f]	CA0082783	0.38 [f]
Stockton WWTP	CA0079138	13
Tracy WWTP	CA0079154	0.77
Unassigned allocation for NPDES facility discharges	[d]	1.7
West Delta		
GWF Power Systems [e]	CA0082309	0.0052
Mirant Delta LLC Contra Costa Power Plant	CA0004863	[e]
Ironhouse Sanitation District	CA0085260	0.030
Unassigned allocation for NPDES facility discharges	[d]	0.22
Yolo Bypass		
Davis WWTP [g]	CA0079049	0.17 [g]
Woodland WWTP	CA0077950	0.43
Unassigned allocation for NPDES facility discharges	[d]	0.42

Table IV-7B Footnotes:

(a) If NPDES facilities that have allocations in Table IV-7B regionalize or consolidate, their waste load allocations can be summed.

(b) Methylmercury waste load allocations apply to annual (calendar year) discharge methylmercury loads.

(c) A methylmercury waste load allocation for non-storm water discharges from the Metropolitan Stevedore Company (CA0084174) shall be established in its NPDES permit once it completes three sampling events for methylmercury in its discharges. Its waste load allocation is a component of the "Unassigned Allocation" for the Central Delta subarea.

(d) Table IV-7B contains unassigned waste load allocations for new discharges to surface water that begin after 20 October 2011. New discharges that may be allotted a portion of the unassigned allocation may come from (1) existing facilities that previously discharged to land and then began to discharge to surface water or diverted discharges to another facility that discharges to surface water as part of ongoing regionalization efforts; (2) newly built facilities that have not previously discharged to land or water; and (3) expansions to existing facilities beyond their allocations listed in Table IV-7B where the additional allocation does not exceed the product of the net increase in flow volume and 0.06 ng/l methylmercury. The sum of all new and/or expanded methylmercury discharges from NPDES facilities within each Delta subarea shall not exceed the Delta subarea-specific waste load allocation listed in Table IV-7B.

(e) Methylmercury loads and concentrations in heating/cooling and power facility discharges vary with intake water conditions. To determine compliance with the allocations, dischargers that that use ambient surface water for cooling water shall conduct concurrent monitoring of the intake water and effluent. The methylmercury allocations for such heating/cooling and power facility discharges are 100%, such that the allocations shall become the detected methylmercury concentration found in the intake water. GWF Power Systems (CA0082309) acquires its intake water from sources other than ambient surface water and therefore has a methylmercury allocation based on its effluent methylmercury load.

(f) The waste load allocation for the Oakwood Lake Subdivision Mining Reclamation (CA0082783) shall be assessed as a five-year average annual methylmercury load.

(g) The City of Davis WWTP (CA0079049) has two discharge locations; wastewater is discharged from Discharge 001 to the Willow Slough Bypass upstream of the Yolo Bypass and from Discharge 002 to the Conaway Ranch Toe Drain in the Yolo Bypass. The methylmercury load allocation listed in Table IV-7B applies only to Discharge 002, which discharges seasonally from about February to June. Discharge 001 is encompassed by the Willow Slough watershed methylmercury allocation listed in Table D.

TABLE IV-7C
MS4 METHYLMERCURY (MeHg) WASTE LOAD ALLOCATIONS FOR URBAN RUNOFF WITHIN EACH DELTA SUBAREA

Permittee	NPDES Permit No.	MeHg Waste Load Allocation [a, b] (g/yr)
Central Delta		
Contra Costa (County of) [c]	CAS083313	0.75
Lodi (City of)	CAS000004	0.053
Port of Stockton MS4	CAS084077	0.39
San Joaquin (County of)	CAS000004	0.57
Stockton Area MS4	CAS083470	3.6
Marsh Creek		
Contra Costa (County of) [c]	CAS083313	0.30
Mokelumne River		
San Joaquin (County of)	CAS000004	0.016
Sacramento River		
Rio Vista (City of)	CAS000004	0.0078
Sacramento Area MS4	CAS082597	1.0
San Joaquin (County of)	CAS000004	0.11
Solano (County of)	CAS000004	0.041
West Sacramento (City of)	CAS000004	0.36
Yolo (County of)	CAS000004	0.041
San Joaquin River		
Lathrop (City of)	CAS000004	0.097
Port of Stockton MS4	CAS084077	0.0036
San Joaquin (County of)	CAS000004	0.79
Stockton Area MS4	CAS083470	0.18
Tracy (City of)	CAS000004	0.65
West Delta		
Contra Costa (County of) [c]	CAS083313	3.2
Yolo Bypass		
Solano (County of)	CAS000004	0.021
West Sacramento (City of)	CAS000004	0.28
Yolo (County of)	CAS000004	0.083

Table IV-7C Footnotes:

(a) Some MS4s service areas span multiple Delta subareas and are therefore listed more than once. The allocated methylmercury loads for all MS4s are based on the average methylmercury concentrations observed in runoff from urban areas in or near the Delta during water years 2000 through 2003, a relatively dry period. Annual loads are expected to fluctuate with water volume and other factors. As a result, attainment of these allocations shall be assessed as a five-year average annual load. Allocations may be revised during review of the Delta Mercury Control Program to include available wet year data.

(b) The methylmercury waste load allocations include all current and future permitted urban discharges not otherwise addressed by another allocation within the geographic boundaries of urban runoff management agencies within the Delta and Yolo Bypass, including but not limited to Caltrans facilities and rights-of-way (NPDES No. CAS000003), public facilities, properties proximate to banks of waterways, industrial facilities, and construction sites.

(c) The Contra Costa County MS4 discharges to both the Delta and San Francisco Bay. The above allocations apply only to the portions of the MS4 service area that discharge to the Delta within the Central Valley Water Quality Control Board's jurisdiction.

TABLE IV-7D
TRIBUTARY WATERSHED
METHYLMERCURY (MeHg) ALLOCATIONS

Tributary	MeHg Load Allocation [a] (g/yr)
Central Delta	
Bear Creek @ West Lane / Mosher Creek @ Morada Lane (sum of watershed loads)	11
Calaveras River @ railroad tracks u/s West Lane	26
Marsh Creek	
Marsh Creek @ Highway 4	0.34
Mokelumne River	
Mokelumne River @ Interstate 5	39.3 (39) [b]
Sacramento River	
Morrison Creek @ Franklin Boulevard	4.2
Sacramento River @ Freeport	1,125 (1,100) [b]
San Joaquin River	
French Camp Slough downstream of Airport Way	4.0
San Joaquin River @ Vernalis	129 (130)[b]
Yolo Bypass	
Cache Creek	30 [c]
Dixon Area	0.77
Fremont Weir	39
Knights Landing Ridge Cut	22
Putah Creek @ Mace Boulevard	2.4
Ulatis Creek near Main Prairie Road	2.1
Willow Slough	3.9

Table IV-7D Footnotes:

(a) Methylmercury allocations are assigned to tributary inputs to the Delta and Yolo Bypass. Mercury control programs designed to achieve the allocations for tributaries listed in Table IV-7D will be implemented by future Basin Plan amendments. Methylmercury load allocations are based on water years 2000 through 2003, a relative dry period. Annual loads are expected to fluctuate with water volume and other factors. As a result, attainment of these allocations shall be assessed as a five-year average annual load. Allocations will be revised during review of the Delta Mercury Control Program to include available wet year data.

(b) Tributary load allocations rounded to two significant figures for compliance evaluation.

(c) The allocation for water from Cache Creek entering the Yolo Bypass in this table is designed to achieve fish tissue objectives in the Yolo Bypass and Delta established by the Delta Mercury Control Program. The allocation in Table IV-6.1 assigned by the Cache Creek Mercury Control Program applies to the Cache Creek Settling Basin and requires a greater reduction so that fish within the Settling Basin can achieve water quality objectives for methylmercury in fish tissue that apply to Cache Creek, including the Settling Basin.

Pesticide Discharges from Nonpoint Sources

The control of pesticide discharges to surface waters from nonpoint sources will be achieved primarily by the development and implementation of management practices that minimize or eliminate the amount discharged. The Board will use water quality monitoring results to evaluate the effectiveness of control efforts and to help prioritize control efforts.

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Regional Board monitoring will consist primarily of chemical analysis and biotoxicity testing of major water bodies receiving irrigation return flows. The focus will be on pesticides with use patterns and chemical characteristics that indicate a high probability of entering surface waters at levels that may impact beneficial uses. Board staff will advise other agencies that conduct water quality and aquatic biota monitoring of high priority chemicals, and will review monitoring data developed by these agencies. Review of the impacts of "inert" ingredients contained in pesticide formulations will be integrated into the Board's pesticide monitoring program.

When a pesticide is detected more than once in surface waters, investigations will be conducted to identify sources. Priority for investigation will be determined through consideration of the following factors: toxicity of the compound, use patterns and the number of detections. These investigations may be limited to specific watersheds where the pesticide is heavily used or local practices result in unusually high discharges. Special studies will also be conducted to determine pesticide content of sediment and aquatic life when conditions warrant. Other agencies will be consulted regarding prioritization of monitoring projects, protocol, and interpretation of results.

To ensure that new pesticides do not create a threat to water quality, the Board, either directly or through the State Water Resources Control Board, will review the pesticides that are processed through the Department of Food and Agriculture's (DFA) registration program. Where use of the pesticide may result in a discharge to surface waters, the Board staff will make efforts to ensure that label instructions or use restrictions require management practices that will result in compliance with water quality objectives. When the Board determines that despite any actions taken by DFA, use of the pesticide may result in discharge to surface waters in violation of the objectives, the Board will take regulatory action, such as adoption of a prohibition of discharge or issuance of waste discharge requirements to control discharges of the pesticide. Monitoring may be required to verify that management practices are effective in protecting water quality.

The Board will notify pesticide dischargers through public notices, educational programs and the Department of Food and Agriculture's pesticide regulatory program of the water quality objectives related to pesticide discharges. Dischargers will be advised to implement management practices that result in full compliance with these objectives by 1 January 1993, unless required to do so earlier. (Dischargers of carbofuran, malathion, methyl parathion, molinate and thiobencarb must meet the requirements detailed in the Prohibitions section.) During this time period, dischargers will remain legally responsible for the impacts caused by their discharges.

The Board will conduct reviews of the management practices being followed to verify that they produce discharges that comply with water quality objectives. It is anticipated that practices associated with one or two pesticides can be reviewed each year. Since criteria, control methods and other factors are subject to change, it is also anticipated that allowable management practices will change over time, and control practices for individual pesticides will have to be reevaluated periodically.

Public hearings will be held at least once every two years to review the progress of the pesticide control program. At these hearings, the Board will

- review monitoring results and identify pesticides of greatest concern,
- review changes or trends in pesticide use that may impact water quality,
- consider approval of proposed management practices for the control of pesticide discharges,
- set the schedule for reviewing management practices for specific pesticides, and
- consider enforcement action.

After reviewing the testimony, the Board will place the pesticides into one of the following three classifications. When compliance with water quality objectives and performance goals is not obtained within the timeframes allowed, the Board will consider alternate control options, such as prohibition of discharge or issuance of waste discharge requirements.

1. Where the Board finds that pesticide discharges pose a significant threat to drinking water supplies or other beneficial uses, it will request DFA to act to prevent further impacts. If DFA does not proceed with such action(s) within six months of the Board's request, the Board will act within a reasonable time period to place restrictions on the discharges.

2. Where the Board finds that currently used discharge management practices are resulting in violations of water quality objectives, but the impacts of the discharge are not so severe as to require immediate changes, dischargers will be given three years, with a possibility of three one year time extensions depending on the circumstances involved, to develop and implement practices that will meet the objectives. During this period of time, dischargers may be required to take interim steps, such as meeting Board established performance goals to reduce impacts of the discharges. Monitoring will be required to show that the interim steps and proposed management practices are effective.

3. The Board may approve the management practices as adequate to meet water quality objectives. After the Board has approved specific management practices for the use and discharge of a pesticide, no other management practice may be used until it has been reviewed by the Board and found to be equivalent to or better than previously approved practices. Waste discharge requirements will be waived for irrigation return water per Resolution No. 82-036 if the Board determines that the management practices are adequate to meet water quality objectives and meet the conditions of the waiver policy. Enforcement action may be taken against those who do not follow management practices approved by the Board.

Carbofuran, malathion, methyl parathion, molinate and thiobencarb have been detected in surface waters at levels that impact aquatic organisms. Review of management practices associated with these materials is under way and is expected to continue for at least another two years. A timetable of activities related to these pesticides is at the end of the Prohibitions section. A detailed assessment of the impacts of these pesticides on aquatic organisms is also being conducted and water quality objectives will be adopted for these materials by the State or Regional Board by the end of 1993.

In conducting a review of pesticide monitoring data, the Board will consider the cumulative impact if more than one pesticide is present in the water body. This will be done by initially assuming that the toxicities of pesticides are additive. This will be evaluated separately for each beneficial use using the following formula:

$$\frac{C_1}{O_1} + \frac{C_2}{O_2} + \ldots + \frac{C_i}{O_i} = S$$

Where:

C = The concentration of each pesticide.

O = The water quality objective or criterion for the specific beneficial use for each pesticide present, based on the best available information. Note that the numbers must be acceptable to the Board and performance goals are not to be used in this equation.

S = The sum. A sum exceeding one (1.0) indicates that the beneficial use may be impacted.

The above formula will not be used if it is determined that it does not apply to the pesticides being evaluated. When more than one pesticide is present, the impacts may not be cumulative or they may be additive, synergistic or antagonistic. A detailed assessment of the pesticides involved must be conducted to determine the exact nature of the impacts.

For most pesticides, numerical water quality objectives have not been adopted. USEPA criteria and other guidance are also extremely limited. Since this situation is not likely to change in the near future, the Board will use the best available technical information to evaluate compliance with the narrative objectives. Where valid testing has developed 96 hour LC50 values for aquatic organisms (the concentration that kills one half of the test organisms in 96 hours), the Board will consider one tenth of this value for the most sensitive species tested as the upper limit (daily maximum) for the protection of aquatic life. Other available technical information on the pesticide (such as Lowest Observed Effect Concentrations and No Observed Effect Levels), the water bodies and the organisms involved will be evaluated to determine if lower concentrations are required to meet the narrative objectives.

To ensure the best possible program, the Board will coordinate its pesticide control efforts with other agencies and organizations. Wherever possible, the burdens on pesticide dischargers will be reduced by working through the DFA or other appropriate regulatory processes. The Board may also designate another agency or organization as the responsible party for the development and/or implementation of management practices, but it will retain overall

review and control authority. The Board will work with water agencies and others whose activities may influence pesticide levels to minimize concentrations in surface waters.

Since the discharge of pesticides into surface waters will be allowed under certain conditions, the Board will take steps to ensure that this control program is conducted in compliance with the federal and state antidegradation policies. This will primarily be done as pesticide discharges are evaluated on a case by case basis.

Diazinon and Chlorpyrifos Runoff into the Sacramento and Feather Rivers

1. The Sacramento and Feather River pesticide runoff control program shall:

    a. ensure compliance with water quality objectives applicable to diazinon and chlorpyrifos water quality objectives in the Sacramento and Feather Rivers through the implementation of management practices;
    b. ensure that measures that are implemented to reduce discharges of diazinon and chlorpyrifos do not lead to an increase in the discharge of other pesticides to levels that cause or contribute to violations of applicable water quality objectives and Regional and State Water Board policies; and
    c. ensure that discharges of pesticides to surface waters are controlled so that the pesticide concentrations are at the lowest levels that are technically and economically achievable.

2. Dischargers must consider whether a proposed alternative to diazinon or chlorpyrifos has the potential to degrade ground or surface water. If the alternative to diazinon or chlorpyrifos has the potential to degrade ground water, alternative pest control methods must be considered. If the alternative to diazinon or chlorpyrifos has the potential to degrade surface water, control measures must be implemented to ensure that applicable water quality objectives and Regional Water and State Board policies are not violated, including State Water Resources Control Board Resolution 68-16.

3. Compliance with water quality objectives, waste load allocations, and load allocations for diazinon and chlorpyrifos in the Sacramento and Feather Rivers is required by August 11, 2008. The water quality objectives and allocations will be implemented through the adoption or modification of waivers of waste discharge requirements, and general or individual waste discharge requirements where provisions necessary for implementation are not already in place.

4. The Regional Water Board will review the diazinon and chlorpyrifos allocations and the implementation provisions in the Basin Plan no later than 30 June 2013.

5. Regional Water Board staff will meet at least annually with staff from the Department of Pesticide Regulation and representatives from the California Agricultural Commissioners and Sealers Association to review pesticide use and instream pesticide concentrations during the dormant spray and irrigation application season and to consider the effectiveness of management measures in meeting water quality objectives and load allocations.

6. The Waste Load Allocations (WLA) for all NPDES-permitted dischargers, Load Allocations (LA) for nonpoint source discharges, and the Loading Capacity of the Sacramento and Feather Rivers shall not exceed the sum (S) of one (1) as defined below.

$$S = \frac{C_D}{WQO_D} + \frac{C_C}{WQO_C} \leq 1.0$$

where
C_D = diazinon concentration in µg/L of point source discharge for the WLA; nonpoint source discharge for the LA; or the Sacramento or Feather Rivers for the LC.
C_C = chlorpyrifos concentration in µg/L of point source discharge for the WLA; nonpoint source discharge for the LA; or the Sacramento or Feather Rivers for the LC.
WQO_D = acute or chronic diazinon water quality objective in µg/L.
WQO_C = acute or chronic chlorpyrifos water quality objective in µg/L.

Available samples collected within the applicable averaging period for the water quality objective will be used to determine compliance with the allocations and loading capacity. Prior to performing any averaging calculations, only chlorpyrifos and diazinon results from the same sample will be used in calculating the sum (S).

For purposes of calculating the sum (S) above, analytical results that are reported as "nondetectable" concentrations are considered to be zero.

Compliance with the load allocations will be determined where the nonpoint source discharges into the Sacramento or Feather Rivers.

7. The established waste load and load allocations for diazinon and chlorpyrifos and the water quality objectives for diazinon and chlorpyrifos in the Sacramento and Feather Rivers represent a maximum allowable level. The Regional Water Board shall require any additional reductions in diazinon or chlorpyrifos levels necessary to account for additive or synergistic toxicity effects or to protect beneficial uses in tributary waters.

8. Pursuant to CWC §13267, the Executive Officer will require dischargers to submit a management plan that describes the actions that the discharger will take to reduce diazinon and chlorpyrifos discharges and meet the applicable allocations.

   The management plan may include actions required by State and federal pesticide regulations. The Executive Officer will require the discharger to document the relationship between the actions to be taken and the expected reductions in diazinon and chlorpyrifos discharge(s). The Executive Officer will allow individual dischargers or a discharger group or coalition to submit management plans.

   The management plan must comply with the provisions of any applicable waiver of waste discharge requirements or waste discharge requirements. The Executive Officer may require revisions to the management plan if compliance with applicable allocations is not attained or the management plan is not reasonably likely to attain compliance. When requiring any revisions to the management plan, the Executive Officer may consider the relative contributions of diazinon and chlorpyrifos to the lack of compliance with the allocations.

9. Any waiver of waste discharge requirements or waste discharge requirements that govern the control of pesticide runoff that is discharged directly or indirectly into the Sacramento or Feather Rivers must be consistent with the policies and actions described in paragraphs 1-8.

10. In determining compliance with the waste load allocations, the Regional Water Board will consider any data or information submitted by the discharger regarding diazinon and chlorpyrifos inputs from sources outside of the jurisdiction of the permitted discharge, including any diazinon and chlorpyrifos present in precipitation; and any applicable provisions in the discharger's NPDES permit requiring the discharger to reduce the discharge of pollutants to the maximum extent practicable.

11. The above provisions for control of diazinon and chlorpyrifos discharges apply to the Sacramento and Feather Rivers as described in Table III-2A.

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Diazinon and Chlorpyrifos Runoff in the San Joaquin River Basin

1. The pesticide runoff control program shall:
   a. Ensure compliance with water quality objectives applicable to diazinon and chlorpyrifos in the San Joaquin River through the implementation of management practices.
   b. Ensure that measures that are implemented to reduce discharges of diazinon and chlorpyrifos do not lead to an increase in the discharge of other pesticides to levels that cause or contribute to violations of applicable water quality objectives and Regional Water Board policies; and
   c. Ensure that discharges of pesticides to surface waters are controlled so that pesticide concentrations are at the lowest levels that are technically and economically achievable.

2. Dischargers must consider whether a proposed alternative to diazinon or chlorpyrifos has the potential to degrade ground or surface water. If the alternative has the potential to degrade groundwater, alternative pest control methods must be considered. If the alternative has the potential to degrade surface water, control measures must be implemented to ensure that applicable water quality objectives and Regional Water Board policies are not violated, including State Water Resources Control Board Resolution 68-16.

3. Compliance with applicable water quality objectives, load allocations, and waste load allocations for diazinon and chlorpyrifos in the San Joaquin River is required by 1 December 2010.

   The water quality objectives and allocations will be implemented through one or a combination of the following: the adoption of one or more waivers of waste discharge requirements, and general or individual waste discharge requirements. To the extent not already in place, the Regional Water Board expects to adopt or revise the appropriate waiver(s) or waste discharge requirements by 31 December 2007.

4. The Regional Water Board intends to review the diazinon and chlorpyrifos allocations and the implementation provisions in the Basin Plan at least once every five years, beginning no later than 31 December 2009.

5. Regional Water Board staff will meet at least annually with staff from the Department of Pesticide Regulation and representatives from the California Agricultural Commissioners and Sealers Association to review pesticide use and instream pesticide concentrations during the dormant spray and irrigation application seasons, and to consider the effectiveness of management measures in meeting water quality objectives and load allocations.

6. The Waste Load Allocations (WLA) for all NPDES-permitted dischargers, Load Allocations (LA) for nonpoint source discharges, and the Loading Capacity of the San Joaquin River from the Mendota Dam to Vernalis shall not exceed the sum (S) of one (1) as defined below.

$$S = \frac{C_D}{WQO_D} + \frac{C_C}{WQO_C} \leq 1.0$$

where

CD = diazinon concentration in µg/L of point source discharge for the WLA; nonpoint source discharge for the LA; or San Joaquin River for the LC.
CC = chlorpyrifos concentration in µg/L of point source discharge for the WLA; nonpoint source discharge for the LA; or San Joaquin River for the LC.
WQOD = acute or chronic diazinon water quality objective in µg/L.
WQOC = acute or chronic chlorpyrifos water quality objective in µg/L.

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Available samples collected within the applicable averaging period for the water quality objective will be used to determine compliance with the allocations and loading capacity. For purposes of calculating the sum (S) above, analytical results that are reported as "non-detectable" concentrations are considered to be zero.

7. At a minimum, Loading Capacity shall be calculated for each of the following six water quality compliance points in the San Joaquin River:

   - San Joaquin River at the Airport Way Bridge near Vernalis (United States Geological Survey (USGS) Identification Number 11303500)
   - San Joaquin River at the Maze Boulevard (Highway 132) Bridge (USGS Identification Number 11290500)
   - San Joaquin River at Las Palmas Avenue near Patterson (USGS Identification Number 11274570)
   - San Joaquin River at Hills Ferry Road
   - San Joaquin River at Highway 165 near Stevinson (USGS Identification Number 11260815)
   - San Joaquin River at Sack Dam

   The load allocations for non-point source discharges into the San Joaquin River are assigned to the following subareas:

   a. The combined Stanislaus River; North Stanislaus; and Vernalis North subareas.
   b. The combined Tuolumne River; Northeast Bank; and Westside Creek subareas.
   c. The combined Turlock; Merced; and Greater Orestimba subareas.
   d. The combined Stevinson and Grassland subareas.
   e. The combined Bear Creek and Fresno-Chowchilla subareas.

   The established waste load and load allocations for diazinon and chlorpyrifos, and the water quality objectives for chlorpyrifos and diazinon in the San Joaquin River represent a maximum allowable level. The Regional Water Board shall require any additional reductions in diazinon and chlorpyrifos levels necessary to account for additional additive or synergistic toxicity effects or to protect beneficial uses in tributary waters.

8. Pursuant to CWC Section 13267, the Executive Officer will require dischargers to submit a management plan that describes the actions that the discharger will take to reduce diazinon and chlorpyrifos discharges and meet the applicable allocations by the required compliance date.

   The management plan may include actions required by State and federal pesticide regulations. The Executive Officer will require the discharger to document the relationship between the actions to be taken and the expected reductions in diazinon and chlorpyrifos discharges. The Executive Officer will allow individual dischargers or a discharger group or coalition to submit management plans.

   The management plan must comply with the provisions of any applicable waiver of waste discharge requirements or waste discharge requirements.

   The Executive Officer may require revisions to the management plan if compliance with applicable allocations is not attained or the management plan is not reasonably likely to attain compliance.

9. If the loading capacity in the San Joaquin River is not being met by the compliance date, dischargers in subareas where load allocations are not being met will be required to revise their management plans and implement an improved complement of management measures to meet the loading capacity.

10. Any waiver of waste discharge requirements or waste discharge requirements that govern the control of pesticide runoff that is discharged directly or indirectly into the San Joaquin River must be consistent with the policies and actions described in paragraphs 1 - 9.

11. In determining compliance with the waste load allocations, the Regional Water Board will consider any data or information submitted by the discharger regarding diazinon and chlorpyrifos inputs from sources outside of the jurisdiction of the permitted discharger, including any diazinon and chlorpyrifos present in precipitation, and other available relevant information; and any applicable provisions in the discharger's NPDES permit requiring the discharger to reduce the discharge of pollutants to the maximum extent possible.

Diazinon and Chlorpyrifos Runoff into the Sacramento-San Joaquin Delta Waterways (as identified in Appendix 42)

1. The pesticide runoff control program shall:
   a. Ensure compliance with water quality objectives applicable to diazinon and chlorpyrifos in the Sacramento-San Joaquin Delta Waterways through the implementation of management practices.
   b. Ensure that measures that are implemented to reduce discharges of diazinon and chlorpyrifos do not lead to an increase in the discharge of other pesticides to levels that cause or contribute to violations of applicable water quality objectives and Regional Water Board plans and policies, and
   c. Ensure that discharges of pesticides to surface waters are controlled so that pesticide concentrations are at the lowest levels that are technically and economically achievable.

2. Dischargers must consider whether any proposed alternative to the use of diazinon or chlorpyrifos has the potential to degrade ground or surface water. If the alternative has the potential to degrade groundwater, alternative pest control methods must be considered. If the alternative has the potential to degrade surface water, control measures must be implemented to ensure that applicable water quality objectives and Regional Water Board plans and policies are not violated, including State Water Resources Control Board Resolution 68-16.

3. Compliance with applicable water quality objectives, load allocations, and waste load allocations for diazinon and chlorpyrifos in the Delta Waterways is required by December 1, 2011.

   The water quality objectives and allocations will be implemented through one or a combination of the following: the adoption of one or more waivers of waste discharge requirements, and general or individual waste discharge requirements. To the extent not already in place, the Regional Water Board expects to adopt or revise the appropriate waiver(s) or waste discharge requirements by December 31, 2009.

4. The Regional Water Board intends to review the diazinon and chlorpyrifos allocations and the implementation provisions in the Basin Plan at least once every five years, beginning no later than December 31, 2010.

5. Regional Water Board staff will meet at least annually with staff from the Department of Pesticide Regulation and representatives from the California Agricultural Commissioners and Sealers Association to review pesticide use and instream pesticide concentrations during the dormant spray and irrigation application seasons and to consider the effectiveness of management measures in meeting water quality objectives and load allocations.

6. The waste load allocations (WLA) for all NPDES-permitted dischargers, load allocations (LA) for nonpoint source discharges, and the loading capacity (LC) of each of the Sacramento-San Joaquin Delta Waterways defined in Appendix 42 shall not exceed the sum (S) of one (1) as defined below.

$$S = \frac{C_D}{WQO_D} + \frac{C_C}{WQO_C} \leq 1.0$$

   where

   C_D = diazinon concentration in mg/L of point source discharge for the WLA; nonpoint source discharge for the LA; or a Delta Waterway for the LC.
   C_C = chlorpyrifos concentration in mg/L of point source discharge for the WLA; nonpoint source discharge for the LA; or a Delta Waterway for the LC.
   WQO_D = acute or chronic diazinon water quality objective in µg/L.
   WQO_C = acute or chronic chlorpyrifos water quality objective in µg/L.

   Available samples collected within the applicable averaging period for the water quality objective will be used to determine compliance with the allocations and loading capacity. For purposes of calculating the sum (S) above, analytical results that are reported as "non-detectable" concentrations are considered to be zero.

7. The established waste load and load allocations for diazinon and chlorpyrifos, and the water quality objectives for chlorpyrifos and diazinon in the Delta Waterways represent a maximum allowable level. The Regional Water Board shall require any additional reductions in diazinon and chlorpyrifos levels necessary to account for additional additive or synergistic

toxicity effects or to protect beneficial uses in tributary waters.

8. Pursuant to CWC Section 13267, the Executive Officer will require dischargers to submit a management plan that describes the actions that the discharger will take to reduce diazinon and chlorpyrifos discharges and meet the applicable allocations by the required compliance date. The management plan may include actions required by State and Federal pesticide regulations. The Executive Officer will require the discharger to document the relationship between the actions to be taken and the expected reductions in diazinon and chlorpyrifos discharges. The Executive Officer will allow individual dischargers or a discharger group or coalition to submit management plans. The management plan must comply with the provisions of any applicable waiver of waste discharge requirements or waste discharge requirements. The Executive Officer may require revisions to the management plan if compliance with applicable allocations is not attained or the management plan is not reasonably likely to attain compliance.

9. If the loading capacity in one or more Delta Waterways is not being met by the compliance date, direct or indirect dischargers to the those waterways whose discharge exceeds their load allocation will be required to revise their management plans and implement an improved complement of management measures to meet the loading capacity.

10. Any waiver of waste discharge requirements or waste discharge requirements that govern the control of pesticide runoff that is discharged directly or indirectly into the Delta Waterways must be consistent with the policies and actions described in paragraphs 1 – 9.

11. In determining compliance with the waste load allocations, the Regional Water Board will consider any data or information submitted by the discharger regarding diazinon and chlorpyrifos inputs from sources outside of the jurisdiction of the permitted discharger, including any diazinon and chlorpyrifos present in precipitation and other available relevant information; and any applicable provisions in the discharger's NPDES permit requiring the discharger to reduce the discharge of pollutants to the maximum extent possible.

12. The above provisions for control of diazinon and chlorpyrifos discharges to the Delta Waterways do not apply to dischargers to the Sacramento and San Joaquin Rivers upstream of the Delta.

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Dredging in the Sacramento River and San Joaquin River Basins

Large volumes of sediment are transported in the waters of the Sacramento and San Joaquin Rivers which drain the Central Valley. The average annual sediment load to San Francisco Bay from these two rivers is estimated to be 8 million cubic yards. Dredging and riverbank protection projects are ongoing, continuing activities necessary to keep ship channels open, prevent flooding, and control riverbank erosion. The Delta, with over 700 miles of waterways, is a major area of activity. At present, the Corps is overseeing the conduct and planning of rehabilitation work along 165 miles of levees surrounding 15 Delta islands. In addition, virtually all of the Delta levees have been upgraded by island owners or reclamation districts. The magnitude of recent operations, such as the Stockton and Sacramento Ship Channel Deepening Projects and Sacramento River Bank Protection Project, is discussed in recent U.S. Army Corps of Engineers Reports. For example, the Corps removes over 10 million cubic yards of sediment yearly from the Sacramento River. If the Sacramento River Deep Water Ship Channel is widened and deepened as proposed currently, 25 million cubic yards of bottom material will be removed from the river during the 5-year project.
Environmental impacts of dredging operations and materials disposal include temporary dissolved oxygen reduction, increased turbidity and, under certain conditions, the mobilization of toxic chemicals and release of biostimulatory substances from the sediments. The direct destruction and burial of spawning gravels and alteration of benthic habitat may be the most severe impacts. The existing regulatory process must be consistently implemented to assure protection of water quality and compliance with the certification requirements of Section 401 of the Federal Clean Water Act.

The Regional Water Board continues to work with dredging interests in the San Francisco Bay and Delta to develop a long term management strategy (LTMS) for handling dredge spoils. We will adopt requirements for all significant dredging operations and upland disposal projects in the Region.

Nitrate Pollution of Ground Water in the Sacramento and San Joaquin River Basins

Since 1980, over 200 municipal supply wells have been closed in the Central Valley because of nitrate levels exceeding the State's 45 mg/l drinking water standard. Proposals have been submitted to assess the extent of the problem and explore possible regulatory responses, but without success. The increasing population growth in the Valley is expected to accelerate the problem's occurrence in the years ahead.

The Regional Water Board considers nitrate pollution to be a critical issue for beneficial use protection in the Central Valley Region. Staff will continue efforts to obtain study funds. Since nitrate pollution of ground water is not restricted to the Central Valley Region, the Regional Water Board recommends the State Water
Board take the lead in developing programs for controlling ground water contamination resulting from the use of nitrogen fertilizer on irrigated crops.

Temperature and Turbidity Increases Below Large Water Storage and Diversion Projects in the Sacramento River Basin

The storage and diversion of water for hydroelectric and other purposes can impact downstream beneficial uses because of changes in temperature and the introduction of turbidity. There are several large facilities in the Basin which have had a history of documented or suspected downstream impairments.

Where problems have been identified, the staff will work with operators to prepare management agency agreements or make recommendations to State Water Board regarding requirements to remedy the problems. Where problems are suspected, the staff will seek additional monitoring.

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Control Program for Factors Contributing to the Dissolved Oxygen Impairment in the Stockton Deep Water Ship Channel (DWSC) (Regional Water Board Resolution No. R5-2005-0005)

The purpose of this control program is to implement a dissolved oxygen TMDL to achieve compliance with the Basin Plan dissolved oxygen water quality objectives in the DWSC. The numeric targets for this TMDL are the existing dissolved oxygen water quality objectives.

The dissolved oxygen impairment in the DWSC is caused by the following three main contributing factors:

- Loads of oxygen demanding substances from upstream sources that react by numerous chemical, biological, and physical mechanisms to remove dissolved oxygen from the water column in the DWSC.
- Geometry of the DWSC that impacts various mechanisms that add or remove dissolved oxygen from the water column, such that net oxygen demand exerted in the DWSC is increased.
- Reduced flow through the DWSC impacts various mechanisms that add or remove dissolved oxygen from the water column, such that net oxygen demand exerted in the DWSC is increased.

For the purpose of this control program, net oxygen demand is defined as the combined impact of all chemical, biological, and physical mechanisms that add or remove dissolved oxygen from the water column. When the amount of oxygen removed from the water column is greater than the amount added there is a decrease in the dissolved oxygen concentration. When dissolved oxygen concentrations in the DWSC are below Basin Plan objectives, the assimilative capacity of the water column has been exceeded and the associated excess net oxygen demand (ENOD) is given by the equation:

$$ENOD = \{DO_{obj} - DO_{meas}\} \times \{Q_{DWSC} + 40\} \times 5.4$$

In the above equation DO_{obj} is the applicable Basin Plan dissolved oxygen objective in milligrams per liter, DO_{meas} is the measured dissolved oxygen concentration in the DWSC in milligrams per liter, Q_{DWSC} is the net daily flow rate through the DWSC in cubic feet per second (adjusted by 40 cfs to account for flow measurement error), and 5.4 is a unit conversion factor that provides ENOD in units of pounds of net oxygen demand per day in the DWSC.

To account for technical uncertainty a margin of safety (MOS) equal to 20% of ENOD is added to the overall required reduction of ENOD:

$$MOS = -0.2 \times ENOD$$

ENOD plus the MOS must be addressed by those collectively responsible for each of the three contributing factors:

$$ENOD - MOS = 1.2 \times ENOD = [\sum WLA + \sum LA] + R_{DWSC} + R_{Flow}$$

where $[\sum WLA + \sum LA]$ is the amount of ENOD and MOS for which sources of oxygen demanding substances are responsible, R_{DWSC} is the amount of ENOD and MOS for which DWSC geometry is responsible, and R_{Flow} is the amount of ENOD and MOS for which reduced DWSC flow is responsible.

This TMDL does not specify the relative responsibility among the three contributing factors. Each of the three contributing factors are considered to be 100% responsible for addressing ENOD and MOS. Those parties collectively responsible for each contributing factor must coordinate with those collectively responsible for the other factors to implement control measures addressing ENOD and MOS.

Those parties responsible for sources of oxygen demanding substances $[\sum WLA + \sum LA]$ are allocated relative responsibility for excess net oxygen demand as follows:

a) 30% as a waste load allocation for the City of Stockton Regional Wastewater Control Facility.

b) 60% as a load allocation to non-point sources of algae and/or precursors in the watershed.

c) 10% as a reserve for unknown sources and impacts, and known or new sources that have no reasonable potential to impact.

In measuring compliance with waste load and load allocations, credit will be given for control measures implemented after 12 July 2004.

For the purpose of this control program, non-point source discharges are discharges from irrigated lands. Irrigated lands are lands where water is applied for producing crops and, for the purpose of this control program, includes, but is not limited to, land planted to row, field, and tree crops, as well as commercial nurseries, nursery stock production, managed wetlands and rice production.

For the purpose of this control program, oxygen demanding substances and their precursors are any substance or substances that consume, have the potential to consume, or contribute to the growth or formation of substances that consume or have the potential to consume oxygen from the water column.

The source area for loads of oxygen demanding substances and their precursors being addressed by this TMDL includes the SJR watershed that drains downstream of Friant Dam and upstream of the confluence of the San Joaquin River and Disappointment Slough, with the exception of the western slope of the Sierra Nevada foothills above the major reservoirs of New Melones Lake on the Stanislaus, Don Pedro Reservoir on the Tuolumne, Lake McClure on the Merced, New Hogan Reservoir on the Calaveras, Comanche Reservoir on the Mokelumne, and those portions of the SJR watershed that fall within Mariposa, Tuolumne, Calaveras, and Amador Counties.

Measures will also need to be implemented to reduce the impact of both the DWSC geometry and reduced flow through the DWSC.

The Regional Water Board will take the following actions, as necessary and appropriate, to implement this TMDL:

1. The Regional Water Board will use its authority under California Water Code § 13267 (or alternately by Waste Discharge Requirements and NPDES permits) to require that entities responsible for point and non-point sources of oxygen demanding substances and their precursors within the TMDL source area perform the following studies by December 2008. These studies must identify and quantify:

    a) sources of oxygen demanding substances and their precursors in the dissolved oxygen TMDL source area

    b) growth or degradation mechanisms of these oxygen demanding substances in transit through the source area to the DWSC

    c) the impact of these oxygen demanding substances on dissolved oxygen concentrations in the DWSC under a range of environmental conditions and considering the effects of chemical, biological, and physical mechanisms that add or remove dissolved oxygen from the water column in the DWSC

A study plan describing how ongoing studies and future studies will address these information needs must be submitted to Regional Water Board staff by 23 October 2006. The study plan and studies may be conducted by individual responsible entities or in collaboration with other entities.

2. The Regional Water Board establishes the following waste load allocations:

    a) The waste load allocations of oxygen demanding substances and their pre-cursors for all NPDES-permitted discharges are initially set at the corresponding effluent limitations applicable on 28 January 2005.

    b) Waste load allocations and permit conditions for new or expanded point source discharges in the SJR Basin upstream of the DWSC, including NPDES and stormwater, will be based on the discharger demonstrating that the discharge will have no reasonable potential to cause or contribute to a negative impact on the dissolved oxygen impairment in the DWSC.

3. The Regional Water Board will require any project that requires a Clean Water Act Section 401 Water Quality Certification from the Regional Water Board, and that has the potential to impact dissolved oxygen conditions in the DWSC, to evaluate and fully mitigate those impacts. This includes, but is not limited to:

    a) Future projects that increase the cross-sectional area of the DWSC

    c) Future water resources facilities projects that reduce flow through the DWSC

4. The Regional Water Board will require, pursuant to California Water Code § 13267, the United States Army Corps of Engineers to submit by 31 December 2006 a technical report identifying and quantifying:

    a) the chemical, biological, and physical mechanisms by which loads of substances into, or generated within the DWSC, are converted to oxygen demand

b) the impact that the Stockton Deep Water Ship Channel has on re-aeration and other mechanisms that affect dissolved oxygen concentrations in the water column

5. The Regional Water Board may consider alternate measures, as opposed to direct control, of certain contributing factors if these measures adequately address the impact on the dissolved oxygen impairment and do not degrade water quality in any other way.

6. The Regional Water Board will review allocations and implementation provisions based on the results of the oxygen demand and precursor studies and the prevailing dissolved oxygen conditions in the DWSC by December 2009.

7. The Regional Water Board will require compliance with waste load allocations and load allocations for oxygen demanding substances and their precursors, and development of alternate measures to address non-load related factors by 31 December 2011.

8. The established allocations and implementation provisions represent a maximum allowable level for the purpose of addressing the dissolved oxygen impairment in the DWSC. Where more than one allocation may be applicable, the most stringent allocation applies. The Regional Water Board may take other, more restrictive, actions affecting the contributing factors to this impairment as needed to protect other beneficial uses or to implement other water quality objectives.

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Clear Lake Nutrients

Nuisance algae blooms impair beneficial uses in Clear Lake, which is a violation of the narrative basin plan objective that states "water shall not contain biostimulatory substances which promote aquatic growths in concentrations that cause nuisance or adversely affect beneficial uses"

Research and studies have concluded that there are likely multiple factors that influence the occurrence of nuisance algae blooms in Clear Lake. Recent improvements in water clarity may be due to a reduction in phosphorus loading or a result of other factors such as iron or sulfur availability, changes to lake ecology (introduced species, etc.), water year type or a combination of factors. For the purposes of this program of implementation both phosphorus loading and other factors that may affect algae growth will be addressed.

1. Modeling studies predict that a 40% reduction in average phosphorus loading will significantly reduce the incidence of algae blooms. A 40% reduction would equal an annual allowable loading of approximately 87,100 kg. Therefore, for this program of implementation, an average annual (five year rolling average) phosphorus load of 87,100 kg is established as the loading capacity for Clear Lake.

2. Waste load allocations for the NPDES facilities discharging to the lake or tributaries are as follows:

    a. Lake County Stormwater Permittees (Lake County, City of Clearlake, City of Lakeport) - 2,000 kg phosphorus/yr
    b. California Department of Transportation (Caltrans) – 100 kg phosphorus/yr

3. The load allocation for nonpoint source dischargers is 85,000 kg/yr average annual load (five year rolling average). The U.S. Bureau of Land Management (USBLM), U.S. Forest Service (USFS), Lake County (County) and irrigated agriculture are responsible for controlling phosphorus discharges from those portions of the watershed within their respective authority.

4. Regional Water Board staff will work with the responsible parties – Stormwater permittees, Caltrans, USBLM, USFS, County and irrigated agriculture – to develop and implement a plan to collect the information needed to determine what factors are important in controlling nuisance blooms and to recommend what control strategy should be implemented. The responsible parties will submit the plan to the Regional Water Board by 19 June 2008. The plan should address the following topics:
    - Studies to assess the current limnological conditions and to determine the appropriate measures necessary for Clear Lake to meet the Basin Plan objectives
    - Appropriate monitoring for evaluating conditions in the lake
    - Effective collection of phosphorus loading information from the various sources
    - Practices implemented or planned to control phosphorus loading to the lake
    - Develop criteria to determine when Clear Lake is no longer impaired

5. Compliance with load and waste load allocations for phosphorus in Clear Lake is required by 19 June 2017. However, by 19 September 2012, the Regional Water Board will consider information developed and determine whether the phosphorus load and waste load allocations should continue to be required or if some other control strategy or approach is more appropriate. To the extent that other controllable water quality factors, besides phosphorus, cause or contribute to nuisance algae blooms, those factors will be addressed in revisions to this program of implementation. Implementation of phosphorus control practices to achieve load and waste load allocations will occur under waste discharge requirements or waivers of waste discharge requirements.

6. If Clear Lake is attaining its beneficial uses and the Regional Water Board determine that phosphorus loads above allocated amounts are not causing or contributing to nuisance algae problems, the Regional Water Board will amend the Basin Plan to revise this nutrient control program for Clear Lake.

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ESTIMATED COSTS OF AGRICULTURAL WATER QUALITY CONTROL PROGRAMS AND POTENTIAL SOURCES OF FINANCING

San Joaquin River Subsurface Agricultural Drainage Control Program

The estimates of capital and operational costs to achieve the selenium objective for the San Joaquin River range from $3.6 million/year to $27.4 million/year (1990 dollars). The cost of meeting water quality objectives in Mud Slough (north), Salt Slough, and the wetland supply channels is approximately $2.7 million /year (1990 dollars).

Potential funding sources include:

1. Private financing by individual sources.
2. Bonded indebtedness or loans from governmental institutions.
3. Surcharge on water deliveries to lands contributing to the drainage problem.
4. Ad Valorem tax on lands contributing to the drainage problem.
5. Taxes and fees levied by a district created for the purpose of drainage management.
6. State or federal grants or low-interest loan programs.
7. Single-purpose appropriations from federal or State legislative bodies (including land retirement programs).

Lower San Joaquin River Salt and Boron Control Program

The estimates of capital and operational costs to implement drainage controls needed to achieve the salt and boron water quality objectives at the Airport Way Bridge near Vernalis range from 27 to 38 million dollars per year (2003 dollars).

Potential funding sources include:

1. Those identified in the San Joaquin River Subsurface Agricultural Drainage Program and the Pesticide Control Program.
2. Annual fees for waste discharge requirements.

Pesticide Control Program

Based on an average of $15 per acre per year for 500,000 acres of land planted to rice and an average of $5 per acre per year for the remaining 3,500,000 acres of irrigated agriculture in the Sacramento and San Joaquin River Basins, the total annual cost to agriculture is estimated at $25,000,000. Financial assistance for complying with this program may be obtainable through the U.S.D.A. Agricultural Stabilization and Conservation Service and technical assistance is available from the University of California Cooperative Extension Service and the U.S.D.A. Soil Conservation Service.

Sacramento and Feather Rivers Diazinon and Chlorpyrifos Runoff Control Program

The total estimated costs for management practices to meet the diazinon and chlorpyrifos objectives for the Sacramento and Feather Rivers range from $0 to $6.2 million/year (2007 dollars). The estimated costs for discharger monitoring, planning, and evaluation range from $0.3 to $1.5 million/year (2007 dollars).

Potential funding sources include:

1. Those identified in the San Joaquin River Subsurface Agricultural Drainage Control Program and the Pesticide Control Program.

San Joaquin River Dissolved Oxygen Control Program

The *Control Program for Factors Contributing to the Dissolved Oxygen Impairment in the Stockton Deep Water Ship Channel (DWSC)* requires agricultural and municipal dischargers to perform various studies. The total estimated cost of the studies to be performed as part of this control program is approximately $15.6 million. The preferred alternative also includes a prohibition of discharge if water quality objectives are not achieved by 31 December 2011. The estimated cost to cease discharge of water from irrigated lands ranges from $95 to $133 million per year. The estimated cost to provide minimum flows that would remove the need

for the prohibition is approximately $37 million dollars per year to eliminate the impairment through provision of purchased water. The cost of construction of an aeration device of adequate capacity to eliminate the impairment, in conjunction with point source load reductions already required, is estimated to be $10 million, with yearly operation and maintenance costs of $200,000 per year.

Potential funding sources:

1. Proposition 13 includes $40 million in bond funds to address the dissolved oxygen impairment in the DWSC. Approximately $14.4 million of this $40 million has been identified to fund the oxygen demanding substance and precursor studies. An additional $1.2 million is being provided from various watershed stakeholders. Approximately $24 million of Proposition 13 funds are available to pay for projects such as the design and construction of an aeration device.

2. The State Water Contractors, Port of Stockton, San Luis and Delta Mendota Water Authority, San Joaquin Valley Drainage Authority, and the San Joaquin River Group Authority have proposed to develop an operating entity for an aeration device and have indicated their commitment to execute a funding agreement among themselves and other interested parties, (subject to ultimate approval of respective governing boards) that would provide the mechanism to support operation of a permanent aerator at a cost expected to be in the annual range of $250,000 to $400,000.

Diazinon and Chlorpyrifos Runoff into the San Joaquin River Control Program

The total estimated costs for management practices to meet the diazinon and chlorpyrifos objectives for the San Joaquin River range from $56,000 to $2.5 million for the dormant season, and from $3.9 million to $5.3 million for the irrigation season. The estimated costs for discharger compliance monitoring, planning and evaluation range from $600,000 to $3.1 million. The estimated total annual costs range from $4.4 million to $10.9 million (2004 dollars).

Potential funding sources include:

1. Those identified in the San Joaquin River Subsurface Agricultural Drainage Control Program and the Pesticide Control Program.

Diazinon and Chlorpyrifos Runoff into the Sacramento-San Joaquin Delta Waterways

The total estimated costs for management practices to meet the diazinon and chlorpyrifos objectives for the Delta Waterways range from $5.9 to $12.7 million. The estimated costs for discharger compliance monitoring, planning and evaluation range from $600,000 to $1.8 million. The estimated total annual costs range from $6.5 to $14.4 million (2005 dollars).

Potential funding sources include:

1. Those identified in the San Joaquin River Subsurface Agricultural Drainage Control Program and the Pesticide Control Program.

Clear Lake Nutrient Control Program

Estimated costs to implement best management practices, if necessary, are $400,000 to $1,800,000 (2006 dollars).

Potential funding sources include:

1. Those identified in the San Joaquin River Subsurface Agricultural Drainage Control Program and the Pesticide Control Program.

Delta Mercury Control Program

The total estimated costs (2007 dollars) for the agricultural methylmercury control studies to develop management practices to meet the Delta methylmercury allocations range from $290,000 to $1.4 million. The estimated annual costs for agricultural discharger compliance monitoring range from $14,000 to $25,000. The estimated annual costs for Phase 2 implementation of methylmercury management practices range from $590,000 to $1.3 million.

1. Potential funding sources include those identified in the San Joaquin River Subsurface Agricultural Drainage Control Program and the Pesticide Control Program.

V. SURVEILLANCE AND MONITORING

This chapter describes the methods and programs that the Regional Water Board uses to acquire water quality information. Acquisition of data is a basic need of a water quality control program and is required by both the Clean Water Act and the Porter-Cologne Water Quality Control Act.

The Regional Water Board's surveillance and monitoring efforts include different types of sample collection and analysis. Surface water surveillance may involve analyses of water, sediment, or tissue samples and ground water surveillance often includes collection and analysis of soil samples. Soil, water, and sediment samples are analyzed via standard, EPA approved, laboratory methods. The Regional Water Board addresses quality assurance through bid specifications and individual sampling actions such as submittal of split, duplicate, or spiked samples and lab inspections.

Although surveillance and monitoring efforts have traditionally relied upon measurement of key chemical/physical parameters (e.g., metals, organic and inorganic compounds, bacteria, temperature, and dissolved oxygen) as indicators of water quality, there is increasing recognition that close approximation of water quality impacts requires the use of biological indicators. This is particularly true for regulation of toxic compounds in surface waters where standard physical/chemical measurement may be inadequate to indicate the wide range of substances and circumstances able to cause toxicity to aquatic organisms. The use of biological indicators to identify or measure toxic discharges is often referred to as *biotoxicity testing*. EPA has issued guidelines and technical support materials for biotoxicity testing. A key use of the method is to monitor for compliance with narrative water quality objectives or permit requirements that specify that there is to be no discharge of toxic materials in toxic amounts. The Regional Water Board will continue to use biotoxicity procedures and testing in its surveillance and monitoring program.

As discussed previously, the protection, attainment, and maintenance of beneficial uses occur as part of a continuing cycle of identifying beneficial use impairments, applying control measures, and assessing program effectiveness. The Regional Water Board surveillance and monitoring program provides for the collection, analysis, and distribution of the water quality data needed to sustain its control program. Under ideal circumstances, the Regional Water Board surveillance and monitoring program would produce information on the frequency, duration, source, extent, and severity of beneficial use impairments. In attempting to meet this goal, the Regional Water Board relies upon a variety of measures to obtain information. The current surveillance and monitoring program consists primarily of seven elements:

Data Collected by Other Agencies

The Regional Water Board relies on data collected by a variety of other agencies. For example, the Department of Water Resources (DWR) has an ongoing monitoring program in the Delta and the United States Geological Survey (USGS) and DWR conduct monitoring in some upstream rivers. The Department of Fish and Game, Fish and Wildlife Service, USGS, and Department of Health Services also conduct special studies and collect data.

Regional Water Board and State Water Board Monitoring Programs

The State Water Board manages its own Toxic Substances Monitoring (*TSM*) program to collect and analyze fish tissue for the presence of bioaccumulative chemicals. The Regional Water Board participates in the selection of sampling sites for its basins and annually is provided with a report of the testing results.

Special Studies

Intensive water quality studies provide detailed data to locate and evaluate violations of receiving water standards and to make waste load allocations. They usually involve localized, frequent and/or continuous sampling. These studies are specially designed to evaluate problems in potential water quality limited segments, areas of special biological significance or hydrologic units requiring sampling in addition to the routine collection efforts.

One such study is the *San Joaquin River Subsurface Agricultural Drainage Monitoring Program*. The program includes the following tasks:

1. The dischargers will monitor discharge points and receiving waters for constituents of concern and flow (discharge points and receiving water points).

2. The Regional Board will inspect discharge flow monitoring facilities and will continue its cooperative effort with dischargers to ensure the quality of laboratory results.

3. The Regional Board will, on a regular basis, inspect any facilities constructed to store or treat agricultural subsurface drainage.

4. The Regional Board will continue to maintain and update its information on agricultural subsurface drainage facilities in the Grassland watershed. Efforts at collecting basic data on all facilities, including flow estimates and water quality will continue.

5. The Regional Water Board, in cooperation with other agencies, will regularly assess water conservation achievements, cost of such efforts and drainage reduction effectiveness information. In addition, in cooperation with the programs of other agencies and local district managers, the Regional Board will gather information on irrigation practices, i.e., irrigation efficiency, pre-irrigation efficiency, excessive deep percolation and on seepage losses.

Another such study is a surveillance and monitoring program conducted by the El Dorado Irrigation District (EID) on Deer Creek in El Dorado and Sacramento Counties. Regional Board staff will work with EID to ensure adequate temperature, flow and biological monitoring is conducted to evaluate compliance with the site-specific temperature objectives for Deer Creek and their effect on beneficial uses.

Aerial Surveillance

Low-altitude flights are conducted primarily to observe variations in field conditions, gather photographic records of discharges, and document variations in water quality.

Self-Monitoring

Self-monitoring reports are normally submitted by the discharger on a monthly or quarterly basis as required by the permit conditions. They are routinely reviewed by Regional Water Board staff.

Compliance Monitoring

Compliance monitoring determines permit compliance, validates self-monitoring reports, and provides support for enforcement actions. Discharger compliance monitoring and enforcement actions are the responsibility of the Regional Water Board staff.

Complaint Investigation

Complaints from the public or governmental agencies regarding the discharge of pollutants or creation of nuisance conditions are investigated and pertinent information collected.

Mercury and Methylmercury

The Regional Water Board will use the following criteria to determine compliance with the methylmercury fish tissue objectives. Site-specific criteria for various water bodies are described below.

The number of fish collected to determine compliance with the methylmercury objective will be based on the statistical variance within each species. The sample size will be determined by methods described in USEPA's Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories (Third Edition, 2000) or other statistical methods approved by the Executive Officer.

Analysis of fish tissue for total mercury is acceptable for assessing compliance. Compliance with the fish tissue objective is achieved when the average concentrations in local fish are equivalent to the respective objective for three consecutive years.

Clear Lake
Fish from the following species will be collected and analyzed every ten years. The representative fish species for trophic level 4 shall be largemouth bass (total length 300-400 mm), catfish (total length 300 – 400 mm), brown bullhead (total length 300-400 mm), and crappie (total length 200-300 mm). The representative fish species for trophic level 3 shall be carp, hitch, Sacramento blackfish, black bullhead, and bluegill of all sizes; and brown bullhead and catfish of lengths less than the trophic level 4 lengths.

Fish tissue mercury concentrations are not expected to respond quickly to remediation activities at Sulphur Bank Mercury Mine, Clear Lake sediments, or the tributaries. Adult fish integrate methylmercury over a lifetime and load reduction efforts are not expected to be discernable for more than five years after remediation efforts. To assess remedial activities, part of the monitoring at Clear Lake will include indicator species, consisting of inland silversides and largemouth bass less than one year old, to be sampled every five years. Juveniles of these species will reflect recent exposure to methylmercury and can be indicators of mercury reduction efforts.

Average concentrations of methylmercury by trophic level should be determined in a combination of the identified species collected throughout Clear Lake.

Total mercury in tributary sediment, lake sediment, and water will be monitored to determine whether loads have decreased. The water and sediment monitoring frequency will be every five years.

Cache Creek, Bear Creek, Harley Gulch, and Sulphur Creek

The Regional Water Board will use the following criteria to determine compliance with the methylmercury fish tissue objectives in Cache and Bear Creeks. Compliance with the respective objectives shall be determined based on fish tissue analysis in Cache Creek from Clear Lake to the Settling Basin, North Fork Cache Creek, and Bear Creek upstream and downstream of Sulphur Creek.

The representative fish species for each trophic level shall be:

- Trophic Level 3: green sunfish, bluegill, and/or Sacramento sucker (rainbow trout also an option for North Fork Cache Creek);
- Trophic Level 4: Sacramento pikeminnow, largemouth bass, smallmouth bass and/or channel catfish.

The sample sets will include at least two species from each trophic level (i.e., bass and Sacramento pikeminnow, for TL4) collected at each compliance point or stream section. The samples will include a range of sizes of fish between 250 and 350 mm, total length, with average length of 300 mm. If green sunfish and bluegill are not available in this size range; those sampled should be greater than 125 mm total length. If two species per trophic level are not available and are unlikely to be present given historical sampling information, one species is acceptable (the only TL4 species typically in North Fork is Sacramento pikeminnow).

Compliance with the Harley Gulch methylmercury water quality objective will be determined using hardhead, California roach, or other small (TL2/3), resident species in the size range of 75-100 mm total length.

Aqueous methylmercury goals are in the form of the annual, average concentration in unfiltered samples. For comparison of methylmercury concentration data with aqueous methylmercury goals, water samples are recommended to be collected periodically throughout the year and during typical flow conditions as they vary by season, rather than targeting extreme low or high flow events. Aqueous methylmercury data may be collected by Regional Water Board staff or required of project proponents.

Monitoring for mine cleanups or other projects that are expected to significantly affect methylmercury or mercury loads are recommended to include the following parameters. The data may be collected by Regional Water Board staff or required of project proponents.

- Monitoring parameters for soil and sediment: concentration of total mercury in soil or sediment in the silt/clay (<63 microns) fraction.
- Monitoring parameters for water: methylmercury (if project is methylmercury source), total mercury, total suspended solids, turbidity, and stream flow. Water sampling in major tributaries is recommended to include high flow events for mercury and total suspended solids. More frequent monitoring (two to four significant storm events for three consecutive years) is recommended after cleanup to evaluate the effectiveness of cleanup actions.
- Monitoring of mercury in suspended sediment: The ratio of concentrations of mercury in suspended sediment (Hg/TSS) is a useful measure of mercury contamination. Effectiveness of cleanup of the mines may be assessed by comparing concentration of mercury in fine-grained sediment discharging from the mines to the average concentration in background (not affected by mining activities) soil or sediment.

Delta

<u>Fish Methylmercury Compliance Monitoring</u>

The Regional Water Board will use the following specifications to determine compliance with the methylmercury fish tissue objectives in the Sacramento-San Joaquin Delta. Beginning 2025, Regional Water Board staff will initiate fish tissue monitoring. Thereafter compliance monitoring will ensue every ten years, more frequently as needed where substantial changes in methyl or total mercury concentrations or loading occur, but not to exceed ten years elsewhere.

Initial fish tissue monitoring will take place at the following compliance reaches in each subarea:

- Central Delta subarea: Middle River between Bullfrog Landing and Mildred Island;
- Marsh Creek subarea: Marsh Creek from Highway 4 to Cypress Road;

- Mokelumne/Cosumnes River subarea: Mokelumne River from the Interstate 5 bridge to New Hope Landing;
- Sacramento River subarea: Sacramento River from River Mile 40 to River Mile 44;
- San Joaquin River subarea: San Joaquin River from Vernalis to the Highway 120 bridge;
- West Delta subarea: Sacramento/San Joaquin River confluence near Sherman Island;
- Yolo Bypass-North subarea: Tule Canal downstream of its confluence with Cache Creek; and
- Yolo Bypass-South subarea: Toe Drain between Lisbon and Little Holland Tract.

Compliance fish methylmercury monitoring will include representative fish species for comparison to each of the methylmercury fish tissue objectives:

- Trophic Level 4: bass (largemouth and striped), channel and white catfish, crappie, and Sacramento pikeminnow.
- Trophic Level 3: American shad, black bullhead, bluegill, carp, Chinook salmon, redear sunfish, Sacramento blackfish, Sacramento sucker, and white sturgeon.
- Small (<50 mm) fish: primary prey species consumed by wildlife in the Delta, which may include the species listed above, as well as inland silverside, juvenile bluegill, mosquitofish, red shiner, threadfin shad, or other fish less than 50 mm.

Trophic level 3 and 4 fish sample sets will include three species from each trophic level and will include both anadromous and non-anadromous fish. Trophic level 3 and 4 fish sample sets will include a range of fish sizes between 150 and 500 mm total length. Striped bass, largemouth bass, and sturgeon caught for mercury analysis will be within the CDFG legal catch size limits. Sample sets for fish less than 50 mm will include at least two fish species that are the primary prey species consumed by wildlife at sensitive life stages. In any subarea, if multiple species for a particular trophic level are not available, one species in the sample set is acceptable.

<u>Water Methylmercury and Total Mercury Compliance Monitoring</u>

Compliance points for irrigated agriculture and managed wetlands methylmercury allocations shall be developed during the Phase 1 Control Studies. In conjunction with the Phase 1 Control Studies, nonpoint sources, irrigated agriculture, and managed wetlands shall develop and implement mercury and/or methylmercury monitoring, and submit monitoring reports.

NPDES facilities' compliance points for methylmercury and total mercury monitoring are the effluent monitoring points currently described in individual NPDES permits.

During Phase 1 and Phase 2, facilities listed in Table IV-7B shall conduct effluent total mercury and methylmercury monitoring starting by 20 October 2012. Monitoring frequencies shall be defined in the NPDES permits. Effluent monitoring requirements will be re-evaluated during the Delta Mercury Control Program Reviews.

Facilities that begin discharging to surface water during Phase 1 and facilities for which effluent methylmercury data were not available at the time Table IV-7B was compiled, shall conduct monitoring.

Compliance points and monitoring frequencies for MS4s required to conduct methylmercury and total mercury monitoring are those locations and wet and dry weather sampling periods currently described in the individual MS4 NPDES permits or otherwise determined to be representative of the MS4 service areas and approved by the Executive Officer on an MS4-specific basis.

Annual methylmercury loads in urban runoff in MS4 service areas within the Delta and Yolo Bypass may be calculated by the following method or by an alternate method approved by the Executive Officer. The annual methylmercury load in urban runoff for a given MS4 service area during a given year may be calculated by the sum of wet weather and dry weather methylmercury loads. To estimate wet weather methylmercury loads discharged by MS4 urban areas, the average of wet weather methylmercury concentrations observed at the MS4's compliance locations may be multiplied by the wet weather runoff volume estimated for all urban areas within the MS4 service area within the Delta and Yolo Bypass. To estimate dry weather methylmercury loads, the average of dry weather methylmercury concentrations observed at the MS4's compliance locations may be multiplied by the estimated dry weather urban runoff volume in the MS4 service area within the Delta and Yolo Bypass.

Diazinon and Chlorpyrifos Runoff into the Sacramento and Feather Rivers

The Regional Water Board requires a focused monitoring effort of agricultural pesticide runoff into the Sacramento and Feather Rivers.

The monitoring and reporting program for any waste discharge requirements or waiver of waste discharge requirements that addresses agricultural pesticide runoff into the Sacramento and Feather Rivers must be designed to collect the information necessary to:

1. determine compliance with established water quality objectives and the loading capacity applicable to diazinon and chlorpyrifos in the Sacramento and Feather Rivers;

2. determine compliance with load allocations for diazinon and chlorpyrifos;

3. determine the degree of implementation of management practices to reduce off-site migration of diazinon and chlorpyrifos;

4. determine the effectiveness of management practices and strategies to reduce off-site migration of diazinon and chlorpyrifos;

5. determine whether alternatives to diazinon or chlorpyrifos are causing surface water quality impacts;

6. determine whether the discharge causes or contributes to a toxicity impairment due to additive or synergistic effects of multiple pollutants; and

7. demonstrate that management practices are achieving the lowest pesticide levels technically and economically achievable.

Dischargers are responsible for providing the necessary information. The information may come from the dischargers' monitoring efforts; monitoring programs conducted by State or federal agencies or collaborative watershed efforts; or from special studies that evaluate the effectiveness of management practices.

Diazinon and Chlorpyrifos Runoff in the San Joaquin River Basin

The Regional Water Board requires a focused monitoring effort of pesticide runoff from orchards and fields in the San Joaquin Valley.

The monitoring and reporting program for any waste discharge requirements or waiver of waste discharge requirements that addresses pesticide runoff from orchards and fields in the San Joaquin valley must be designed to collect the information necessary to:

1. determine compliance with established water quality objectives and the loading capacity applicable to diazinon and chlorpyrifos in the San Joaquin River;
2. determine compliance with established load allocations for diazinon and chlorpyrifos;
3. determine the degree of implementation of management practices to reduce off-site movement of diazinon and chlorpyrifos;
4. determine the effectiveness of management practices and strategies to reduce off-site migration of diazinon and chlorpyrifos;
5. determine whether alternatives to diazinon and chlorpyrifos are causing surface water quality impacts;
6. determine whether the discharge causes or contributes to a toxicity impairment due to additive or synergistic effects of multiple pollutants; and
7. demonstrate that management practices are achieving the lowest pesticide levels technically and economically achievable.

Dischargers are responsible for providing the necessary information. The information may come from the dischargers' monitoring efforts; monitoring programs conducted by State or federal agencies or collaborative watershed efforts; or from special studies that evaluate the effectiveness of management practices.

Diazinon and Chlorpyrifos Runoff into the Sacramento-San Joaquin Delta Waterways

The Regional Water Board requires a focused monitoring effort of pesticide runoff from orchards and fields discharging to the Sacramento-San Joaquin Delta Waterways (as identified in Appendix 42).

The monitoring and reporting program for any waste discharge requirements or waiver of waste discharge requirements that addresses pesticide runoff into the Delta Waterways must be designed to collect the information necessary to:

1. Determine compliance with established water quality objectives and loading capacity, applicable to diazinon and chlorpyrifos in the Delta Waterways.

2. Determine compliance with the load allocations applicable to discharges of diazinon and chlorpyrifos into the Delta Waterways.

3. Determine the degree of implementation of management practices to reduce off-site movement of diazinon and chlorpyrifos.

4. Determine the effectiveness of management practices and strategies to reduce off-site migration of diazinon and chlorpyrifos.

5. Determine whether alternatives to diazinon and chlorpyrifos are causing surface water quality impacts.

6. Determine whether the discharge causes or contributes to a toxicity impairment due to additive or synergistic effects of multiple pollutants.

7. Demonstrate that management practices are achieving the lowest pesticide levels technically and economically achievable.

Dischargers are responsible for providing the necessary information. The information may come from the dischargers' monitoring efforts; monitoring programs conducted by State or federal agencies or collaborative watershed efforts; or from special studies that evaluate the effectiveness of management practices.

With Regional Water Board Executive Officer approval, monitoring can be performed in a subset of the Delta Waterways listed in Appendix 42, and the tributaries of those waterways, to determine compliance with the water quality objectives, loading capacity and load allocations.

Clear Lake Nutrients

The responsible parties – Lake County, City of Clearlake, City of Lakeport, Caltrans, USBLM, USFS and irrigated agriculture – will work with Regional Water Board staff to estimate nutrient loadings from activities in the watershed. Loading estimates can be conducted using either water quality monitoring or computer modeling or a combination of the two.

A P P E N D I X

APPENDIX DIRECTORY

ITEM*	DESCRIPTION
1.	State Water Board Policy for Water Quality Control
2.	State Water Board Resolution No. 68-16, Statement of Policy with Respect to Maintaining High Quality of Waters in California
3.	State Water Board Resolution No. 74-43, Water Quality Control Policy for the Enclosed Bays and Estuaries of California
4.	State Water Board Resolution No. 75-58, Water Quality Control Policy on the Use and Disposal of Inland Waters Used for Powerplant Cooling
5.	State Water Board Resolution No. 77-1, Policy with Respect to Water Reclamation in California
6.	State Water Board Resolution No. 87-22, Policy on the Disposal of Shredder Waste
7.	State Water Board Resolution No. 88-23, Policy Regarding the Underground Storage Tank Pilot Program
8.	State Water Board Resolution No. 88-63, Sources of Drinking Water Policy
9.	State Water Board Resolution No. 92-49, Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code Section 13304
10.	State Water Board Resolution No. 93-62, Policy for Regulation of Discharges of Municipal Solid Waste
11.	State Water Board Water Quality Control Plan for Temperature in Coastal and Inerstate Waters and Enclosed Bays and Estuaries in California (Thermal Plan)
12.	State Water Board Resolution No. 92-82, exception to the Thermal Plan for Sacramento Regional County Sanitation District
13.	State Water Board MAA with Forest Service, U. S. Department of Agriculture
14.	State Water Board MOA with Department of Health Services (implementation of hazardous waste program)
15.	State Water Board MOA with Department of Health Services (use of reclaimed water)
16.	State Water Board MAA with the Board of Forestry and California Department of Forestry and Fire Protection
17.	State Water Board MOA with CA Department of Conservation, Division of Oil and Gas

* Appendix items are paginated by: item number/item page/item total pages

APPENDIX DIRECTORY

ITEM*	DESCRIPTION
18.	State Water Board MOU with Department of Health Services/Department of Toxic Substances Control
19.	State Water Board MOU with Soil Conservation Service, U.S. Department of Agriculture for Planning and Technical Assistance Related to Water Quality Policies and Activities
20.	State Water Board MOU with the Environmental Affairs Agency, Air Resources Board, and California Integrated Waste Management Board
21.	State Water Board MOU with the California Department of Pesticide Regulation for the Protection of Water Quality from Potentially Adverse Effects of Pesticides
22.	State Water Board MOU with Several Agencies Regarding the Implementation of the San Joaquin Valley Drainage Program's Recommended Plan
23.	State Water Board MOU with the California Integrated Waste Management Board
24.	State Water Board MOU with the Bureau of Land Management US Department of Interior - Nonpoint Source Issues, Planning and Coordination of Nonpoint Source Water Quality Policies and Activities
25.	Regional Water Board Resolution No. 70-118, Delegation of Certain Duties and Powers of the Regional Water Board to the Board's Executive Officer
26.	Regional Water Board MOU with U.S. Bureau of Land Management (Ukiah District)
27.	Regional Water Board MOU with U.S. Bureau of Land Management (Susanville District)
28.	Regional Water Board MOU with U.S. Bureau of Land Management (Bakersfield District)
29.	Regional Water Board MOA with U. S. Bureau of Reclamation
30.	Regional Water Board MOU with California Dept. of Fish and Game and Mosquito Abatement and Vector Control Districts of the South San Joaquin Valley Regarding Vegetation Management in Wastewater Treatment Facilities
~~31.~~	~~Regional Water Board Resolution No. 89-247, Conditional Waiver of Waste Discharge Requirements at Retail Fertilizer Facilities~~ - - - Removed 13 August 2009
~~32.~~	~~Regional Water Board Resolution No. 90-34, Conditional Waiver of Waste Discharge Requirements at Pesticide Applicator Facilities~~ - - - Removed 13 August 2009

* Appendix items are paginated by: item number/item page/item total pages

APPENDIX DIRECTORY

ITEM*	DESCRIPTION
33.	Regional Water Board Guidelines for Winery Waste
34.	Regional Water Board Guidelines for Erosion
35.	Regional Water Board Guidelines for Small Hydroelectric Facilities
36.	Regional Water Board Guidelines for Disposal from Land Developments
37.	Regional Water Board Guidelines for Mining
~~38.~~	~~Regional Water Board list of Water Quality Limited Segments~~ - - - Removed 6 September 2002
39.	Federal Anti-degradation policy (40 CFR 131.12)
40.	Grassland Watershed Wetland Channels
41.	San Joaquin Area Subarea Descriptions
42.	Sacramento-San Joaquin Delta Waterways
43.	Delta and Yolo Bypass Waterways Applicable to the Delta Mercury Control Program

* Appendix items are paginated by: item number/item page/item total pages

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October 25, 2007

Written testimony of Theo Colborn, PhD, President of TEDX, Paonia, Colorado before the House Committee on Oversight and Government Reform, hearing on The Applicability of Federal Requirements to Protect Public Health and the Environment from Oil and Gas Development, October 31, 2007.

Good morning Mr. Waxman and members of the Committee. Thank you for this opportunity to speak to you about the emerging public health and environmental issues as a result of natural gas production in the west. My name is Theo Colborn. I am here to speak as an environmental health analyst and as a resident of western Colorado whose watershed and air are being threatened by natural gas production and delivery. I have a B.S. in pharmacy from Rutgers University, an M.A. in fresh water ecology from Western State College of Colorado, and a PhD in zoology, with distributed minors in epidemiology, toxicology, and water chemistry from the University of Wisconsin, Madison. My field and laboratory research for these degrees looked at the mobilization of low levels of toxic trace metals in high altitude streams in Colorado. In 1985 I moved to Washington DC on a Fellowship from the US Congress, Office of Technology Assessment and later established and ran the Wildlife and Contaminants Program at World Wildlife Fund until 2002. I have served on the EPA Science Advisory Board and several EPA panels; on a Canada/US International Joint Commission Health Committee since 1989; advised Environment Canada, Health Canada, the US Fish and Wildlife Service, the US Department of the Interior, the ATSDR; and advised similar government agencies in Europe, the UK, and Japan. I have published in scientific journals and books on the effects of low level and/or ambient exposure to toxic chemicals called endocrine disruptors which has triggered action at the state, national, and international level to improve the protocols for testing chemicals when determining their safety.

In 2002, I returned to Paonia, Colorado where I established TEDX (The Endocrine Disruption Exchange) and became its president. At that time I also accepted a Professorship at the University of Florida, Gainesville.

I had no intention of getting involved with natural gas development when I set up my non-profit until someone handed me the formula for the fracturing fluid to be used in 17 proposed gas wells on the Grand Mesa National Forest, which my family and I consider our back yard. After looking at the possible health effects of just one of the chemicals the company planned to use, I decided to submit a letter to the regional US Forest Service and BLM Director who were issuing the drilling permits. In the letter I described the structure and physical characteristics of the chemical 2-butoxy ethanol (2-BE), as well as a long list of bizarre health effects that were possible at relatively low levels of exposure. 2-BE is odorless, colorless,

tasteless, and evaporates at room temperature. If this chemical were to surface as a gas or get into a drinking water supply, it could cause health problems in domestic and wild animals and humans that could baffle veterinarians or physicians. See Appendix A.

Two years later, a woman from Silt, Garfield County, Colorado called to tell me that she had developed a very rare adrenal tumor and had to have the tumor and her adrenal gland removed. One of the effects of 2-BE was adrenal tumors. She told me that she lived within 900 feet of a busy gas well pad where frac'ing took place frequently. During one frac'ing episode her domestic water well erupted. She also began describing the health problems of others who lived near her. This prompted me to begin to find out more about how natural gas is produced. When I found out that each fracturing incident, commonly called frac'ing, uses approximately one million gallons of fluid and that each well can be frac'ed 10 times or more, I became very interested.

Soon TEDX became a clearing house for information about the products that were being used in natural gas operations. In order to organize the data we set up computer spreadsheets. We also searched the peer reviewed literature and government and industry documents for the health effects of the chemicals on our list and added the information to the spreadsheets. We have over 1,700 citations to back up the Colorado data. See Appendix B.

It is impossible to provide quantitative information about what is being used at any stage of developing natural gas because much of this information is proprietary. For example, in what quantities and mixtures are the products being used? How much water or other fluids are used to attain the million gallons needed to fracture a well? TEDX believes that every citizen has a right to know what is being introduced into our pristine and very fragile, arid ecosystems where every drop of potable water is precious. Nonetheless, we are certain of one thing, even at extremely low levels one would not want to drink the majority of the chemicals on the list.

The last time TEDX updated the Colorado spreadsheet, there were 171 products and 245 chemicals on the list. 92% of the products had health effects. The other 8% are products for which there is no information because it is either proprietary or no health studies could be found. Most of the products had multiple health effects with some having as many as 14 effects. See Appendix B.

As the list of the products grew, a consistent pattern of health effects kept emerging. Taking into consideration that air and water were the most likely pathways of exposures, we broke out the chemicals into two groups: volatile chemicals and water soluble. We also realize now that air is the most immediate pathway. From 68% to 86% of the volatile chemicals cause mild to severe irritation of the skin, eye, sinuses, nose, throat, lungs, and the stomach, and cause effects on the brain and nervous system ranging from headaches, blackouts, memory loss, confusion, fatigue or exhaustion, and permanent neuropathies. Many of these chemicals are called sensitizers; they can lead to the development of allergic reactions. 35% to 55% of the chemicals cause disorders that develop slowly such as cardiovascular, kidney, immune system changes, and reproductive organ damage and are toxic to wildlife. Medical practitioners have no way to link health effects such as these with an environmental contaminant. See Appendix B.

We also found that the muds used in drilling are not as safe as industry claims. Using data from a drilling operation where there had been a blowout, the pattern of the possible health effects of the chemicals used in that operation, matched the general health pattern of our overall analyses. See Appendix C.

It is not general knowledge that when methane surfaces it brings along with it some very toxic gases that are being vented by the tons every year from each operational unit. These include benzene, toluene, ethyl benzene, and xylene, often referred to as BETX. These VOCs, (Volatile Organic Compounds) plus the VOCs in the products being used and the vast amounts of fugitive methane (which is a VOC and powerful greenhouse gas) plus the NOx (Nitrogen Oxide) produced from diesel and gas burning stationary and mobile equipment to produce and pump the gas are contributing to a growing increase in ozone in the west, that heretofore has been ignored.

And it is not general knowledge that when methane surfaces, it is wet, and this water, called condensate water, is often put into an evaporation pit on the well pad, or stored in condensate tanks and later picked up by "water trucks" and moved to large, receiving, open evaporation facilities. It takes fleets of water trucks to handle the volume of water surfacing. Last year, it was estimated that 5,500 condensate tanks across western Colorado released over 100 tons of VOCs each, including BTEX. This gas field activity will be a continuing source of NOx and VOCs for the life of each well, which can be as long as 20 years.

We had been unable to find any information on the chemical content of waste pits until we were sent results of a chemical analysis of the residues from six waste pits in New Mexico. The 51 chemicals that were detected in those pits produced a health pattern even more toxic than anything we found in the past. Most important is that 43 of the 51 chemicals detected in the pits were not on our list of chemicals being used during natural gas operations. And 13 of the chemicals were at concentrations above state and federal safety levels. We found out later that except for those eight chemicals, their study design did not include testing for the chemicals on our list of what is used during production and delivery. We also discovered that 84% of the chemicals detected in the pits are on the CERCLA superfund list. See Appendix D.

A finding such as this raises a number of questions that only adequately designed testing requirements and protocols can address --- **and points out the need for full disclosure**. Data such as this also suggests that eventually, as each pit and well pad is closed down, it has the potential to become a new superfund site.

APPENDIX A

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October 22, 2002

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RE: **An Analysis of Possible Increases in Exposure to Toxic Chemicals in Delta County, Colorado Water Resources as the Result of Gunnison Energy's Proposed Coal Bed Methane Extraction Activity**

BACKGROUND
Gunnison Energy is proposing to extract coal bed methane in Delta County, Colorado. In its notices to the public it makes claims that "…the threats posed by hydraulic fracturing of CBM wells to USDWs [US drinking water supplies] are low and do not justify additional study." They also claim that the "…fluids used to extract coal bed methane from the ground do not substantially threaten public health." [1] The following addresses these claims and looks at possible direct and indirect health effects of CBM extraction on the citizens, domestic animals, and wildlife in Delta County.

THE FRACTURING FLUIDS
Gunnison Energy proposes to use a solvent, ethylene glycol monobutyl ether (2-butoxyethanol), hereafter designated as 2-BE, in a liquid fracturing mixture to facilitate the extraction of coal bed methane in Delta County. 2-BE will be present in the liquid component of the fluid at approximately 7 ppm (parts per million) based on data provided to Delta County Commissioners following three local Area Planning Committee meetings by Gunnison Energy Corporation (GEC), May 29, 2002.

The structural formula for 2-BE is:

CH3-CH2-CH2-CH2-O-CH2-CH2-OH

2-BE is a highly soluble, colorless liquid with a very faint, ether-like odor.[2] At the concentration it is to be used in Delta County, it might not be detectable through odor or taste. 2-BE has low volatility, vaporizes slowly when mixed with water, and remains well dissolved throughout the water column.[Error! Bookmark not defined.] Photolysis (degradation by sunlight) is not a factor in the breakdown of 2-BE. It mobilizes in soil and can easily leach into groundwater.[Error! Bookmark not defined.] Because of these characteristics, it could remain entrapped underground for years and eventually migrate to a domestic well or to a surfacing spring. This contaminated water in

[1] The Daily Sentinel, Sunday, September 8, 2002. p. 8C
[2] Agency for Toxic Substances and Disease Registry . US Department of Health and Human Services. (1998) Toxicological Profile of 2-Butoxethanol and 2-Butoxyethanol Acetate.

some cases might not reach wells, springs, and rivers in Delta County until long after GEC will have gone out of business.

The half-life of 2-BE in natural surface waters ranges from 7 to 28 days.[2] With an aerobic bio-degradation rate this slow, humans, wildlife and domestic animals could come into direct contact with 2-BE through ingestion, inhalation, dermal sorption, and the eye in its liquid or vapor form as the entrapped water reaches the surface. Aerobic biodegradation requires oxygen and therefore the deeper 2-BE is injected underground the longer it will persist. To date the aerobic biodegradation breakdown products of 2-BE have not been identified. The chemistry to detect the glycol ethers, including 2-BE, in environmental samples is very difficult and therefore there are few laboratories with the ability to accurately quantify its presence.[Error! Bookmark not defined.]

DIRECT HEALTH EFFECTS OF 2-BE

Immediate/Direct

Following inhalation or swallowing, 2-BE is distributed rapidly to all tissues in the body via the blood stream in laboratory animals. When applied directly to the skin, 2-BE is rapidly absorbed.[Error! Bookmark not defined.] In solution, it is absorbed more rapidly. It is broken down to its toxic component, 2-butoxyacetic acid (BAA) in both humans and laboratory animals following all three exposure pathways[3]. Breakdown and excretion of BAA through the urine is identical regardless of the pathway of exposure according to laboratory studies[Error! Bookmark not defined.] No laboratory studies could be found that assessed cumulative effects from simultaneous ingestion, inhalation, and dermal exposure to 2-BE, which could be the scenario in Delta County.

Hemolytic Effects - Primary

The most critical direct effect of 2-BE as the result of laboratory studies is its impact on red blood cells. It causes hemolysis (breakdown of red blood cells) by dissolving the fat in the cell membrane and causing the membrane to break down. 2-BE causes hematuria (blood in the urine) and blood in the feces. Blood appears in the urine as a result of kidney damage which can eventually lead to kidney failure. It is especially toxic to the spleen, the bones in the spinal column, and bone marrow (where new blood cells are formed) and the liver, where chemicals are detoxified (broken down for easy excretion from the body).[Error! Bookmark not defined.] Chronic exposure can cause anemia, and in laboratory animals it leads to insufficient blood supply, cold extremities, and tail necrosis (a condition where the tail rots away.)[4]

Other Effects - Secondary

In a sub-chronic study over a period of 14 weeks, mice exposed to 2-BE exhibited the hemolytic effects mentioned above as well as a number of secondary problems involving the spleen and liver, and degeneration of kidney tubules.[5] In addition, females were more sensitive to fore-stomach necrosis, ulceration, and inflammation occurring at half the dose required to cause the same problems in males. Female fertility was also significantly reduced in mice because of embryo

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[3] US Environmental Protection Agency. Toxicological Review of Ethylene Glycol Monobutyl Ether (EGBE) In Support of Summary Information on the Integrated Risk Information System (IRIS), October 1999

[4] Nyska A, Maronpot RR, PH Long, JH Roycroft, JR Hailey, GS Traylor, BI Ghanayem (1999) Disseminated thrombosis and bone infarction in female rats following inhalation exposure to 2-butoxyethanol. Toxicol Pathol 27(3):287-294.

[5] National Toxicology Program (NTP). 1998 NTP Technical report on the toxicology and carcinogenesis studies of 2-butoxyethanol (Cas No. 111-76-2) in F344/N rats and B6C3F1 mice (inhalation studies). US Department of Health and Human Services, Public Health Service, National Institutes of Health, Research Triangle Park, NC NTP TR 484. NIH Draft Publ. No. 98 -3974.

mortality.[6] In this study, the dead embryos were discarded, and as a result, the prenatal effects of 2-BE on the embryos were not determined.

EPA recommends that 2-BE be classified as a mild eye irritant.[Error! Bookmark not defined.] However, a recent study published after EPA reached this classification could lead to a higher risk classification. Using oral exposure in rats, severe damage to the eye was discovered that led to retinal detachment, photoreceptor degeneration and occlusion resulting from multiple thrombosis of the blood vessels in the eye.[7] In this study, females were more susceptible.

With few exceptions most of the evidence mentioned above was derived from inhalation studies. All of the studies used standard, high-dose testing protocols to detect obvious birth defects and organ damage, cancer, mutations, convulsions, and skin and eye irritation. No long-term, multigenerational, chronic oral studies at environmentally relevant concentrations are available that could rule out prenatal damage.

Immunotoxicity

Early studies suggested that perhaps 2-BE does not affect the immune system[8],[9] more recent studies using more sophisticated measures and lower doses have determined otherwise. In an early immunotoxicity study, the lowest doses significantly increased the natural killer (NK) cell response in males and females, and the highest doses induced no response.[Error! Bookmark not defined.] The investigators never did find the lowest dose at which there would be no effect. However, they did not consider this an indication of adversity.

In another study, rats exposed to 2-BE in water for 21 days showed no structural effects in the liver or the testes, however their livers were significantly heavier and the animals experienced reduced body weight even at the lowest dose. However, they were surprised to find that at the lowest 2-BE dose NK cell responses were increased. A more recent study exposing female mice topically for 4 days once again confirmed the elevated NK cell response.[10]

A 2002 study reports that 2-BE at unusually low doses inhibits a normal contact hypersensitivity response in female mice.[11]

Carcinogenicity

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[6] Heindel,JJ, Gulati, DK, Russell, VS, et al. (1990) assessment of ethylene glycol monobutyl and monoethyl ether reproductive toxicity using a continuous breeding protocol in Swiss CD-1 mice. Fundam Apply Toxicol 15:683-696.

[7] Nyska A, RR Maronpot, BI Ghanayam. (1999) Ocular thrombosis and retinal degeneration induced in female F344 rats by 2-butoxyethanol. Hum Exp. Toxiol 18(9):577-582.

[8] Smialowicz, RJ, Williams, WC, Riddle,MM. etal. (1992). Comparative immunosuppression of various glycol ethers orally administered to Fischer 344 rats. Fundam Apply Toxiocl 18:621-627.

[9] Exon JH, GG Mather, JLBussiere, DP Olson, PA Talcott. (1991) Effects of subchronic exposure of rats to 2-methoxyethanol or 2-butoxyethanol: thymic atrophy and immunotoxicity. Fudam Appl Toxicol 16(4):830-840.

[10] Singh P, Zhao S, Blaylock RL. ()2001). Topical exposure to 2-butoxyethanol alters immune responses in female BALB/c mice. Int Jrl Toxicol 20:383-390.

[11] Singh P, Morris B, Zhao S, Blaylock RL. (2002) Suppresssion of the contact hypersensitivity response following topical exposure to 2-butoxyethanol in female BALB/c mice. Int Jrl Toxicol, 21:107-115.

At the end of a two year chronic bioassay, elevated numbers of combined malignant and non-malignant tumors of the adrenal gland were reported in female rats and male and female mice.[Error! Bookmark not defined.] Low survival rates in the male mice in this study may have been the result of the high rate of liver cancers in the exposed animals.[Error! Bookmark not defined.] This study revealed that long-term exposure to 2-BE often led to liver toxicity before the hemolytic effects were discernible. [Error! Bookmark not defined.]

No human epidemiological studies are available to assess the potential carcinogenicity of 2-BE. However, from the results of laboratory studies, using Guidelines for Carcinogenic Risk Assessment (1986), 2-BE has been classified by the USEPA as a *possible human carcinogen.* [Error! Bookmark not defined.]

SENSITIVE POPULATIONS

A number of laboratory studies confirmed that aging increases susceptibility to the effects of 2-BE. Older animals have reduced ability to metabolize the toxic metabolite BAA and this, combined with reduced kidney function that accompanies aging reduces their ability to excrete it in the urine.[Error! Bookmark not defined.]

Females are more susceptible to the hematological effects in laboratory animal and human studies. There is an obvious gender and age sensitivity to 2-BE in humans as determined from accidental poisonings with females being more sensitive. In addition, among humans there may be sub-populations that might be more sensitive than others.[Error! Bookmark not defined.]

A list of risk factors for people exposed to 2-BE includes those:
(1) using the pharmaceuticals hydralazine, dilantin, chloramphenicol, and sulfonamides;
(2) with infections, such as herpes, malaria, parasites, and rubella;
(3) with a family history of gallstones, cholestectomy, jaundice, Rh and APO positive;
(4) with iron deficiency; and
(5) with systemic illnesses, such as cardiac, gastrointestinal, liver, and kidney disease, and hypothyroidism.[Error! Bookmark not defined.,12]

From a wildlife and domestic animal perspective, it is important to note that a variety of studies with laboratory animals revealed that some species are more sensitive to 2-BE than others.[Error! Bookmark not defined.] For example, rats are more sensitive than mice to the toxic effects of 2-BE on the liver. No studies were found using wildlife or domestic animals.

INDIRECT HEALTH EFFECTS OF 2-BE

2-BE is widely used as an emulsifying agent and as a solvent for mineral oils[Error! Bookmark not defined.]. This makes it an excellent candidate for releasing the natural, oily, coal-tar hydrocarbons found in coal that have been recognized for over a century to cause cancer.

CUMULATIVE AND AGGREGATE HEALTH HAZARDS

As mentioned above, no cumulative exposure studies have been done that evaluate the simultaneous impact of ingestion, inhalation, and topical exposure to 2-BE, which could be the mode of exposure to residents in Delta County. If 2-BE comes directly into the home via a well it will be used for drinking, bathing, showering, and doing laundry and dishes. Laboratory studies have revealed that in the case of bathing or applying 2-BE to the skin, it is readily absorbed through the skin rather than volatilizing. If water containing 2-BE is heated, as it comes out of the tap some of the 2-BE will off-

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[12] (Berliner N, Duffy, TP, Abelson HT. (1999) Approach to adult and child anemia. In: Hoffman, R ed. Hematology:Basic Principles and Practice. 2nd ed. New York, NY: Churchill Livingtsone, pp.468-483.

gas into the home environment. Most of the studies mentioned above used inhalation as the pathway of exposure to 2-BE. Inhalation of 2-BE in the home could become a problem. For example, concern about exposure to the volatile by-products (trihalomethanes or THMs) in chlorine treated tap water[13] led to the discovery that taking a bath or a shower can lead to excessively high dose exposure to THMs. This exposure can exceed the level of exposure from drinking the water and add to the dose from drinking the water. Because of the volatility of 2-BE, the same pathway of exposure could become of concern for Delta County residents if 2-BE reaches their wells and especially if the water is heated.

Of increasing concern by federal health agencies are the *unpredictable,* interactive effects of mixtures of chemicals.[14] Under the scenario described in Gunnison Energy's prospectus, the concentrations of three classes of chemicals that are toxic individually at very low concentrations could become introduced or increased in the environment of Delta County. These include (1) the trace elements arsenic, molybdenum, and selenium, already a problem in Delta county, (2) a synthetic solvent, 2-BE, and (3) the polyaromatic hydrocarbons and coal tars found in coal beds. Arsenic, 2-BE, and aromatic coal bed tar derivatives are known carcinogens. In aggregate, whether their effects would be additive or synergistic has not been determined. However, in one study, the authors were surprised to find that 2-BE potentiated the lethality of low level exposure to another toxicant, a bacterially produced lipopolysaccharide (LPS) that is found in the human gut under certain conditions.**Error! Bookmark not defined.**

Additional contamination of potable water could come from the impurities in the 2-BE product used in the extraction process. Commercial grade 2-BE can range in impurities depending upon the production process, manufacturer, and grade of the solvent. One impurity, sodium hydroxide (lye), a strong caustic, might possibly contribute to the alkalinity of the water. It was discovered in one product at 0.25%. Even high grade 2-BE with greater than 99% purity can contain 0.2% w/w ethylene glycol (anti-freeze), diethylene glycol, and diethyl monobutyl ether, sister compounds to 2-BE with much higher toxicity.**Error! Bookmark not defined.**

ENVIRONMENTAL EFFECTS

Increased salinity

2-BE leaves an alkaline residue upon evaporation which might slightly add to the alkalinity problem that increases as surface water approaches the lower reaches of Delta County. Because of the solubility of sodium salts they can travel long distances in rivers and could increase the salinity problem in the Colorado River downstream.

Locally, any additional water that increases the salinity could also increase the mobilization of some of the alkaline soluble, problem elements such as arsenic and selenium, already posing health risks in Delta County. Health advisories are already in effect for Sweitzer Lake warning people not to eat the fish because of the high levels of selenium in the fish tissue.

A peer reviewed report by the US Forest Service on the threat of increased selenium contamination in the Mancos and La Plata River drainages describes a scenario similar to the Gunnison River

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[13] Nester AM, Singer PC, Ashley DL, Lynberg MC, Mendola P, Langlois PH, Nichols JR. (2002). Comparison of trihalomethanes in tap water and blood. Env Sc Techn. 36(8):1692-1698.

[14] Department of Health and Human Services, Agency for Toxic Substances and Disease Registry , (2001). Guidance Manual for the Assessment of Joint Toxic Action of Chemical Mixtures. Draft for Public Comment.

drainage in Delta County where selenium is already at levels of concern.[15] The hazards include threats to wetlands, aquatic habitat, invertebrates, fish, birds and other wildlife reproduction. Delta County is in a unique and fragile situation – (1) it already has the natural geological existence of selenium, (2) its local hydrology that has been embellished and complicated through extensive irrigation activity, and (3) a climate prone to drought .

There is a growing collection of scientific papers on the adverse health effects of selenium in wildlife exposed to elevated concentrations of selenium in seep-like situations (natural and human-induced) in the West. Waterfowl, fish, and invertebrates have experienced decreased hatching success and increased birth defects as a result of exposure in the egg. Chicks of avocets, stilts, ducks, coots, etc. have been found with crossed bills, missing eyes, and other deformities in aquatic systems where irrigation run off water collects.

HEALTH RISKS TO BE TAKEN INTO CONSIDERATION

Although no standard has been established yet for 2-BE in drinking water, in 1993 the EPA set a minimum risk level (MRL) for 2-BE at 0.07 mg/kg/day based on an adult 70 kg male drinking two liters of water a day. This value is based on liver toxicity studies in rats and not on more sensitive immune, developmental, and functional health effects that have become of concern over the past decade. In 1998 EPA derived a reference dose RfD for 2-BE at 0.5 mg/kg/day for non-cancer effects. This is based on lifetime exposure. EPA admits " Since drinking water exposures are highly complex and variable, a simplifying assumption was used in all simulations ….". EPA had no human data to derive its value.[3]

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[15] Lemly AD (1997). Environmental hazard of selenium in the Animas La Plata water development project. Ecotoxicol Environ Safety 37:92-96.

GEC is planning to inject fluid into the ground in Delta County at 7 ppm. If this fluid reaches the taps in Delta County at that concentration, it will be providing 0.2 mg/kg/day per two liters of water, approximately three times higher than the MRL and a little more than half the RfD.

RECOMMENDATIONS

1. First and most important, it is imperative to understand the hydrology of Delta County better. In addition, the complex diversions of potable water for irrigation and domestic use throughout the county must be factored into this knowledge.

2. Second, it is imperative to determine the current concentrations of the toxic chemicals in the coal bed water to be released during extraction prior to introducing the fracturing liquids. This must include the entire scope of trace elements from alkaline to acid based derivatives in both their dissolved and suspended form. In addition, the entire scope of polyaromatic hydrocarbons (both parent and alkylated forms) in the underground coal bed water should be quantified prior to any activity. Because of the toxicity of the elements and compounds of concern, detection limits throughout this monitoring should be no higher than a part per trillion. Information such as this will allow for determining if the fracturing liquid releases additional toxic components, and in the case of the PAHs, through dissolution by the 2-BE.

3. Throughout the mining life of the well, the underground fluid with which it will interface should be monitored on a regular basis for its toxic components. See those components mentioned in Number 2. If the concentrations of the contaminants decrease, this could indicate that precious potable subsurface or surface water is being drained from above. This provides an approach for detecting dewatering before too much potable water is lost.

4. If exploration begins, GEC must keep daily inventories of the total amount of fracturing liquid injected, including the exact amount of each component in the fluid.

5. GEC should be required to retrieve all surfacing liquid for containment. The volume of the retrieved liquid should be reported and the concentrations of the chemicals in that liquid quantified on a regular basis for auditing purposes to account for the toxic chemicals that were introduced under Number 4.

5. GEC's plans for disposal of this toxic liquid should be presented to the residents of Delta County for approval before any leases are approved.

6. Any changes in the composition of the fracturing liquid must be reported to the citizens of Delta County for consideration before the liquid is used.

7. If GEC should find that it needs or wants to use anything other than sand for propping, it must provide to the citizens of Delta County for consideration all the components in the alternative material before the material is used. The purity of the alternative products used must be provided as well. Trade names will not be acceptable.

APPENDIX B

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ANALYSIS OF
CHEMICALS USED IN NATURAL GAS DEVELOPMENT AND DELIVERY
in COLORADO

April 4, 2007

Introduction

This project was designed to explore the health effects of the products and chemicals used in drilling, fracturing, and recovery of natural gas. It provides a glimpse at the pattern(s) of possible health hazards for those living in regions where gas development is taking place. In order to do this, we collected lists of products and chemicals which we placed in a spreadsheet. We make no claim that this list is complete.

In the process of researching the literature, we discovered that drilling companies have access to hundreds of products, the components of which are in many cases unavailable for public scrutiny. This analysis addresses only those chemicals and products for which there is evidence that they are being, or have been used in Colorado.

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1. Our list consists of 171 products used in natural gas development and delivery. These products contain 245 chemicals and cover all stages of production and development.

2. The four most common adverse health effects for the chemicals on the list are skin and sensory organ toxicity, respiratory problems, neurotoxicity, and gastrointestinal and liver damage.

3. Examination of the products used in gas development and delivery shows that 92% have one or more adverse health effects. Of the 14 products without health effects, we have little or no data on 8 of them.

4. The following figures are based on the data in the Chemicals Used in Natural Gas Development and Delivery in Colorado Spreadsheet. They include the percentage and the actual number of chemicals in each health category. They are presented to define a pattern of the possible health effects of the chemicals and products that are being used. Health effects of the 245 chemicals break out as follows:

Percentage	Number	Effect
63%	154	skin and sensory organ toxicants
58%	143	respiratory toxicants
50%	122	gastrointestinal and liver toxicants
34%	84	neurotoxicants
30%	73	kidney toxicants
28%	69	cardiovascular and blood toxicants
26%	63	immunotoxicants
23%	56	carcinogens
22%	55	reproductive toxicants
21%	52	wildlife toxicants
20%	50	developmental toxicants
14%	34	endocrine disruptors
14%	35	result in other disorders
12%	29	mutagens

Of the **65** (27%) of the chemicals on the list that can vaporize:

Percentage	Number	Effect
83%	54	skin and sensory organ toxicants
77%	50	respiratory toxicants
75%	49	gastrointestinal and liver toxicants
68%	44	neurotoxicants
55%	36	cardiovascular and blood toxicants
55%	36	kidney toxicants
43%	28	developmental toxicants
43%	28	reproductive toxicants
37%	24	immunotoxicants
37%	24	wildlife toxicants
35%	23	carcinogens
22%	14	mutagens
22%	14	endocrine disruptors
22%	14	result in other disorders

Of the **69** (28%) of the chemicals on the list that are soluble, or miscible:

Percentage	Number	Effect
86%	59	skin and sensory organ toxicants
83%	57	respiratory toxicants
75%	52	gastrointestinal and liver toxicants
52%	36	neurotoxicants
42%	29	cardiovascular and blood toxicants
36%	25	immunotoxicants
36%	25	kidney toxicants
32%	22	wildlife toxicants
29%	20	reproductive toxicants
28%	19	developmental toxicants
26%	18	result in other disorders
23%	16	carcinogens
22%	15	endocrine disruptors
17%	12	mutagens

5. Forty-nine percent of the 245 chemicals listed have between four and 14 different reported health effects. Twenty-four percent of the chemicals have between one and three known health effects, and 27% have no health effects.

6. Many of the citations used to establish the health effects of the chemicals are old. For some of the chemicals we were unable to find studies newer than those done in the 60's or 70's. In some cases we were able to get data only from an abstract, not the full report or manuscript. In other cases, we were able to get quotations about the health effect(s) from toxic chemical databases, such as TOXNET, HAZMET, etc. Many reports submitted to the Environmental Protection Agency for the registration of some of these chemicals are not accessible.

7. Several reasons led to the lack of data about the health effects of some of the products and chemicals on the spread sheet:

(a) We found no health effect data for a particular chemical or product.
(b) Some products list no ingredients.
(c) Some products provide only a general description of the content, such as "plasticizer", "polymer" etc.
(d) Some products list the ingredients as "proprietary" or provide only the name of one or two chemicals plus "proprietary".

8. Much of the information about the composition of the products on the list comes from the Materials Safety Data Sheet (MSDS) for that product. The information on these sheets is limited to only those chemicals that are required by law to be disclosed. Ingredients are often labeled as "proprietary", or "no hazardous ingredients" even when there are significant health effects listed on the MSDS.

9. MSDS sheets are designed to provide information to protect those who handle, ship, and use the product(s). The sheets are also designed to protect emergency response crews in case of accidents or spills. The data in the MSDSs do not generally take into consideration the health impacts resulting from chronic or long-term, continuous, and/or intermittent exposure. Many chemicals have not gone through a rigorous and extensive scientific peer-review process that would permit conclusions to be drawn about "safe" and "hazardous" exposure levels.

10. The MSDSs are often sketchy and provide health effects information for only one or two chemicals in a product. In many cases the chemicals listed equal less than 100% of the product. In the case of mixtures, the health effects warnings are often not chemical specific.

Comments

Chemical use and disposal

Fracturing of wells is a common practice in parts of the west, in which a million gallons of fluids are injected underground, creating a mini-earthquake that facilitates the release of natural gas. The gas industry claims that 70% of the material it injects underground is retrieved. While the fate of the remaining 30% is unknown, the recovered product is placed in holding pits on the surface and allowed to evaporate. This results in many highly toxic chemicals being released into the air, as well as being dispersed into local surface waters. The condensed residues remaining in the pits are taken off-site and dealt with in two ways: (1) They can be re-injected in the ground posing concerns for aquifers, or (2) they can be "land farmed" by which they are incorporated into the soil through tilling. Land farming can release toxic chemicals to the air via volatile substances and dusts, or result in accumulation of mixtures of toxic metals in the soil.

At some locations, because of regional differences in geology and technology, 100% of the injected material may remain underground. The mobility of these residues in the environment, or their ability to contaminate ground water and aquifers has not been evaluated.

After development ceases on a pad and the well(s) goes into production, the residues in the evaporation pits are often bulldozed over. It is impossible to predict how long the buried chemicals will remain in place. Highly persistent and mobile chemicals could migrate from these pits into underground water resources.

Prior to use, these products must be shipped to and stored somewhere before being transported to the well site. They pose a hazard on our highways, roads, and rail systems, as well as to people living and working near the storage facilities. The recent evacuation of a neighborhood in New Mexico after a leak at a storage facility is one example of the dangers posed by these facilities.

It is important to note that once a well goes into production, the gas passes through a dehydrator to remove the water which is often stored in holding tanks on the pad. It is sometimes re-injected on site or can be trucked or piped to an evaporation pit where volatile chemicals escape. Any chemicals used during drilling and fracturing could be mingling with this gas production source of water.

Health Effects

We were unable to find health effects associated with 66 of the chemicals on the list. Of these, only 14 had been assigned a chemical identification number (CAS number) by the American Chemical Society enabling us to search the literature. We found no adverse health effects for these. However, we were unable to determine the safety of the other 52 chemicals either because they were listed as mixtures, proprietary or unspecified (15), or had chemical names that were so general that the specific chemical could not be identified (37).

Many of the chemicals on this list have been tested for lethality and acute toxicity based on short-term contact. The majority have never been tested at realistic, environmentally relevant, chronic exposure levels, or for delayed effects that may not be expressed until long after exposure. Nor have adequate ecological studies been done. For example, most of the chemicals have not been tested for their effects on terrestrial wildlife or birds, fish, and invertebrates. It is reasonable to assume that the health endpoints listed above could very well be seen in wildlife, domestic animals, and pets.

The products labeled as biocides are among the most lethal on the list, and with good reason. Bacterial activity in well casings, pipes and joints can be highly corrosive, costly, and dangerous. Bacteria can also alter the chemical structure of polymers and make them useless. Nonetheless, when these products return to the surface either through deliberate retrieval processes or accidentally they pose a significant danger to workers and those living near the well and evaporation ponds. They can also sterilize the soil and inhibit normal bacterial and plant growth for many years.

In general, the volatile chemicals have more adverse health effects associated with them than the soluble chemicals. Not only are they more toxic, but in the area of skin and sensory organ toxicity, gastrointestinal and liver, and the respiratory system toxicity, over 75% of them cause harm. They also show a higher percentage of adverse effects overall than the soluble chemicals.

The soluble chemicals are associated with more adverse health effects than the total number of chemicals. While they do not show as high a percentage of effects as the volatile chemicals, between

75% and 86% can cause harm to the same systems as listed above. They are slightly more harmful than the volatiles in these systems only.

The use of respirators, goggles and gloves is advised on many of the MSDSs for products on this list. This indicates serious, acute toxicity problems that are not being addressed in the recovery process when the chemicals come back to the surface. It raises concern over possible hazards posed to those living in regions where development activity is taking place

Full Disclosure

When comparing the toxicity of the chemicals used in the four western states, the need for full disclosure became more evident. If it had not been for several accidents or spills where local citizens took it upon themselves to find out the names of products that were involved, TEDX would not have learned as much as we have. These accidents provided unique situations in which companies were inclined to more fully disclose product information and thus we gained greater insight about chemicals used to develop and deliver natural gas. We know for certain, that a great deal more than water and soap is being used to drill a gas well.

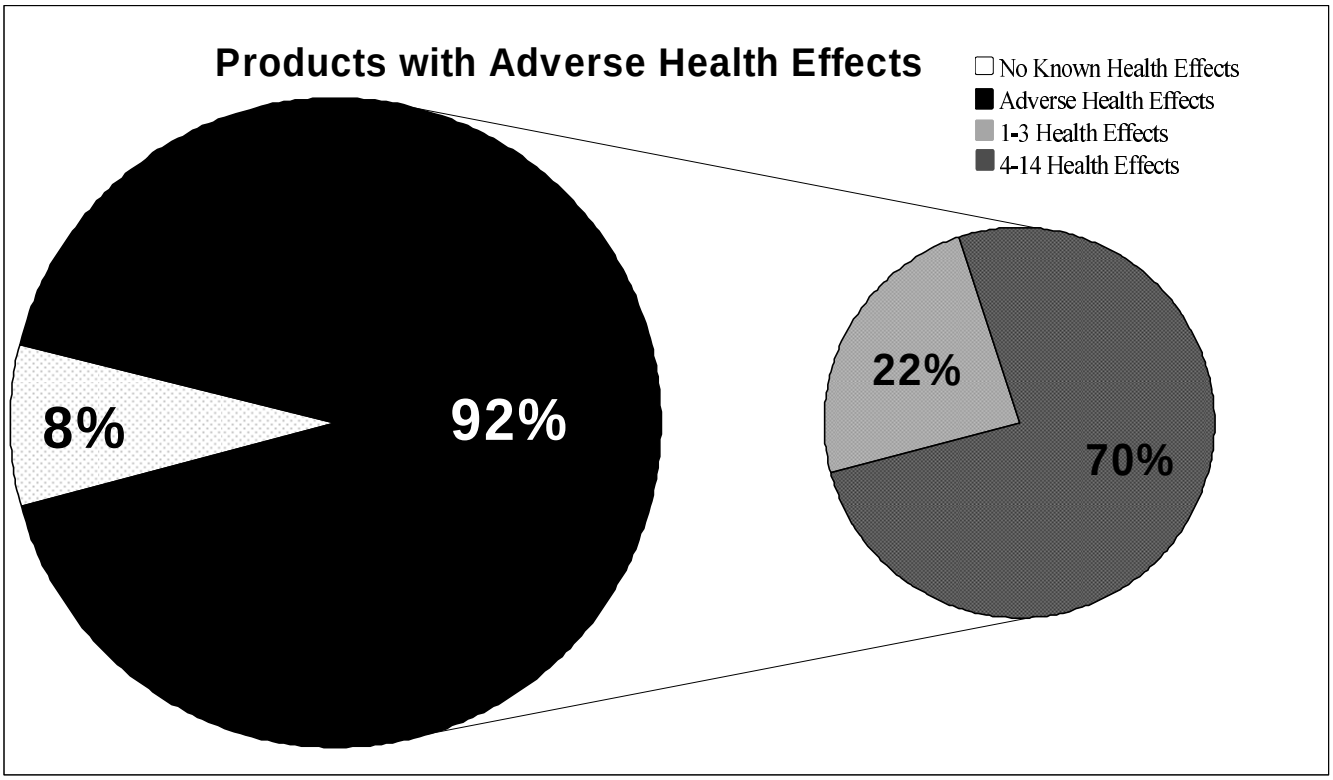
The information we have for many products in Colorado is limited. The health effects for the chemicals and products used in Colorado are consistently lower as compared with those in Wyoming, Washington or New Mexico. The percentage of health effects in Colorado are, in fact, between 4 and 14 percentage points lower than the averages for the other three states. The major difference between these states is the amount of information available on the products in use. In Wyoming and Washington we have all the MSDS sheets for the products on our list. In New Mexico we have a high proportion of MSDS sheets and data from Tier II reports, which are required by the Emergency Planning and Right to Know Act for stored materials. The Colorado information comes from far fewer MSDS sheets and other specific sources of product data. As we have gained access to product MSDS sheets from other states, this information has been incorporated into the same products on the Colorado list, with a corresponding rise in the percentage of adverse health effects.

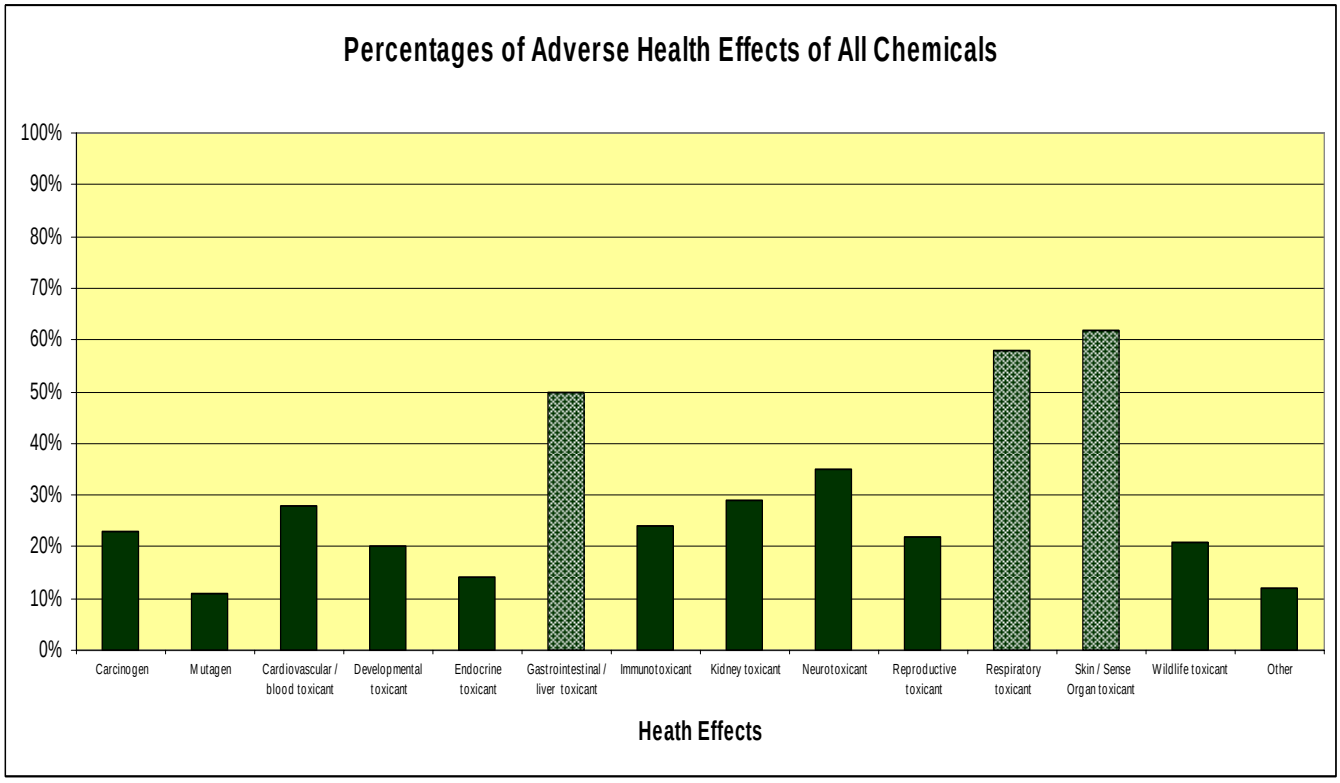
Through these comparisons we feel it is safe to say that our report *underestimates* the hazards of the situation.

A number of chemicals can be toxic when encountered in high concentrations, or, perhaps, during certain exposures (such as inhalation versus skin contact). Because only a small percentage of the total composition of most of the products on this list is available, we cannot say for certain whether such chemicals are harmless in their application. Under the present system, there are not enough data to determine the safety of products that contain mixtures of relatively “benign” ingredients and unknown chemicals, when the actual percentage composition is not provided.

This list provides only a hint of the combinations and permutations of mixtures possible and the possible aggregate exposure. Each drilling and fracturing incident is custom designed depending on the geology, depth, and resource available. The chemicals and products used, and the amounts or volumes used can differ from well to well. The only way to get a realistic picture of what is being introduced into our watersheds and air is for a complete record of information of the specific well site (state, county, township, section, etc.), the formulation of chemicals and products used at each stage, the quantity of each product (weight and/or volume), total volume injected and recovered, and the depths at which material/mixtures were injected and recovered, the composition of the recovered liquids and those liquids and solids removed from site. This needs to be public information.

As we have added products to the list, the percentages of health effects occasionally shifted. Changes such as this will continue as more products and chemicals are entered into the database. Thus far, despite small increases or decreases in percentage, the top four health effects of concern have remained the same. They are skin and sensory organ, gastrointestinal and liver, respiratory, and neurological system damage.





APPENDIX C

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Crosby 25-3 Well – Windsor Energy, Park County Wyoming

Analysis of Products Used for Drilling

September 11, 2007

Introduction

This analysis was designed to explore the health effects of the products and chemicals used in drilling a natural gas well, Crosby 25-3, northwest of Clark, Park County, Wyoming. This well was directionally drilled with a total vertical depth of 8,038 feet. Natural gas, petroleum condensate, and drilling fluids were accidentally released from the ground adjacent to the well. The release occurred over a period of about 58 hours between 11 and 13 August 2006 and resulted in surface soil impacts in an area estimated to cover approximately 25,000 square feet.[16]

This analysis provides a glimpse at the pattern(s) of possible health hazards for those living in the region. We were able to do this analysis because we were provided the Materials Safety Data Sheets (MSDS) for the products in use at the time of the blowout. We make no claim that this list of products is complete.

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1. Our list consists of 25 products used in natural gas drilling. These products contain 36 chemicals.

2. The four most common adverse health effects for the chemicals on the list are skin and sensory organ toxicity, respiratory problems, cardiovascular and/or blood damage, and gastrointestinal and/or liver damage.

3. Examination of the products used in drilling in Wyoming on this list shows that 100% have one or more adverse health effects.

4. The following figures are based on the data in TEDX's Chemicals Used to Drill the Crosby 25-3 Well in Wyoming Spreadsheet. They include the percentage and the actual number of chemicals in each health category. They are presented to define a pattern of the possible health effects of the chemicals and products that are being used. Health effects of the 36 chemicals break out as follows:

[16] Monitoring Report, April 2007, Prepared by Terracon Consulting Engineers and Scientists.

Percentage	Number	Effect
94%	34	respiratory toxicants
89%	32	skin and sensory organ toxicants
72%	26	gastrointestinal and liver toxicants
50%	18	cardiovascular and blood toxicants
44%	16	immunotoxicants
44%	16	kidney toxicants
44%	16	neurotoxicants
39%	14	reproductive toxicants
39%	14	wildlife toxicants
33%	12	carcinogens
28%	10	developmental toxicants
28%	10	result in other disorders
25%	9	endocrine disruptors
11%	4	mutagens

Of the **8** (22%) of the chemicals on the list that can vaporize:

Percentage	Number	Effect
100%	8	gastrointestinal and liver toxicants
100%	8	respiratory toxicants
100%	8	skin and sensory organ toxicants
75%	6	neurotoxicants
63%	5	cardiovascular and blood toxicants
63%	5	immunotoxicants
63%	5	kidney toxicants
63%	5	reproductive toxicants
50%	4	wildlife toxicants
38%	3	developmental toxicants
38%	3	result in other disorders
25%	2	carcinogens
25%	2	mutagens
25%	2	endocrine disruptors

Of the **14** (39%) of the chemicals on the list that are soluble, or miscible:

Percentage	Number	Effect
100%	14	skin and sensory organ toxicants
93%	13	respiratory toxicants
86%	12	gastrointestinal and liver toxicants
64%	9	wildlife toxicants
50%	7	neurotoxicants
50%	7	result in other disorders
43%	6	cardiovascular and blood toxicants
43%	6	immunotoxicants
43%	6	kidney toxicants
36%	5	reproductive toxicants
21%	3	mutagens
21%	3	developmental toxicants
14%	2	carcinogens
7%	1	endocrine disruptors

5. Sixty-seven percent of the 36 chemicals listed have between four and 14 different reported health effects. Thirty-three percent of the chemicals have between one and three known health effects.

6. Many of the citations used to establish the health effects of the chemicals are old. For some of the chemicals we were unable to find studies newer than those done in the 60's or 70's. In some cases we were able to get data only from an abstract, not the full report or manuscript. In other cases, we were able to get quotations about the health effect(s) from toxic chemical databases, such as TOXNET, HAZMET, etc. Many reports submitted to the Environmental Protection Agency for the registration of some of these chemicals are not accessible.

7. Several reasons led to the lack of data about the health effects of some of the products and chemicals on the spread sheet:

(a) We found no health effect data for a particular chemical or product.
(b) Some products list no ingredients.
(c) Some products provide only a general description of the content, such as "no hazardous substances."

8. All of the information about the composition of the products on the list comes from either the MSDS for that product, or information disclosed in the Terracon Remedial Investigation Work Plan – Amended Draft, dated July 2, 2007. The information on the MSDSs is limited to only those chemicals that are required by law to be disclosed. Ingredients are often labeled as "no hazardous ingredients" even when there are significant health effects listed on the MSDS. The information disclosed by the Terracon report lists chemicals included in the products, but there is no indication if that information is the complete composition of the product.

9. A number of chemicals can be toxic when encountered in high concentrations, or, perhaps, during certain exposures (such as inhalation versus skin contact). Because only a small percentage of the total composition of most of the products on this list is available, we cannot say for certain whether such chemicals are harmless in their application. Under the present system, there are not enough data to determine the safety of products that contain mixtures of relatively "benign" ingredients and unknown chemicals, when the actual percentage composition is not provided.

10. MSDSs are designed to provide information to protect those who handle, ship, and use the product(s). The sheets are also designed to protect emergency response crews in case of accidents or spills. The data in the MSDSs do not generally take into consideration the health impacts resulting from chronic or long-term, continuous, and/or intermittent exposure. Many chemicals have not gone through a rigorous and extensive scientific peer-review process that would permit conclusions to be drawn about "safe" and "hazardous" exposure levels.

11. The MSDSs are often sketchy and provide health effects information for only one or two chemicals in a product. In many cases the chemicals listed equal less than 100% of the product. In the case of mixtures, the health effects warnings are often not chemical specific.

Comments

Health Effects

We found adverse health effects for all the chemicals on this list. This is true even though MSDSs for four of the products stated that they contained no hazardous substances. All of the MSDSs for these

products contained information that the ingredients were eye or skin irritants or toxicants, 75% were respiratory toxicants, 50% were dangerous to wildlife, and one was a gastrointestinal toxicant.

Many of the chemicals on this list have been tested for lethality and acute toxicity based on short-term contact. The majority have never been tested at realistic, environmentally relevant, chronic exposure levels, or for delayed effects that may not be expressed until long after exposure. Nor have adequate ecological studies been done. For example, most of the chemicals have not been tested for their effects on terrestrial wildlife or birds, fish, and invertebrates. It is reasonable to assume that the health endpoints listed above could very well be seen in wildlife, domestic animals, and pets.

In general, the volatile chemicals have more adverse health effects associated with them than the soluble chemicals. Not only are they more toxic, but in the area of skin and sensory organ toxicity, gastrointestinal and liver, and the respiratory system toxicity, 100% of them cause harm.

The soluble chemicals are associated with more adverse health effects than the total number of chemicals. While they do not show as high a percentage of effects as the volatile chemicals, between 85% and 100% can cause harm to the same systems as listed above.

The use of respirators, goggles and gloves is advised on many of the MSDSs for products on this list. This indicates serious, acute toxicity problems that are not being addressed when the chemicals come back to the surface, either during the recovery process or, as in this case, during a blowout. It raises concern over possible hazards posed to those living in regions where development activity is taking place.

Prior to use, these products must be shipped to and stored somewhere before being transported to the well site. They pose a hazard on our highways, roads, and rail systems, as well as to people living and working near the storage facilities. The recent evacuation of a neighborhood in New Mexico after a leak at a storage facility is one example of the dangers posed by these facilities.

Full Disclosure

While this list was compiled from MSDS information, it is still far from a complete picture of what is in use. The limitations of MSDS data are outlined above. Also, this list provides only a hint of the combinations and permutations of mixtures possible and the possible aggregate exposure. Each drilling and fracturing incident is custom designed depending on the geology, depth, and resource available. The chemicals and products used, and the amounts or volumes used can differ from well to well. The only way to get a realistic picture of what is being introduced into our watersheds and air is for a complete record of information of the specific well site (state, county, township, section, etc.), the formulation of chemicals and products used at each stage, the quantity of each product (weight and/or volume), total volume injected and recovered, and the depths at which material/mixtures were injected and recovered, the composition of the recovered liquids and those liquids and solids removed from site. This needs to be public information. From the data in this list, we know for certain that a great deal more than water and soap is being used to drill a natural gas well.

APPENDIX D

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Number of chemicals detected in reserve pits for 6 wells in New Mexico that appear on national toxic chemicals lists

November, 2007

Toxic chemicals lists and the 51 chemicals detected

LIST	# of chemicals on list	Percentage
CERCLA 2005	37	72.5%
EPCRA 2006	24	47%
EPCRA List of Lists	30	58.8%

Chemicals not on any list:

N-Propylbenzene	O-Terphenyl	2-Fluorobiphenyl	Dibromofluoromethane
4-Bromochlorobenzene	2,3,4-Trifluorotoluene	2-Fluorophenol	Tetrachloro-m-xylene
Diesel range organics[1]	2,4,6-Tribromophenol	Decachlorobiphenyl[2]	Uranium
Gasoline range organics[1]			

[1] Too general to be included on lists that categorize by CAS numbers
[2] a PCB

Toxic chemicals lists and the 13 chemicals detected over state limits

LIST	# of chemicals on list	Percentage
CERCLA 2005	11	84.6%
EPCRA 2006	9	69%
EPCRA List of Lists	9	69%

Chemicals not on any list:

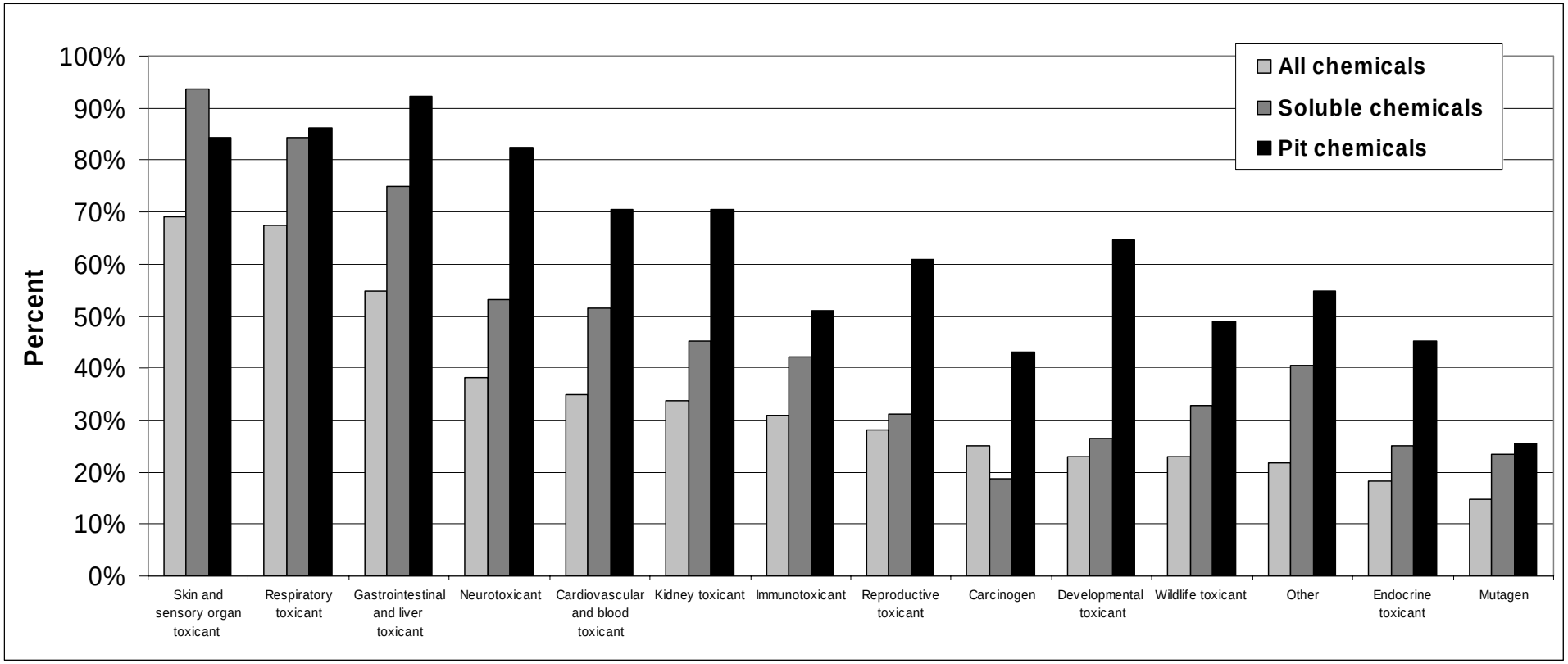
N-Propylbenzene
Diesel range organics[1]

[1] Too general to be included on lists that categorize by CAS numbers

CERCLA 2005: Comprehensive Environmental Response, Compensation, and Liability Act Summary Data for 2005 Priority List of Hazardous Substances
EPCRA 2006: Emergency Planning & Community Right to Know Act Section 313 Chemical List For Reporting Year 2006 (including Toxic Chemical Categories)
EPCRA List of Lists: Consolidated List of Chemicals Subject to the Emergency Planning and Community Right-To-Know Act (EPCRA) and Section 112(r) of the Clean Air Act

Comparison of the patterns of adverse health effects associated with 175 chemicals on the TEDX Chemicals Used in Oil and Gas Development and Delivery in New Mexico spreadsheet:

1) **All chemicals**
2) **Soluble chemicals only**
3) **Chemicals detected in 6 reserve pits**



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Hazard Assessment Articles

Natural Gas Operations from a Public Health Perspective

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ABSTRACT

The technology to recover natural gas depends on undisclosed types and amounts of toxic chemicals. A list of 944 products containing 632 chemicals used during natural gas operations was compiled. Literature searches were conducted to determine potential health effects of the 353 chemicals identified by Chemical Abstract Service (CAS) numbers. More than 75% of the chemicals could affect the skin, eyes, and other sensory organs, and the respiratory and gastrointestinal systems. Approximately 40–50% could affect the brain/nervous system, immune and cardiovascular systems, and the kidneys; 37% could affect the endocrine system; and 25% could cause cancer and mutations. These results indicate that many chemicals used during the fracturing and drilling stages of gas operations may have long-term health effects that are not immediately expressed. In addition, an example was provided of waste evaporation pit residuals that contained numerous chemicals on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Emergency Planning and Community Right-to-Know Act (EPCRA) lists of hazardous substances. The discussion highlights the difficulty of developing effective water quality monitoring programs. To protect public health we recommend full disclosure of the contents of all products, extensive air and water monitoring, coordinated environmental/human health studies, and regulation of fracturing under the U.S. Safe Drinking Water Act.

Key Words: drilling, health, hydraulic fracturing, natural gas, ozone, pollution.

INTRODUCTION

Over the past two decades, in an effort to reduce dependence on imported fossil fuels, the U.S. government has supported increased exploration and production of

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natural gas. The responsibility for overseeing the nation's underground minerals lies with the U.S. Department of Interior, Bureau of Land Management (BLM) with some oversight from the U.S. Environmental Protection Agency (USEPA). Attempting to meet the government's need for energy self-sufficiency, the BLM has auctioned off thousands of mineral leases and issued permits to drill across vast acreages in the U.S. Rocky Mountain West. Since 2003, natural gas operations have increased substantially, with annual permits in Colorado alone increasing from 2,249 to 8,027 in 2008 (Colorado Oil and Gas Conservation Commission 2010).

In tandem with federal support for increased leasing, legislative efforts have granted exclusions and exemptions for oil and gas exploration and production from a number of federal environmental statutes, including the Clean Water Act, the Clean Air Act, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, better known as the Superfund Act), the Resource Conservation and Recovery Act (RCRA), the Toxic Release Inventory under the Emergency Planning and Community Right-to-Know Act (EPCRA), and the National Environmental Policy Act (NEPA) (Oil and Gas Accountability Project 2007). The most recent of these efforts was an amendment included in the 2005 Energy Policy Act that prevented the use of the Safe Drinking Water Act to regulate certain activities, known as hydraulic fracturing, which are involved in 90% of natural gas drilling.

The cumulative effect of these exemptions and exclusions has been to create a federal void in environmental authority over natural gas operations, leaving the responsibility primarily up to the states. Although some states have oil and gas commissions to watch over natural gas production activity, the primary mission of these agencies has been to facilitate natural gas extraction and increase revenues for the states. In addition, when states issue permits to drill, they have not traditionally required an accounting of how the resulting liquid and solid waste would be handled. In short, their focus has not typically been on health and the environment.

The Need for Chemicals

In keeping with the rush to produce more natural gas, technological advances have permitted the industry to drill deeper and expand wider, tapping into gas reserves with greater facility and profitability. While these advances have allowed the mining of vast, newly discovered gas deposits, the new technology depends heavily on the use of undisclosed types and amounts of toxic chemicals.

Chemicals are used throughout operations to reach and release natural gas. First, combinations of chemicals are added to the "muds" used to drill the bore hole. Chemicals are added to increase the density and weight of the fluids in order to facilitate boring, to reduce friction, to facilitate the return of drilling detritus to the surface, to shorten drilling time, and to reduce accidents. After drilling, hydraulic fracturing (also known as fracking, frac'ing, or stimulation) is done to break up the zone in which the gas is trapped and make it easier for the gas to escape, increasing a well's productivity. In the U.S. West, approximately a million or more gallons of fluid containing toxic chemicals are injected underground during this operational stage. As with drilling, chemicals are used in fracking fluids for many purposes (Table 1). One well can be fracked 10 or more times and there can be up to 30 wells on one pad. An estimated 10% to 90% of the fracking fluid is returned to the surface during

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Table 1. Functional categories of hydraulic fracturing chemicals.

Acids	To achieve greater injection ability or penetration and later to dissolve minerals and clays to reduce clogging, allowing gas to flow to the surface.
Biocides	To prevent bacteria that can produce acids that erode pipes and fittings and break down gellants that ensure that fluid viscosity and proppant transport are maintained. Biocides can produce hydrogen sulfide (H2S) a very toxic gas that smells like rotten eggs.
Breakers	To allow the breakdown of gellants used to carry the proppant, added near the end of the fracking sequence to enhance flowback.
Clay stabilizers	To create a fluid barrier to prevent mobilization of clays, which can plug fractures.
Corrosion inhibitors	To reduce the potential for rusting in pipes and casings.
Crosslinkers	To thicken fluids often with metallic salts in order to increase viscosity and proppant transport.
Defoamers	To reduce foaming after it is no longer needed in order to lower surface tension and allow trapped gas to escape.
Foamers	To increase carrying-capacity while transporting proppants and decreasing the overall volume of fluid needed.
Friction reducers	To make water slick and minimize the friction created under high pressure and to increase the rate and efficiency of moving the fracking fluid.
Gellants	To increase viscosity and suspend sand during proppant transport.
pH control	To maintain the pH at various stages using buffers to ensure maximum effectiveness of various additives.
Proppants	To hold fissures open, allowing gas to flow out of the cracked formation, usually composed of sand and occasionally glass beads.
Scale control	To prevent build up of mineral scale that can block fluid and gas passage through the pipes.
Surfactants	To decrease liquid surface tension and improve fluid passage through pipes in either direction.

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well completion and subsequent production (BC Oil and Gas Commission 2010; New York State Department of Environmental Conservation Division of Mineral Resources 2009), bringing with it toxic gasses, liquids, and solid material that are naturally present in underground oil and gas deposits. Under some circumstances, none of the injected fluid is recovered.

In most regions of the country, raw natural gas comes out of the well along with water, various liquid hydrocarbons including benzene, toluene, ethylbenzene, and xylene (as a group, called BTEX), hydrogen sulfide (H_2S), and numerous other organic compounds that have to be removed from the gas. When the gas leaves the well it is passed through units called heater treaters that are filled with triethylene glycol and/or ethylene glycol that absorbs the water from the gas. Once the glycol solution becomes saturated with water, the heaters turn on and raise the temperature enough to boil off the water, which is vented through a closed system

and upon cooling, ends up in a nearby tank labeled "produced water." The glycol fluid, which has a higher boiling point than water, cools and is reused. During the heating process at critical temperatures the oily substances that came up with the gas become volatile and then re-condense into a separate holding tank. This is known as "condensate" water. The contaminated water can be re-injected underground on the well pad or off site, common practices in the eastern United States, or hauled off the well pad to waste evaporation pits in the U.S. West. Temporary pits are also constructed during drilling to hold the cuttings, used drilling mud which is often re-used, and any other contaminated water that comes to the surface while drilling. These reserve pits on well pads are supposed to be drained and covered with top soil or other suitable material within a month after drilling stops.

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An Unexpected Side Effect: Air Pollution

In addition to the land and water contamination issues, at each stage of production and delivery tons of toxic volatile compounds (VOCs), including BETX, other hydrocarbons, and fugitive natural gas (methane), can escape and mix with nitrogen oxides (NOx) from the exhaust of diesel-fueled, mobile, and stationary equipment, to produce ground-level ozone (CH2MHILL 2007; Colorado Department of Public Health and Environment [CDPHE] 2007; URS 2008; U.S. Congress, Office of Technology Assessment 1989). One highly reactive molecule of ground level ozone can burn the deep alveolar tissue in the lungs, causing it to age prematurely. Chronic exposure can lead to asthma and chronic obstructive pulmonary disease (COPD), and is particularly damaging to children, active young adults who spend time outdoors, and the aged (Islam *et al.* 2007; Tager *et al.* 2005; Triche *et al.* 2006). Ozone combined with particulate matter less than 2.5 micrometers produces smog (haze) that has been demonstrated to be harmful to humans as measured by emergency room admissions during periods of elevation (Peng *et al.* 2009). Gas field ozone has created a previously unrecognized air pollution problem in rural areas, similar to that found in large urban areas, and can spread up to 200 miles beyond the immediate region where gas is being produced (U.S. Congress, Office of Technology Assessment 1989; Roberts 2008). Ozone not only causes irreversible damage to the lungs, it is similarly damaging to conifers, aspen, forage, alfalfa, and other crops commonly grown in the western United States (Booker *et al.* 2009; Reich 1987; U.S. Congress, Office of Technology Assessment 1989). Adding to this air pollution is the dust created by fleets of diesel trucks working around the clock hauling the constantly accumulating condensate and produced water to large waste facility evaporation pits on unpaved roads. Trucks are also used to haul the millions of gallons of water from the source to the well pad.

PROJECT DESIGN

The following project grew from a year 2004 request by OGAP (Oil and Gas Accountability Project) to TEDX (The Endocrine Disruption Exchange) to explore the potential health effects of chemicals used during drilling, fracking, processing, and delivery of natural gas. OGAP, a project of Earthworks, is a national non-profit

organization established in 1999 to watchdog the oil and natural gas industry. TEDX is a non-profit organization dedicated to compiling and disseminating technical information on chemicals that affect health and the environment.

Data Sources

In order to find out what chemicals were being used to extract natural gas, we took advantage of the information on the Material Safety Data Sheets (MSDSs) that accompany each product used during natural gas operations. MSDSs detailing specific products in use were provided by multiple sources including the BLM, U.S. Forest Service, state government departments, and the natural gas industry. MSDSs are designed to inform those who handle, ship, and use products that contain dangerous chemicals. They provide information about the physical and chemical characteristics of the chemicals in a product, and the immediate and chronic health effects, in order to prevent injury while working with the products. They are also designed to inform emergency response crews in case of accidents or spills. In addition to the MSDSs, we also used State Tier II Reports that must be filed by storage facilities under EPCRA. This Act sets a minimum amount above which a product that contains a hazardous substance in a storage facility has to be reported. We also supplemented our analysis with product information from disclosures in Environmental Impact Statements, Environmental Assessment Statements, and accident and spill reports. At first we looked only at what was taking place in Colorado and over the course of several years we acquired information from Wyoming, New Mexico, Texas, Washington, Montana, Pennsylvania, and New York. The list of products and chemicals quickly grew, making it apparent that hundreds of different products serving many purposes were being used in natural gas operations across the country. The number of chemical products manufacturers has also grown, making this a highly competitive industry.

It should be clear that our list of products is not complete, but represents only products and chemicals that we were able to identify, through a variety of sources, as being used by industry during natural gas operations. For most products, we cannot definitively say whether they were used during drilling or during fracking. However, an accidental blow-out of the Crosby well in Wyoming provided a unique opportunity to analyze the chemicals used during drilling, as fracking had not yet begun on that well. When the blow-out occurred, methane and other gases, petroleum condensates, and drilling fluids (muds) were released from fissures in the ground adjacent to the well. During the 58 hours the eruption took place, 25,000 square feet of soil surface in the area were contaminated. The driller released copies of the MSDSs for the products used during the blow-out and later we found the names of several more products from remedial action work plans to clean up the site (Terracon 2007).

On another occasion we were provided data from a 2007 New Mexico study, sponsored by 19 oil and gas companies and conducted by a third party consultant and analytical laboratory. This gave us the opportunity to explore the health effects of chemicals in samples of pit solids drawn from six evaporation pits where gas operations were ceasing.

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Data Limitations

MSDSs and Tier II reports are fraught with gaps in information about the formulation of the products. The U.S. Occupational Safety and Health Administration (OSHA) provides only general guidelines for the format and content of MSDSs. The manufacturers of the products are left to determine what information is revealed on their MSDSs. The forms are not submitted to OSHA for review unless they are part of an inspection under the Hazard Communication Standard (U.S. Department of Labor 1998). Some MSDSs report little to no information about the chemical composition of a product. Those MSDSs that do may only report a fraction of the total composition, sometimes less than 0.1%. Some MSDSs provide only a general description of the content, such as "plasticizer," "polymer," while others describe the ingredients as "proprietary" or just a chemical class. Under the present regulatory system all of the above "identifiers" are permissible. Consequently, it is not surprising that a study by the U.S. General Accounting Office (1991) revealed that MSDSs could easily be inaccurate and incomplete.

Tier II reports can be similarly uninformative, as reporting requirements vary from state to state, county to county, and company to company. Some Tier II forms include only a functional category name (*e.g.,* "weight materials" or "biocides") with no product name. The percent of the total composition of the product is rarely reported on these forms.

The most critical limiting factor in our research was that Chemical Abstract Service (CAS) numbers were often not provided on MSDSs. The American Chemical Society has established the CAS number system to identify unique chemical substances. A single substance can have many different names, but only one CAS number. CAS numbers identify substances that may be a single chemical, an isomer of a chemical, a mixture of isomers, polymers, biological sequences, or a mixture of related chemicals. For purposes of accuracy, our research into the health effects of chemicals used in natural gas operations was restricted to only chemicals for which a CAS number was available.

Health Effects

Information on the health effects associated with identified chemicals was obtained from MSDSs, as well as government toxic chemical databases such as TOXNET and the Hazardous Substances Database, and through literature searches of biomedical studies. Information available for some chemicals is limited due to lack of access to studies performed on the toxicity of the substance. For example, many laboratory studies submitted to USEPA for the registration of chemicals are not accessible on the basis that the information is proprietary to the industry.

Health effects were divided into 14 health categories, focusing on the main target organs or systems that are identified on MSDSs, government toxicological reports, and in medical literature. The categories include all seven priority health conditions identified by the Agency for Toxic Substances and Disease Registry (ATSDR 2010) associated with uncontrolled hazard waste sites listed as required by CERCLA, 1984, as amended (U.S. Environmental Protection Agency 1984). We reduced these to 12 categories by combining developmental and reproductive health impacts under endocrine disruption. The resulting 12 categories included: skin, eye and sensory

organ, respiratory, gastrointestinal and liver, brain and nervous system, immune, kidney, cardiovascular and blood, cancer, mutagenic, endocrine disruption, other, and ecological effects.

Data Analysis

Using the data sources described earlier, we entered the names of all the products and chemicals into a spreadsheet. Initially, chemicals were separated according to the state in which the data source originated. Analysis of the profiles of health effects revealed minimal differences across states, thus for this report we combined all the data into one multi-state analysis. Using only the chemicals on the multi-state list for which CAS numbers were available, we produced a profile based on how often each of the 12 possible health effects were associated with the chemicals. We created separate profiles for the water soluble chemicals alone, and the volatile chemicals alone. We also did an analysis of the drilling chemicals from the Wyoming well-blowout and an analysis of the chemicals found in the New Mexico evaporation pits. Finally, we tested the utility of the spreadsheet for providing guidance for water quality monitoring, focusing on the most potentially harmful and frequently used chemicals. The spreadsheet is available at http://www.endocrinedistruption.org/chemicals.multistate.php.

RESULTS

Product Information

As of May, 2010, TEDX identified 944 products used in natural gas operations in the United States. Of these, between 95 and 100% of the ingredients were available for 131 (14%) of the products (Figure 1). For 407 (43%) of the products, less than 1% of the total product composition was available. For many of those 407 products, only the name of the product with no identifiable chemical name or percent composition was reported. A total of 632 chemicals were reported in the products and we were able to locate CAS numbers for 353 (56%) of them.

Health Effects Profile

Using the health effect information for the 353 chemicals with CAS numbers, we created a profile of possible health effects that depicts the percentage of chemicals associated with each of the 12 health effect categories (Figure 2). Viewing the profile from left to right, more than 75% of the chemicals on the list can affect the skin, eyes, and other sensory organs, the respiratory system, the gastrointestinal system, and the liver. More than half the chemicals show effects on the brain and nervous system. These first four categories represent effects that would likely be expressed upon immediate exposure, such as eye and skin irritation, nausea and/or vomiting, asthma, coughing, sore throat, flu-like symptoms, tingling, dizziness, headaches, weakness, fainting, numbness in extremities, and convulsions. Products containing chemicals in powder form, irritants, or highly corrosive and volatile chemicals would all come with MSDS warnings in one or more of these categories. In all probability, none of the chemicals in these categories would normally be ingested during natural

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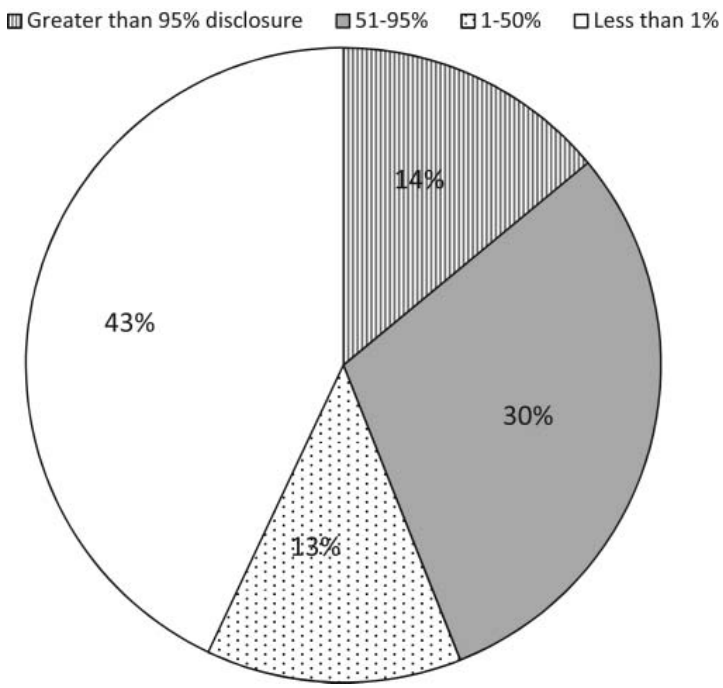

Figure 1. Percent of composition disclosed for 944 products used in natural gas operations.

gas operations, but immediate eye, nasal, dermal contact, and inhalation could lead to rapid absorption and cause direct exposure to the brain and other vital organ systems.

Health categories that reflect chronic and long-term organ and system damage comprise the middle portion of Figure 2. These include the nervous system (52%), immune system (40%), kidney (40%), and the cardiovascular system and blood (46%). More than 25% of the chemicals can cause cancer and mutations. Notably, 37% of the chemicals can affect the endocrine system that encompasses multiple organ systems including those critical for normal reproduction and development. The category of "other" is more common, and includes effects on weight, teeth, and bone and the ability of a chemical to cause death. More than 40% of the chemicals have been found to have ecological effects, indicating that they can harm aquatic and other wildlife.

Volatile and Soluble Chemicals

Separate health category profiles are shown in Figure 3 for the volatile and water soluble chemicals. Approximately 37% of the chemicals are volatile and can become airborne. More than 89% of these chemicals can harm the eyes, skin, sensory organs, respiratory tract, gastrointestinal tract, or liver. Compared with the soluble chemicals, far more of the volatile chemicals (81%) can cause harm to the brain and nervous system. Seventy one percent of the volatile chemicals can harm the cardiovascular system and blood, and 66% can harm the kidneys. Overall, the volatile chemicals produce a profile that displays a higher frequency of health effects than the water soluble chemicals. In addition, because they vaporize, not only can

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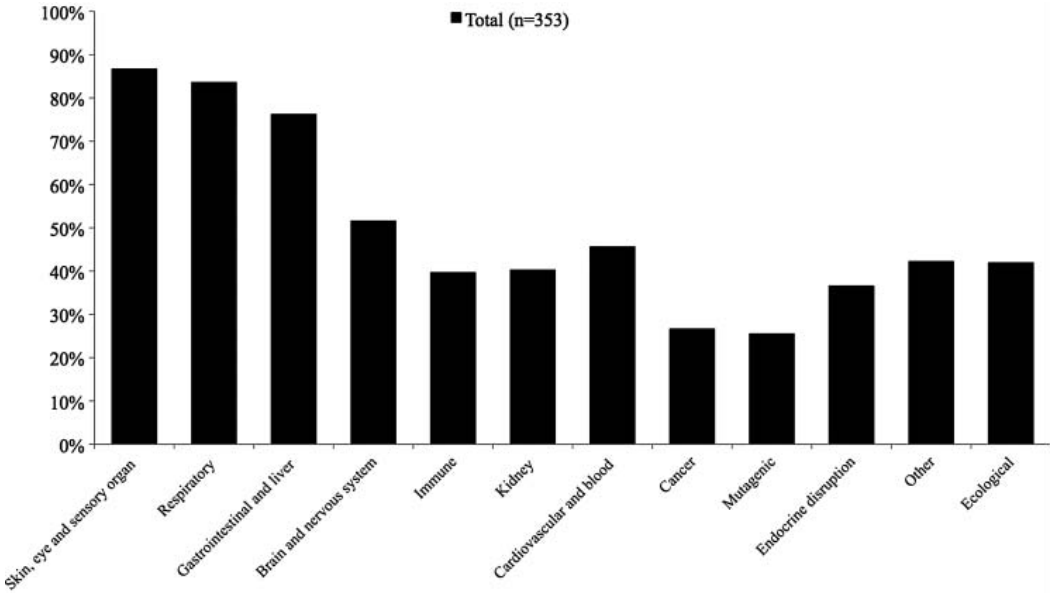

Figure 2. Profile of possible health effects of chemicals with CAS numbers used in natural gas operations.

they be inhaled, but also ingested and absorbed through the skin, increasing the chance of exposures.

Drilling Chemicals

The profile for the 22 drilling chemicals identified from the well blow-out in Wyoming are shown in Figure 4. The profile was unique in the following ways. All

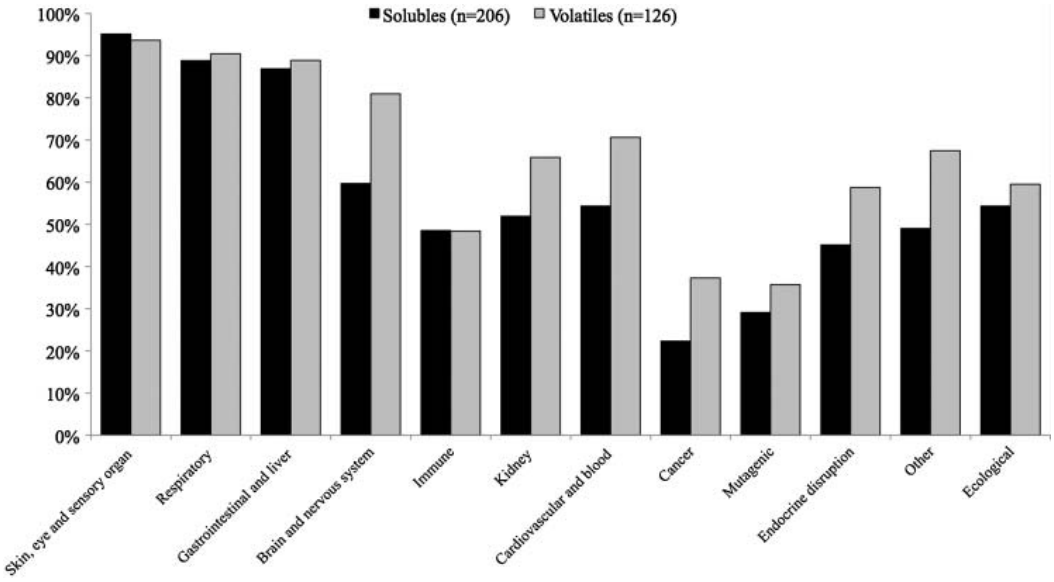

Figure 3. Profile of possible health effects of soluble and volatile chemicals with CAS numbers used in natural gas operations.

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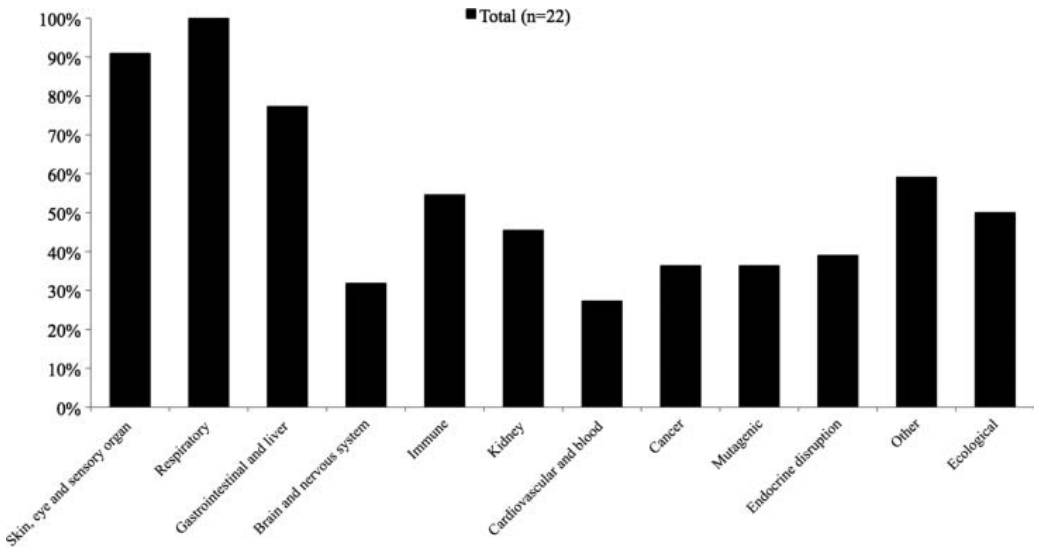

Figure 4. Profile of possible health effects of chemicals with CAS numbers used to drill the Crosby 25-3 well, Wyoming.

the chemicals used in the drilling fluids were associated with respiratory effects. Nearly 60% were associated with "other" effects, a category that includes outright mortality as an end point. A relatively high percentage of chemicals that affect the immune system were used.

Evaporation Pit Chemicals

Shown in Figure 5 are the health effects of the 40 chemicals and metals reported in the New Mexico evaporation pits. These chemicals produced a health profile even

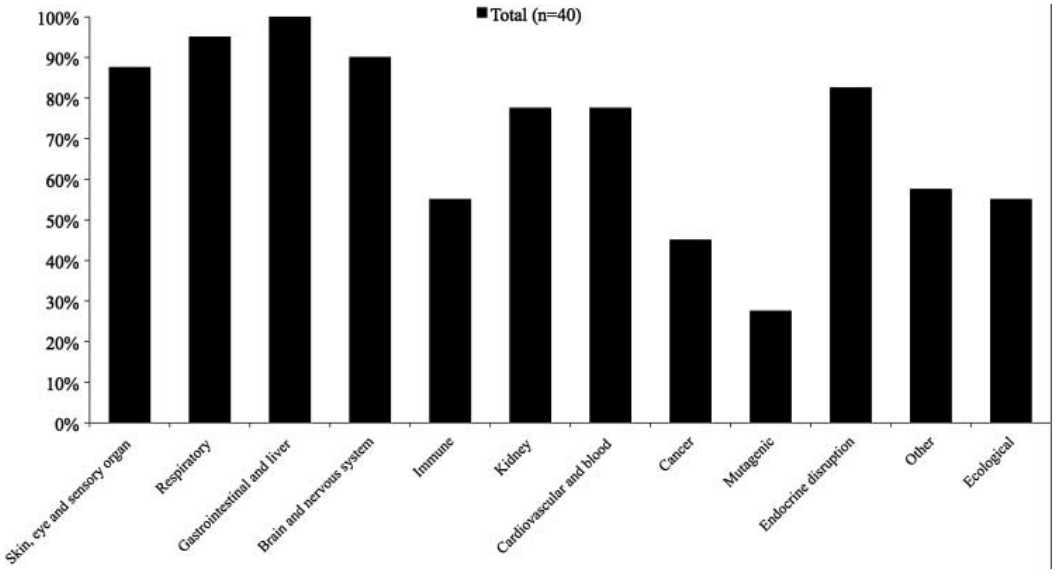

Figure 5. Profile of possible health effects of chemicals with CAS numbers found in six New Mexico drilling evaporation pits.

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more hazardous than the pattern produced by the drilling and fracking chemicals. Upon further investigation, we discovered that 98% of the 40 chemicals found in the pits are listed on USEPA's 2005 CERCLA (Superfund) list and 73% are on the 2006 EPCRA List of Lists of reportable toxic chemicals. Of the nine chemicals found to exceed the New Mexico state limits, all are on the CERCLA list and all but one are on the EPCRA List of Lists.

Analyses for Water Quality Monitoring

For the purpose of water quality monitoring guidance, we analyzed the data according to the most potentially harmful chemicals and the most frequently used chemicals. In Table 2 is provided a list of the most egregious chemicals, those with 10 or more health effects. Roughly half of these chemicals are used in only one product on our list, making it impractical and a waste of time and money to try to test water for the most harmful chemicals. A more practical approach would be to test for the most frequently used chemicals. Although we do not know how often each product is used, we assume that the more products that contain a given chemical, the more likely it is to be detected in a water sample. Shown in Table 3 are all the chemicals on our list that were found in at least seven different products. Many of these chemicals are relatively harmless. The most frequently cited chemical was crystalline silica (quartz), which was reported in 125 different products. Note that petroleum distillates and a variety of alcohols are found in numerous products, as are several forms of potassium, which is a relatively easy and inexpensive chemical to detect in water. This list may prove useful in devising a water monitoring program. Regardless of how many health effects a chemical has, elevated levels of frequently used chemicals found in a water source could provide evidence of communication between natural gas operations and water resources.

DISCUSSION

Industry representatives have said there is little cause for concern because of the low concentrations of chemicals used in their operations. Nonetheless, pathways that could deliver chemicals in toxic concentrations at less than one part-per-million are not well studied and many of the chemicals on the list should not be ingested at any concentration. Numerous systems, most notably the endocrine system, are extremely sensitive to very low levels of chemicals, in parts-per-billion or less. The damage may not be evident at the time of exposure but can have unpredictable delayed, life-long effects on individuals and/or their offspring. Effects of this nature would be much harder to identify than obvious impacts such as skin and eye irritation that occur immediately upon contact. Health impairments could remain hidden for decades and span generations. Specific outcomes could include reduced sperm production, infertility, hormone imbalances, and other sex-related disorders. Further compounding this concern is the potential for the shared toxic action of these contaminants, especially those affecting the same and/or multiple organ systems.

It was difficult to arrive at a "short list" of chemicals that would be informative for water quality monitoring because of the vast array of products constantly being developed, and the wide selection of chemicals used in those products. We can,

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Table 2. Chemicals with CAS numbers that have 10 or more adverse health effects.

Chemical	CAS #	Number of products
(2-BE) Ethylene glycol monobutyl ether	111-76-2	22
2,2′,2″-Nitrilotriethanol	102-71-6	3
2-Ethylhexanol	104-76-7	7
5-Chloro-2-methyl-4-isothiazolin-3-one	26172-55-4	2
Acetic acid	1186-52-3	1
Acrolein	107-02-8	1
Acrylamide (2-propenamide)	79-06-1	6
Acrylic acid	79-10-7	2
Ammonia	7664-41-7	3
Ammonium chloride	12125-02-9	2
Ammonium nitrate	6484-52-2	2
Aniline	62-53-3	1
Benzyl chloride	100-44-7	2
Boric acid	10043-35-3	4
Cadmium	7440-43-9	1
Calcium hypochlorite	7778-54-3	1
Chlorine	7782-50-5	1
Chlorine dioxide	10049-04-4	2
Dibromoacetonitrile	3252-43-5	1
Diesel 2	68476-34-6	19
Diethanolamine	111-42-2	4
Diethylenetriamine	111-40-0	1
Dimethyl formamide	68-12-2	1
Epidian	25068-38-6	1
Ethanol	64-17-5	8
Ethyl mercaptan	75-08-1	1
Ethylbenzene	100-41-4	7
Ethylene glycol	107-21-1	17
Ethylene oxide	75-21-8	2
Ferrous sulfate	7720-78-7	1
Formaldehyde	50-00-0	4
Formic acid	64-18-6	8
Fuel oil #2	68476-30-2	9
Glutaraldehyde	111-30-8	11
Glyoxal	107-22-2	2
Hydrodesulfurized kerosene	64742-81-0	1
Hydrogen sulfide	7783-06-4	1
Iron	7439-89-6	3
Isobutyl alcohol (2-methyl-1-propanol)	78-83-1	3
Isopropanol (propan-2-ol)	67-63-0	47
Kerosene	8008-20-6	3
Light naphthenic distillates, hydrotreated	64742-53-6	2

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Table 2. Chemicals with CAS numbers that have 10 or more adverse health effects. *(Continued)*

Chemical	CAS #	Number of products
Mercaptoacetic acid	68-11-1	2
Methanol	67-56-1	74
Methylene bis(thiocyanate)	6317-18-6	2
Monoethanolamine	141-43-5	5
NaHCO3	144-55-8	5
Naphtha, petroleum medium aliphatic	64742-88-7	2
Naphthalene	91-20-3	18
Natural gas condensates	68919-39-1	1
Nickel sulfate	7786-81-4	1
Paraformaldehyde	30525-89-4	2
Petroleum distillate/naptha	8002-05-9	7
Petroleum distillate/naphtha	8030-30-6	1
Phosphonium, tetrakis(hydroxymethyl)-sulfate	55566-30-8	2
Propane-1,2-diol	57-55-6	6
Sodium bromate	7789-38-0	1
Sodium chlorite (chlorous acid, sodium salt)	7758-19-2	1
Sodium hypochlorite	7681-52-9	1
Sodium nitrate	7631-99-4	3
Sodium nitrite	7632-00-0	3
Sodium sulfite	7757-83-7	1
Styrene	100-42-5	1
Sulfur dioxide	7446-09-5	1
Sulfuric acid	7664-93-9	1
Tetrahydro-3,5-dimethyl-2H-1,3,5-thiadiazine-2-thione (Dazomet)	533-74-4	3
Titanium dioxide	13463-67-7	2
Tributyl phosphate	126-73-8	1
Triethylene glycol	112-27-6	1
Urea	57-13-6	3
Xylene	1330-20-7	11

however, provide some guidance by pointing out four types of chemicals that are used in a relatively high number of products. These include (1) the silicas, which appear frequently as product components; (2) potassium based chemicals, which are also found in numerous products, although with relatively low toxicity; (3) petroleum derived products, which take on many different forms (including some without CAS numbers), and some of which are toxic at low concentrations and might be detected with diesel or gasoline range organics tests; and (4) the alcohols for which new detection technology is being developed, and because they are among the chemicals with the most health effects.

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Table 3. Chemicals with CAS numbers found in the highest number of products.

Chemical	CAS #	Number of products	Number of health effects
Crystalline silica, quartz	14808-60-7	125	7
Methanol	67-56-1	74	11
Isopropanol (propan-2-ol)	67-63-0	47	10
Petroleum distillate hydrotreated light	64742-47-8	26	6
(2-BE) Ethylene glycol monobutyl ether	111-76-2	22	11
Bentonite	1302-78-9	20	6
Diesel 2	68476-34-6	19	10
Naphthalene	91-20-3	18	12
Aluminum oxide	1344-28-1	17	3
Ethylene glycol	107-21-1	17	10
Sodium hydroxide	1310-73-2	17	5
Barite (BaSO4)	7727-43-7	15	5
Heavy aromatic petroleum naphtha	64742-94-5	15	5
Crystalline silica, cristobalite	14464-46-1	14	5
Mica	12001-26-2	14	3
Sodium chloride	7647-14-5	14	9
Crystalline silica, tridymite	15468-32-3	13	3
Hydrochloric acid (HCl)	7647-01-0	13	7
Glutaraldehyde	111-30-8	11	11
Xylene	1330-20-7	11	10
Guar gum	9000-30-0	10	3
Iron oxide (ferric oxide)	1309-37-1	10	5
Potassium chloride	7447-40-7	10	8
Potassium hydroxide	1310-58-3	10	7
Xanthan gum	11138-66-2	10	4
Fuel oil #2	68476-30-2	9	11
Hydrotreated heavy petroleum naphtha	64742-48-9	9	8
Limestone (calcium carbonate)	1317-65-3	9	2
Polyacrylamide/polyacrylate copolymer	25085-02-3	9	3
Sodium carboxymethylcellulose (polyanionic cellulose)	9004-32-4	9	5
Calcium hydroxide	1305-62-0	8	8
Crystalline silica (silicon dioxide)	7631-86-9	8	4
Ethanol	64-17-5	8	12

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Table 3. Chemicals with CAS numbers found in the highest number of products. *(Continued)*

Chemical	CAS #	Number of products	Number of health effects
Formic acid	64-18-6	8	11
Graphite	7782-42-5	8	4
2-Ethylhexanol	104-76-7	7	11
Acetic acid	64-19-7	7	9
Asphaltite (gilsonite, hydrocarbon black solid)	12002-43-6	7	4
Butanol (n-butyl alcohol, butan-1-ol, 1-butanol)	71-36-3	7	8
Calcium carbonate (sized)	471-34-1	7	6
Calcium chloride	10043-52-4	7	8
Ethoxylated nonylphenol	9016-45-9	7	6
Ethylbenzene	100-41-4	7	11
Petroleum distillate naphtha	8002-05-9	7	12
Propargyl alcohol (prop-2-yn-1-ol)	107-19-7	7	9
Tetramethylammonium chloride	75-57-0	7	8

Detection of increasing or elevated concentrations of these chemicals near gas operations could indicate that communication between natural gas activities and a water resource such as a domestic well, creek, pond, wetland, and so on is occurring. If a longitudinal monitoring program were to reveal any increase in concentration in one of these target groups, even if the concentrations were well below any water quality standards, it should trigger more testing immediately.

For many years, drillers have insisted that they do not use toxic chemicals to drill for gas, only guar gum, mud, and sand. While much attention is being given to chemicals used during fracking, our findings indicate that drilling chemicals can be equally, if not more dangerous. What we have learned about the chemicals used in the Crosby well blowout provides insight into why citizens living nearby suffered severe respiratory distress, nausea, and vomiting and had to be evacuated from their homes for several days. It might also shed light on why other individuals living near gas operations have experienced similar symptoms during the gas drilling phase (prior to fracking).

From the first day the drill bit is inserted into the ground until the well is completed, toxic materials are introduced into the borehole and returned to the surface along with produced water and other extraction liquids. In the western United States it has been common practice to hold these liquids in open evaporation pits until the wells are shut down, which could be up to 25 years. These pits have rarely been examined to ascertain their chemical contents outside of some limited parameters (primarily metals, chlorides, and radioactive materials). Our data reveal

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that extremely toxic chemicals are found in evaporation pits and indeed, these and other similar sites may need to be designated for Superfund cleanup. In the eastern United States, and increasingly in the West, these chemicals are being re-injected underground, creating yet another potential source of extremely toxic chemical contamination. In other words, what ends up in evaporation pits in the West will in other parts of the country be injected underground.

RECOMMENDATIONS

TEDX has collected the names of nearly a thousand products used in natural gas operations in the United States. We have no idea how many more products are in use. We have health data on only a small percentage of the chemicals in use because CAS numbers are often not provided on MSDSs and without a CAS number it is difficult to search for health data. Working under the assumption that our results underestimate the consequences of the health impacts to the labor force, residents living in close proximity to the wells, and those dependent upon potable and agricultural water that could be affected by natural gas operations, we make the following recommendations:

1. Product labels and/or MSDSs must list the complete formulation of each product, including the precise name and CAS number and amount of every chemical, as well as the composition of the vehicle used to fill the product container. To prevent serious injury and mortality the products used during natural gas operations should be exempt from confidentiality.
2. If an ingredient does not have a CAS number it must be clearly defined, leaving no doubt about its possible health impact(s).
3. Records should be kept for each drilling and fracking operation, listing the total volume of fluid injected, the amount of each product used, the depth at which the products were introduced, and the volume of fluid recovered.
4. The volume and concentration of all liquids and solids removed from the work sites should be made available to the public. Without this information the full health and environmental hazards posed by natural gas production cannot be predicted.
5. Air quality monitoring for individual VOCs as well as ozone must become standard procedure in any region where natural gas activity is taking place and must commence prior to initiation of operations to establish baseline levels. Estimating tonnage of VOCs and NOx released and ignoring ozone should no longer be the practice.
6. Comprehensive water monitoring programs should be established in every gas play across the United States both prior to and after gas production commences, that include new chemical species indicators based on toxicity and mobility in the environment, to monitor sub-surface and above-surface domestic and agricultural water resources, and all domestically used aquifers and underground sources of drinking water.
7. We recommend the development of labeled isotopic fingerprints of the chlorinated compounds in products used to drill and fracture. Each manufacturer

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would have its own fingerprint. A plot of this isotopic data found down gradient of a hydraulically fractured well would aid a state or federal regulator in identifying the contamination source.

8. Given the general consistency of reported adverse health effects by citizens and laborers across many gas plays, public health authorities should establish an epidemiological monitoring program that merges at the state and national level in order to increase power and be able to reach conclusions early on. The design of the study should include environmental monitoring of air and water as well as any health changes in those living and working in regions of natural gas operations. The health monitoring should be able to detect early trends in parameters, such as asthma, hypertension, chemical sensitization, chronic skin and eye irritation, and neurological alterations, to mention a few.
9. As underground injection of waste is becoming the most frequent choice for waste disposal, rigid accounting of the date, volume, and source of all materials, and the exact location in the geological formation(s) in which it is injected should be become a part of permanent government records that will be publicly available for future generations.
10. Before a permit is issued to drill for natural gas, complete waste management plans should be reviewed and approved and become part of the permit.
11. The injection of hydraulic fracturing fluids should be regulated under the Safe Drinking Water Act. This is needed to assure mechanical integrity of the injection wells and isolation of the injection zone from underground sources of drinking water.

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Chemical	# of Products	Product
Aluminum tristearate	4	Aluminum Sterate 1,3&5, Aluminu
Amoco NT-45 process oil [Diesel 2]	2	Puredrill HT-40, Mineral Seal Oil
Chromium	2	New Flow, Desco #6
Crystalline silica, quartz	124	Acfrac CR-4000D, Acfrac PR-6000
Distillates (petroleum), hydrotreated (mild) heavy naphthenic (9CI)	2	Puredrill HT-40, SGA-HT
Distillates (petroleum), hydrotreated (mild) heavy paraffinic (9CI)	1	Puredrill HT-40
Drakeol	1	Puredrill HT-40
Formic acid sodium salt (Sodium formate)	2	Hercules Sodium Formate Technica
Gas oils (petroleum), vacuum, hydrocracked, hydroisomerized, hydrogena	1	Puredrill HT-40
Gas oils (petroleum), vacuum, hydrocracked, hydroisomerized, hydrogena	1	Puredrill HT-40
Gas oils (petroleum), vacuum, hydrocracked, hydroisomerized, hydrogena	1	Puredrill HT-40
Lubricating oils (petroleum), C15- 30, hydrotreated neutral oil-based	1	Puredrill HT-40
Lubricating oils (petroleum), C20- 50, hydrotreated neutral oil-based	1	Puredrill HT-40
Lubricating oils (petroleum), C20- 50, hydrotreated neutral oil-based, high	1	Puredrill HT-40
Lubricating oils, (petroleum), C15-30, hydrotreated neutral oil-based, con	1	Puredrill HT-40
Monopentaerythritol	1	Hercules Sodium Formate, Technica
Petroleum distillate hydrotreated light	24	FRW-14 #1,2, SGA-III, Bara-Defoa
Petroleum product	1	Puredrill HT-40
Polyacrylamide/polyacrylate copolymer (Copolyer of acrylamide & sodiu	7	Alcomer 60 RD Version 2, EZ-Mud
Sepiolite	1	Sea Mud
Xanthan gum	10	Barazan D Plus, Kelzan XC & XCD
Polyaminated fatty acid	1	EZ-Mul
Biopolymer	1	Flowzan Biopolymer
Ground paper	2	Multi Seal, Dicks Mud Seal
Isoalkane fluid	1	Puredrill HT-40
Oxidized tall oil	1	Invermul
Proprietary	34	U106, Desco Chrome Free #1, EXP
Unknown	46	Developmental Foamer XE913, Anc
Barite	15	Barite #1, Baroid, Mil-bar #1, OSL
Bentonite	20	Aquagel, Aquagel Gold Seal #1,2, E
Butanol (N-butyl alcohol, Butan-1-OL, 1-Butanol)	8	F105, OptiPlus, 1-Butanol, APSA-8
Calcium carbonate (sized)	6	Safe-Carb 1&2, Baracarb 25 #1, Ba
Carbon	2	G-Seal Plus, LC-Glide
Cellulose derivative (carboxymethylcellulose sodium salt)	4	Fed Pac, Polypac UL, Fed Pac R, Fe
Chlorine	1	Rock Drill Lubricant
Crystalline silica, tridymite	13	Aquagel, Max-Gel, Aquagel Gold S
D-Glucophranoside, methyl	1	DeepDrill Inhibitor
Ethylene glycol monobutyl ether (2-BE)	23	AQF-2, Ezeflo103 #1,2, EMI-1702,
Ferrous sulfate (Monohydrate ferrous sulfate)	3	Desco #1, Desco Chrome Free #1, D
Graphite	8	Steelseal, Stop-Frac, Stop-Frac-S, G
Gypsum respirable fraction (phosphogypsum)	4	Bentonite #3, Soli-Bond, Max-Gel,
Lignosulfonic acid, chromium salt	2	New Flow, Chrome Lignosulfonate
Magnesium oxide	5	Soli-Bond, Expanding Cement Add
Mica	14	Mica #1,2,3,4, MicaTex, Barite #1,
Modified polysaccharide or Pregelatinized cornstarch or starch	6	Impermex, Drill Starch, Adomite Re

Naphthalene	19	Busan 1030, CI-25, NE-118, W53,
Nitrogen	5	Nitrogen -Analytical, Condensate W
Polyglycerine	1	DeepDrill Inhibitor
Sodium bicarbonate	5	Bicarbonate of Soda, Sodium Bicar
Sodium carboxymethylcellulose (*Polyanionic cellulose)*	9	Aquaflo Cellulose Polymer, Aquapa
Sodium hydroxide	17	U42, U28, Sodium hydroxide, U106
Sulfomethylated quebracho	1	Drill-Thin #2
Xylene	12	NE-118, DWP-931, W54, Xylene B
Zinc	2	Zinc, Rock Drill Lubricant
Crystalline silica	1	Drill-Thin Thinner #1
Fatty acid ester	1	Drill-N-Slide
Oxidized organic material	1	Fed Rheosmart
Acrylate polymer	1	OptiVis PS
Additives and/or other ingredients	1	Rock Drill Lubricant
Anionic acrylamide copolymer	1	Poly-Plus Dry
Anionic acrylamide copolymer powder	3	HyperDill AF 204RD, AF 207RD, A
Anionic polyacrylamide	2	Poly-Plus, FRP-121
Copolymer beads	1	Quick Slide
Esters	1	Drilzone L
Fatty acid amine derivative	1	Drilzone L
Glycol blend	1	Defoam-X^ Version 2
Glycol ether blend	1	Lube 945
Ground pecan shells	1	Milplug
Hulls	1	Fed Seal
Inorganic salt	1	WPS Sticks
Iron salts	1	Drill-Thin Thinner #1
Modified alkanolamide	1	DynaDet
Modified tannin extract	1	Fed Rheosmart
Natural fibers	1	Fed Seal
No hazardous ingredients	1	Drilling Paper #1
Non-hazardous and other components below reportable levels	7	Caustic Soda #1, Ligco, Mil-Bar #2
Non-regulated components	1	EMI-1702
Oxyethylated alcohol	1	Drilzone L
Particulates not otherwise classified	2	Cedar Fiber #4, Drilling Paper #2
Petroleum solvent	1	OptiPlus *Version 2*
Polysaccharide	1	Dual-Flo
Propene polymer	1	Fed Seal
Refined mineral oil	1	Rock Drill Lubricant
Shredded cellophane	1	Cellophane Flake
Silicates	1	Quick Slide
Sodium polyacrylate	1	CY-EX+
Sodium polyacrylate/polyacrylamide	1	Cypan
Sodium salt of acrylamide polymer	1	HyperDrill DF 2020
Styrene copolymer	1	Alpine Drill Beads
Sulfonate	1	Fed Prime Sol
Sulfonated asphalt residuum	1	Soltex #2
Super absorbant polyacrylamide	1	HyperDill A 200 Series
Surfactant	6	Flo-Back 30, Foamatron VDF-127,
Surfactant NJ trade secret Reg# 99783600-5133P	1	Alcomer 123 L
Terpene	1	EMI-1702
Various oxides as nuisance particulates	1	Torque Less
Vegetable oil	2	Lube 945, Pipe-Lax
Wood dust, soft wood	1	Sawdust Version 2

totals

mud listed under purpose

drilling listed under purpose

If a chemical had both under purpose then the cell is pink

* Chemical Abstract Service (CAS) numbers are only listed if they were provided on the MSDS. Some products list vague terms, such as unspecified, and many MSDS provide no CAS numbers at all for some ingredients.

Volatile and Soluble Codes

X	Either soluble or volatile
L	Partially soluble or volatile
T	Slightly soluble or volatile
M	Miscible
D	Dispersable

Health Effects Codes

S	Suspected

Purpose	CAS #*	Readily evaporates/volatile	Water Soluble/ Miscible	Skin, eye and sensory organ	Respiratory	Gastrointestinal and liver	Brain and nervous system	Immune	Kidney
Drilling mud additive, unknown	637-12-7			S	S	S			
Mud base, fracturing	64742-46-7	X		S	S	S	S		
Drilling mud additive	7440-47-3			S	S	S	S	S	S
Weighting material, unknown, sealer	14808-60-7			S	S			S	S
Mud base, gellant, fracturing	64742-52-5			S	S	S			
Mud base	64742-54-7			S		S	S		
Mud base	8042-47-5			S	S	S			
Drilling mud additive, cement frictio	141-53-7		X	S	S	S	S		S
Mud base	178603-64-0	X							
Mud base	178603-65-1	X							
Mud base	178603-66-2	X							
Drill mud base fluid	72623-86-0			S	S	S			
Drill mud base fluid	72623-87-1			S	S	S			
Drill mud base fluid	72623-85-9			S	S	S			
Drill mud base fluid	72623-84-8			S	S	S	S		
Drilling mud additive	115-77-5		L	S	S	S	S		
Fracturing, shale control inhibitor, ur	64742-47-8	X		S	S	S	S		
Drill mud base fluid	445411-73-4			S	S				
Flocculant, shale inhibitor, unknown	25085-02-3		L	S	S				
Unknown	63800-37-3				S				
Corrosion inhibitor, viscosifier, addi	11138-66-2		X	S	S	S			
Oil mud emulsifier, fracturing	unspecified								
Drilling mud additive	proprietary		X		S				
Sealer									
Drill mud base fluid									
Oil mud emulsifier, fracturing				S					
Corrosion inhibitor, deflocculant, proppant, cement extender, unknown, viscosifier, drilling mud additive, lubrication, surfactant, gellant, biocide, chelatin									
Scale inhibitor, corrosion inhibitor, surfactant, emulsifier, foamer, demulsifier, flocculent, viscosifier, shale stabilizer, drilling mud additive, fracturing, we									
Weighting material, drilling additive,	7727-43-7		T	S	S			S	
Viscosifier/gellant, unknown, sealer,	1302-78-9			S	S	S		S	
Surfactant, fracturing, all purpose sp	71-36-3	X	X	S	S	S	S		S
Lost circulation material, weighting a	471-34-1			S	S	S			S
Drilling additive, lost circulation mat	7440-44-0			S	S	S	S		S
Fluid loss additive, fracturing, drillin	9004-32-4		X	S	S	S			S
Lubricant, fracturing	7782-50-5		X	S	S	S	S	S	S
Viscosifier/gellant, drilling additive,	15468-32-3				S				
Shale control inhibitor	3149-68-6								
Foamer, surfactant, fracturing, drillin	111-76-2	X	M	S	S	S	S	S	S
Deflocculant, thinner	17375-41-6		X	S		S			
Lost circulation material, fliud loss a	7782-42-5			S	S	S			
Drilling additive, stabilizer	13397-24-5			S	S	S			S
Drilling additive	9066-50-6		X	S	S	S		S	
Cement, cement additive, stabilizer,	1309-48-4		T	S	S	S	S		
Lost circulation material, unknown, f	12001-26-2				S	S			
Unknown, fluid loss additive, biocid	9005-25-8		X	S	S	S			

Biocide, drilling fluid additive, non e	91-20-3	X		S	S	S	S	S	S
Drilling fliud, condensate water, prop	7727-37-9	X		S	S	S			
Shale control inhibitor	025618-55-7		X						
pH control, fracturing, buffer, oil wel	144-55-8		X	S	S	S		S	S
Drilling fluid additive polymer, unkn	9004-32-4		X	S	S	S		S	
Gellant, chelating agent, fracturing, a	1310-73-2		X	S	S	S			
Thinner	68201-64-9		X	S					
Non-emulsifier, emulsion breaker, un	1330-20-7	X		S	S	S	S	S	S
Unknown, lubricant, fracturing	7440-66-6			S	S	S	S	S	S
Thinner	various								
Lubricant, fracturing	mixture			S	S				
Drilling fluid additive	unspecified								
Drilling									
Lubricant, fracturing									
Drilling fluid			X	S	S	S			
Drilling fluid additive				S					
Friction reducer, fracturing, drilling fluid additive, shale control agent									
Oil well drill fluid additive									
Oil well drilling fluid additive, anticrete additive									
Oil well drilling fluid additive, anticrete additive									
Oil well drilling fluid additive, defoamer				S	S	**S**			
Drilling fluid additive									
Drilling compound NOS				S	S			S	
Drilling additive									
Drilling									
Thinner									
Drilling detergent			X						
Drilling fluid additive									
Drilling additive									
Lost circulation material, fracturing									
Alkalinity control, filtration contol agent, lost circulation material, viscosifier, shale stabilizer, defoamer, fracturing									
Drilling additive			X						
Oil well drilling fluid additive, anticrete additive		X	X						
Lost circulation material, fracturing, oil well drilling fluid additive				S	S	S		S	
Drilling									
Oil well drilling fluid additive			X	S	S	S			
Drilling additive									
Lubricant, fracturing									
Drilling fluid additive									
Oil well drilling fluid additive									
Drilling additive			T						
Drilling additive			L						
Drilling									
Drilling additive				S	S	S			
Drilling fluid additive			X	S	S	S			
Drilling fluid additive			X						
Drilling									
Surfactant, foamer, fracturing, drilling fluid additive, unknown									
Drilling									
Drilling additive		X	X						
Drilling fluid additive									
Drilling fluid additive									
Oil well drilling fluid additive, lost circulation material				S	S	S		S	

50	49	42	15	15	14

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Cardiovascular and blood	Cancer	Mutagen	Developmental	Reproductive	Endocrine disruptors	Other	Ecological
							S
S	S	S	S	S		S	
	S	S			S		
		S				S	
	S						
		S		S			S
							S
						S	S
		S					
							S
S							
						S	
	S						
g agent, fracturing, additive, emulsifier, thinner							
eighting materials, unknown, polymerized friction reducer, iron chelator							
						S	S
	S						S
S						S	S
	S						S
S	S					S	
							S
S						S	S
	S	S					
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Isn’t this radiation naturally occurring?

By Rachel Morgan Shalereporter.com | Posted: Sunday, January 27, 2013 10:15 pm

Wastewater from hydraulic fracturing in the Marcellus shale region can be radioactive.

Highly radioactive.

Through a drilling technique known formally as hydraulic fracturing, a stratum of shale rock one mile beneath the surface is blasted with chemically laced, high-pressure water to release pockets of natural gas. That water, now containing mineral debris from the rock formation, is then sucked back out of the earth to be disposed of or recycled.

A constituent element of that wastewater is radium-226. The Marcellus shale is full of it.

Mark Engle, a U.S. Geological Survey research geologist, said the main reason the Marcellus shale is so high in radium is because the shale contains enriched concentrations of uranium, which has a half-life of 4.5 billion years. That means, Engle said, “these rocks will continue to generate radium and other uranium series progeny for a very long time.”

Engle co-authored a USGS report that found that millions of barrels of wastewater from unconventional (fracked) wells in Pennsylvania and vertical wells in New York were 3,609 times more radioactive than the federal limit for drinking water and 300 times more radioactive than a Nuclear Regulatory Commission limit for industrial discharges to water. He also said the Marcellus’ high levels of uranium and radioactivity has to do with the surrounding geology.

Marvin Resnikoff, a physicist at the University of Michigan and senior associate at Radioactive Waste Management Associates, said the Marcellus shale contains about 30 times the amount of radium found in topsoil sampled from New York and Pennsylvania.

And with higher levels of radium in the black shale itself comes increased levels of radium in wastewater, Resnikoff said.

While the radioactive materials contained within the Marcellus during fracking are naturally occurring, experts say high levels still pose a threat to health.

The EPA classifies radon, radium and uranium as “naturally occurring radionuclides found in the environment.” But the EPA also classifies both radium and radon as “potent carcinogens.” The agency says that radium, through oral exposure, can cause lung, bone, head and nasal passage tumors. And radon, if inhaled, causes lung cancer.

Resnikoff agrees.

“Radium is of concern because when ingested or inhaled, it concentrates in bone and can give rise to leukemia,” he said.

While the World Nuclear Association says that naturally occurring radiation makes up for the average person’s annual exposure and is usually not a threat, it also says that certain industries handle significant quantities of Naturally Occurring Radioactive Material, or NORM, which usually ends up their waste streams.

“Over time, as potential NORM hazards have been identified, these industries have increasingly become subject to monitoring and regulation,” the association said. “However, there is as yet little consistency in NORM regulations among industries and countries. This means that material which is considered radioactive waste in one context may not be considered so in another. Also, that which may constitute low-level waste in the nuclear industry might go entirely unregulated in another industry.”

That’s why the nuclear industry is subject to much stricter regulations than the gas industry in terms of regulating potentially radioactive waste, said David Lochbaum, a nuclear engineer who heads the Nuclear Safety Project for the Union of Concerned Scientists.

“NRC's regulations require that every drop of water and every molecule of air discharged from a plant be monitored for radiation,” Lochbaum said.

Ivan White, a career scientist for the National Council on Radiation Protection, said radiation exposure to humans should be limited.

“The goal is to limit the total radiation dose to large populations because of the increased probability of health effects,” he said. “In the current case, the uncontrolled release of hazardous waste could result in the exposure of millions of people over decades.”

White also authored a report issued by the New York-based Grassroots Environmental Education that says fracking can produce waste much higher in radiation than previously thought.

And environmentalists say that radiation is becoming a serious issue in the disposal or treatment of fracking waste.

“The issue with oil and gas development -- and especially fracking, given the large amount of fluids injected -- is that the deep drilling and fracking bring these NORMs back up to the surface as drill cuttings and wastewater,” said Adam Kron, attorney for the Environmental Integrity Project.

“As fracking has rapidly expanded, we’re seeing much more of this radioactive waste, which is a problem, since traditional landfills and wastewater treatment plants aren’t

accustomed to handling it," he said. "In fact, wastewater treatment plants aren’t able to remove radioactivity, and we’re starting to hear accounts of landfills receiving -- and sometimes turning away -- radioactive cuttings and sand from across state lines.”

Third of a four-part series on radiation in fracking wastewater. Next up, how dangerous is the radiation in frackwater?

Ocean Discharge Criteria Evaluation for Oil and Gas Exploration Facilities on the Outer Continental Shelf and Contiguous State Waters in the Beaufort Sea, Alaska

(NPDES Permit No.: AKG-28-2100)

United States Environmental Protection Agency

October 2012 – FINAL

Prepared by:

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Executive Summary

The U.S. Environmental Protection Agency (EPA) is reissuing a National Pollutant Discharge Elimination System (NPDES) general permit for wastewater discharges associated with oil and gas exploration activities in the Outer Continental Shelf and contiguous state waters in the Beaufort Sea, off northern Alaska. Section 403(c) of the Clean Water Act (CWA) requires that NPDES permits for discharges into the territorial seas, the contiguous zone and the oceans, including the Outer Continental Shelf, comply with EPA's Ocean Discharge Criteria. The purpose of this Ocean Discharge Criteria Evaluation (ODCE) is to review the discharges authorized under the Beaufort Exploration NPDES General Permit (Permit No. AKG-28-2100) (Beaufort general permit) and evaluate their potential cause unreasonable degradation of the marine environment.

This document evaluates the impacts of waste water discharges associated with the Beaufort general permit for offshore oil and gas exploratory activities in the Beaufort Sea. Development and production activities, and their associated discharges, are not covered by the general permit. As such, development and production operations are outside the scope of the activities considered in this ODCE and are not discussed in this document.

The Beaufort general permit will authorize discharges from exploratory operations in all areas offered for lease in the Beaufort Sea, including past leases and lease sale areas that might be offered in the immediate future (i.e., in the next 5 years). Lease sales in the next 5 years (i.e., 209 and 217) are expected to occur in the Area of Coverage. In June 2012, the Department of Interior (DOI) Bureau of Ocean Energy Management (BOEM) announced a new Five-Year Outer Continental Shelf (OCS) Oil and Gas Leasing Program for 2012 through 2017. This Five-Year Program includes the Beaufort Sea Lease Sale 242, which is planned for 2017. As such, the Beaufort general permit's Area of Coverage includes approximately 101,750 square miles (mi) (65.12 million acres), and extends offshore north of Barrow and east to the Canadian border. Leases begin just offshore and encompass 4,250 square mi (2.72 million acres) in water depths ranging from approximately 20 to 170 feet (ft). See Figure 1-1 in section 1.

Exploration activities in the OCS must be conducted in accordance with BOEM and the Bureau of Safety and Environmental Enforcement (BSEE) regulations at 30 CFR Part 550 Subpart B and 30 CFR Part 250 Subpart B, respectively. These regulations establish requirements for well design, pollution prevention, personnel training, and technical specifications for the specific drilling rig and the drilling unit (NMFS 2011). No drilling activity can be conducted until BOEM has approved an Exploration Plan (EP) and BSEE has approved the well-specific Application for Permit to Drill (APD). Drilling in the offshore Arctic most often employ drill ships or jack-up rigs. Ice is present much of the year in the Beaufort Sea; therefore, EPA expects that wells will be drilled from drill ships or moveable platforms during the open water season when pack ice is not present.

The types of wells that might be drilled include exploration wells and delineation wells. An exploration well is a well that is drilled into a previously undrilled geologic formation to test for the presence of hydrocarbon accumulation. A delineation well is drilled at a distance from a discovery well to determine the spatial and vertical extent of the reserves and likely production rate of a new oil or gas field. Because there are no differences between the characteristics of discharges from exploration and delineation wells, the permit treats both types of discharges the same. Such wells will be plugged at the end of the exploratory drilling program or capped for continued drilling the following year.

An exploratory well can be drilled within 40 days of operation, however, drilling operations can range between 30 and 90 days (MMS 2008; NMFS 2011), depending on the depth to the target formation, difficulties during drilling, logging/testing operations, and uncertainties associated with weather conditions. Considering the relatively short open-water season in the Beaufort Sea (July–October), an operator, using a single rig, would be able to complete drilling, testing, and abandoning of up to two exploration wells during a single season. However, with the shallow water depths in nearshore Beaufort Sea, exploration wells could be drilled from artificial islands. For purposes of this evaluation, EPA estimates that 18 to 34 exploration and delineation wells will be drilled in the Beaufort Area of Coverage during the 5-year permit term (2012–2017).

Offshore oil and gas exploration activities are generally characterized as short-term at any location and typically involve only a small number of wells. The activities, however, generate numerous waste streams that are discharged from the drilling rig into the ocean. For the Beaufort general permit, such waste streams are related to the drilling process, equipment maintenance and personnel housing, and consist of the following:

- Discharge 001 – water-based drilling fluids and drill cuttings
- Discharge 002 – deck drainage
- Discharge 003 – sanitary wastes
- Discharge 004 – domestic wastes
- Discharge 005 – desalination unit wastes
- Discharge 006 – blowout preventer fluid
- Discharge 007 – boiler blowdown
- Discharge 008 – fire control system test water
- Discharge 009 – non-contact cooling water
- Discharge 010 – uncontaminated ballast water
- Discharge 011 – bilge water
- Discharge 012 – excess cement slurry
- Discharge 013 – muds, cuttings, and cement at the seafloor

EPA derived discharge estimates on a per well basis using information submitted in notices of intent (NOIs) by Shell Exploration, Inc. (Shell) for potential exploration well projects in the Beaufort Area of Coverage. The NOIs were submitted under the prior general permit (Arctic Exploration NPDES General Permit, AKG-28-0000). Discharge estimates are summarized in Table ES-1, which includes average and maximum discharge quantities on a per well basis, as derived from the NOIs. Besides Shell, EPA is not aware of any other operators who have expressed intent to explore in either the OCS or state lease locations covered by the Beaufort general permit during the 5-year permit term.

Table ES-1. Estimated average and maximum discharge quantities based on NOIs

Discharge	Average Discharge Quantities[a] (bbl/well)	Maximum Discharge Quantities (bb/well)
Water-based drilling fluids and drill cuttings (001)	3,712[b]	3,709
Deck drainage (002)	214	250
Sanitary wastes (003)	1,275[b]	1,290
Domestic wastes (004)	14,167[b]	14,333
Desalination unit wastes (005)	5,350	6,250
Blowout preventer fluid (006)	50	56.4
Boiler blowdown (007)	0[c]	0
Fire control system test water (008)	477[d]	572
Non-contact cooling water (009)	1,099,871	1,935,000
Uncontaminated ballast Water (010)	213[b]	215
Bilge water (011)	537[b]	543
Excess cement slurry (012)	50	50
Muds, cuttings, and cement at the seafloor (013)	3,512	5,335

Notes:

bbl = barrel

a. Average estimated quantities based on Shell's NOIs, which are reported on a per well basis, for exploration activities in the Beaufort Sea.

b. Shell's NOIs indicated zero discharge in Camden Bay at the Sivulliq and Torpedo prospects.

c. Shell's NOIs indicated zero discharge.

d. Shell's NOIs indicated zero discharge in Harrison Bay at the Cornell and Mauya prospects.

EPA's Ocean Discharge Criteria (Title 40 of the *Code of Federal Regulations* [CFR] Part 125, Subpart M) set forth specific determinations of unreasonable degradation that must be made before permit issuance. Unreasonable degradation of the marine environment is defined (40 CFR 125.121[e]) as follows:

- Significant adverse changes in ecosystem diversity, productivity, and stability of the biological community within the area of discharge and surrounding biological communities;
- Threat to human health through direct exposure to pollutants or through consumption of exposed aquatic organisms; or
- Loss of aesthetic, recreational, scientific, or economic values, which are unreasonable in relation to the benefit derived from the discharge.

The ODCE is based on 10 criteria (40 CFR 125.122):

- Quantities, composition, and potential for bioaccumulation or persistence of the pollutants to be discharged;
- Potential transport of such pollutants by biological, physical, or chemical processes;
- Composition and vulnerability of the biological communities that might be exposed to such pollutants, including the presence of unique species or communities of species, the presence of species identified as endangered or threatened pursuant to the Endangered Species Act, or the presence of those species critical to the structure or function of the ecosystem, such as those important for the food chain;

- Importance of the receiving water area to the surrounding biological community, including the presence of spawning sites, nursery/forage areas, migratory pathways, or areas necessary for other functions or critical stages in the life cycle of an organism;
- Existence of special aquatic sites including marine sanctuaries and refuges, parks, national and historic monuments, national seashores, wilderness areas, and coral reefs;
- Potential effects on human health through direct and indirect pathways;
- Existing or potential recreational and commercial fishing, including finfishing and shellfishing;
- Any applicable requirements of an approved Coastal Zone Management Plan;
- Other factors relating to the effects of the discharge as appropriate; and
- Marine water quality criteria developed pursuant to CWA section 304(a)(1).

If the Regional Administrator determines that the discharge will not cause unreasonable degradation of the marine environment, an NPDES permit may be issued. If the Regional Administrator determines that the discharge will cause unreasonable degradation of the marine environment, an NPDES permit may not be issued.

If the Regional Administrator has insufficient information to determine, prior to permit issuance, that there will be no unreasonable degradation of the marine environment, an NPDES permit may not be issued unless the Regional Administrator, on the basis of best available information, determines that: (1) such discharge will not cause irreparable harm to the marine environment during the period in which monitoring will take place; (2) there are no reasonable alternatives to the on-site disposal of these materials; and (3) the discharge will be in compliance with certain specified permit conditions (40 CFR 125.122). "Irreparable harm" is defined as "significant undesirable effects occurring after the date of permit issuance which will not be reversed after cessation or modification of the discharge" (40 CFR 125.122[a]).

A summary of the evaluation conducted for each of the 10 criteria is presented below.

Criterion 1. The quantities, composition, and potential for bioaccumulation or persistence of the pollutants to be discharged.

The primary discharges of concern for oil and gas exploration (drilling fluids and cuttings) do not cause an unreasonable degradation to marine waters because the pollutants associated with those discharges do not bioaccumulate or persist in the environment. Recent studies show that metals associated with water-based drilling fluids are not readily absorbed by living organisms, but they do carry organic additives that can result in oxygen depletion, which could adversely affect benthic organisms in the immediate area of discharge. Likewise, increased sedimentation by the discharges of water-based drilling fluids and drill cuttings adversely affect benthic organisms in the area of discharge. However, the impacts of oxygen depletion and increased sedimentation are limited to the discharge area encircling each well (100-m radius) and have few long-term impacts. Studies show benthic communities in the Arctic and cold weather environments are resilient, with relatively short-lived effects. Effects on zooplankton communities are nearly always restricted to sediments in the immediate vicinity of the discharge, within about 300 ft (Neff 2010). The Beaufort general permit further limits the potential for adverse impacts by

prohibiting the discharge of oil- and synthetic-based drilling fluids, cuttings associated with those fluids, and restricting the number of wells drilled within a lease block to no more than five.

Literature reviews indicate some bioaccumulation of barium and chromium can occur in benthic organisms, but pollutant concentrations have been shown to decrease once the organism is removed from the contaminate source; tissue sample concentrations are not significantly different from control organisms. Bioturbation has not been quantified in the Beaufort Sea.

All other waste streams that will be authorized by the Beaufort general permit (e.g., sanitary and domestic wastes, deck drainage, blowout preventer fluid) do not contain pollutants that bioaccumulate or persist in the marine environment.

No unreasonable degradation of the marine environment of the Beaufort Sea is expected to occur from bioaccumulation or persistence of pollutant discharges from oil and gas exploration activities. EPA is requiring Environmental Monitoring Programs at each drill site during the 5-year permit term to ensure unreasonable degradation does not occur on a continuing basis, and to use in future agency decision-making.

Criterion 2. The potential transport of such pollutants by biological, physical, or chemical processes.

Pollutant transfer can occur through biological, physical, or chemical processes, and while some degree of transfer is expected from exploratory drilling in the Area of Coverage, the effects would be limited by the relatively short duration of activity at any individual well and the quantity and composition of discharges.

Physical transport models show that water quality standards for the water column will be met within 100 meters from the discharge point. Drilling fluid and cuttings deposition are predicted to deposit on the seafloor in substantially different patterns due to the difference in solids characteristics. The drilling fluids are predicted to deposit in a thinner layer (0.4 mm), and over a larger area (1,250 m), than the cuttings deposits. The coarser cuttings are predicted to cause deeper deposits near the outfall (up to 113 cm at 10 meters distance), and most cuttings deposition is predicted to occur within 100 meters radius, with predicted deposition of 0 to 10 cm thickness at that distance (Technical Memo, 2012). Ice gouging in the Area of Coverage is not well documented, but is not expected to play a substantial role in sediment transport.

Chemical transport of drilling fluids is not well described in the literature. Any occurrence would most likely result from oxidative/reductive reactions in sediments that change the speciation and sorption-desorption processes that change the physical distribution of pollutants.

Overall, discharges from exploration activities are short-lived and intermittent and are unlikely to result in significant accumulation on the seafloor.

Criterion 3. The composition and vulnerability of the biological communities that could be exposed to such pollutants, including the presence of unique species or communities of species, the presence of species identified as endangered or threatened pursuant to the Endangered Species Act, or the presence of those species critical to the structure or function of the ecosystem, such as those important for the food chain.

Authorized exploration discharges present some potential to produce either acute or chronic effects on a localized basis through exposure in the water column or in the benthic environment. The discharges would result in localized areas where the density and diversity and biomass of benthic organisms would be reduced for some time. Benthic organisms within such areas might also be exposed to sources of contaminants, including trace metals; however, the extent of exposure is not expected to result in long-term changes to the local species composition. Exposure of bottom feeders such as sea ducks and gray whales to these benthic communities is not anticipated to result in any adverse effects.

Four threatened or endangered species occur within the Area of Coverage: one cetacean species (bowhead whale), one carnivore (polar bear) and two birds (spectacled and Steller's eiders). Two seals, ringed and bearded, and the Pacific walrus and Yellow-billed loons are proposed or are candidate species for listing and under the Endangered Species Act. These species spend a portion of their lives in the Area of Coverage. Bowhead whales migrate through the area between summer feeding grounds in the Canadian Beaufort Sea and wintering areas in the Bering Sea. Humpback whales have been identified in the Beaufort Sea; their occurrence is only incidental, and no regular population is known to occur in the area. The occurrences of polar bear and seals are tied closely to the pack ice and would tend to be found further north during the anticipated periods of operations (open water seasons). Spectacled and Steller's eiders nest onshore in the summer and can spend time in the shallow near-shore waters immediately following the breeding period. The potential effects on those species include behavioral changes resulting from the physical presence of exploration rigs, permitted discharges, and drilling support activities.

As discussed under Criterion 1, bioaccumulation within prey is not expected to be an exposure pathway to those species. On the basis of the transient use of the area by those species, the limited areal extent of the potential impacts in relation to the total lease area containing prey, and the overall mobility of the species, impacts from oil and gas exploration will have insignificant effects on the ESA listed and proposed species. The Biological Evaluation of threatened and endangered species has been completed for the Beaufort general permit. The BE concluded that the discharges ~~"m~~ay affect, but are not likely to adversely affect" ESA listed, candidate, and proposed species, or their designated critical habitat areas. EPA received concurrence from these determinations from both the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) on March 30, 2012 and April 11, 2012, respectively.

Criterion 4. The importance of the receiving water area to the surrounding biological community, including the presence of spawning sites, nursery/forage areas, migratory pathways, or areas necessary for other functions or critical stages in the life cycle of an organism.

The Area of Coverage provides foraging habitat for a number of species including marine mammals and birds. Bowhead whale migrations occur through the southern portions of area with whales following open water leads generally in the shear zone as they move from the Chukchi Sea to the Beaufort Sea. The spring migration would generally be completed before discharges begin. Fish with demersal eggs might spawn in the Area of Coverage; however, the spawning habitats of resident fish populations are not well known. A number of other habitats and biological communities exist outside the Area of Coverage, primarily in the shallow and protected waters near the coast.

Sea ice provides a platform for hunting and feeding, for seeking mates and breeding, for denning, for resting, and for long-distance movement. Ringed seals are polar bear's primary food source, and areas near ice edges, leads, or polynyas where ocean depth is minimal are the most productive hunting grounds (USFWS 2009). Polar bears are unlikely to occur near permitted wells during the open water period, but

may occasionally be found swimming in open water. Polar bears are more likely to be encountered during year-round exploration activities anticipated in shallow, nearshore lease locations in the Beaufort Sea; however, the effects are anticipated to be insignificant because contaminants in the effluent are not expected to bioaccumulate or persist in the environment and would disperse quickly into the receiving waters.

To protect the regional biological communities, the Beaufort general permit contains prohibitions on the discharges of water-based drilling fluids and drill cuttings, including area restrictions, seasonal restrictions, stable ice restrictions, and no discharge during fall bowhead whale hunting activities by the communities of Nuiqsut and Kaktovik. Below is a summary of the permit restrictions:

- Area Restrictions. The permittee is prohibited from discharging at or within the following locations:
  - in areas where the water depth is less than 5 meters, as measured from mean lower low water (MLLW);
  - within 1000 meters of the Stefansson Sound Boulder Patch (near the mouth of the Sagavanirktok River) or between individual Boulder Patches where the distance between those patches is greater than 2000 meters but less than 5000 meters; and
  - within State waters unless a zone of deposit (ZOD) has been authorized for the discharge by DEC.
- Seasonal Restrictions
  - Open-Water, Unstable, or Broken Ice Restrictions. The permittee is prohibited from discharging at or within the following locations:
    - at depths greater than 1 meter below the surface of the receiving water between the 5 and 20 meters isobaths as measured from the MLLW during open-water conditions;
    - within 1000 meters of river mouths or deltas; and
    - shoreward of 20 meter isobath as measured from the MLLW during unstable or broken ice conditions except when the discharge is prediluted to a 9:1 ratio of seawater to drilling fluids and cuttings.
  - During Fall Bowhead Whale Hunting Restrictions. The permittee is prohibited from discharging water-based drilling fluids and drill cuttings (i.e., Discharge 001) during fall bowhead whale hunting in the Beaufort Sea by the Nuiqsut and Kaktovik communities.
    - The permittee must cease Discharge 001 discharges starting on August 25, and may not resume discharging until after whaling activities are completed, as determined by coordination with the respective Whaling Captains Associations. Discharges may be resumed upon receipt of notice of completion of whale hunting.
    - The permittee, in coordination with the respective Whaling Captains Associations, must submit documentation to EPA and the Alaska Department of Environmental Conservation (DEC) identifying the dates and times that (1) Discharge 001 was ceased and restarted, and (2) the bowhead whale hunt by the respective communities began and was completed.
  - The permittee is prohibited from discharging water-based drilling fluids and drill cuttings (Discharge 001), sanitary wastes (Discharge 003) and domestic wastes (Discharge 004) to

stable ice unless authorized in writing by EPA or DEC in accordance with the following requirements.

  - An applicant/permittee who proposes to discharge any or all of the three waste streams to stable ice must submit a detailed written alternatives analysis to EPA and DEC. The alternatives analysis must demonstrate that there are no technically feasible land-based disposal alternatives and means to transport these waste streams to alternative land-based disposal sites (e.g., underground injection control wells, EPA or DEC permitted treatment facilities, etc.).
  - The permittee must submit the alternatives analysis with the Notices of Intents (NOI(s)) to EPA and DEC. EPA or DEC may authorize discharge of these waste streams or any of them to stable ice under terms and conditions contained in a written authorization, which are integral and legally enforceable terms under this general permit.

- Stable Ice Restrictions. Unless authorized by the EPA or DEC, as appropriate, the permittee is prohibited from discharging as follows:
  - below the ice, and must avoid to the maximum extent possible areas of sea ice cracking or major stress fracturing;
  - below the ice within State waters unless a Zone of Depposit (ZOD) has been authorized for the discharge by DEC and the ZOD authorization is incorporated into the discharge authorization letter; and/or
  - onto any stable ice surface unless authorized in writing by EPA or DEC in accordance with the Alternatives Analysis submission and review requirements under the Beaufort general permit.

Finally, the Alaska Department of Natural Resources (ADNR) has identified the following areas and periods as sensitive areas that require special consideration when proposing leasing activities:

- The Boulder Patch in Stefansson Sound, year round;
- The Canning River Delta, January–December;
- The Colville River Delta, January–December;
- The Cross, Pole, Egg, and Thetis Islands, June–December;
- The Flaxman Island waterfowl use and polar bear denning areas, including the Leffingwell Cabin national historic site on Flaxman Island;
- The Jones Island Group (Pingok, Spy, and Leavitt Islands) and Pole Island are known polar bear denning sites, November–April;
- The Sagavanirktok River delta, January-December; and
- Howe Island supports a snow goose nesting colony, May–August.

The intermittent nature and limited extent of the discharges, combined with the effluent limitations, restrictions, and prohibitions established in the Beaufort general permit, will prevent unreasonable degradation of those resources.

Criterion 5. The existence of special aquatic sites including, but not limited to, marine sanctuaries and refuges, parks, national and historic monuments, national seashores, wilderness areas, and coral reefs.

No marine sanctuaries or other special aquatic sites, as defined by 40 CFR 125.122, are in or adjacent to the Beaufort general permit Area of Coverage. The nearest special aquatic site—the Alaska Maritime National Wildlife Refuge, is managed by the U.S. Fish and Wildlife Service (USFWS) as a unit of the National Wildlife Refuge System. Within the Alaska Maritime Refuge system, the Chukchi Sea Unit includes more mainland and barrier island acreage than any of the other units. The Chukchi Sea Unit extends nearly from Barrow to just north of Cape Prince of Wales in the Bering Strait, a distance of more than 360 miles. Both the northern and southern ends of the unit are dominated by several large lagoons and low-lying barrier islands and are relatively shallow with an extensive continental shelf. No other marine sanctuaries or other special aquatic sites are known to be in or adjacent to the Area of Coverage.

Criterion 6. The potential impacts on human health through direct and indirect pathways.

Human health within the North Slope Borough is directly related to the subsistence activities in and along the Beaufort Sea. In addition to providing a food source, subsistence activities serve important cultural and social functions for Alaska Natives. Individuals in the North Slope and Northwest Arctic Boroughs have expressed concerns related to contaminant exposure through consumption of subsistence foods and other environmental pathways. Concerns have also been expressed over animals swimming through discharge plumes that contain drilling fluids, cuttings, domestic or sanitary wastes, and other waste streams that might contain chemicals.

EPA recognizes that even the perception of contamination could produce an adverse effect by causing hunters to avoid harvesting particular species or from particular areas. Reduction of subsistence harvest or consumption of subsistence resources because of a lack of confidence in the foods could produce an effect on human health. The discharges authorized under the Beaufort general permit could cause a bioaccumulation of metals in benthic communities, and the discharges of non-contact cooling water discharge could cause avoidance behavior in marine mammals because of temperature increases. Because both types of discharges could affect subsistence resources or could influence subsistence harvest activities, EPA has included an Environmental Monitoring Program to be conducted before, during, and after drilling activities to monitor and collect operational data at site-specific locations. EPA will also request that the Agency for Toxics Substances and Disease Registry (ATSDR) review the data and reports from the EMP to evaluate the potential risks associated with exploration discharges at site-specific locations on the communities that rely on marine resources for subsistence.

Criterion 7. Existing or potential recreational and commercial fishing, including finfishing and shellfishing.

The Northwest Pacific Fishery Management Council developed a fishery management plan (FMP) for fish resources in the Arctic Management Area in 2009. The plan prohibits commercial fishing in the area until sufficient information is available to enable a sustainable commercial fishery to proceed (74 FR 56734). The FMPs applicable to salmon and Pacific halibut fisheries likewise prohibit the harvest of those species in the Arctic Management Area. Commercial fishing is not authorized within the lease areas within the Area of Coverage. Subsistence fishing occurs in the nearshore areas of the Beaufort Sea. However, the permit contains effluent limitations that are protective of beneficial uses of the Beaufort Sea, which include aquaculture water supply, seafood processing water supply, industrial water supply,

contact and secondary recreation, growth and propagation of fish, shellfish, other aquatic life, and wildlife, and harvesting for consumption of raw mollusks or other raw aquatic life.

Criterion 8. Any applicable requirements of an approved Coastal Zone Management Plan.

As of July 1, 2011, there is no longer an approved Coastal Zone Management Act (CZMA) program in the State of Alaska, per AS 44.66.030, because the Alaska State Legislature did not pass legislation required to extend the program. Consequently, federal agencies are no longer required to provide the State of Alaska with CZMA consistency determinations.

Criterion 9. Such other factors relating to the effects of the discharge as appropriate.

EPA has determined that the discharges authorized by the Beaufort general permit will not have disproportionately high and adverse human health or environmental effects with respect to the discharge of pollutants on minority or low-income populations living on the North Slope, including coastal communities near the proposed exploratory operations. In making this determination, EPA considered the potential effects of the discharges on the communities, including subsistence areas, and the marine environment. EPA's evaluation and determinations are discussed in more detail in the *Beaufort and Chukchi Exploration NPDES General Permits Environmental Justice Analysis*, which is included in the administrative record for the permit actions.

Criterion 10. Marine water quality criteria developed pursuant to CWA section 304(a)(I)

Compliance with federal water quality criteria and Alaska water quality standards is evaluated under this criterion. Parameters of concern for impacts on water quality in discharges from oil and gas exploration activities include oil and grease, fecal coliform bacteria, metals, temperature, chlorine, turbidity, total suspended solids (TSS), and settleable solids.

- Because of the nature of oil and gas exploration activities, discharges of oil and grease are of concern to water quality. However, the permit contains a no discharge provision if the applicable waste streams contain free oil, as determined by visual observation and/or the static sheen test. The discharges of deck drainage (Discharge 002) and ballast water (Discharge 010) contaminated with oil and grease, and all bilge water (Discharge 011) must be treated through an oil-water separator prior to discharge. Therefore, oil and grease are adequately controlled by the permit and water quality standards are expected to be met.
- Fecal coliform bacteria in discharges of sanitary wastewater are of concern for water quality. In addition to limits for fecal coliform, sanitary wastewater is limited for biochemical oxygen demand, and total residual chlorine. Those effluent limitations are expected to be protective of the water quality objectives of the water body.
- Drilling fluids are the largest potential source of metals, however, analysis shows that the projected water column pollutant concentrations would not exceed applicable federal or state water quality criteria or standards. Metals concentrations in the discharges, including drilling fluids and cuttings, are therefore expected to meet water quality criteria. Additionally, an Environmental Monitoring Program is required at each drill site to evaluate the potential for metals effects on the marine environment before, during, and after drilling activities.

- The permit authorizes discharges of non-contact cooling water, which has a higher temperature than the receiving water body. Dilution modeling indicates that complete mixing is achieved within 100 meters, and the temperature of the discharge will not exceed any temperature water quality objectives.
- The Beaufort general permit contains a daily maximum limitation of 1 milligrams per liter of chlorine, but also contains an average monthly limitation of 0.5 mg/L, which will limit the long-term average to concentrations that, at the edge of the 100-m mixing zone (if granted for discharges of sanitary and domestic wastes in state waters), are expected to meet applicable water quality objectives.
- Discharges of drilling fluids and discharges of sanitary effluent are expected to contain settleable solids and total suspended solids (TSS), which contribute to turbidity. The permit contains effluent limitations for TSS that are based on secondary treatment standards for discharges of sanitary effluent that are based on best professional judgment. The permit also contains an effluent toxicity limitation for suspended particulate phase material in discharges of drilling fluids and drill cuttings. The effluent limitations are expected to be protective of water quality.

Because the effluent limitations and requirements contained in the permit comply with federal and state water quality criteria, EPA concludes that the discharges will not cause an unreasonable degradation of the marine environment.

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ABBREVIATIONS AND ACRONYMS

BOD	biochemical oxygen demand
BOEM	Bureau of Ocean Energy Management
BPJ	best professional judgment
BSEE	Bureau of Safety and Environmental Enforcement
CFR	*Code of Federal Regulations*
CWA	Clean Water Act
DEC	Alaska Department of Conservation
DNR	Alaska Department of Natural Resources
EFH	essential fish habitat
ELG	effluent limitation guideline
EPA	U.S. Environmental Protection Agency
FMP	Fisheries Management Plan
FR	*Federal Register*
LC_{50}	lethal concentration to 50% test organisms
MLC	mudline cellar
MLLW	mean lower low water
MSD	marine sanitation device
NOI	notice of intent
NPDES	National Pollutant Discharge Elimination System
OCS	Outer Continental Shelf
ODCE	Ocean Discharge Criteria Evaluation
OOC	Offshore Operators Committee
SPP	suspended particulate phase
TOC	total organic carbon
TSS	total suspended solids
WBF	water-based drilling fluid
WET	whole effluent toxicity

UNITS

µg/g	micrograms per gram
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
µm	micrometers
bbl	barrel
bbl/day	barrels per day
bbl/h	barrels per hour
°C	degrees Celsius
cm	centimeters
cm/s	centimeters per second
colonies/100 mL	colonies per 100 milliliters
°F	degrees Fahrenheit
fm	fathoms
ft	feet
ft/mi	feet per mile
ft/s	feet per second
g	grams
gal	gallons
g/day	grams per day
g/L	grams per liter
g/mL	grams per milliliter
gpd	gallons per day
h	hour
ha	hectares
in	inches
kg	kilograms
kg/L	kilogram per liter
kg/m^3	kilograms per cubic meter
km	kilometers
km^2	square kilometers

kn	knots
L	liters
lb	pounds
lb/bbl	pounds per barrel
lb/gal	pounds per gallon
L/h	liters per hour
m	meters
m^2	square meters
mg/cm^2	milligram per square centimeter
mgd	million gallons per day
mg/kg	milligram per kilogram
mg/L	milligrams per liter
m^3/h	cubic meters per hour
mi	miles
m/km	meters per kilometer
mL	milliliter
mm	millimeter
m/s	meters per second
nmi	nautical miles
ppm	part per million
ppt	part per thousand
v/v	volume component per total volume

1. INTRODUCTION

1.1. Purpose

The U.S. Environmental Protection Agency (EPA) is issuing a National Pollutant Discharge Elimination System (NPDES) general permit for wastewater discharges associated with oil and gas exploration activities in the Outer Continental Shelf (OCS) and contiguous state waters designated as the Beaufort Sea Area of Coverage off northern Alaska (Figure 1-1). Section 403(c) of the Clean Water Act (CWA) requires that NPDES permits for discharges into the territorial seas, the contiguous zone, and the oceans, including the OCS, comply with EPA's Ocean Discharge Criteria. The purpose of this Ocean Discharge Criteria Evaluation (ODCE) is to assess the discharges authorized under the Beaufort Exploration NPDES General Permit (AKG-28-2100) (Beaufort general permit) and evaluate the potential for unreasonable degradation of the marine environment.

EPA's Ocean Discharge Criteria (Title 40 of the *Code of Federal Regulations* [CFR] Part 125, Subpart M) set forth factors the Regional Administrator must consider when determining whether discharges to the OCS will cause unreasonable degradation to the marine environment. Unreasonable degradation is defined as follows (40 CFR 125.121(e)):

- Significant adverse changes in ecosystem diversity, productivity, and stability of the biological community within the area of discharge and surrounding biological communities;
- Threat to human health through direct exposure to pollutants or through consumption of exposed aquatic organisms; or
- Loss of aesthetic, recreational, scientific, or economic values that are unreasonable in relation to the benefit derived from the discharge.

EPA regulations set out 10 criteria to consider when conducting an ODCE (40 CFR 125.122):

- Quantities, composition, and potential for bioaccumulation or persistence of the pollutants to be discharged;
- Potential transport of such pollutants by biological, physical, or chemical processes;
- Composition and vulnerability of the biological communities that could be exposed to such pollutants, including the presence of unique species or communities of species, the presence of species identified as endangered or threatened pursuant to the Endangered Species Act, or the presence of those species critical to the structure or function of the ecosystem, such as those important for the food chain;
- Importance of the receiving water area to the surrounding biological community, including the presence of spawning sites, nursery/forage areas, migratory pathways, or areas necessary for other functions or critical stages in the life cycle of an organism;
- Existence of special aquatic sites including marine sanctuaries and refuges, parks, national and historic monuments, national seashores, wilderness areas, and coral reefs;
- Potential impacts on human health through direct and indirect pathways;
- Existing or potential recreational and commercial fishing, including finfishing and shellfishing;

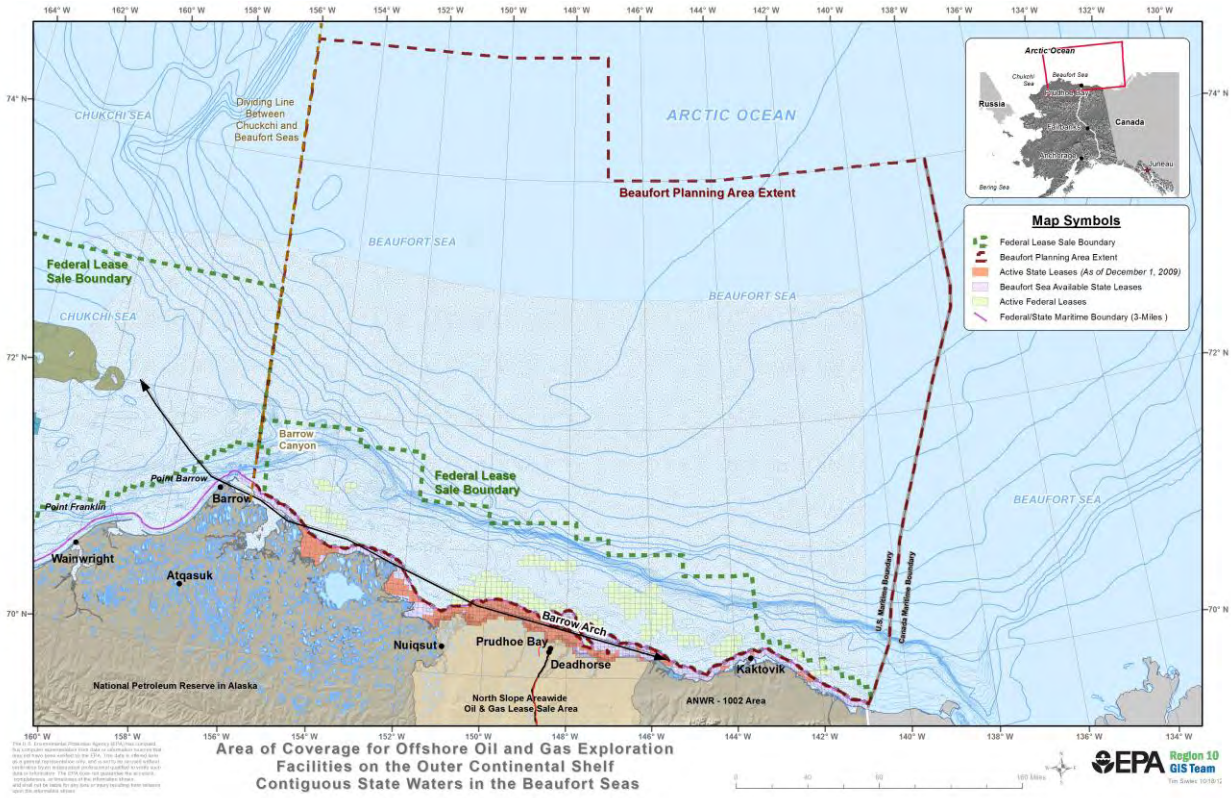


Figure 1-1. Beaufort NPDES General Permit Area of Coverage

- Any applicable requirements of an approved Coastal Zone Management Plan;
- Other factors relating to the effects of the discharge, as appropriate; and
- Marine water quality criteria developed pursuant to CWA section 304(a)(1).

On the basis of the analysis in this ODCE, the Regional Administrator will determine whether the general permit may be issued. The Regional Administrator can make one of three findings:

1. The discharges will not cause unreasonable degradation of the marine environment and issue the permit;
2. The discharges will cause unreasonable degradation of the marine environment, and deny the permit; or
3. There is insufficient information to determine, before permit issuance, that there will be no unreasonable degradation of the marine environment, and issue the permit if, on the basis of available information,
   - Such discharge will not cause irreparable harm[1] to the marine environment during the period in which monitoring will take place;
   - There are no reasonable alternatives to the on-site disposal of the materials; and

[1] *Irreparable harm* is defined as, ―significant undesirable effects occurring after the date of permit issuance which will not be reversed after cessation or modification of the discharge" [40 CFR 125.121(a)].

- The discharge will be in compliance with additional permit conditions set out under [40 CFR 125.123(d)].

1.2. Scope of Analysis

Offshore oil and gas activities fall into three operational categories: exploration, development, and production operations. Exploratory drilling operations, which identify the location of producing formations, are generally conducted in the Beaufort Sea from drilling units such as floating vessels (e.g., jack-up rigs, drill ships), bottom-founded structures such as the steel drilling caisson (SDC), or gravel and natural islands. After a commercially viable reserve has been identified, development operations are conducted on platforms from which multiple wells are drilled. Production operations happen during and after developmental drilling.

This document evaluates the sources, fate, and potential effects of wastewater discharges associated with the Beaufort general permit for offshore oil and gas exploratory activities in the Beaufort Sea. Development and production activities, and their associated discharges, are not discussed in this document because such activities and discharges are not authorized by the Beaufort general permit.

This document relies extensively on information provided in the Draft or Final Environmental Impact Statements (DEIS or FEIS) for BOEM Multiple Lease Sales 209, 212, 217 and 221 (MMS 2007, 2008; BOEMRE 2010); the Environmental Assessment for Sale 202 (MMS 2006); the Effects of Oil and Gas Activities in the Arctic Ocean DEIS (NMFS 2011), and the ODCE for the Arctic General Permit (USEPA 2006). Where appropriate, this document refers to those publications for more detailed information about certain topics. The information presented here is a synthesis of those documents, along with the inclusion of discharge modeling results and relevant new findings published in the scientific literature.

1.2.1. Beaufort Sea Area of Coverage

The Beaufort general permit authorizes wastewater discharges from exploratory operations in areas offered for lease within the OCS, and within Alaska waters contiguous to the landward boundary of the OCS areas of the Beaufort Sea, including past leases and lease sale areas that might be offered in the immediate future (i.e., within the next 5 years). Lease sales in the next 5 years are expected to occur within the Area of Coverage. The Beaufort Sea Area of Coverage includes approximately 101,750 square miles (mi) (65.12 million acres), and extends offshore north of Barrow and east to the Canadian border. Leases begin just offshore and encompass 4,250 square mi (2.72 million acres) in water depths ranging from approximately 20 to 170 feet (ft).

1.2.2. Duration of Activity, Type, and Number of Potential Wells

Ice is present much of the year in the Beaufort Sea. Whereas EPA anticipates that most exploration activities would occur from drill ships or moveable platforms during the summer months when pack ice is not present, it is reasonable to assume that some drilling could occur during other periods of the year in the nearshore Beaufort Sea.

The types of wells that could be drilled include exploration wells and delineation wells. An exploration well is a well that is drilled into a previously undrilled geologic formation to test for the presence of hydrocarbon accumulation. If an exploration well indicates positive results in terms of a resource, a delineation well could be drilled at a distance from that well to determine the spatial and vertical extent of

the reserves. The delineation well could also be used to estimate the production rate of a new oil or gas field. Because there are no differences between the characteristics of discharges from exploration and delineation wells, the permit treats both types of discharges the same. Note that both types of wells would be plugged[2] at the end of the exploratory drilling program or capped for continued drilling the following season.

An exploratory well is expected to be completed within 40 days; however, the drilling operations per well can range between 30 and 90 days (MMS 2008; NMFS 2011). Shell estimates that a well can be drilled within 32-35 days (Shell 2009a and b). Between 1982 and 2003, 30 exploration wells were drilled in the Beaufort Sea. For purposes of this evaluation, EPA estimates that 18–34 wells will be drilled during the 5-year permit term. That estimate used the NMFS 2011 DEIS Activity Level 2 assumption of two drilling programs (i.e., two operators with simultaneous drilling programs) per season at 2–4 wells/program per year in 2014–2017. Activity Level 2 for the Beaufort Sea assumes there would be one exploratory program in federal waters and one in state waters. This estimate also assumes that Shell is the only operator in this Beaufort Sea theatre during 2013.

1.2.3. Authorized Discharges

The Beaufort general permit covers facilities that discharge wastewater associated with oil and gas exploration activities in the OCS and contiguous state waters of the Beaufort Sea. Authorized discharges include the following:

- Discharge 001 – water-based drilling fluids and drill cuttings
- Discharge 002 – deck drainage
- Discharge 003 – sanitary wastes
- Discharge 004 – domestic wastes
- Discharge 005 – desalination unit wastes
- Discharge 006 – blowout preventer fluid
- Discharge 007 – boiler blowdown
- Discharge 008 – fire control system test water
- Discharge 009 – non-contact cooling water
- Discharge 010 – uncontaminated ballast water
- Discharge 011 – bilge water
- Discharge 012 – excess cement slurry
- Discharge 013 – muds, cuttings, and cement at the seafloor

Authorized oil and gas discharges are subject to the effluent limitation guidelines (ELGs) for the Offshore Category of the Oil and Gas Extraction Point Source Category, found at 40 CFR Part 435, Subpart A. The Offshore Subcategory applies to those facilities that are in waters that are seaward of the inner boundary

[2] *Plugging* refers to abandonment or closure of the wells, which includes the requirement to backfill a portion of the well with cement to ensure that hydrocarbons are not released from the well once it has been closed.

of the territorial seas, as defined in CWA section 502(8). The area of coverage does not include areas of state waters, defined as waters landward of the inner boundary of the territorial seas, covered by the Coastal Subcategory, Subpart D of the Oil and Gas Extraction Point Source Category, 40 CFR Part 435, Subpart D. ELGs are technology-based national standards for controlling conventional and toxic pollutants, based on the performance of treatment and control technologies.

The permit requires the permittees to implement an Environmental Monitoring Program that assess the site-specific impacts of discharges of drilling fluids and drill cuttings on water, sediment, and biological quality. The monitoring program includes assessments of pre-, during, and post-drilling conditions and evaluations of the potential for bioaccumulative and persistent impact of the water-based drilling fluids/cuttings discharge on aquatic life. Permittees are required to assess the areal extent of cuttings deposition and conduct ambient measurements including temperature and turbidity monitoring. Finally, the permittee is required to maintain a chemical additive inventory and must report rates of use, locations in the drilling process where they are used, and discharge concentrations.

Permittees are required to develop a Quality Assurance Project Plan to ensure that monitoring data are accurate, and to develop and implement a Best Management Practices Plan to prevent or minimize the potential for generating or releasing pollutants from the facility. Additionally, permittees are required to develop and implement a Drilling Fluids Plan that specifies the drilling fluid and additives used and a procedural plan for formulating and controlling the drilling fluid system.

1.3. Overview of Document

This ODCE provides an evaluation of the types of exploration discharges, estimated discharge volumes, and potential effects from operations authorized under the Beaufort general permit on receiving water quality, biological communities, and human receptors. Section 2 provides a general description of the proposed exploration activities. Section 3 discusses the types and estimated quantities of discharges and describes a modeling exercise to support the analysis. Section 4 summarizes the physical environment in the Beaufort Sea. Section 5 summarizes the aquatic communities and important species, including threatened and endangered species, in the Beaufort Sea and describes the potential biological and ecological effects from oil and gas exploration on those species. Section 6 addresses the 10 criteria and evaluates whether the Beaufort general permit will cause an unreasonable degradation of the marine environment.

2. DESCRIPTION OF EXPLORATORY ACTIVITIES

Exploratory drilling activities in the OCS must be conducted in accordance with BOEM and BSEE regulations. Additionally, no drilling can occur until BOEM and BSEE have provided their approval of the operator's exploration plan and application for permit to drill, respectively (NMFS 2011). This section describes, in general terms, the exploratory operations and rig types that may be used during drilling activities in the Beaufort Sea.

Offshore drilling activities are divided into two phases: Exploratory drilling and development. During the exploration phase of drilling operations, the goal is to identify areas in a formation that have the potential for hydrocarbon reserves. Exploration activities in the Beaufort Sea can be conducted from floating vessels, bottom-founded structures, or artificial or natural islands. Exploratory wells are generally drilled vertically to simplify well design and maximize benefits from subsurface area collection (NMFS 2011).

Exploratory drilling in the OCS requires first drilling a mudline cellar (MLC). The purpose of the MLC is to protect the well head and blowout preventer from ice gouging during ice-over periods. An MLC is not constructed when a well is drilled from an artificial island. The MLC is drilled using a large-diameter drill bit, to create a cellar size of approximately 20 feet wide and 40 feet deep. Cuttings and displaced sediments generated while drilling the MLC are jetted out of the well, either at the seafloor or closer to the surface, depending on the drilling configuration, and fall back to the surface of the seafloor in the vicinity of the well. The drilling process for the MLC generally does not use drilling fluid (i.e., seawater is commonly used as a "lubricant") and could produce approximately 3,000 barrels (bbl) of cuttings and displace approximately 566 cubic yards of material from the ocean floor. Drill cuttings are chips of the naturally occurring rock that are removed from the drill hole during the drilling process (Shell 2009a).

After the MLC is drilled, the process of preparing the first few hundred feet of a well is called *spudding*. The spudding process typically requires a large-diameter pipe, called the conductor casing, that is hammered, jetted, or placed on the seafloor, depending on the composition of the substrate (USEPA 1993). As the drill hole deepens, drilling is stopped periodically to add sections of cylindrical steel casing through which the drill string operates. The casing keeps the walls from collapsing and binding the drill string. To keep each string of casing in place, cement is pumped down through the new string of casing, forced out of the open hole and back up the annular space outside the casing, between it and the open hole, filling the voids. Once the cement is set outside the casing, the drilling process can continue. The addition of casing can be continued until final well depth is reached.

During exploration drilling, drilling fluid (or drilling *mud*) is pumped down through the drill pipe and ejected from the drill bit into the well. The drilling fluids lift cuttings off the bottom of the well away from the drill bit, and circulate the cuttings back to the surface through the annular space between the outside of the pipe and the borehole. The cuttings and fluid are sent through a series of shaker tables and separators to remove the fluid from the cuttings. The cuttings are then disposed through an outfall or disposal caisson, depending on the type of exploratory drilling rig or unit.

The drilling fluid is returned to the mud pit for recycling. The solids-control equipment is unable to separate fine clay and colloidal particles that accumulate in the drilling fluid system during drilling; therefore, as drilling proceeds, these components accumulate and eventually the fluid becomes too viscous for further use. When this happens, a portion of the drilling fluid is discharged, and water and mud additives, such as barite (barium sulfate), are added to the remaining drilling fluid to bring

concentrations back to proper levels, to counteract reservoir pressures and prevent water from seeping into the well from the surrounding rock formation (Neff 2008; USEPA 2000). The discharge of drilling fluids and cuttings is an intermittent process, generally occurring only during active well drilling. The discharge of drilling fluids and drill cuttings ceases during the process of adding more pipe to the drill string or conducting cementing operations, or during well logging activities. The discharge of drilling fluids and cuttings occurs approximately 25-75% percent of the time the rig is on station.

To prevent well blowouts, blowout preventers (i.e., hydraulically operated high-pressure safety valves), are attached at the top of the well in the MLC. At the end of the entire exploratory operation, cement is used to plug the well after the formation has been fully characterized and the well is tested.

Only water-based drilling fluids and drill cuttings are authorized for discharge under the Beaufort general permit, subject to effluent limitations and requirements. Additionally, drilling fluids and drill cuttings may not be discharged onto stable ice unless an alternative disposal analysis is submitted to EPA and the Alaska Department of Environmental Conservation (DEC) for review with the Notice of Intent (NOI), and prior written authorization is provided.

The three general types of exploration drilling units are described below (NMFS 2011). All the drilling operations would result in similar, if not identical, types of discharges.

2.1. Floating Drilling Vessels

Floating drilling vessels that can be employed in the Arctic include drill ships (e.g., *Noble Discoverer*) or other floating vessels (e.g., *Kulluk*). These types of drilling vessels can typically be used in water depths greater than 18 meters (60 feet) in the Beaufort and Chukchi Seas. They are held over a well drilling location either by a mooring system or by the use of dynamic positioning.

2.1.1. Drillship

A drillship is a marine vessel that can be equipped with a drilling apparatus. Drillships are completely independent, and some of their greatest advantages are their ability to drill in water depths of more than 2,500 meters (8,202 feet). Shell Exploration and Production Company (Shell) plans to use the *Noble Discoverer* in both the Beaufort and Chukchi Seas. The *Discoverer* was built in in 1976 and has been retrofitted for operating in Arctic waters. It is a 156 meter (512 feet) conventionally-moored drillship with equipment on a turret.

2.1.2. Jackup Rig

A jackup rig is an offshore structure composed of a hull, support legs, and a lifting system that allows it to be towed to a site, lower its legs into the seabed and elevate its hull to provide a stable work deck. Because jackup rigs are supported by the seabed, they are preloaded when they first arrive at a site to simulate the maximum expected support leg load to ensure that, after they are jacked to full height above the water and experience operating loads, the supporting soil will provide a reliable foundation. A typical jackup rig is approximately 50 meters (164 feet) in length, 44 meters (144 feet) beam, and 7 meters (23 feet) deep.

2.2. Bottom-Founded Structures

2.2.1. Steel Drilling Caisson

A steel drilling caisson (SDC) is a bottom-founded structure and is a ―fit for purpose" drilling unit constructed typically by modifying the forward section of an ocean-going large crude carrier. The main body of the structure is approximately 162 meters (531 feet) long, 53 meters (174 feet) wide, and 25 meters (82 feet) high. The SDC is designed to conduct exploratory year-round drilling under Arctic environmental conditions. The SDC is the only existing man-made bottom-founded structure that could be used in the Beaufort Sea in relatively shallow water depths ranging from 8 to 24 meters (26 to 79 feet).

2.2.2. Artificial and Natural Islands

Artificial islands are constructed in shallow offshore waters for use as drilling platforms. In the Arctic, artificial islands have been constructed from a combination of gravel, boulders, artificial structures, and/or ice. Artificial islands can be constructed at various times of the year. During summer, gravel is removed from the seafloor or onshore sites and barged to the proposed site and deposited to form the island. In the winter, gravel is transported over ice roads from an onshore site to the island site. After the artificial island is constructed to its full size, slope protection systems are installed. Construction of artificial islands will be subject to the appropriate federal and state permitting and environmental review requirements. Due to economic and engineering considerations, gravel or ice island construction has historically been restricted to waters less than 15 meters (49 feet) deep. Artificial islands would be sized to accommodate the necessary drilling equipment from exploratory drilling activities and may be converted and used as for long-term development and production drilling pads. Exploratory drilling operations can also be conducted on natural islands in the nearshore Beaufort Sea. The concept of which is similar to artificial islands.

3. DISCHARGED MATERIALS, ESTIMATED QUANTITIES, AND MODELED BEHAVIOR

This section discusses the composition and quantity of potential discharges authorized by the Beaufort general permit to the Area of Coverage (see Section 1.0). The information presented here is also reflected in EPA's *Final Development Document for Effluent Limitation Guidelines and New Source Performance Standards for the Offshore Subcategory of the Oil and Gas Extraction Point Source Category* (USEPA 1993), and the notices of intent (NOIs) submitted by applicants who have requested coverage under the expired Arctic NPDES general permit (AKG-28-0000). This section also presents the results of modeling that estimates dilution and settling of solids under a variety of receiving water conditions.

3.1. Authorized Discharges

Offshore oil and gas exploration activities are generally characterized as short-term at any particular location and typically involve only a small number of wells. These activities, however, do generate numerous waste streams that are discharged into the ocean. These waste streams are related to the drilling process, equipment maintenance and personnel housing.

The Beaufort general permit authorizes discharges of thirteen waste streams listed above in Section 1.2.3, which is discussed further below. Table 3-4 at the end of this section lists anticipated discharge quantities that are based on NOIs received from Shell for exploratory drilling discharges into the Beaufort Sea Area of Coverage.

3.2. Water-Based Drilling Fluids and Drill Cuttings (Discharge 001)

The Beaufort general permit authorizes two types of drill cuttings, cuttings associated with constructing the MLC and the top hole, and cuttings generated from drilling the well to the desired depth. The cuttings generated from well drilling activities are broken loose by the drill bit and carried to the surface by drilling fluids that circulate through the borehole. The cuttings are composed of the naturally occurring solids found in subsurface geologic formations and, to a much lesser extent, bits of cement used during the drilling process. Cuttings are separated from the drilling fluids by a shale shaker and other solids control equipment. Drilling fluids are recovered, reconditioned, and circulated back down the borehole to be reused during drilling to the extent practicable. The cuttings are discharged to the sea and can contain small amounts of drilling fluids that remained adhered to the surface of the cuttings after the solids separation process.

The other category of drilling cuttings is produced while preparing the MLC and the top hole, which generally do not involve the use of drilling fluids. These are discussed below (Discharge 013).

The two types of cuttings are permitted differently. Drill cuttings associated drilling fluids are categorized under Discharge 001, which includes the following requirements under the permit:

1. Suspended particulate phase acute toxicity testing;
2. No discharge upon failure of the static sheen test;
3. No discharge of drilling fluids or drill cuttings generated using drilling fluids that contain diesel oil;
4. Mercury and cadmium are limited in stock barite at concentrations of 1 mg/kg and 3 mg/kg, respectively; and

5. Monitor for total aromatic hydrocarbons (TAH) and total aqueous hydrocarbons (TAqH).

The term *drilling fluids* is also referred to as *drilling muds*. For purposes of describing Discharge 001 in the Beaufort general permit and this ODCE, EPA uses the terms ~~"d~~rilling fluids and drill cuttings." The Beaufort general permit define drilling fluids as the circulating fluid (mud) used in the rotary drilling of wells to clean and condition the hole and to counterbalance formation pressure. This discharge is separate and should be distinguished from muds, cuttings, and cement at the seafloor (Discharge 013), which EPA defines as the materials discharged to the surface of the ocean floor during construction of the mudline cellar, during the early phases of drilling operations before the riser is installed, and during well abandonment and plugging. This document uses the term drilling fluids throughout to discuss Discharge 001; however, the term drilling muds might be used in support documents and documents cited as references.

Drilling fluids are specifically formulated for each well to meet unique physical and chemical requirements and to perform specific functions. The well's location, depth, rock type, and other conditions are all considered to develop a drilling fluid with the appropriate viscosity, density, sand content, and gel strength. During exploratory drilling, fluids are pumped down the borehole and circulated back to the surface, and are designed to perform one or more of the following primary functions:

- Remove cuttings and transport them to the surface;
- Cool and clean the drill bit;
- Lubricate the drill string;
- Maintain the stability of uncased sections of the borehole; and/or
- Counterbalance formation pressure to prevent formation fluids (i.e., oil, gas, and water) from entering the well prematurely (Berger and Anderson 1992; Sounders 1998).

Because of the costs of transporting and formulating drilling fluids, they are recovered, reconditioned and reused to the extent feasible during the drilling process. Drilling fluids from one exploration well are typically used on subsequent exploration wells during the same season if possible to conserve the fluid and limit discharges. The operator might need to discharge drilling fluids under a variety of circumstances, including fouling of the drilling fluid over time, significant changes in the required type of fluid, changes in drilling phases, and well completion/closure. An important factor governing the need to discharge fluids is the constraint of solids storage on the vessel. The slurry tanks are sized such that the vessel integrity is maintained, but storage capacity may not be sufficient to store and reuse all drilling fluids throughout the well-drilling process.

The Beaufort general permit authorizes the discharge of only water-based drilling fluids and drill cuttings. Operators can choose to use oil-based or synthetic-based fluids during exploration activities, but those drilling fluids may not be discharged under the Beaufort general permit. In addition, the discharge prohibition extends to all cuttings generated with those fluids. Because the discharge of oil- and synthetic-based fluids and associated cuttings is prohibited, those fluids are not discussed further in this document. Any operator wishing to discharge synthetic-based fluids and cuttings may request authorization under individual permits, and the proposed discharges' potential impacts to the marine environment would be evaluated at that time.

The Beaufort general permit incorporates the suspended particulate phase toxicity limit of 96-hour LC_{50} of 30,000 parts per million (ppm) for drilling fluids and drill cuttings. The permit also establishes mercury and cadmium concentration limits for stock barite and no discharge if free oil or diesel oil is detected

using a static sheen test. These effluent limits are consistent with the national Effluent Limitation Guidelines (ELGs) for technology-based controls on toxicity, metals, and other toxic and nonconventional pollutants (USEPA 1993).

3.2.1. Composition

Water-based drilling fluids is a suspension of particulate minerals, dissolved salts, and organic compounds in freshwater, seawater, or concentrated brine. These fluids are composed of approximately 50 to 90 percent water by volume, with additives composing the rest. Water-based drilling fluids are used most frequently because they are the least expensive, although they are not always the most effective in a given situation. Water-based drilling fluids have limited lubricity and cause reactivity with some shale formations. In deep holes or high-angle directional drilling, water-based drilling fluids are not able to provide sufficient lubricity to avoid sticking of the drill pipe. Reactivity with clay shale can cause destabilization of the borehole.

The eight generic types of water-based drilling are (USEPA 1993):

1. Potassium/polymer fluids are inhibitive fluids because they do not change the formation after it is cut by the drill bit. This fluid is used in soft formations such as shale where sloughing can occur.
2. Seawater/lignosulfonate fluids are inhibitive fluids that maintain viscosity by binding lignosulfonate cations onto the broken edges of clay particles. This fluid is used to control fluid loss and to maintain the borehole stability. This type of fluid can be easily altered to address complicated drilling conditions, like high temperature in the geologic formation.
3. Lime (or calcium) fluids are inhibitive fluids that change viscosity as calcium binds clay platelets together to release water. This fluid can maintain more solids and is used in hydratable, sloughing shale formations.
4. Nondispersed fluids are used to maintain viscosity, to prevent fluid loss, and to provide improved penetration, which can be impeded by clay particles in dispersed fluids.
5. Spud fluids are non-inhibitive fluids that are used in approximately the first 300 meters of drilling. This is the most basic fluid mixture which contains mostly seawater and few additives.
6. Seawater/freshwater gel fluids are inhibitive fluids used in early drilling to provide fluid control, shear thinning, and lifting properties for removing cuttings from the hole. Prehydrated bentonite is used in both seawater and freshwater fluids and attapulgite (a type of clay with special properties) is used in seawater when fluid loss is not a concern.
7. Lightly treated lignosulfonate freshwater/seawater fluids resemble seawater/ lignosulfonate liquids, except their salt content is less. The viscosity and gel strength of this fluid are controlled by lignosulfonate or caustic soda.
8. Lignosulfonate freshwater fluids are similar to the fluids at numbers 2 and 7 above, except the lignosulfonate content is higher. This fluid is used for higher temperature drilling.

The composition of drilling fluids can be adjusted over a wide range from one borehole to the next, and during the course of drilling one hole when encountering different formations. In addition to the variability among water-based drilling fluids depending on the character of the borehole, additives can be adjusted depending on needs in the drilling process. Table 3-1 shows several common water-based

drilling fluid formulations that have been used in offshore drilling operations. Table 3-2 represents an example drilling fluid system from Shell's exploration activities in the Beaufort and Chukchi Seas.

The list below presents some of the more common additives and is followed by a more detailed discussion of some of the additives.

- Weighting materials, primarily barite (barium sulfate), are commonly used to increase the density of the mud to equilibrate the pressure between the borehole and formation when drilling through pressurized zones.
- Corrosion inhibitors such as iron oxide, aluminum bisulfate, zinc carbonate, and zinc chromate protect pipes and other metallic components from acidic compounds encountered in the formation.
- Dispersants, including iron lignosulfonates, break up solid clusters into small particles so they can be carried by the fluid.
- Flocculants, primarily acrylic polymers, cause suspended particles to group together so they can be removed from the fluid at the surface.
- Surfactants, like fatty acids and soaps, are used to defoam and emulsify the mud.
- Biocides, typically organic amines, chlorophenols, or formaldehydes, kill bacteria that can produce toxic hydrogen sulfide gas.
- Fluid loss reducers include starch and organic polymers. These limit the loss of drilling fluid to under-pressurized or high-permeability formations (USEPA 1987).

Table 3-1. Generic fluid formulations

Seawater/potassium/polymer fluid		Seawater/freshwater gel fluid	
Components	**lb/bbl**	**Components**	**lb/bbl**
KCl	5–50	Attapulgite or Bentonite Clay	10–50
Starch	2–12	Caustic	0.5–3
Cellulose Polymer	0.25–5	Cellulose Polymer	0–2
XC Polymer	0.25–2	Drilled Solids	20–100
Drilled Solids	20–100	Barite	0–50
Caustic	0.5–3	Soda Ash/Sodium Bicarbonate	0–2
Barite	0–450	Lime	0–2
Seawater	As Needed	Seawater/Freshwater	As Needed
Seawater lignosulfonate fluid		**Lime fluid**	
Components	**lb/bbl**	**Components**	**lb/bbl**
Attapulgite or Bentonite	10–50	Lime	2–20
Lignosulfonate	2–15	Bentonite	10–50
Lignite	1–10	Lignosulfonate	2–15
Caustic	1–5	Lignite	0–10
Barite	25–450	Barite	25–180
Drilled Solids	20–100	Caustic	1–5
Soda Ash/Sodium Bicarbonate	0–2	Drilled Solids	20–100
Cellulose Polymer	0.25–5	Soda Ash/Sodium Bicarbonate	0–2
Seawater	As Needed	Freshwater	As Needed

Source: USEPA 1985

lb/bbl = pounds per barrel

Table 3-2. Example Drilling Fluid System

Example Mud Systems Generic Description	Product Name(s)
Base Muds	
Biopolymer[a]	DUOVIS
sodium chloride in brine[a]	Salt/NaCl
Soda ash[b]	stock product
Acrylic Polymer[b]	IDCAP D
Shale/Clay Inhibitor[b]	EMI-2009
Polyanionic Cellulose[b]	POLYPAC SUPREME UL
Sodium Hydroxide[b]	Caustic Soda
Barite[b]	M-I WATE
Additives	
Crushed nut hulls[a]	NUT PLUG
Copolymeric shale stabilizer[b]	POROSEAL
Deflocculant[b]	CF Desco®II
Sodium Bicarbonate[b]	stock product
Citric Acid[b]	stock product
Biocide[b]	Busan 1060
Liquid defoamer[b]	DEFOAM-X
Crushed nut hulls[b]	NUT PLUG MED
Crushed nut hulls[b]	NUT PLUG FINE
Vegetable, polymer fiber blend[b]	MI SEAL
Cellulose fiber[b]	MIX II Fine
Cellulose fiber[b]	MIX II MED
Graphite[b]	G-SEAL
Calcium carbonate[b]	SAFECARB-20
Calcium carbonate[b]	SAFECARB-40
Calcium carbonate[b]	SAFECARB-250
Sodium Chloride[b]	stock product
Contingencies	
Barite[a]	M-I WATE
Dye[a]	Sodium Fluoresceine Green Dye
caustic soda[a]	stock product
citric acid[a]	stock product
Mixture[b]	FORM-A-BLOK
Cellulose[b]	FORM-A-SET AK
Mixture[b]	Pipelax ENV WH

Notes:

[a] Products proposed in Seawater/Salt Water Polymer Sweeps

[b] Products proposed in KLA Shield

Toxicity: Base mud products range in LC50 values from 178,000 to >500,000 ppm. Additive mud products range in LC50 values from 391,155 to >1,000,000 ppm and Contingency products range in LC50 values from 117,275 to >500,000 ppm, all well above the permitted toxicity limit (i.e., <than 30,000 ppm is prohibited) (The toxicity results were tested at anticipate maximum concentrations of the proposed products by one company and will vary depending on the concentration of the product.)

3.2.1.1. Barite

Barite is a chemically inert mineral that is heavy and soft, and is the principal weighting agent in water-based drilling fluids. Barite is composed of over 90 percent barium sulfate, which is virtually insoluble in seawater and is used to increase the density of the drilling fluid to control formation pressure (Perricone 1980). Quartz, chert, silicates, other minerals, and trace levels of metals can also be present in barite.

The presence of potentially toxic trace elements in drilling fluids and adherence to cuttings is a concern. Barite is a concern because it is known to contain trace contaminants of several toxic heavy metals such as mercury, cadmium, arsenic, chromium, copper, lead, nickel, and zinc (USEPA 2000). To control the concentration of heavy metals in drilling fluids, EPA promulgated regulations applicable to the offshore subcategory of the oil and gas industry in 1993 (40 CFR Part 435, Subpart A) requiring that stock barite meet the criteria limits of 3 milligrams per kilogram (mg/kg) for cadmium and 1 mg/kg for mercury. Table 3-3 presents the metals concentrations in barite that were the basis for the cadmium and mercury limitations in the offshore subcategory.

Table 3-3. Metals concentrations in barite used in drilling fluids

Metal	"Clean" barite concentrations (mg/kg)
Aluminum	9,069.9
Antimony	5.7
Arsenic	7.1
Barium	359,747.0
Beryllium	0.7
Cadmium	1.1
Chromium	240.0
Copper	18.7
Iron	15,344.3
Lead	35.1
Mercury	0.1
Nickel	13.5
Selenium	1.1
Silver	0.7
Thallium	1.2
Tin	14.6
Titanium	87.5
Zinc	200.5

Source: USEPA 1993, 821-R-93-003 (Offshore ELG Development Document); Table XI-6

3.2.1.2. Clay

Clay compounds are added to drilling fluids to control certain physical properties, such as fluid loss, viscosity and yield point, and eliminate borehole problems. The most commonly used commercial clay is sodium montmorillonite. Bentonite is another common additive used to increase the fluid's viscosity and gel strength, which increases the carrying capacity for solids removal from the borehole. Bentonite, an absorbent colloidal clay, also greatly improves the filtration and filter cake properties of the fluid (Lyons 2009). The concentration of bentonite in mud systems is usually 5 to 25 lb/bbl. In the presence of

concentrated brine, or formation waters, attapulgite or sepiolite clays (10 to 30 lb/bbl) are substituted for bentonite (Perricone 1980).

3.2.1.3. Lignosulfonate

Lignosulfonate is used to control viscosity in drilling muds by acting as a thinning agent or deflocculant for clay particles. Concentrations in drilling fluid range from 1 to 15 lb/bbl. It is made from the sulfite pulping of wood chips used to produce paper and cellulose. Ferrochrome lignosulfonate, the most commonly used form of lignosulfonate, is made by treating lignosulfonate with sulfuric acid and sodium dichromate. The sodium dichromate oxidizes the lignosulfonate and cross linking occurs. Hexavalent chromium supplied by the chromate is reduced in the reaction to the trivalent state and complexes with the lignosulfonate. At high downhole temperatures, the chrome binds onto the edges of clay particles and reduces the formation of colloids. Ferrochrome lignosulfonate retains its properties in high soluble salt concentrations and over a wide range of alkaline pH (USEPA 1993).

3.2.1.4. Caustic Soda

Sodium hydroxide is used to maintain the filtrate pH between 9 and 12. A pH of 9.5 provides for maximum deflocculation and keeps the lignite in solution. A more basic pH lowers the corrosion rate and provides protection against hydrogen sulfide contamination by limiting microbial growth (Lyons 2009).

3.2.1.5. Spotting Compounds

Spotting compounds are used to help free stuck drill strings. A concentrated *pill* of the spotting agent is pumped downhole and up the annular space between the borehole and drill pipe. After working to free the stuck pipe the pill is then pumped back to the surface. Some of those (e.g., vegetable oil or fatty acid glycerol) are easily broken down in the environment. The most effective and, consequently, most frequently used compounds are oil-based (diesel or mineral oil). Mineral oils can contribute potentially toxic organic pollutants to drilling fluids to which they are added. Data show that the concentration of organic pollutants in the drilling fluids is roughly proportional to the amount of mineral oil added. The Beaufort general permit does not authorize the discharge of fluids and cuttings contaminated by diesel- or mineral oil-based spots or pills.

3.2.1.6. Lubricants

Lubricants are added to the drilling fluid when high torque conditions are encountered on the drill string. These can be vegetable, paraffinic, or asphaltic-based compounds such as Soltex. The Beaufort general permit does not authorize the discharge of mineral oil-based lubricants can contribute to organic pollutant loading and, like spotting fluids.

3.2.1.7. Zinc Carbonate

Zinc carbonate is used as a sulfide scavenger when formations containing hydrogen sulfide are expected to be encountered during drilling. The zinc sulfide and unreactive zinc compounds are discharged with the drilling fluid, thus contributing to the overall loading of zinc when they are used. While the potential need exists, most drilling activities do not encounter conditions that warrant using sulfide scavengers (Lyons and Plisga 2005).

3.3. Other Discharges

In addition to water-based drilling fluids and drill cuttings, the Beaufort general permit authorizes 12 other exploration waste streams. Note that the discussion for sanitary and domestic wastewater is combined in the discussion below. The Beaufort general permit includes specific effluent limitations, a requirement to report and monitor the quantities of chemicals added to any of the discharge wastestreams, including limitations on chemical additive concentrations. The permit also establishes a pH limit or requires monitoring for pH in all the waste streams, requires reporting of the total discharge volumes, and prohibits any discharge if oil sheen is detected. Finally, whole effluent toxicity testing (WET) of applicable waste streams is required under certain conditions. Specific requirements pertinent to each waste stream are discussed below.

3.3.1. Deck Drainage (Discharge 002)

Deck drainage refers to any wastewater generated from platform washing, deck washing, spillage, rainwater, and runoff from curbs, gutters, and drains, including drip pans and wash areas. Such drainage could include pollutants such as detergents used in platform and equipment washing, oil, grease, and drilling fluids spilled during normal operations.

When water from rainfall or from equipment cleaning comes in contact with oil-coated surfaces, the water becomes contaminated and must be treated prior to discharge. Oil and grease are the primary pollutants identified in the deck drainage waste stream (USEPA 1993). In addition to oil, various other chemicals used in drilling operations might be present in deck drainage. Such chemicals can include drilling fluids, ethylene glycol, lubricants, fuels, biocides, surfactants, detergents, corrosion inhibitors, cleaners, solvents, paint cleaners, bleach, dispersants, coagulants, and any other chemical used in the daily operations of the facility (Dalton, Dalton, and Newport 1985).

Untreated deck drainage can contain oil and grease in quantities ranging from 12 to 1,310 milligrams per liter (mg/L). The permit requires the operator to separate area drains that might be contaminated with oil and grease with those that might not be contaminated. Ranges for other pollutant quantities in untreated deck drainage are provided in Table 3-4.

EPA determined that the best practicable control technology currently available for treating deck drainage is a sump and skim pile system (USEPA 1993). Oil and water are gravity-separated in the sump, and the oil is sent off-site. After treatment in an oil water separator, clean water is discharged, and oily water is stored onboard until it can be transferred to an approved disposal site.

The Beaufort general permit requires separate area drains for washdown and rainfall that may be contaminated with oil and grease from those area drains that would not be contaminated so the waste streams are not comingled. The permit also requires that deck drainage contaminated with oil and grease be processed through an oil-water separator prior to discharge. The permit prohibits the discharge of deck drainage if free oil is detected using the static sheen test. The permit also requires monitoring for pH, total aqueous hydrocarbons (TAqH), and total hydrocarbons (TAH). Furthermore, the permit requires toxicity testing of the deck drainage waste stream using an initial toxicity screening tool. If initial toxicity screening indicates the potential for toxicity, or once per well, if the discharge exceeds a flow rate or volume greater than 10,000 gallons during any 24-hour period and if chemicals are added to the system, additional WET monitoring is required.

Table 3-4. Pollutant concentrations in untreated deck drainage

Pollutant	Range
Conventional (mg/L)	
pH	6.6–6.8
Biochemical Oxygen Demand	< 18–550
TSS	37.2–220.4
Oil and Grease	12–1,310
Nonconventionals (µg/L)	
Temperature (°C)	20–32
TOC (mg/L)	21–137
Aluminum	176–23,100
Barium	2,420–20,500
Boron	3,110–19,300
Calcium	98,200–341,000
Cobalt	< 20
Iron	830–81,300
Magnesium	50,400–219,000
Manganese	133–919
Molybdenum	< 10–20
Sodium	$151x10^4$–$568x10^4$
Tin	< 30
Titanium	4–2,030
Vanadium	< 15–92
Yttrium	< 2–17
Priority Metals (µg/L)	
Antimony	< 4–<40
Arsenic	< 2–<20
Beryllium	< 1–1
Cadmium	< 4–25
Chromium	< 10–83
Copper	14–219
Lead	< 50–352
Mercury	< 4
Nickel	< 30–75
Selenium	< 3–47.5
Silver	< 7
Thallium	< 20
Zinc	2,970–6,980
Priority Organics (µg/L)	
Acetone	ND–852
Benzene	ND–205
m-Xylene	ND–47
Methylene chloride	ND–874
N-octadecane	ND–106
Naphthalene	392–3,144
o,p-Xylene	105–195
Toluene	ND–260
1,1-Dichloroethene	ND–26

Source: USEPA 1993

ND = not detected; µg/L = micrograms per liter

NOTE: The table presents ranges for four samples, two each, at two of the three facilities in the three-facility study conducted by EPA. The study was conducted over 4 days in 1989 at three oil and gas production facilities that used granular filtration for treating produced water: Thums Long Beach Island Grissom, Shell Western E&B, Inc – Beta Complex, and Conoco's Maljamar Oil Field.

Finally, the Beaufort general permit prohibits the discharge of surfactants and dispersants and requires development of best management practices to control the use of deck washdown detergents needed to prevent slippery conditions on decks and work areas. The permit also require the permittee to keep an inventory of all chemicals used for all discharges and where in the process they are used, establish maximum concentrations based on manufacturer or label recommendations, report the rates and concentrations used, and document each additive's concentration and limitations determinations in the End-of-Well Report.

3.3.2. Sanitary and Domestic Waste (Discharges 003 and 004)

While some exploration facilities discharge sanitary and domestic waste water separately, many combine those waste streams before discharge. Therefore, this section discusses sanitary waste, domestic waste and the combined waste. Sanitary waste (Discharge 003) is human body waste discharged from toilets and urinals and treated with a marine sanitation device (MSD). The discharge is subject to secondary treatment and consists of chlorinated effluent. Domestic waste (Discharge 004) refers to gray water from sinks, showers, laundries, safety showers, eyewash stations, and galleys. Gray water can include kitchen solids, detergents, cleansers, oil and grease. Domestic waste includes solid materials such as paper and cardboard which must be disposed of properly (the Beaufort general permit prohibits the discharge of floating solids, garbage, debris, sludge, deposits, foam, scum, or other residues of any kind) . Domestic waste is sometimes incinerated, reused, or treated and discharged into the receiving waters.

The volume of sanitary and domestic wastes varies widely with time, occupancy, facility characteristics and operational situation. Pollutants of concern in sanitary waste include biochemical oxygen demand, pH, total suspended solids (TSS), fecal coliform bacteria, total residual chlorine, and dissolved oxygen. Furthermore, the Beaufort general permit prohibits the discharge if oil is detected. Because the Beaufort general permit authorizes the discharges to both state and federal waters, it must include prohibitions and discharge requirements that comply with Alaska water quality standards (WQS). Additionally, Alaska may authorize mixing zones of 100 meters for water quality-based limits (i.e., pH, fecal coliform, and total residual chlorine); as such, the Beaufort general permit includes end-of-pipe effluent limitations for discharges with and without a 100-meter mixing zone. The permit also applies similar requirements for discharges to federal waters that are consistent with the Alaska WQS.

3.3.3. Desalination Unit Waste (Discharge 005)

Desalination unit waste is residual high-concentration brine, associated with the process of creating freshwater from seawater. The concentrate is similar to sea water in chemical composition; however, anion and cation concentrations are higher. Discharges from desalination units can vary in volume depending on the freshwater needs of the rig.

The Beaufort general permit prohibits the discharge of free oil in this waste stream. If a sheen is visible or detected using a sheen test, the waste stream cannot be discharged. Furthermore, the permit requires pH monitoring and testing for WET if initial toxicity screening indicates the potential for toxicity, or once per well, if the discharge exceeds a flow rate or volume greater than 10,000 gallons during any 24-hour period and if chemicals are added to the system.

3.3.4. Blowout Preventer Fluid (Discharge 006)

As discussed previously, the blowout preventer is a device typically below the sea floor designed to maintain the pressure in the well that cannot be controlled by the drilling fluid. Fluid used to test the blowout preventer may be discharged. The volumes are relatively small in quantity, consisting of approximately 50 barrels (bbl) per well or approximately 7 bbl per testing event. Testing of the blowout preventer device must be conducted periodically, typically weekly, and the discharges occur during those periods. The primary constituents of blowout preventer fluid are oil (vegetable or mineral) or seawater mixed with an antifreeze solution (ethylene glycol).

The Beaufort general permit prohibits the discharge of free oil in this waste stream. If a sheen is visible or detected using a sheen test, the waste stream may not be discharged. The permit also requires pH monitoring.

3.3.5. Boiler Blowdown (Discharge 007)

Boiler blowdown is the discharge of water and minerals drained from boiler drums to minimize solids buildup in the boiler. Discharge volumes from boiler blowdown are also relatively small (see Table 3-5).

The Beaufort general permit prohibits the discharge of free oil in this waste stream. If a sheen is visible or detected using a sheen test, the waste stream cannot be discharged. Furthermore, the permit requires pH monitoring and testing for WET if initial toxicity screening indicates the potential for toxicity, or once per well, if the discharge exceeds a flow rate or volume greater than 10,000 gallons during any 24-hour period and if chemicals are added to the system.

3.3.6. Fire Control System Test Water (Discharge 008)

Fire control system test water is sea water that is released while training personnel in fire protection, and testing and maintaining fire protection equipment on the drilling facility.

The Beaufort general permit prohibits the discharge of free oil in this waste stream. If a sheen is visible or detected using a sheen test, the waste stream may not be discharged. Furthermore, the permit requires pH monitoring and testing for WET if initial toxicity screening indicates the potential for toxicity, or once per well, if the discharge exceeds a flow rate or volume greater than 10,000 gallons during any 24-hour period and if chemicals are added to the system.

3.3.7. Non-Contact Cooling Water (Discharge 009)

Non-contact cooling water is seawater that is used for non-contact, once-through cooling of various machinery and equipment on the drilling facility. Non-contact cooling water consists of the highest volume of the discharges authorized under the Beaufort general permit. The volume of non-contact cooling water depends on the configuration of heat exchange systems on the drilling rig. Some systems use smaller volumes of water that are heated to a greater extent, resulting in a higher temperature differential between waste water and receiving water. Other systems use larger volumes of water to cool equipment, resulting in a smaller difference between the temperature of waste water and receiving water. Depending on the heat exchanger materials and the system's design, biocides or oxidizing agents might be needed to control biofouling on condenser tubes and intake and discharge conduits.

The Beaufort general permit prohibits the discharge of free oil in this waste stream. If a sheen is visible or detected using a sheen test, the waste stream may not be discharged. The permit also establishes a pH limit if chemicals are used in the system; if chemicals are not used, then pH monitoring is required. The permit also requires temperature monitoring and testing for WET if initial toxicity screening indicates the potential for toxicity, or once per well, if the discharge exceeds a flow rate or volume greater than 10,000 gallons during any 24-hour period and if chemicals are added to the system.

3.3.8. Uncontaminated Ballast Water (Discharge 010)

Ballast water is seawater added or removed to maintain the proper ballast floater level and ship draft. For purposes of the Beaufort general permit, ballast water also includes water used for jackup rig-related sea bed support capability tests, such as preload water. The Beaufort general permit requires all ballast water contaminated with oil and grease to be treated through an oil-water separator before discharge. If a sheen is visible or detected using a sheen test, the waste stream may not be discharged. The permit also requires monitoring for pH.

3.3.9. Bilge Water (Discharge 011)

Bilge water is seawater that collects in the lower internal parts of the drilling vessel hull. It could become contaminated with oil and grease and with solids, such as rust, when it collects at low points in the bilges. The Beaufort general permit requires treatment of all bilge water through the oil-water separator before discharge, monitoring for pH, and WET testing if initial toxicity screening indicates the potential for toxicity, or once per well, if the discharge exceeds a flow rate or volume greater than 10,000 gallons during any 24-hour period and if chemicals are added to the system. In addition, the permit includes a best management practices (BMP) provision requiring the operator to ensure that intake and exchange activities minimize the risk of introducing non-indigenous/invasive species to the Beaufort Sea.

3.3.10. Excess Cement Slurry (Discharge 012)

Excess cement slurry is created from equipment washdown after cementing operations. Excess cement slurry is discharged in small quantities when installing the drill casing, but the amount can vary according to drilling conditions. The Beaufort general permit prohibits the discharge of free oil in this waste stream. If a sheen is visible or detected using a sheen test, the waste stream may not be discharged. The permit also requires pH monitoring.

3.3.11. Muds, Cuttings, and Cement at Seafloor (Discharge 013)

Muds, cuttings, and cement discharge occurs at the seafloor in the early phases of drilling operations, such as during constructing the MLC, during construction of the top hole before the well casing is set, and during well abandonment and plugging activities. Seawater is generally used as a ―drilling fluid" during those periods. Cement, cement extenders, and accelerators are the main chemicals added to this discharge.

The Beaufort general permit prohibits the discharge of free oil in this waste stream. If a sheen is visible or detected using a sheen test, the waste stream may not be discharged.

3.4. Estimated Discharge Quantities

The actual number of wells that will be drilled in the Area of Coverage during the 5-year term of the Beaufort general permit is not known; therefore, the volumes of various discharges must be estimated. Based on available information, EPA estimates a total of 18–34 wells may be drilled during the term of the permit. To date, 30 exploration wells have been drilled in the Beaufort Sea.

EPA developed per-well discharge estimates by averaging the volumes reported in the NOIs submitted by Shell for proposed well projects in the Beaufort Area of Coverage. The volumes provide a reasonable estimate of the potential volumes that could be discharged for each waste stream during the five-year term of the Beaufort general permit (Table 3-5).

Table 3-5. Estimated average and maximum discharge quantities based on NOIs

Discharge	Average Discharge Quantities[a] (bbl/well)	Maximum Discharge Quantities (bb/well)
Water-based drilling fluids and drill cuttings (001)	3,712[b]	3,709
Deck drainage (002)	214	250
Sanitary wastes (003)	1,275[b]	1,290
Domestic wastes (004)	14,167[b]	14,333
Desalination unit wastes (005)	5,350	6,250
Blowout preventer fluid (006)	50	56.4
Boiler blowdown (007)	0[c]	0
Fire control system test water (008)	477[d]	572
Non-contact cooling water (009)	1,099,871	1,935,000
Uncontaminated ballast Water (010)	213[b]	215
Bilge water (011)	537[b]	543
Excess cement slurry (012)	50	50
Muds, cuttings, and cement at the seafloor (013)	3,512	5,335

Note:
bbl = barrel
a. Average estimated quantities based on Shell's NOIs for exploration activities in the Beaufort Sea.
b. Shell's NOIs indicated zero discharge in Camden Bay at the Sivulliq and Torpedo prospects.
c. Shell's NOIs indicated zero discharge.
d. Shell's NOIs indicated zero discharge in Harrison Bay at the Cornell and Mauya prospects.

3.5. Predictive Modeling of Discharges

3.5.1. Drilling Fluid Transport, Deposition, and Dilution

Drilling fluids contain quantities of coarse material, fine material, dissolved solids, and free liquids. The fluids behave like a slurry in that the coarse material/solids are denser than water and sink rapidly to the seafloor, whereas portions of the aqueous component remain above in the water column (USEPA 2000). The upper plume contains dissolved constituents and fine-grained solids accounting for about 5 to 7 percent, by weight, of the total drilling fluid and drill cuttings discharge (Ayers et al. cited in USEPA 1985). The lower plume contains the majority of the discharged materials, including most of the solids.

The Offshore Operators Committee (OOC) developed a model for predicting the behavior of solid and soluble components of drilling-related discharges. The OOC model was first made available to OOC member companies and federal and state agencies concerned with offshore drilling discharge regulation

in 1983. The dilution of the drilling effluent is simulated by considering three phases of plume behavior: convective descent, dynamic collapse, and a later passive diffusion phase. A Gaussian formulation is used to sum the three component phases and to track the distribution of solids from the lower plume to the bottom. The model predicts concentrations of solids and soluble components in the water column and the initial deposition of solids on the seafloor. The model version employed for this ODCE is Version 2.5 supplied by Brandsma Engineering and is identical to that used in the previous ODCEs for the Arctic (USEPA 2006). For detailed information about the model and simulation results, see *Results from Beaufort/Chukchi Permit Dilution Modeling Scenarios Technical Memorandum* (Modeling Technical Memorandum), dated October 23, 2012 (Hamrick 2012).

The OOC model results do not include cuttings, so a separate analysis of cuttings was conducted (see Modeling Technical Memorandum). The cuttings are generally expected to be coarser-grained (1 millimeter [mm] wide or larger) than drilling fluids; therefore, the bulk of the cuttings are expected settle out of the water column more rapidly than the drilling fluids. The total discharge of cuttings is generally about 1.3 times greater (as dry weight) than the total discharge of drilling fluids for these operations.

Because the permit is issued before the drilling activity occurs, the modeling analysis employs assumptions about the discharge that can vary from actual conditions at a site (e.g., a single discharge of limited duration and unidirectional currents). The model predictions discussed below provide a generalized and conservative picture of expected dilution and deposition.

The OOC model was used to examine discharge scenarios within the potential areas of discharge and representative of the maximum discharge rates (see below). Discharge scenarios were determined by examining relevant information sources describing exploratory oil and gas drilling practices. This includes information obtained from NOIs submitted by Shell for proposed drilling in the Beaufort Sea (Shell 2009b). Model parameters held constant for all test cases are presented in Table 3-6.

The Beaufort general permit includes the following restrictions for the discharge of drilling fluids and drill cuttings. The discharge rate must not exceed the following where depth is measured as meters at mean lower low water (MLLW):

- 1,000 bbl/h in water depths exceeding 40 m (131 ft);
- 750 bbl/h in water depths greater than 20 m (65 ft) but not exceeding 40 m (131 ft);
- 500 bbl/h in water depths greater than 5 m (16 ft) but not exceeding 20 m (65 ft); and
- No discharge in water depths less than 5 m (16 ft).

The modeling predicts sediment deposition for a range of drilling fluid discharges consistent with the permitted discharge levels (Hamrick 2012).

OOC model test cases that reflect the permit stipulations discussed above were generally run for open-water discharges and shunting (discussed below). The results for all model runs are provided in the Modeling Technical Memorandum and Appendix A. The following section describes the results of the model runs specifically related to the Beaufort Sea discharges.

Table 3-6. OOC model input parameters held constant

Discharge conditions				
Angle of Pipe (degrees downward from horizontal)			90.0	
Depth of Pipe Mouth (m)			0.3	
Pipe Radius (m)			0.1	
Rig Type			Generic	
Rig Length (m)			70.1	
Rig Width (m)			61.0	
Rig Wake Effect			Included	
Drilling fluid characteristics				
Bulk Density (g/cm3)			2.085	
Initial Solids Concentration in Whole Drilling Fluid (mg/L)			1,441,000	
Drilling fluid particle distribution				
Class number	**Density (g/cm^3)**	**Volume fraction in whole fluid (cm^3/cm^3)**	**Settling velocity**	
			(cm/sec)	**(ft/sec)**
1	3.959	0.0364	0.658	0.021600
2	3.959	0.0364	0.208	0.006820
3	3.959	0.0437	0.085	0.002780
4	3.959	0.0728	0.044	0.001430
5	3.959	0.1383	0.023	0.000758
6	3.959	0.0364	0.013	0.000427
Receiving water characteristics				
Significant Wave Height (m)			0.6	
Significant Wave Period (sec)			12.0	
Surface Water Density (σ_t)			22.0	
Density Gradient ([kg/m^3]/m)			+0.1	

Note: mg/L = milligrams per liter; g/cm^3 = grams per cubic centimeter; cm^3 = cubic centimeter; cm/s = centimeters per second; ft/s = feet per second; σ_t = the sigma-t value based on local temperature and salinity; [kg/m^3]/m = kilograms per cubic meter divided by meters

3.5.1.1. Deposition of Open-Water Drilling Fluid Solids in the Beaufort Sea

In the Beaufort Sea, expected discharge scenarios are consistent with the following conditions:

- Discharges at water depths of 40–50 m (131–164 ft);
- Discharges near the surface;
- Current speeds of 0.1 m per second (m/s) to 0.3 m/s where discharges are likely to occur.

For the 51 model scenarios at the acceptable water depth (deeper than 5 m), 8 scenarios fall within those conditions. The model results for those scenarios indicate maximum deposition thicknesses ranging from 0.008 to 0.024 cm (0.003 to 0.009 in) along the current direction. Those scenarios, however, include total discharges ranging from 750 to 1,000 bbl. Scaling the results upward to reflect total discharges of up to 5,000 bbl, the maximum deposition thicknesses would range from 0.03 to 0.13 cm (0.01 to 0.05 in). The maximum deposition for a slower current speed (0.1 m/s [0.32 ft/sec]) occurs from 100 to 500 m (328 to 1,640 ft) from the discharge point while the maximum deposition occurs 800 to 1,400 m (2,624 to 4,600 ft) from the discharge point for a higher current speed of (0.3 m/s [1 ft/sec]). As discussed in Section 4.2.2 below, current speeds in the Beaufort Sea can exceed 1 ft/sec.

For all 51 scenarios, the maximum predicted deposit was approximately 2 cm (0.8 in), and the median for all scenarios was a deposit of approximately 0.2 cm (0.07 in). Under most conditions, the majority of the solids are deposited within 1,000 m (3,280 ft) of the discharge. Plan view contour plots showing the variation in deposit thickness for each scenario are included in the Modeling Technical Memorandum and appendices. Table 3-7 shows the predicted deposition of the drilling fluids discharge.

Table 3-7. Predicted Solids Deposition and Plume Dilution for Drilling Fluid Discharge

	Ambient		*Discharge*					
Case ID	Water Depth (m)	Current Speed (m/sec)	Depth (m)	Rate (bbl/hr)	Duration (sec)	*Deposit Thick. cm*	*Center-line Dilution Factor at model termination (distance in m)*	Center-line Dilution Factor at 100 m
CASE-1	2.0	0.20	0.3	250	2.0	Na	30 (1)	3000
CASE-2	2.0	0.10	0.3	250	2.0	0.118	27 (2)	1350
CASE-3	2.0	0.30	0.3	250	2.0	0.077	120 (5)	2400
CASE-4	2.0	0.40	0.3	250	2.0	0.067	145 (8)	1810
CASE-5	5.0	0.02	0.3	250	8280	0.242	125 (2)	6250
CASE-6	5.0	0.10	0.3	250	3600	0.070	100 (2)	5000
CASE-7	5.0	0.30	0.3	250	3600	0.050	420 (15)	2800
CASE-8	5.0	0.40	0.3	250	3600	0.041	510 (30)	1700
CASE-9	20.0	0.02	0.3	250	8280	0.051	840 (7)	1800
CASE-10	40.0	0.02	0.3	250	8280	0.016	860 (7)	1650
CASE-11	50.0	0.02	0.3	250	8280	0.011	860 (7)	1650
CASE-12	40.0	0.10	35.3	250	3600	0.042	100 (2)	5000
CASE-13	40.0	0.10	38.3	250	3600	0.058	26 (2)	1300
CASE-14	50.0	0.10	35.3	250	3600	0.026	950 (13)	7300
CASE-15	50.0	0.10	38.3	250	3600	0.028	760 (10)	7600
CASE-16	5.0	0.02	0.3	500	8280	0.400	82 (2)	4100
CASE-17	5.0	0.10	0.3	500	3600	0.121	56 (2)	2300
CASE-18	5.0	0.30	0.3	500	3600	0.076	375 (13)	2900
CASE-19	5.0	0.40	0.3	500	3600	0.069	410 (21)	1950
CASE-20	20.0	0.02	0.3	500	8280	0.119	380 (2)	19000
CASE-21	20.0	0.10	0.3	500	3600	0.031	900 (30)	900
CASE-22	20.0	0.30	0.3	500	3600	0.015	1020 (70)	1100
CASE-23	20.0	0.40	0.3	500	3600	0.012	1010 (78)	1050
CASE-24	40.0	0.02	0.3	500	8280	0.029	760 (8)	1650
CASE-25	40.0	0.10	35.3	500	3600	0.062	56 (2)	2800
CASE-26	40.0	0.30	20.3	500	3600	0.018	2400 (85)	2500
CASE-27	40.0	0.40	20.3	500	3600	0.011	3200 (100)	3200
CASE-28	50.0	0.02	0.3	500	8280	0.020	760 (8)	1650
CASE-29	50.0	0.10	35.3	500	3600	0.042	700 (13)	5400
CASE-30	50.0	0.30	20.3	500	3600	0.010	4400 (100)	4400
CASE-31	50.0	0.40	20.3	500	3600	0.007	3500 (100)	3500
CASE-32	20.0	0.02	0.3	750	8280	0.145	310 (2)	15500
CASE-33	20.0	0.10	0.3	750	3600	0.044	550 (38)	600
CASE-34	20.0	0.30	0.3	750	3600	0.023	980 (76)	1000
CASE-35	20.0	0.40	0.3	750	3600	0.017	1000 (95)	1000
CASE-36	40.0	0.02	0.3	750	8280	0.038	720(9)	5250
CASE-37	40.0	0.10	0.3	750	3600	0.020	870 (33)	1350
CASE-38	40.0	0.30	0.3	750	3600	0.010	980 (75)	1000
CASE-39	40.0	0.40	0.3	750	3600	0.008	1000 (95)	1000

Case ID	Ambient		Discharge			Deposit Thick. cm	Center-line Dilution Factor at model termination (distance in m)	Center-line Dilution Factor at 100 m
	Water Depth (m)	Current Speed (m/sec)	Depth (m)	Rate (bbl/hr)	Duration (sec)			
CASE-40	40.0	0.10	20.3	750	3600	0.046	580 (8)	7250
CASE-41	50.0	0.02	0.3	750	8280	0.027	720(9)	5250
CASE-42	50.0	0.10	0.3	750	3600	0.013	870 (33)	1350
CASE-43	50.0	0.30	0.3	750	3600	0.006	980 (75)	1000
CASE-44	50.0	0.40	0.3	750	3600	Na	1000 (95)	1000
CASE-45	50.0	0.10	20.3	750	3600	0.037	1320 (22)	7320
CASE-46	40.0	0.02	0.3	1000	8280	0.069	350 (2)	17500
CASE-47	40.0	0.10	0.3	1000	3600	0.024	870 (35)	1350
CASE-48	40.0	0.30	0.3	1000	3600	0.013	920 (80)	980
CASE-49	40.0	0.40	0.3	1000	3600	0.011	950 (100)	950
CASE-50	40.0	0.10	20.3	1000	3600	0.056	425 (6)	7100
CASE-51	50.0	0.02	0.3	1000	8280	0.037	650 (8)	1350
CASE-52	50.0	0.10	0.3	1000	3600	0.017	870 (35)	1500
CASE-53	50.0	0.30	0.3	1000	3600	0.008	950 (80)	975
CASE-54	50.0	0.40	0.3	1000	3600	0.006	950 (100)	950
CASE-55	50.0	0.10	20.3	1000	3600	0.041	1050 (16)	6550

3.5.1.2. Shunting of Drilling Fluid Discharges

Both open-water and below-ice discharges can be shunted (i.e., discharged at depth rather than near the surface). As expected, OOC modeling results for deposition show that shunting discharges below the surface leads to a greater depositional thicknesses that extends over a smaller overall area of deposition compared to near surface discharges at the same discharge rates and current speeds. For example, model results for the maximum allowable discharge rate of 1000 bbl per hour at a water depth of 50 m (164 ft), current speed of 0.2 m/s (0.64 ft/s), and discharge depth of 20.3 m (66.6 ft) showed a maximum deposition depth of 0.041 cm (0.016 in) compared to a maximum drilling fluid depth of 0.017 cm (0.007 ft) for a comparable discharge at a depth of 0.3 m (1.0 ft). In such a case, the deeper discharge led to most deposition within 500 m (1,640 ft) of the discharge, while the primary deposition area for the shallow discharge extended to 800 to 900 m (2,624 to 2,952 ft). Overall, the depositional thicknesses and areas are generally within the range of the near surface discharges; i.e., no drilling fluid thicknesses greater than 1 cm (0.39 in).

3.5.1.3. Thickness and Areal Extent of Solids Deposition

As noted above, drilling fluid and cuttings deposition were analyzed separately. Restating the drilling fluid estimates, the OOC model predicts maximum deposition thicknesses ranging from 0.03 to 0.13 cm (0.01 to 0.05 in) for a 5,000 bbl discharge of drilling fluid. The maximum deposition for a slower current speed (0.1 m/s [0.32 ft/sec]) occurs from 100 to 500 m (328 to 1,640 ft) from the discharge point while the maximum deposition occurs 800 to 1,400 m (2,624 to 4,600 ft) from the discharge point for a higher current speed of (0.3 m/s [1 ft/sec]). As discussed in Section 4.2.2 below, current speeds in the Beaufort Sea can exceed 1 ft/sec. Under most conditions, the majority of the solids are deposited within 1,000 m (3,280 ft) of the discharge.

Since the OOC model does not include a cuttings component, an application of the advection/diffusion equation (including particle settling) was used as a model to predict cuttings deposition (Modeling

Technical Memorandum). The model scenarios included five grain sizes (62.5, 125, 250, 500, and 1,000 micrometers) and 20 different discharge conditions (varied outfall depths and current speeds) for a total of 100 scenarios. Twenty of these 100 scenarios are representative of conditions expected in the Beaufort Sea (current speeds of 0.1 to 0.3 m/s, depths of 40 to 50 meters).

A cuttings volume of 1,000 bbl was assumed for the base model predictions, but the results can be linearly scaled to make estimates for higher discharge volumes. Table 3-8 shows that most cuttings would settle within 100 meters of the discharge point under all scenarios. At a distance of 10 meters from the outfall, a cuttings discharge of 1,000 bbl is predicted to deposit cuttings at depths ranging from 0.4 cm to 113 cm. For a 2,500 bbl cuttings discharge, these deposits would be a factor of 2.5 higher (linear scaling). At a distance of 100 meters, a 2,500 bbl discharge is predicted to result in cuttings deposits ranging from 0 cm (coarse cuttings) to 10 cm (medium coarseness cuttings).

Overall, the drilling fluid and cuttings deposition are predicted to deposit on the seafloor in substantially different patterns due to the difference in solids characteristics. The drilling fluids are predicted to deposit in a thinner layer, and over a larger area, than the cuttings deposits. The coarser cuttings are predicted to cause thicker deposits near the outfall, with most of the deposition occurring within 100 meters radius.

Table 3-8. Predicted Solids Deposition for Cuttings Discharge (1,000 bbl, 250 um grain size)

Case ID	Discharge Height Above Bottom Depth (m)	Current Speed (m/sec)	Deposition Thickness 250 um Cutting At 1, 3.2, 10, 32, and 100 meters (meters)				
			1 m	3.2 m	10 m	32 m	100 m
CASE-101	2.0	0.02	158.823	17.681	0.059	0.000	0.000
CASE-102	2.0	0.10	57.879	23.549	4.745	0.105	0.000
CASE-103	2.0	0.30	21.322	10.767	4.299	0.821	0.015
CASE-104	2.0	0.40	16.193	8.400	3.654	0.914	0.040
CASE-105	5.0	0.02	63.014	18.543	1.339	0.001	0.000
CASE-106	5.0	0.10	16.021	7.917	2.952	0.454	0.004
CASE-107	5.0	0.30	5.558	2.995	1.468	0.536	0.077
CASE-108	5.0	0.40	4.190	2.282	1.158	0.471	0.095
CASE-109	20.0	0.02	9.864	4.719	1.588	0.177	0.001
CASE-110	20.0	0.10	2.095	1.141	0.579	0.235	0.047
CASE-111	20.0	0.30	0.705	0.393	0.213	0.108	0.043
CASE-112	20.0	0.40	0.530	0.296	0.162	0.084	0.037
CASE-113	40.0	0.02	3.621	1.878	0.817	0.204	0.009
CASE-114	40.0	0.10	0.746	0.413	0.221	0.106	0.036
CASE-115	40.0	0.30	0.250	0.140	0.077	0.041	0.020
CASE-116	40.0	0.40	0.188	0.105	0.058	0.032	0.016
CASE-117	50.0	0.02	2.610	1.376	0.630	0.185	0.013
CASE-118	50.0	0.10	0.535	0.297	0.160	0.079	0.030
CASE-119	50.0	0.30	0.179	0.100	0.056	0.030	0.015
CASE-120	50.0	0.40	0.134	0.075	0.042	0.023	0.012

3.5.1.4. Effluent Dilution

The OOC model was also used to evaluate the dilution of all of the drilling-related effluents associated with each of the discharges authorized by the Beaufort general permit in the water column. The results were used to calculate parameter concentrations at specific distances from the discharge point. Dilution modeling was performed for the same 55 cases that were evaluated for solids deposition. The model indicates that effluent dilution at a given distance from the discharge point is inversely correlated to the discharge rate and current speed, because the rapid travel of the plume limits lateral mixing and plume expansion (Hamrick 2012). On the basis of the full set of scenario runs analyzed, the minimum dilution ratio (seawater to effluent) occurred for model scenario Case #33 (discharge rate of 750 bbl/hour, depth of 20 m, and a current speed of 40 cm (1.3 ft) per second). The predicted dilution for this worst-case scenario was approximately 600:1 at 100 meters from the discharge point.

4. DESCRIPTION OF THE EXISTING PHYSICAL ENVIRONMENT

4.1. Climate and Meteorology

The Area of Coverage is in the Arctic climate zone. The Arctic climate is characterized by high spatial variability and affected by the extreme solar radiation conditions of high latitudes. Important meteorological conditions that could affect the discharges covered under the Beaufort general permit are air temperature, precipitation (rain and snowfall), and wind speed and direction.

Air temperature controls ice formation and breakup and whether ice would need to be managed as part of exploratory activities. Precipitation determines the quantity and concentration of pollutants discharged in deck drainage discharges, and wind speed and direction control coastal oceanographic conditions (ice distribution, current speed and direction, vertical and horizontal mixing, and wave action). The following discussion is included to describe the physical setting of the discharges authorized under the Beaufort general permit.

4.1.1. Air Temperature

In the Beaufort Sea, the air temperatures are below freezing the majority of the year. During the summer months from June to September, the highest temperatures occur in July, ranging from 45 °F to 55 °F, while average minimum temperatures are lowest in February at -25 °F (NMFS 2011). An extreme maximum temperature of 83 °F has been recorded at Prudhoe Bay and Kuparuk (MMS 2008).

The *Arctic Climate Impact Assessment* (ACIA 2005) summarizes spatial and temporal temperature trends in the Arctic according to observations from the Global Historical Climatology Network database (Peterson and Vose 1997 cited in MMS 2008) and the Climate Research Unit database (Jones and Moberg 2003 cited in MMS 2008). Both time series for stations north of latitude 60°N show a statistically significant warming trend of 0.16 °F per decade for the period of 1900 to 2003 (ACIA 2005 cited in MMS 2008). In general, temperatures increased from 1900 to the mid-1940s, decreased until about the mid-1960s, and then increased again the present. When temperature trends are broken down by season, the largest changes occurred in winter and spring. The greater amount of warming in the Arctic compared to that for the globe as a whole is consistent with climate model projections (Intergovernmental Panel on Climate Change 2007 cited in MMS 2008). As discussed in Section 7 (Criterion 2), temperature would not have a substantial effect on the behavior of the discharges and therefore changes in temperature are not expected to affect the discharges.

4.1.2. Precipitation

Along the Beaufort Sea, the average annual precipitation ranges from 4.00 inches at Kuparuk to 6.19 inches at Barter Island (www.wrcc.dri.edu). Rainfall usually is light during the short summers; however, heavier rainstorms occasionally occur, with the greatest amount of precipitation falling in July and August. Snow cover in the region begins between late September and early October and disappears from late May through mid-June (MMS 2003). The typical amount of snow received in this region is equivalent to approximately 0.8 inches of precipitation. The average monthly precipitation in August ranges from 1.03 to 1.14 inches. The average precipitation in the driest month ranges from 0.08 to 0.13 inches (MMS 2008).

4.1.3. Winds

Observed wind directions over the area are seasonally variable and range from an average summer flow of 8.0 to 11.4 miles per hour (mph) from the south and southwest to a winter flow, which averages 8.0 to 17.3 mph from the east and southeast. Westward winds in the nearshore area of the Beaufort Sea are strongest in the late fall and early winter and occur most frequently in October, November, and March (Weingartner et al. 2009).

The dominant wind direction in the open-water season is easterly to northeasterly with an average wind speed of 11 mph in Stefansson Sound; wind speeds greater than 18 mph fully mix the vertical column of water in Stefansson Sound (MMS 2003). During winter, the Area of Coverage lies between a semipermanent high-pressure system to the north and a low-pressure system to the south over the Gulf of Alaska. The northerly high-pressure system results in clear to partly cloudy skies much of the time. Strong westerly winds are a common feature of this region in winter. Cold stable air moving from the north is stacked against the Brooks Range and results in a west wind parallel to the mountains. Stations to the east of Prudhoe Bay have more frequent westerly winds than stations to the west, such as Barrow. The average wind speeds are 9-13 mph (MMS 2003).

MMS has collected data from five meteorological stations from January 2001 through September 2006 at sites along a 62-mile stretch of the Beaufort Sea coast centered on Prudhoe Bay. The sites were Milne Point, Cottle Island, Northstar Island, Endicott, and Badami. Wind directions at those stations have a strong bimodal distribution, with the greatest frequency from the east-northeast and a secondary maximum from the southwest to west-southwest. The average wind speeds range from 11.4 to 13.2 mph, and peak winds ranged from 51 to 62 mph (Veltkamp and Wilcox, 2007 as cited in MMS 2008).

Surface winds along the coast between Point Lay and Barrow commonly blow from the east and northeast, whereas winds at Cape Lisburne are predominantly from the east and southeast (Brower et al. 1988 cited in MMS 2008). Coastal wind speeds are typically between 9 to 18 mph, with winds exceeding 18 mph occurring less than 4 percent of the time (MMS 1991). Sustained winds of 58.2 to 64.9 mph, with higher gusts, have been recorded (Wilson et al. 1982 cited in MMS 2008).

4.2. Oceanography

Oceanographic considerations include tides, wind, freshwater overflow and inputs, ice movement, stratification, and current regime. The following is a brief review of the oceanographic and meteorological conditions affecting dilution and dispersion of discharged materials into the Beaufort Sea.

4.2.1. Bathymetric Features and Water Depths

The Area of Coverage includes the continental shelf, slope, and rise of the Alaskan Beaufort Sea. Water depths in the Beaufort Sea Area of Coverage range from approximately 5 ft nearshore to more than 11,482 ft further offshore (MMS 2008); at least 75 percent of the area is deeper than 98 ft. The major bathymetric features include Barrow Canyon and barrier islands and shoals; those important bathymetric features influence the flow and distribution of water masses (Feder et al. 1994).

Barrow Canyon is just northwest of Barrow, and serves to drain water from the Chukchi Sea and bring upwelled water from the basin to the shelf. They are narrow (less than 250 m), have low elevations (less than 2 m) and, particular to the Arctic, they are short (Stutz, Trembainis, and Pilkey 1999 as cited in MMS 2008). Shoals rise 5–10 m (16–33 ft) above the surrounding seafloor and are found in water depths

of 10–20 m (33–65 ft). East of the Beaufort sale areas, the Mackenzie Trough and the Kugamllit Valley act as conduits for cross-shelf exchange (MMS 2008).

Barrier islands provide two main benefits: they protect the coastlines from severe storm damage; and they harbor several habitats that are refuges for wildlife. The salt marsh ecosystems of the islands and the coast help to purify runoff from mainland streams and rivers. Barrier islands are constantly changing; they are influenced by the following conditions:

- Waves—deposit and remove sediments from the ocean side of the island
- Currents—longshore currents that are caused by waves hitting the island at an angle can move the sand from one end of the island to another.
- Tides—move sediments into the salt marshes and eventually fill them in. Thus, the sound sides of barrier islands tend to build up as the ocean sides erode.
- Winds—blow sediments from the beaches to help form dunes and into the marshes, which contributes to their buildup.
- Sea level changes—rising sea levels tend to push barrier islands toward the mainland
- Storms—storms have the most dramatic effects on barrier islands by creating overwash areas and eroding beaches as well as other portions of barrier islands.
- Continental shelves vary in width from almost zero up to the 930 mi-wide Siberian shelf in the Arctic Ocean and average 78 km (48 mi) in width. The continental slope in the Beaufort Sea has water depths varying from 60 to 1,500 m (197 to 4,921 ft). The shelf varies in width between Barrow and Canada and generally is a narrow shelf averaging about 80.5 km (50 mi).

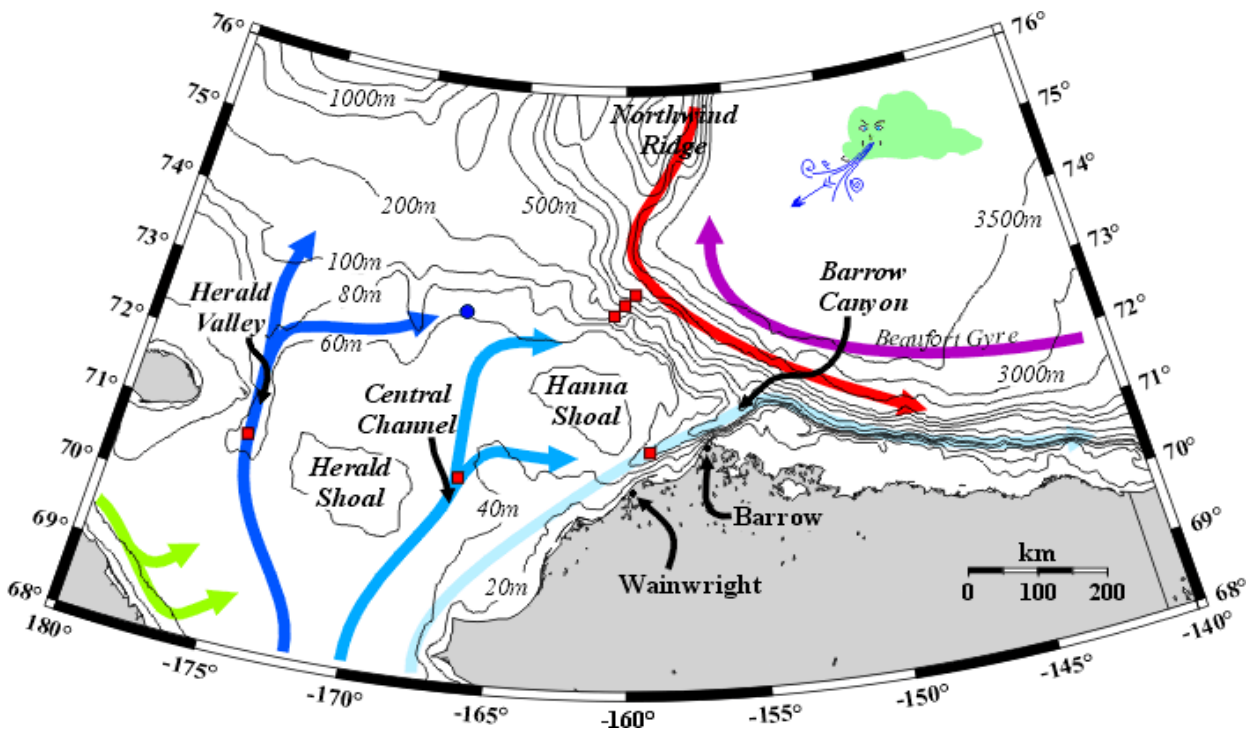
4.2.2. Circulation and Currents

Current velocity and turbulence can vary markedly with location/site characteristics and affect the movement and concentration of suspended matter, and entrainment/resuspension/advection of sedimented matter. The direction of the current determines the predominant location of potential impacts, while current velocity influences the extent of area affected. Velocity and boundary conditions also affect mixing because turbulence increases with current speed and proximity to the seafloor.

Circulation in the Beaufort Sea can be divided into two main areas: nearshore (water shallower than 40 m; and offshore (water deeper than 40 m). Offshore waters are primarily influenced by the large-scale Arctic circulation known as the Beaufort Gyre, which is driven by large atmospheric pressure fields. In the Beaufort Gyre, water moves to the west in a clockwise motion at a mean rate of 5–10 cm per second. The southern portion of the Beaufort Gyre is found in the offshore region of the proposed Beaufort Sea sales area. The Beaufort Gyre expands and contracts, depending on the state of the Arctic Oscillation (Steele et al. 2004 as cited in MMS 2008). Below the surface flow of the Beaufort Gyre, the mean flow of the Atlantic layer (centered at 500 m) is counterclockwise in the Canada Basin. Below the polar mixed layer, currents appear to be driven primarily by ocean circulation rather than the winds (Aagaard, Pease, and Salo 1988 as cited in MMS 2008).

Pickard (2004) documents the presence of the Beaufort shelfbreak, a narrow eastward current that carries much of the outflowing water from the Chukchi Sea toward the eastern Canada Basin. Depending on the season, the Beaufort shelfbreak is associated with advection of summer-time Bering water, winter-

transformed Bering water or upwelled Atlantic water. Figure 4-1, below, illustrates the major watermass flows in the Chukchi and Beaufort Seas.



Source: IMS (2010)

Figure 4-1. Major water-mass flows in the Chukchi and Beaufort Seas.

The Alaska Coastal Current (ACC) is a narrow, fast-moving current flowing northeasterly at approximately 0.16 ft/sec along the Alaska coastline. North of Cape Lisburne, the ACC parallels the 66-ft isobath until it reaches the Barrow Sea Valley at Wainwright. It then follows parallel with the valley from Wainwright to Point Barrow where it turns and flows southeasterly parallel to the Beaufort Sea coastline. The ACC flow is variable, and directional reversals can persist for several weeks because of changes in wind direction.

For nearshore waters, there are three distinct circulation periods; open water, river breakup, and ice covered (Weingartner et al. 2005). Open water circulation depends mostly on the direction (rather than speed) of the wind; the two dominant wind directions are northeast and southwest (Morehead et al. as cited in MMS 2008). Nearshore surface currents respond within 1–3 hours to changes in wind direction (MMS 2008). Easterly winds cause surface currents to flow west, and westerly winds cause surface currents to flow east. The mean surface current direction year-round is to the west and parallels the bathymetry. The tidal action coupled with the easterly nearshore circulation results in the gradual removal of warm, brackish water from nearshore and replaces it with colder, more saline water. Alternatively, tidal action coupled with westerly nearshore circulation causes accumulation of warm, brackish water along the coast. Other controls on nearshore circulation include river discharge, ice melt, bathymetry, and the configuration of the coastline.

In the landfast ice zone of the nearshore Beaufort, Weingartner et al. (2009) determined that during the open water season, mid-depth currents are at least 20 cm/s, whereas during the landfast ice season, they generally are less than 10 cm/s. Tidal currents are less than 3 cm/s and most likely have a negligible dynamical effect on the currents and circulation (MMS 2008). During ice covered periods, landfast ice in the nearshore areas protects the water from the effects of the winds. Therefore, the circulation pattern is influenced by storms and brine drainage (MMS 2008).

The third circulation pattern occurs during the spring breakup of rivers. In the Arctic spring (late May to early June), small and large rivers break up and flow at maximum discharge over and under the still frozen landfast ice, creating a large freshwater input on a short seasonal basis (Rember and Trefry 2004; Akire and Trefry 2006 as cited in MMS 2008). Spring river runoff results in an offshore spreading of a watermass under and over the landfast ice and indicates that a river plume under ice followed the local circulation. The seasonal cycle modifies temperature and salinity properties through freezing, melting, and river discharge and, thus, changes nearshore watermasses over time.

4.2.3. Tides

In the Beaufort Sea, tides propagate from west to east along the coast. The principal lunar diurnal for areas near the Beaufort Sea, as determined by Kowalik and Matthews (1982) range from 2.3 to 6 cm, and the semidiurnal tidal range is 6–10 cm in the Beaufort Sea (MMS 2008).

4.2.4. Stratification, Salinity, and Temperature

Nearshore waters are typically influenced by fresh water from rivers. In this area, a two-layered stratified system is formed with fresher water from riverine input overlying more saline oceanic water. The surface layer generally shows a marked decrease in salinity in the vicinity of major rivers. In the winter, the lack of freshwater input into coastal waters results in weak stratification. Freshwater input also causes a marked temperature division between nearshore and offshore waters. In the Beaufort area, the MacKenzie River flows all year long, contributing the largest amount of freshwater per year.

Coastal water temperature typically ranges from 41 to 50 °F and has salinities that are generally less than 31.5 parts per thousand (ppt) (Lewbel and Gallaway 1984 in MMS 2003). Offshore waters are colder and more saline than the coastal waters. Water temperatures are near 32 °F and have salinities of 32.2 to 33ppt (Lewbel and Gallaway 1984 cited in MMS 2003).

4.3. Ice

Sea ice is frozen seawater with most of the salt extruded out that floats on the ocean surface; it forms and melts with the polar seasons. In the Arctic, some sea ice persists year after year. Sea ice in the Arctic appears to play a crucial role in regulating climate because it regulates heat, moisture, and salinity in the polar oceans. Sea ice insulates the relatively warm ocean water from the cold polar atmosphere, except where cracks or leads (areas of open water between large pieces of ice) in the ice allow exchange of heat and water vapor from ocean to atmosphere in winter.

The three general forms of sea ice in the Arctic are landfast ice, stamukhi (or shear) ice, and pack ice. Each of those zones is discussed below.

4.3.1. Landfast Ice Zone

Landfast ice, or fast ice, which is attached to the shore, is relatively immobile and extends to variable distances off shore: generally 8- to 15-m isobaths, but it can extend beyond the 20-m (65.6-ft) isobath. It is usually reformed yearly, although it can contain floes of multiyear pack ice. About mid-May, the near-shore ice begins to melt; by July, the pack ice retreats northward. Much of the fast ice melts within the 10 m isobath during the summer, but it is very dependent upon the wind direction which controls the ice floes. Traditional knowledge workshop participants indicated that breakup varies from year to year, generally occurring in June or July. Freeze up typically occurs in October, although open water might be present in certain areas all winter long (SRB&A 2011). Landfast ice is characterized by a gradual advance from the coast in early winter and a rapid retreat in the spring (Mahoney et al. 2007 cited in MMS 2008). The advance is not a continuous advance but involves the forming, breakup, and reforming of the landfast ice.

The two types of landfast ice are bottomfast and floating. Bottomfast ice is frozen to the bottom out to a depth of about 2 m; in areas deeper than 2 m, landfast ice floats. Movement of ice in the landfast zone (called ice shoves, or *ivu* by the Inupiaq) is intermittent and can occur at any time but is more common during freeze up and breakup. Onshore winds are highly correlated with ice shoves (MMS 2008).

Landfast ice moves in two general ways: (1) pile-ups and rideups and (2) breakouts. Onshore movement of the ice generates pileups and rideups, which can extend up to 20 m inland (MMS 2008). Landfast ice can also move because of breakouts, where landfast ice breaks and drifts with pack ice. In the Beaufort Area of Coverage, landfast ice exists from Point Barrow to Barter Island; Barter Island to Herschel Island; and east of Herschel Island to Banks Island.

4.3.2. Stamukhi Ice Zone

Seaward of the landfast-ice zone is the stamukhi, or shear, ice zone. In this zone, large pressure ridges and rubble fields occur between stationary landfast ice and mobile pack ice when winds drive the pack ice into the landfast ice (MMS 2008). Pressure ridges in the Beaufort reach depths of 18–25 m and act as sea anchors for landfast ice.

4.3.3. Pack Ice Zone

Pack ice is seaward of the stamukhi ice zone and includes first-year ice, multiyear ice, and ice islands. First-year ice that forms in fractures, leads, and polynyas (large areas of open water) varies in thickness from a few centimeters to more than a meter. Multiyear ice is ice that has lasted one or more melt seasons. Ice islands are large icebergs that break away from the ice shelves off the coast of Greenland.

Movement in the pack ice zone in the Area of Coverage is generally small during the winter, moving from east to west in response to the Beaufort Gyre (MMS 2008). Ridges indicate deformed pack ice. In the nearshore region, an increase in ridging is found in the vicinity of shoals and promontories; beyond the 20-m isobath, massive ridges occur.

4.3.4. Sea Ice

Sea ice is frozen seawater that floats on the ocean surface; it forms and melts with the polar seasons. In the Arctic, some sea ice persists year after year. Sea ice in the Arctic plays a role in regulating climate by regulating heat, moisture, and salinity in the polar oceans. Sea ice insulates the relatively warm ocean

water from the cold polar atmosphere, except where cracks or leads in the ice allow exchange of heat and water vapor from ocean to atmosphere in winter.

In the Beaufort Sea, sea ice generally begins forming in late September or early October, with full ice coverage by mid-November or early December. Ice begins melting in early May in the southern part of Beaufort Sea, and early to mid-June in the northern region. Maximum open water occurs in September (MMS 2008).

The analysis of long-term data sets indicates substantial reductions in both the extent (area of ocean covered by ice) and thickness of the Arctic sea-ice cover during the past 20 to 40 years during summer and more recently during winter. Simulations conducted for the trajectory of Arctic sea ice indicate decreasing September ice trends that are typically 4 times larger than observed trends, and predict near ice-free September conditions by 2040 (Holland et al. 2006). Factors causing reductions in winter sea ice can be different from those in summer.

4.4. Sediment Transport

Sediment transport and distribution in the Beaufort Sea is controlled by several factors, including storms, ice gouging, entrainment in sea ice, wave action, currents, and bioturbation. The bulk of sediment on the Alaskan continental shelf is transported northwards with the prevailing current. Sediment transport in response to severe storms is an important means of sediment transport within the Area of Coverage. Storm transport of sediment is particularly effective in the fall when storms are associated with fresh ice, which enhances erosion and often entraps sediments in new ice. In the spring, the breakup and melting of the sediment-laden ice can result in sediment being transported far distances from the point of entrapment.

4.5. Water and Sediment Quality

4.5.1. Turbidity and Total Suspended Solids

Turbidity is caused by suspended matter or other impurities that interfere with the clarity of the water. It is an optical property that is closely related to the concentration of total suspended solids in the water. In the Beaufort Sea, natural turbidity is caused by particles from riverine discharge, coastal erosion, and resuspension of seafloor sediment, particularly during summer storms (NMFS 2011). Turbidity levels are generally higher during the summer open-water period relative to the winter ice-covered period. Under relatively calm conditions, turbidity levels are likely to be less than 3 Nephelometric Turbidity Units (NTU) and may be in excess of 80 NTU during high wind conditions. Nearshore waters generally have high concentrations of suspended material during spring and early summer due to runoff from rivers. The highest levels of suspended particles are found during breakup (NMFS 2011).

4.5.2. Metals

In the marine environment, metals are found in the dissolved, solid, and colloidal phases. The distribution of metals amounts among the three phases depends upon the chemical properties of the metal, the properties of other constituents of the seawater, and physical parameters. Current EPA water quality criteria for metals in marine waters are based on dissolved-phase metal concentrations because they most accurately reflect the bioavailable fraction, and hence the potential toxicity of a metal (NMFS 2011). The State of Alaska has adopted these criteria for protection of state waters in 18 AAC 70. Although EPA has

established water quality criteria for water, there are no comparable national criteria or standards for chemical concentrations in sediment.

Table 4-1 below summarizes sediment metals data collected between 1984 and 2008 in the Beaufort Sea by BOEM (formerly Minerals Management Service [MMS]) and oil industry monitoring programs. Most samples were collected some distance in both time and space, from exploratory drilling activities, so the concentrations can be considered to represent the natural background. Concentration ranges are mg/kg dry weight (ppm) (Neff 2010).

Table 4-1. Concentrations of Metals Collected in Beaufort Sea Sediments

Years	Arsenic	Barium	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Vanadium	Zinc
1984-1986	--	128-704	0.06-0.27	22-89	7.6-30	--	--	5.7-19	37-142	37-123
1993	10-43	--	0.06-0.43	77-110	11-63	0.04-0.15	21-75	11-26	--	65-160
1997-1999	7-16	116-569	0.11-0.27	13-63	7-27	0.008-0.02	7-34	6-15	24-117	18-96
1999-2001[a]	1.0-23	142-863	0.03-0.75	13-104	3.6-46	0.003-0.11	--	2.8-22	27-173	15-136
1999-2002[a]	4.2-28	155-753	0.03-0.82	13-104	3.6-50	0.003-0.20	6.0-48	3.2-22	27-173	15-157
2001-2002	15-31	525-631	0.14-0.20	91-188	31-37	0.05-0.10[c]	45-52	16-26	147-211	114-146
2003	6.9-20	329-649	0.08-0.45	56-84	16-55	0.005-0.09	26-54	11-29	87-136	48-111
2004-2006	4.7-25	142-863	0.03-0.77	15-100	3.9-46	0.003-0.11	6.9-46	4.3-20	87-156	64-108
2008	9.5-22	456-714	0.16-0.31	59-96	15-27	0.03-0.08	--	9.9-18	87-156	64-108
2008[b]	10-21	585-18,300	0.15-0.24	73-135	21-53	0.04-0.06	--	14-49	113-131	64-108

[a] Brown et al. (2010) summarizes data for 1999 to 2002 MMS ANIMIDA Program; Trefry et al. (2003) summarizes data for 1999 to 2001 for the same program.

[b] Surface sediment samples collected near the Hammerhead exploratory drilling site in Camden Bay in 2008.

[c] Concentration of methylmercury ranged from 0.00001 to 0.00013 ppm.

4.5.3. Ocean Acidification

Over the last few decades, the absorption of atmospheric carbon dioxide (CO_2) by the ocean has resulted in an increase in the acidity of the ocean waters. The greatest degree of ocean acidification worldwide is predicted to occur in the Arctic Ocean. This amplified scenario in the Arctic is due to the effects of increased freshwater input from melting snow and ice and from increased CO_2 uptake by the sea as a result of ice retreat (NMFS 2011). Experimental evidence suggests that if current trends in CO_2 continue, key marine organisms, such as corals and some plankton, will have trouble maintaining their external calcium carbonate skeletons (Orr et al. 2005).

5. DESCRIPTION OF THE EXISTING BIOLOGICAL ENVIRONMENT

This section provides an overview of the biological communities found in the Beaufort Sea. The general groups of aquatic organisms that inhabit the lease sale areas include pelagic (living in the water column), epontic (living on the underside of or in the sea ice), or benthic (living on or in the bottom sediments) plants and animals. The categories of offshore biological environment that discussed are

- Plankton;
- Attached macro- and microalgae;
- Benthic invertebrates;
- Fishes (demersal and pelagic);
- Marine mammals;
- Coastal and marine birds;
- Threatened and endangered species;
- Essential fish habitat (EFH); and
- Beaufort Sea community subsistence profiles.

Each of those biological resources is assessed in terms of seasonal distribution and abundance, growth and production, environmental factors, and habitats. Additional discussions of these resources are found in the Beaufort Sea Biological Evaluation (BE) (Tetra Tech 2012a) and the Essential Fish Habitat (EFH) Assessment (Tetra Tech 2012b).

5.1. Plankton

Plankton can be divided into two major classes: phytoplankton and zooplankton. Plankton are the primary food base for other groups of marine organisms found in the Beaufort Sea Area of Coverage. The distribution, abundance, and seasonal variation of these organisms are strongly influenced by the physical environment. The highest concentrations of phytoplankton in the Beaufort Sea were observed near Barrow (Dunton et al. 2003). The coast near Kaktovik was identified as another productive area with upwelling of nutrient-rich water from offshore areas. The combination of regular upwelling from deep offshore waters in such areas and increased light intensity allow for increased productivity (Dunton et al. 2003). For a full discussion of distribution and abundance of plankton, see the Beaufort Sea BE (Tetra Tech 2012a).

The growth rates of planktonic organisms are relatively rapid, and the generation lengths are relatively short. The major environmental factors influencing phytoplankton production are temperature, light, and nutrient availability. Phytoplankton production is usually limited to the *photic zone*, or the depth to which sunlight penetrates the water. Phytoplankton provide the food base for a variety of secondary producers, including herbivorous zooplankton. Phytoplankton concentrations in coastal waters have been measured 100 times greater than in offshore surface waters. Coastal zones (within 3 mi [5 km]) are the most productive areas for phytoplankton in the Beaufort Sea (MMS 2003).

The growth rates of zooplankton are relatively rapid, and the generation lengths are relatively short. Zooplankton diversity and abundance increase with distance from the shore. Zooplankton standing stock generally fluctuates in response to phytoplankton production. Ongoing research has found that a combination of winds and tides leads to the formation of oceanographic *fronts* between water masses in the Beaufort Sea (Ashjian et al. 2007; Moore et al. 2008 cited in BOEMRE 2008). The fronts concentrate the abundant zooplankton in the coastal water off the Elson Lagoon making it easier for predators to feed on the zooplankton (BOEMRE 2008). No areas or habitats of extraordinary importance have been identified.

5.2. Macroalgae and Microalgae

Alaska's Beaufort Sea shelf is typically characterized by silty sands and mud with an absence of macroalgal beds and associated organisms (Barnes and Reimnitz 1974). A diverse kelp community occurs in the Boulder Patch near Prudhoe Bay in Stefansson Sound. Algae in the Boulder Patch contribute to the important food web supporting many epibenthic and benthic organisms in the area. Differences in biomass between surrounding sediment areas and the Boulder Patch demonstrate the importance of this biologically unique area (Konar 2006; Dunton and Schonberg 2000; Dunton et al. 2005).

A study conducted in the Beaufort Sea, found that kelp grows fastest in late winter and early spring because of higher concentrations of inorganic nitrogen in the water column. The presence of macroalgae is considered rare in the Beaufort Sea. Kelp make up between 50 and 55 percent of the available carbon in the Stefansson Sound kelp community; phytoplankton make up between 23 and 42 percent (Dunton 1984).

During the spring and summer months, large biomasses of photosynthetic ice algae develop on the lower sections of sea ice. Ice algae contribute organic matter to the water column and are an important part of the Arctic marine food web, contributing an average of 57 percent to total Arctic marine primary production (Gosselin 1997). For a full discussion of distribution and abundance of algae, see the Beaufort Sea BE (Tetra Tech 2012a).

5.3. Benthic Invertebrates

Benthic invertebrates live on the bottom of a water body or in the sediment. The distribution, abundance and seasonal variation of benthic species in the Beaufort Sea are strongly correlated with physical factors (e.g., substrate composition, water temperature, depth, dissolved oxygen concentrations, pH, salinity, sediment carbon/nitrogen ratios, and hydrography) (MMS 1990). Benthic organisms are abundant and increase in numbers and diversity in the summer during open water conditions. Areas of high benthic biomass serve as important feeding grounds for known benthic grazers such as walrus, bearded seals, and gray whales. A high abundance of benthic-feeding animals indicates a healthy benthic population (Feder et al. 2007). Available nutrition decreases as the distance from shore increases, resulting in decreased benthic productivity.

The abundance, diversity, biomass, and species composition of benthic invertebrates can be used as indicators of changing environmental conditions. The biomass of benthic invertebrates declines if communities are affected by prolonged periods of poor water quality especially when anoxia and hypoxia are common. Benthic communities can change in response to:

- Nutrient enrichment leading to eutrophication;

- Bioaccumulation of toxins to lethal levels in mollusks (shellfish), crustaceans, polychaetes and echinoderms, and cause the loss of herbivorous and predatory species;
- Lethal and sub-lethal effects of heavy metals and other toxicants derived from oil and gas activities;
- Dislodged epifauna and infauna from trawling and dredging which might result in the collection and mortality of a substantial invertebrate bycatch;
- The replacement of the existing benthic community with other benthic species because of physiological stress or by competition or predation by species better physiologically suited to the modified conditions; and
- Changes in the physical and biological characteristics and structure of habitats (i.e., their function), including supporting habitat such as seagrass meadows and sandy soft bottom areas.

Burrowing and tube-building by deposit-feeding benthic invertebrates (bioturbators) help to mix the sediment and enhance decomposition of organic matter. Nitrification and denitrification are also enhanced because a range of oxygenated and anoxic micro-habitats are created. Loss of nitrification and denitrification (and increased ammonium efflux from sediment) in coastal systems is an important cause of hysteresis, which can cause a shift from clear water to a turbid state. The loss of benthic suspension-feeding macroinvertebrates can further enhance turbidity levels because they filter suspended particles including planktonic algae, and they enhance sedimentation rates through biodeposition (i.e., voiding of their wastes and unwanted food).

Changes in the composition of macrofauna and macroflora cause changes in nutrient storage pools and the flux of nutrients between fauna and flora. Macrofauna are important constituents of fish diets and thus are an important link for transferring energy and nutrients between trophic levels, therefore, driving pelagic fish and crustacean production. For those reasons and others, benthic invertebrates are extremely important indicators of environmental change. Because of the disturbance from grounded ice, most of the benthic species in the Area of Coverage are small and widely distributed, with no obvious spatial trends in the biomass or density of benthic organisms.

5.4. Fishes

Conservative estimates by the U.S. Department of the Interior report that at least 17 species of marine fishes, 13 species of freshwater fishes, 5 species of anadromous fishes, and 7 fish species that can have both freshwater (only) and anadromous populations can be found in the waters of the Beaufort Sea (Wiswar 1992; Wiswar et al. 1995; Wiswar and Fruge 2006; Scanlon 2009; MMS 2008). Anadromous fish-bearing streams flowing through or into the Area of Coverage include the Sagavanirktok, Kuparuk, Colville Aichilik, Hulahula, Alaktak, Chipp, Topagoruk, Okpilak, Kogotpak, Egaksrak, Kongakut, Aichiklik, Canning, Staines, Shaviovik, Kogru, Ikpikpuk, and Meade Rivers. Together, the Beaufort and Chukchi Seas support a large and dynamic Arctic ecosystem that includes as many as 98 fish species representing 23 families (Mecklenburg et al. 2002; MMS 2006:Tables III.B-1 cited in MMS 2008). Fish species likely to be found in the Beaufort general permit Area of Coverage are listed in Table 5-1.

The physical environment, mainly temperature and salinity of the Arctic waters, exerts a strong influence on the temporal and spatial distribution and abundance of fish (MMS 1990, 1991). The Beaufort Sea is characterized by sub-Arctic climate, especially during the open-water season in the later spring and summer. Marine fish in the Beaufort Sea are generally smaller than those in areas farther south, and

densities are much lower (Frost and Lowry 1983). The lower diversity, density, and size of fish in the region have been attributed to low temperatures, low productivity, and lack of nearshore winter habitat because of the presence of ice (MMS 1987b). Table 5-1 lists common fish in the Area of Coverage.

Table 5-1. Common fishes in the Area of Coverage

Freshwater		Anadromous		Marine	
Common name	**Scientific name**	**Common name**	**Scientific name**	**Common name**	**Anadromous**
Arctic blackfish	*Dallia pectoralis*	Arctic cisco*	*Coregonus autumnalis*	Arctic flounder	*Liopsetta glacialis*
Arctic char	*Salvelinus alpinus*	Arctic lamprey*	*Lampetra japonica*	Starry founder	*Platichthys stellatus*
Burbot	*Lota lota*	Bering cisco*	*Coregonus laurettae*	Arctic cod	*Boreogadus saida*
Arctic grayling	*Thymallus arcticus*	Broad whitefish*	*Coregonus nasus*	Saffron cod	*Eleginus gracilis*
Lake chub	*Couesius plumbeus*	Dolly Varden char*	*Salvelinus malma*	Snailfish	*Liparus sp.*
Lake trout	*Salvelinus namaycush*	Humpback whitefish*	*Coregonus pidschian*	Pacific sand lance	*Ammodytes hexapterus*
Longnose sucker	*Catostomus catostomus*	Least cisco*	*Coregonus sardinella*	Pacific Herring	*Clupa harengus*
Ninespine stickleback	*Pungitius pungitius*			Slender eelblenny	*Lurnpenus fabricil*
				Stout eelblenny	*Lumpenus medius*
Round whitefish	*Prosopium cylindraceum*			Eelpout	*Lycodes spp.*
Sheefish	*Stenodus leucichthys*			Arctic sculpin	*Myoxocephalus scorpiodes*
Slimy sculpin	*Cottus cognatus*	Rainbow smelt	*Osmerus mordax dentex*	Whitespotted greenling	*Hexagrammus stelleri*
Trout-perch	*Percopsis omiscomaycus*			Capelin	*Mallotus villosus*
				Fourhorn sculpin	*Myoxocephalus quadricornis*
				Arctic staghorn sculpin	*Gymnocanthus tricuspis*
				Arctic hookear	*Artediellus scaber*
				Bering wolffish	*Anarchichas orientalis*

* The species has populations that can be freshwater only or anadromous (USFWS 2008)

Pacific salmon (chinook, coho, pink, sockeye, and chum), Arctic cod, saffron cod, and snow crab are addressed in detail in the Beaufort EFH (Tetra Tech 2012b).

During the open-water season, the nearshore zone of the Beaufort Sea area is dominated by a band of relatively warm, brackish water that extends across the entire Alaskan coast. The summer distribution and abundance of coastal fishes (marine and anadromous species) are strongly affected by this band of brackish water. The band typically extends 1.6 to 9.7 km (1 to 6 mi) offshore and contains more abundant food resources than waters farther offshore. The areas of greatest species diversity within the nearshore zone are the river deltas. Fish distribution and abundance in the Beaufort Sea vary by species and are determined primarily by nutritional and spawning needs. Anadromous fish in the Beaufort Sea spend

most of their lives in fresh water and do not travel far into deep ocean waters. In comparison, many marine fish species are pelagic, spending their entire life in deeper ocean waters. The more common anadromous fish species in the Beaufort Sea are Dolly Varden char, whitefish, cisco and salmon.

A lack of overwintering habitat is the primary factor limiting Arctic fish populations (DNR 1999). Spawning in the Arctic environment can take place only where there is an ample supply of oxygenated water during winter. Because of that and because few potential spawning sites meet that requirement, spawning often takes place in or near the same area where fishes overwinter (MMS 2008). Most marine species spawn in shallow coastal areas during the winter. The warmer nearshore zone with its more moderate salinity is thought to be an essential nursery area for juvenile Arctic cod (Cannon et al. cited in MMS 2003). Because of the key role Arctic cod play in the food chain of the Beaufort Sea, any identified spawning habitats could be considered critical areas. Although Arctic cod are known to spawn in the winter under the ice, most of their spawning areas are unknown (Morris 1981). Arctic cod are most often found around pressure ridges and rafted ice, where the undersurface of the ice is rough (MMS 1991). Typical habitats include crevices, holes, caverns, and small ice cracks. Traditional knowledge workshop participants identified the Colville River Delta as one of the most significant nearshore fish habitat along the coast. Respondents indicated that broad white fish and Arctic cisco spawn inside the various channels of the Colville River Delta (SRB&A 2011).

5.5. Marine Mammals

Common (at least seasonally) marine mammals in the Area of Coverage include spotted, ringed, and bearded seals; bowhead, beluga, killer, and gray whales; polar bear; and walrus. At least six other species of marine mammals (minke whales, fin whales, humpback whales, harbor porpoise, narwhal, and ribbon seals) are found occasionally in the Area of Coverage. Those species of marine mammals that are protected by the Endangered Species Act within in the Area of Coverage (bowhead whale, fin whale, and polar bear) are discussed in the Beaufort Sea BE (Tetra Tech 2012a).

Ringed Seal. Ringed seals (*Phoca hispida*) are circumpolar in distribution (Angliss and Outlaw 2008). They are found in all seas of the Arctic Ocean including the northern Bering, Chukchi, and Beaufort (ADF&G 1994). Ringed seals live on or near the ice year-round; therefore, the seasonal ice cycle has an important effect on their distribution and abundance (MMS 2008). In winter, highest densities of ringed seals occur in the stable shorefast ice. Ringed seals appear to prefer ice-covered waters and remain in contact with ice for most of the year (Allen and Angliss 2010). Ringed seals live on and under extensive, largely unbroken, shorefast ice (Frost et al. 2002), and they are generally found over water depths of about 10 to 20 m (33 to 66 ft) (Moulton et al. 2002). Traditional knowledge workshop participants identified general areas where seals were reported to congregate included along the pack ice, in merging currents, in bays, lagoons, and river deltas (SRB&A 2011).

Spotted Seal. The spotted seal (*Phoca largha*) is found in the Bering, Chukchi, and Beaufort Seas (Angliss and Outlaw 2008; NMFS 2009). From September to mid-October, spotted seals that summered in the Beaufort Sea migrate to the Bering Sea and spend the winter and spring periods offshore north of the 200-m (656-ft) isobath along the ice front, where pupping, breeding, and molting occur (Lowry et al. 2000). Spotted seal is usually a summer visitor and they are usually in the lagoons around the barrier islands or around bays like Admiralty Bay, and Smith Bay. Workshop participants identified Dease Inlet as important feeding area because of the abundance of fish (SRB&A 2011).

Bearded Seal. Bearded seals (*Erignathus barbatus*) are distributed over the continental shelf of the Bering and Chukchi seas with only seasonal migrations into the Beaufort Sea. They tend to be found over waters less than 200 m (656 ft) deep. The majority of the bearded seal population in Alaska is found in the Bering and Chukchi Seas. This species usually prefers areas of less-stable or broken sea ice, where breakup occurs early in the year (Burns 1967). They are found in nearshore areas of the central and western Beaufort Sea during summer (MMS 2008). Important feeding grounds for bearded seal include areas along ice edges, in the currents between the barrier islands and near river mouths, and in shallow areas with abundant clam beds. Traditional knowledge workshop participants indicated that bearded seals are not confined to ice areas. Bearded seals like the feel of moving water, especially during molting (SRB&A 2011).

Walrus. The Pacific walrus (*Odobenus rosmarus divergens*) is most commonly found in relatively shallow water areas, close to ice or land. The majority of the walrus population occurs west of Barrow (Chukchi Sea), although a few walrus can move east throughout the Alaskan portion of the Beaufort Sea to Canadian waters during the open-water season (Fay 1982). Pacific walrus are benthic feeders, foraging in the sediments of the seafloor. Such feeding behavior results in disturbance of wide areas of the seafloor (Nelson et al. 1994). Traditional knowledge workshop participants identified that while it is relatively rare to see walruses in the Beaufort Sea, Nuiqsut residents have spotted them near Cross Island, Thetis Island, the area outside the Nigliq Channel of the Colville River. Respondents typically spotted walrus hauled out on Cross Island or feeding near Cross Island when sea ice was far from shore (SRB&A 2011).

Beluga Whale. Two stocks of beluga whales (*Delphinapterus leucas*) inhabit the Alaskan Chukchi Sea: the Eastern Chukchi Stock and the Beaufort Stock. The summer Beaufort Sea stock breeds during the summer mostly in the Mackenzie Delta (Hazard 1988) and spends the early fall along the edge of the Beaufort Sea pack ice before they too migrate through the Chukchi to Bering Sea wintering grounds (Allen and Angliss 2010). During the late summer and early fall, both stocks can be found as far north as latitude 80°N in waters deeper than 200 m (656 ft) (Suydam et al. 2005). Local hunters report that beluga regularly use an area near Cape Beaufort. They indicate that the area experienced a landslide in which a significant portion of a shoreline mountain slid into the sea resulting in a rocky area used by many fish (SRB&A 2011). Traditional knowledge workshop participants identified that feeding areas for beluga are generally closer to shore than feeding areas for bowhead whales and that they tend to concentrate in bays, mouths of rivers, Elson Lagoon, and near reefs (SRB&A 2011).

Gray Whale. The gray whale (*Eschrichtius robustus*) migrates into the Chukchi and Beaufort Seas during spring to feed throughout the late spring, summer, and early fall. They migrate out of the Chukchi and Beaufort Seas with freeze up and migrate south out of the Bering Sea during November to December (Rice and Wolman 1971). Small numbers of gray whales have been observed in the Beaufort Sea east of Point Barrow. Most migrating whales occur within 15 km (9.3 mi) of land (Green et al. 1995) but have been observed up to 200 km (124.3 mi) offshore (Bonnell and Dailey 1993). Traditional knowledge workshop participants noted seeing gray whales in Camden Bay by Collinson Point and stated that the entire area near Kaktovik is an important whale habitat area for several species of whales (SRB&A 2011).

Polar Bear. Polar bears *(Ursus maritimus)* are widely distributed throughout the Arctic where the sea is ice-covered for large portions of the year. Sea ice provides a platform for hunting and feeding, for seeking mates and breeding, for denning, and for long-distance movement. Ringed seals are polar bear's primary food source, and areas near ice edges, leads, or polynyas where ocean depth is minimal are the most

productive hunting grounds. While polar bears primarily hunt seals for food, they may occasionally consume other marine mammals, including via scavenging on their carcasses (USFWS 2009).

This behavior was also discussed during the Traditional knowledge workshops, where participants indicated that whale carcasses provide easy feeding opportunities and attract polar bears, making Cross Island, Barter Island, and Point Barrow (areas where butchered whale carcasses are deposited) prime feeding grounds. Additionally, respondents indicated that polar bears follow bearded seals in the fall and are seen near the barrier islands (SRB&A 2011). Traditional knowledge workshop participants reported that during the winter, polar bear dens are found in both offshore and onshore environments. Participants commented that on land, polar bears will den along rivers and in areas with larger snow drifts. They also stated that polar bears will den offshore when there is adequate ice and pressure ridges in which they can make their den (SB&RA 2011).

5.6. Coastal and Marine Birds

Migratory birds are a significant component of the marine ecosystem of the Area of Coverage. The area encompasses foraging, nesting, and rearing areas for several million birds. Descriptions of coastal and marine bird distribution are discussed in detail in the Beaufort BE (Tetra Tech 2012a). Most species in the Area of Coverage are migratory and present in the Arctic only seasonally, from May through early November. Some species appear only during migration; others nest, molt, feed, and accumulate critical fat reserves needed for migration while in the area (MMS 1987a). The main categories of species in the Area of Coverage include waterfowl (e.g., duck, goose, swan), seabirds (e.g., loon, gull, tern), shorebirds (e.g., sandpiper, plover, crane), and raptors (e.g., hawks, eagles, falcons). A complete list of all bird species within those groups for the Area of Coverage is presented in Table 5-2 through Table 5-5.

Table 5-2. Shorebirds in the Area of Coverage

Common name	Scientific name	Breeds in Area
Sandhill crane	*Grus Canadensis*	X
Black-bellied plover	*Pluvialis squatarola*	
American golden-plover	*Pluvialis dominica*	X
Semipalmated plover	*Charadrius semipalmatus*	X
Whimbrel	*Numenius phaeopus*	X
Hudsonian godwit	*Limosa haemastica*	
Bar-tailed godwit	*Limosa lapponica*	X
Ruddy turnstone	*Arenaria interpres*	X
Black turnstone	*Arenaria melanocephala*	
Sanderling	*Calidris alba*	
Semipalmated sandpiper	*Calidris pusilla*	X
Western sandpiper	*Calidris mauri*	X
White-rumped sandpiper	*Calidris fuscicollis*	X
Baird's sandpiper	*Calidris bairdii*	X
Stilt sandpiper Pectoral sandpiper	*Calidris himantopus* *Calidris melanotos*	X
Buff-breasted sandpiper	*Tryngites subruficollis*	
Dunlin	*Calidris alpina*	X
Long-billed dowitcher	*Limnodromus scolopaceus*	X
Common snipe	*Gallinago gallinago*	X
Red-necked phalarope	*Phalaropus lobatus*	X
Red phalarope	*Phalaropus fulicaria*	X
Pelagic cormorant	*Phalacrocorax pelagicus*	X

Table 5-3. Raptors in the Area of Coverage

Common name	Scientific name	Breeds in Area
Northern harrier	*Cirus cyaneus*	X
Rough-legged hawk	*Buteo lagopus*	X
Golden eagle	*Aquila chrysaetos*	X
Peregrine falcon	*Falco peregrinus*	X
Gyrfalcon	*Falco rusticolus*	X
Snowy owl	*Bubo scandiacus*	X
Short-eared owl	*Asio flammeus*	X
Merlin	*Falco columbarius*	

Table 5-4. Seabirds in the Area of Coverage

Common name	Scientific name	Breeds in Area
Red-throated loon	*Gavia stellata*	X
Pacific loon	*Gavia pacifica*	X
Yellow-billed loon	*Gavia adamsii*	X
Red-necked grebe	*Podiceps grisegena*	X
Northern fulmar	*Fulmarus glacialis*	
Pomerine jaeger	*Stercorarius pomarinus*	X
Parasitic jaeger	*Stercorarius parasiticus*	X
Long-tailed jaeger	*Stercorarius longicaudus*	X
Mew gull	*Larus canus*	X
Herring gull	*Larus argentatus*	
Glaucous gull	*Larus hyperboreus*	X
Sabine's gull	*Xema sabini*	X
Glaucous-winged gull	*Larus glaucescens*	
Black-legged kittiwake	*Rissa tridactyla*	X
Arctic tern	*Sterna paradisaea*	X
Black guillemot	*Cepphus grille*	X

Table 5-5. Waterfowl in the Area of Coverage

Common name	Scientific name	Breeds in Area
Mallard	*Anas platyrhynchos*	X
Tundra swan	*Cygnus columbianus*	X
Greater white-fronted goose	*Anser albifrons*	X
Snow goose	*Anser caerulescens*	
Canada goose	*Branta canadensis*	X
Emperor goose	*Anser canagicus*	X
Green-winged teal	*Anas crecca*	X
Black Brant (or brent)	*Branta bernicla nigricans*	X
Northern pintail	*Anas acuta*	X
Northern shoveler	*Anas clypeata*	X
American wigeon	*Anas americana*	+
Greater scaup	*Aythya marila*	X
Common eider	*Somateria mollissima*	X
King eider	*Somateria spectabilis*	X
Oldsquaw or long-tailed duck	*Clangula hyemalis*	X

Common name	Scientific name	Breeds in Area
Black (or common) scoter	*Melanitta nigra*	
Surf scoter	*Melanitta perspicillata*	
White-winged scoter	*Melanitta fusca*	
Red-breasted merganser	*Mergus serrator*	X

Aerial surveys in the Beaufort Sea have documented that birds are widespread in substantial numbers in both nearshore and offshore waters of the Area of Coverage (MMS 2008) and it is likely that this approximate distribution prevails along most of or all the Beaufort coastline and into the northern Chukchi Sea during the open-water season. Traditional knowledge workshop participants stated that birds follow open ice leads during spring migration (SRB&A 2011). The Sagavanirktok, Kuparuk, Ikpikpuk, and Colville Rivers have been identified as important nesting and breeding areas for waterfowl (MMS 1996). Traditional knowledge workshop participants confirmed the Colville River Delta, the mouth of the Kalikpik River, Fish Creek, Teshekpuk Lake, and the barrier islands as important feeding grounds and nesting areas for birds (SRB&A 2011).

Birds occur out to at least 70 km (43.5 mi) offshore where open water is available, although bird densities generally are lower in offshore areas. Offshore, the highest bird density is associated with open-water leads (MMS 1991). Most avian species migrate eastward along a broad front, which could include inland, coastal, and offshore routes; arrival dates for various species range from late April to early June (MMS 2003). The availability of open water off river deltas and in leads determines migratory routes and distribution of waterfowl and seabirds. Raptors (Table 5-3) are present in the Area of Coverage during the spring.

Most shorebirds and other waterfowl concentrate in snow-free coastal or inland areas until nest sites are available (MMS 1982). Traditional knowledge workshop participants identified that the entire coast is important for a variety of eider, geese, and duck species that migrate to this area for nesting in warmer months. Sea birds such as eiders migrate along the coast and in open leads from the west and east, whereas inland waterfowl migrate along rivers and through mountain passes. Shorebirds also nest and feed in the same areas as other waterfowl. Key nesting habitat areas identified included barrier islands, sand spits, and river banks (SRB&A 2011). Traditional knowledge workshop participants said that brants, long-tailed ducks, and Canada geese molt at the various points found along the Beaufort Sea coast, including Beechy Point and the area east of Oliktok Point (SRB&A 2011).

Shorebirds are numerically dominant in most coastal plain bird communities occurring across northern Alaska (including the Arctic National Wildlife Refuge) and Canada (including Kendall Island Bird Sanctuary). Along the Beaufort coastline, nonincubating members of shorebird pairs concentrate in coastal habitats as early as mid-June. In late June to early July, several species move to habitats surrounding small coastal lagoons and nearby brackish pools. In late July and early August, adults relieved of parental duties flock in shoreline areas before migration. Most shorebirds have departed the area by mid-September.

Five types of habitat particularly capable of supporting a variety of marine and coastal avifauna are the barrier islands, coastal lagoons, coastal salt marshes, river deltas, and offshore areas. The coastal waters are primary habitat for nesting, molting, feeding, and resting activities of migratory marine birds. The highest nesting densities generally occur in areas of mixed wet and dry habitats, whereas birds often move to wetter areas for broodrearing. Islands in river deltas and barrier islands provide the principal nesting

habitat for several waterfowl and marine bird species in the Area of Coverage. Shorebirds prefer wet-tundra habitats or well-drained, gravelly areas for nesting, whereas loons use lakes, and geese prefer deeper ponds or wet tundra near lakes. Lagoons formed by barrier islands, bays, and river deltas provide important broodrearing and staging habitat for waterfowl, particularly molting oldsquaws. (MMS 2008).

Major concentrations of birds occur nearshore [in waters shallower than 20 m (66 ft)] and in coastal areas along the Beaufort Sea. Important nesting habitat for loons, waterfowl, and shorebirds and foraging habitat for seabirds nesting also occur in the region. Populations of molting waterfowl occur along the Beaufort Sea coast from late June through August. Post-molting and broodrearing brant use various coastal habitats such as sloughs and tidal flats from early July through August (MMS 2003).

5.7. Threatened and Endangered Species

The Endangered Species Act (ESA) requires federal agencies to consult with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service (NMFS) if the federal agency's actions could beneficially or adversely affect any threatened or endangered species or their critical habitat. In this case, the federal agency is the EPA, and the federal action is the issuance of the Beaufort general permit.

The action could affect species under the jurisdiction of both the U.S. Fish and Wildlife Service and NMFS. This section describes the endangered, threatened, and proposed species in the Area of Coverage and their critical habitat designations. Potential effects on these species and their critical habitat from the exploration discharges are discussed in Section 6.3. As noted above, a separate Biological Evaluation (BE) has been conducted for these species. Two listed birds (spectacled and Steller's eider), one listed whale (bowhead), and one listed carnivore (polar bear) spend a portion of their lives in or migrate through the Area of Coverage. Two species of seals (ringed and bearded) are proposed for protection under ESA and are also evaluated. A summary of each species' status, and which species have critical habitat designations, is provided in Table 5-6. The BE contains a detailed analysis of the potential effects of the permit action on the listed species.

On February 2, 2012, EPA sent the BEs to USFWS and NMFS and initiated the ESA Section 7 consultation process. EPA requested concurrence from USFWS and NMFS that the reissuance of the general permits "may affect, but are not likely to adversely affect" federally listed threatened, endangered or proposed species under their jurisdiction. EPA received ESA concurrence letters from USFWS and NMFS on March 30, 2012, and April 11, 2012, respectively. USFWS and NMFS concurred with EPA's determinations that the discharges from exploration activities in the Beaufort Sea, as authorized by the general permit, may affect, but are not likely to adversely affect, the following listed, candidate, and proposed species and designated critical habitats: bowhead, fin, and humpback whales, bearded and ringed seals, spectacled and Steller's eiders, Pacific walrus, Yellow-billed loons, and polar bears.

Table 5-6. Summary of Endangered Species Act-listed, candidate, and proposed species occurring in the Area of Coverage

Common name	Scientific name	ESA status	Critical habitat designated within the action area	Reason for ESA listing
Bowhead whale	*Balaena mysticetus*	Endangered	No	Effects on population due to historic commercial whaling, habitat degradation, and ongoing whaling in other countries and other anthropogenic related disturbances
Fin whale	*Balaenoptera physalus*	Endangered	No	Effects on population due to historic commercial whaling, habitat degradation, and ongoing whaling in other countries and other anthropogenic related disturbances
Humpback whale	*Megaptera novaeangliae*	Endangered	No	Effects on population due to historic commercial whaling, habitat degradation, and ongoing whaling in other countries and other anthropogenic related disturbances
Polar bear	*Ursus maritimus*	Threatened	Yes	Global climate change and its effects on Arctic sea-ice is the primary effect on polar bear populations
Spectacled eider	*Somateria fischeri*	Threatened	Yes	The causes of the spectacled eider's population decline are currently unknown; however, it is likely due to loss of habitat
Steller's eider	*Polsticta stelleri*	Threatened	No	The causes of the Steller's eider population decline include increased predation, over hunting, ingestion of lead shot, habitat loss, exposure to environmental toxins, scientific exploitation, and the effects of global climate change
Bearded seal	*Erignathus barbatus nauticus*	Proposed	No	Effects on bearded seal populations have included direct harvesting, indirect mortalities as a result of fisheries, mortalities resulting from marine mammal research activities, and the effects of global climate change in the Arctic environment
Ringed seal	*Phoca hispida hispida*	Proposed	No	Effects on ringed seal populations have included direct harvesting, indirect mortalities as a result of fisheries, mortalities resulting from marine mammal research activities, and the effects of global climate change in the Arctic environment
Pacific walrus	*Odobenus rosmarus brevirostris*	Candidate	No	Effects on walrus populations have included historic commercial hunting, pollution and noise disturbances related to the oil and gas industry, and the effects of global climate change on the Arctic environment
Yellow-billed loon	*Gavia adamsii*	Candidate	No	Yellow-billed loons are vulnerable to population decline due to their small population size, low reproductive rate, and specific breeding habitat requirements

5.8. Essential Fish Habitat

Essential Fish Habitat (EFH) consists of the waters and substrate necessary for fish to spawn, breed, feed, or grow to maturity, as defined by NMFS for specific fish species. The *Fishery Management Plan for Fish Resources of the Arctic Management Area* (Arctic FMP) (NPFMC 2009) and the *Salmon Fishery Management Plan for Coastal Alaska* (NPFMC 1990) apply within the Area of Coverage. Within the Beaufort Sea, EFH has been established for Arctic cod (adult and late juvenile), saffron cod, opilio crab and the five species of Pacific salmon, chinook, coho, pink, sockeye, and chum in the adult and late juvenile life stages. The Magnuson-Stevens Fishery Conservation and Management Act (January 21, 1999) requires EPA to consult with NMFS when a proposed discharge has the potential to adversely affect (reduce quality or quantity, or both, of) EFH. The EFH assessment, included as Appendix A to the BE, concluded that the discharges will not adversely affect essential fish habitat in the Beaufort Sea Area of Coverage. Table 5-7 lists the EFH species potentially present in the Area of Coverage.

Table 5-7. EFH species potentially present in the Area of Coverage

Common name	Scientific name
Pacific salmon- chinook, coho, pink, sockeye, chum	*Oncorhynchus tshawytscha, O. kisutch, O. gorbuscha, O. nerka, O. keta*
Arctic cod	*Boreogadus saida*
Saffron cod	*Eleginus gracilis*
Opilio snow crab	*Chionoecetes opilio*

5.9. Beaufort Sea Community Subsistence Profiles

Subsistence uses are central to the customs and tradition of many communities and Native Villages in Alaska, including the North Slope Iñupiat. Subsistence customs and traditions encompass processing, sharing, redistribution networks, and cooperative and individual hunting, fishing, and ceremonial activities. Both federal and state regulations define subsistence uses to include the customary and traditional uses of wild renewable resources for food, shelter, fuel, clothing and other uses (Alaska National Interest Lands Conservation Act, Title VIII, Section 803, and Alaska Statute [AS] 16.05.940[33]). Regionally, the North Slope Borough Municipal Code defines subsistence as, ―a activity performed in support of the basic beliefs and nutritional needs of the residents of the Borough and includes hunting, whaling, fishing, trapping, camping, food gathering, and other traditional and cultural activities." (NSBMC 19.20.020[67])

While subsistence-resource harvests differ among communities, with a few local exceptions, the combination of caribou, bowhead whales, and fish has been identified as the primary grouping of resources harvested. The bowhead whale is the preferred meat and the subsistence resource of primary importance because it provides a unique and powerful cultural basis for sharing and community cooperation (Stoker 1983, as cited by MMS 2008). Depending on the community, fish is the second or third most important resource. Bearded seals and various types of birds also are considered primary subsistence species. Waterfowl are particularly important during the spring, when they provide variety to the subsistence diet. Seal oil from hair seals and bearded seals is an important staple and a necessary complement to other subsistence foods.

The community subsistence profiles include the North Slope coastal communities closest to the potential areas of discharge in the Area of Coverage and focus on the primary marine subsistence resources of the communities of Barrow, Kaktovik, and Nuiqsut. Table 5-8 below summarizes the percent total subsistence harvest by species (NMFS 2011).

Table 5-8. Percent Total Subsistence Harvest by Species.

Species	Barrow (1987-1989)	Kaktovik (1992-1993)	Nuiqsut (1993)
Bowhead whale	38%	63%	29%
Beluga whale	--	--	--
Seals	6%	3%	3%
Walrus	9%	--	--
Fish	11%	13%	34%
Polar bear	2%	1%	--
Waterfowl	4%	2%	2%

5.9.1. Barrow

Barrow, with a population of 4,212 in 2010 (U.S. Census Bureau 2010), enjoys a diverse resource base that includes marine and terrestrial animals. Barrow's location at the demarcation point between the Chukchi and Beaufort Seas is unique, offering opportunities for hunting a diversity of marine and terrestrial mammals and fishes (MMS 2008). The Barrow marine subsistence resource areas extend 97 km (60 mi) to the north as far east as Prudhoe Bay, and as far west as Kasegaluk Lagoon near Wainwright (SRB&A 2011). The City of Barrow was incorporated in 1958 and is the largest community within the North Slope Borough.

Barrow Subsistence-Harvest

Bowhead Whale. Barrow residents hunt the bowhead whale during both spring and fall; however, more whales are harvested during the spring whale hunt, which is the major whaling season (MMS 2008). In 1977 the International Whaling Commission established an overall quota for subsistence hunting of the bowhead whale by the Alaskan Iñupiat. The Alaska Eskimo Whaling Commission regulates the quota, and it annually decides how many bowheads each whaling community may take. Barrow whalers continue to hunt in the fall to meet their quota and often provide assistance to other communities. During the spring hunt, there are approximately 30 whaling camps along the edge of the landfast ice. The locations of the camps depend on ice conditions and currents. Most whaling camps are south of Barrow, some as far south as Walakpa Bay (MMS 2008).

Depending on the season, the bowhead whale is hunted in two areas. In the spring (from early April until the first week of June), bowhead whales are hunted from open leads in the ice (e.g., areas of open water) when pack-ice conditions deteriorate. At that time, they are harvested along the coast from Point Barrow to the Skull Cliff area; the distance of the leads from shore varies from year to year. The leads generally are parallel and quite close to shore, but occasionally they break directly from Point Barrow to Point Franklin and force Barrow whalers to travel over the ice as much as 10 miles offshore to the open leads. Typically, the lead is open from Point Barrow to the coast; and hunters whale only 1.6–4.8 km (1–3 mi) from shore. A struck whale can be chased in either direction in the lead. Spring whaling in Barrow is conducted almost entirely with skin boats, because the narrow leads prohibit the use of aluminum skiffs,

which are more difficult to maneuver than the traditional skin boats (MMS 2008). Fall whaling occurs east of Point Barrow from the Barrow vicinity to Cape Simpson.

Hunters use aluminum skiffs with outboard motors to chase the whales during the fall migration, which takes place in open water up to 48.3 km (30 mi) offshore. No other marine mammal is harvested with the intensity and concentration of effort that is expended on the bowhead whale (MMS 2008; SRB&A 2011, Map 27).

Beluga Whale. Beluga whales hunting begins at the spring whaling season through June and occasionally in July and August in ice-free waters. Barrow hunters do not like to hunt beluga whales during the bowhead hunt, preferring to harvest them after the spring bowhead season ends, a situation that depends on when the bowhead quota is met. Beluga whales are harvested in the leads between Point Barrow and Skull Cliff. Later in summer, they occasionally are harvested on both sides of the barrier islands of Elson Lagoon (MMS 2008; SRB&A 2011, Map 26).

Seals. Hair seals are available from October through June; however, because of the availability of bowheads and bearded seals during various times of the year, seals are harvested primarily during the winter, especially from February through March. Ringed seals are the most common hair seal species harvested, and spotted seals are harvested only in the ice-free summer months. Ringed seal hunting is concentrated in the Chukchi Sea, although some hunting occurs off Point Barrow and along the barrier islands that form Elson Lagoon. During the winter, leads in the area immediately adjacent to Barrow and north toward the point make this area an advantageous spot for seal hunting.

The hunting of bearded seals is an important subsistence activity in Barrow because the bearded seal is a preferred food and because bearded seal skins are the preferred covering material for the skin boats used in whaling. Six to nine skins are needed to cover a boat. For those reasons, bearded seals are harvested more than the smaller hair seals. Most bearded seals are harvested during the spring and summer months and from open water during the pursuit of other marine mammals in both the Chukchi and Beaufort seas (NSB 1998; SRB&A 2011, Map 29). Occasionally, they are available in Dease Inlet and Admiralty Bay (MMS 2008).

Fishes. Barrow residents harvest marine and riverine fishes, but their dependency on fish varies according to the availability of other resources. Capelin, char, cod, grayling, salmon, sculpin, and whitefish are harvested (MMS 2008). Fishing occurs primarily in the summer and fall months and peaks in September and October. Tomcod are harvested during the fall and early winter when there is still daylight (NSB 1998). The subsistence-harvest area for fish is extensive, primarily because Barrow residents supplement their camp food with fish whenever they are hunting (MMS 2008; SRB&A 2011, Map 31).

Walrus. Walruses are harvested during the summer marine mammal hunt west of Point Barrow and southwest to Peard Bay. Most hunters will travel no more than 24–32 km (15–20 mi) to hunt walruses. The major walrus hunting effort occurs from late June through mid-September, with the peak season in August (MMS 2008; SRB&A 2011, Map 30).

Waterfowl. Migratory birds, particularly eider ducks and geese, provide an important food source for Barrow residents because of the dietary importance of birds as the first source of fresh meat in the spring. In May geese are hunted, and hunters travel great distances along major inland rivers and lakes to harvest them; most eider and other ducks are harvested along the coast (Schneider, Pedersen, and Libbey 1980;

SRB&A 2011, Map 32). Eggs from a variety of species still are gathered occasionally, especially on the offshore islands where foxes and other predators are less common. Waterfowl, hunted during the whaling season (beginning in late April or early May) when their flights follow the open leads, provide a source of fresh meat for whaling camps. Later in the spring, Barrow residents harvest many geese and ducks, with the harvest peaking in May and early June but continuing until the end of June. Birds may be harvested throughout the summer but only incidentally to other subsistence activities. In late August and early September, with peak movement in the first 2 weeks of September, ducks and geese migrate south and are again hunted by Barrow residents. Birds, primarily eiders and other ducks, are hunted along the coast from Point Franklin to Admiralty Bay and Dease Inlet. Concentrated hunting areas also are along the shores of the major barrier islands of Elson Lagoon. During spring whaling, families not involved with whaling might go geese hunting; successful whaling crews also might be hunting geese while other crews are still whaling (NSB 1998; MMS 2008).

Polar Bear. Barrow residents hunt polar bears from October to June (SRB&A 2011, Map 28). Polar bears compose a small portion of the Barrow subsistence harvest (MMS 2008).

5.9.2. Kaktovik

Kaktovik is on Barter Island off the Beaufort Sea coast with population of 239 residents (U.S. Census Bureau 2010). Important Kaktovik marine subsistence resources include bowhead and beluga whales, seals, polar bears, fishes, and marine and coastal birds (MMS 2008). All Kaktovik's marine subsistence-harvest area is within the Area of Coverage (SRB&A 2011). The maximum distance for Kaktovik's reported offshore use is 56 km (35 mi) (for bowhead and walrus). Along the coast, their use area extends as far east as the Mackenzie River Delta in Canada (fish and waterfowl) and the west as far as the Return Islands near the Kuparuk River Delta (for waterfowl) (SRB&A 2011).

Kaktovik Subsistence Harvest

Bowhead Whale. Bowhead whaling occurs between late August and early October with the exact timing depending on ice and weather conditions. The whaling season can range anywhere from longer than 1 month to less than 2 weeks, depending on conditions. As in Nuiqsut, Kaktovik whalers hunt the bowhead in the fall in aluminum skiffs in open water rather than in skin boats from the edge of ice leads. Whaling crews generally hunt bowheads within 16 km (10 mi) of shore but occasionally can range as much as 32 km (20 mi) from the coast (MMS 2008; SRB&A 2011, Map 54).

Beluga Whale. Beluga whales usually are harvested in August through November incidental to the bowhead harvest. However, belugas are sometimes taken earlier in the open-water season, when boating and camping groups are concentrating on the harvest of seals, caribou, or fish (MMS 2008). Traditional knowledge workshop participants reported that the community harvests beluga near Kaktovik in Bernard Harbor and Jago and Kaktovik Lagoons and noted that beluga are found in many other bays and areas along the coast and could be harvested from those locations (SRB&A 2011).

Seals. Seals are hunted year-round, but the bulk of the seal harvest occurs during the open-water season from July to September. During winter, those harvests consist almost exclusively of ringed seals taken along open leads in the ocean ice many miles offshore. Summer harvests are made by boat crews and consist of ringed, bearded, and spotted seals. Summer seal hunting typically occurs 8–16 km (5–10 mi) offshore but can range up to 32 km (20 mi) offshore. The seal use area extends from Prudhoe Bay to Demarcation Bay (MMS 2008; SRB&A 2011, Map 56). Traditional knowledge workshop participants

reported that the seal use areas for the community are also from Cross Island south to areas all along the coastline (SBR&A 2011). Seal meat is eaten, and bearded seal meat is most preferred. However, the primary dietary significance of seals comes from seal oil, which is served with every meal that includes subsistence foods. Seal oil also is used as a preservative for meats, greens, and berries. Sealskins are important in manufacturing clothing. Because of their beauty, spotted seal skins often are preferred for making boots, slippers, mitts, and parka trim, but ringed seal skins also are important in manufacturing those same items. Bearded seal hides are necessary for the manufacturing boot soles. Sealskin products such as boots, slippers, mitts, and parkas are sold, bartered, and given as gifts to relatives and friends (MMS 2008).

Walrus. Walruses are harvested much less frequently than seals in Kaktovik, because the community lies east of the walruses' optimum range. They are harvested only opportunistically by boat crews hunting other species in July and August. Harvests occur in open water along the coast in conjunction with seal hunting. Walruses are rare for Kaktovik because they are on the eastern limit of the walrus migratory range; however, if a hunter brings one home, there is a great celebration as one animal could feed an entire village (MMS 2008; SRB&A 2011, Map 57).

Polar Bear. Polar bears are harvested during the winter months on ocean ice and along ocean leads (MMS 2008). Kaktovik's subsistence use area for polar bear extends all along the coast from the west of Mikkelsen Bay to the east around Demarcation Bay and extends offshore of Kaktovik approximately 48 km (30 mi) (SRB&A 2011, Map 55).

Fishes. Fish is an important subsistence resource for Kaktovik. The community's harvest of most other subsistence resources can fluctuate widely from year to year because of variable migration patterns of game. Additionally, in January and February, fish can provide the only source of fresh subsistence foods. In the summer, Kaktovik residents primarily harvest Arctic char. Sea-run char are caught all along the coast, around the barrier islands, and up the navigable portions of the river deltas. Char are the first fish to appear after the ice is gone in early July and are caught until late August. Arctic cisco are harvested in the ocean after the Arctic char run peaks, beginning about the first of August through early September. Grayling are a major subsistence fish taken in the Hulahula River and in many other area rivers and river deltas. Late summer, after freeze up, and again in the spring, are the most likely times to catch grayling. Cisco are taken in the lagoons, river deltas, and particularly the small lakes and streams of the river drainages. Broad whitefish are harvested in the deeper lakes and channels of the Canning River Delta from July through September. Less commonly harvested are round whitefish, also harvested in the Canning River, and pink and chum salmon are occasionally taken in July and August near Barter Island (Jacobsen and Wentworth 1982; MMS 2008; SRB&A 2011, Map 58).

Arctic flounder and fourhorn sculpin occasionally are taken during summer ocean fishing off Manning Point, Drum Island, Arey Spit, and in Kaktovik Lagoon between Manning Point and the mainland. Arctic cod, or tomcod, and smelt are caught in the summer along the Beaufort Sea coast, sometimes near the spits off Barter Island. Tomcod and smelt are sometimes caught by jigging in October and November north of Barter Island and at Iglukpaluk. Blackfish is harvested in the spring in the Canning, Hulahula, Kongakut, and, especially, the Aichilik Rivers. Because of the important role of fish as an abundant and stable source of fresh food during midwinter months, it is shared at Thanksgiving and Christmas feasts, and given to relatives, friends, and village elders. Subsistence uses in Kaktovik are similar to those found elsewhere on the North Slope, where fish figures in existing traditional sharing and bartering networks of the communities (Jacobsen and Wentworth 1982; MMS 2008; SRB&A 2011, Map 58).

Waterfowl. Since the mid-1960s, waterfowl and coastal birds as a subsistence resource have been growing in importance. The most important subsistence species of birds for Kaktovik are the black brant, long-tailed duck, eiders, snow goose, Canada goose, and pintail duck. Other birds, such as loons, occasionally are harvested. Waterfowl hunting occurs mostly in the spring, from May through early July; normally, a less-intensive harvest continues throughout the summer and into September. During spring, birds are harvested by groups of hunters that camp along the coast, with spits and points of land providing the best hunting locations. In summer and early fall, bird hunting occurs as an adjunct to other subsistence activities, such as checking fishing nets (MMS 2008; SRB&A 2011, Map 59).

Virtually the entire community of Kaktovik participates in the spring bird hunt. The hunt occurs at the end of the school year and has become a major family activity. Because waterfowl is a highly preferred food, it is shared extensively in the community, and birds are given to relatives, friends, and village elders. While most birds are eaten fresh, usually in soup, some are stored for the winter. Waterfowl is served for special occasions and holiday feasts such as *Nalukataq* and Thanksgiving, and occasionally birds are bartered (MMS 2008).

5.9.3. Nuiqsut

The Nuiqsut community population is 402 (U.S. Census Bureau 2010). Nuiqsut is near the mouth of the Colville River, which drains into the Beaufort Sea. For Nuiqsut, important marine subsistence resources include bowhead whales, fish, waterfowl, and, to a lesser extent, seals, polar bears, beluga whales, and walruses are seldom hunted but can be taken opportunistically while in pursuit of other subsistence species. Nuiqsut's entire marine subsistence harvest area within the Area of Coverage. Nuiqsut residents have reported traveling up to 97 km (60 mi) offshore to the north and as far east as Camden Bay for bowhead, additionally use areas (for seal) extend to the west to Cape Halkett (SRB&A 2011, Maps 41 & 44). Cross Island and vicinity is a crucially important region for Nuiqsut's subsistence-bowhead whale hunting. Nuiqsut residents use Cross Island as a base for bowhead whaling activities (SRB&A 2011). Offshore, in addition to bowhead whale hunting, seals were historically hunted as far east as Flaxman Island (MMS 2008). Traditional knowledge workshop respondents stated that Nuiqsut residents do not exclusively harvest mammals from the ocean. One resident reported that residents can harvest caribou that have swum out to the barrier islands (SRB&A 2011).

Nuiqsut Subsistence Harvest

Bowhead Whale. Even though Nuiqsut is not on the coast but approximately 25 miles inland with river access to the Beaufort Sea, bowhead whales are a major subsistence resource. Bowhead whale hunting usually occurs between late August and early October, with the exact timing depending on ice and weather conditions. Ice conditions can dramatically extend the season up to 2 months or contract it to less than 2 weeks. Unlike the Barrow spring whale hunt staged from the edge of ice leads using skin boats, Nuiqsut whalers use aluminum skiffs with outboard motors to hunt bowheads in open water in fall. Generally, bowhead whales are harvested by Nuiqsut residents within 10 miles of Cross Island, but hunters might at times travel 20 miles or more from the island. Historically, the entire coastal area from Nuiqsut east to Flaxman Island and the Canning River Delta has been used, but whale hunting to the west of Cross Island has never been as productive; and whale hunting too far to the east requires long tows of the whales back to Cross Island for butchering, creating the potential for meat spoilage (Impact Assessment, Inc. 1990; MMS 2008; SRB&A 2011, Map 41).

Fishes. The harvesting of fish is not subject to seasonal limitations, a situation that adds to their importance in the community's subsistence round. Nuiqsut has been shown to have the largest documented subsistence fish harvest on the Beaufort Sea coast (Moulton 1997; Moulton et al. 1986). Moreover, in October and November, fish might provide the only source of fresh subsistence foods. Fishing is an important activity for Nuiqsut residents because of the community's location on the Nechelik Channel of the Colville River, which has large resident fish populations on the North Slope. Local residents generally harvest fish during the summer and fall, but the fishing season basically runs from January through May and from late July through mid-December. The summer, open-water harvest lasts from breakup to freeze up (early June to mid-September).

Salmon species reportedly have been caught in August but not in large numbers. Pink and chum are the most commonly caught salmon, although there reportedly has not been a great interest in harvesting them (George and Nageak 1986).

Humpback and broad whitefish, sculpin, and some large rainbow smelt also are harvested, but only in low numbers (George and Kovalsky 1986; George and Nageak 1986). A fish identified as *spotted least cisco* also has been harvested. That fish is not identified by Morrow (1980) but could be a resident form of least cisco (George and Kovalsky 1986). Additionally, weekend fishing for burbot and grayling occurs at Itkillikpaat, 9.7 km (6 mi) from Nuiqsut (George and Nageak 1986; ADF&G 1995). Fish are eaten fresh or frozen. Because of their important role as an abundant and stable food source, and as a fresh food source during the midwinter months, fish are shared at Thanksgiving and Christmas feasts and given to relatives, friends, and community elders. Fish also appear in traditional sharing and bartering networks that exist among North Slope communities. Because it often involves the entire family, fishing serves as a strong social function in the community, and most Nuiqsut families (out of a total 91 households in 1993) participate in some fishing activity (ADF&G 1993; MMS 2008; SRB&A 2011, Map 45).

Seals. Seals are hunted year-round, but the bulk of the seal harvest takes place during the open-water season, with breakup usually occurring in June. In spring, seals can be hunted once the landfast ice has retreated. Present-day seal hunting is most commonly done at the mouth of the Colville River when it begins flooding in June. While seal meat is eaten, the dietary significance of seals primarily comes from seal oil, served with almost every meal that includes subsistence foods. Seal oil also is used as a preservative for meats, greens, and berries. Also, sealskins are important in the manufacture of clothing and, because of their beauty, spotted seal skins often are preferred for making boots, slippers, mitts, and parka trim. In practice, however, ringed seal skins are used more often in making clothing, because the harvest of this species is more abundant (MMS 2008; SRB&A 2011, Map 44).

Polar Bear. The harvest of polar bears by Nuiqsut hunters begins in mid-September and extends into late winter (MMS 2008; SRB&A 2011, Map 43). Traditional knowledge workshop participants indicated that few Nuiqsut residents harvest polar bears. When they do, bears are normally taken near Cross Island or along the coast from the Colville Delta to Cape Halkett (SRB&A 2011).

Beluga Whale. Some sources have mentioned beluga whales being taken incidentally during the bowhead whale harvest. Traditional knowledge workshop participants indicated that it is less common to see beluga whales in the area of Nuiqsut because they tend to migrate earlier than the bowhead whales and farther out. Beluga sightings are relatively rare and as a result few residents harvest beluga whales (SRB&A 2011).

Walrus. Walruses are incidentally taken during whaling and seal hunting (MMS 2008). Walruses are not commonly seen in the Nuiqsut area and are rarely harvested; thus, they have not been documented in previous subsistence mapping studies. However one traditional knowledge workshop respondent said that there is a subsistence area for walrus approximately 13–15 km (8–9 mi) northwest of Thetis Island (SRB&A 2011).

Waterfowl. Birds are harvested year-round, with peak harvests in May–June and September–October. The most important species for Nuiqsut hunters are the Canada and whitefronted goose and brant; eiders are harvested in low numbers. Waterfowl hunting occurs mostly in the spring, beginning in May, and continues throughout the summer. In the summer and early fall, such hunting usually occurs as an adjunct to other subsistence activities, such as checking fishnets (MMS 2008). Waterfowl coastal subsistence use areas extend from the eastern side of Harrison Bay to Camden Bay (SRB&A 2011, Map 46).

5.9.4. Arctic Climate Change and Effects on Subsistence

Climate in the Arctic is showing signs of rapid change; nevertheless further study is needed to better understand the changes that have been observed and their significance to the Arctic Climate Region as well as global climate change (NMFS 2011). Evidence of climate change in the past few decades, commonly referred to as global warming, has accumulated from a variety of geophysical, biological, oceanographic, atmospheric, and anthropogenic sources. Since much of this evidence has been derived from relatively short time periods, and climate itself is inherently variable, the recent occurrence of unusually high temperatures may not necessarily be abnormal since it could fall within the natural variability of climate patterns and fluctuations. However, with that possibility, it should be noted that evidence of climate changes in the Arctic have been identified and appear to generally agree with climate modeling scenarios. Such evidence suggests (NMFS 2011):

- Air temperatures in the Arctic are increasing at an accelerated rate;
- Year-round sea ice extent and thickness has continually decreased over the past three decades;
- Water temperatures in the Arctic Ocean have increased;
- Changes have occurred to the salinity in the Arctic Ocean;
- Rising sea levels;
- Retreating glaciers;
- Increases in terrestrial precipitation;
- Warming permafrost in Alaska; and
- Northward migration of the treeline.

The implications of climate change on subsistence resources are difficult to predict, although some trends are consistent and anticipated to continue. The North Slope communities and their reliance on subsistence resources will be stressed to the extent the observed changes continue. Those stressors could include alterations to traditional hunting locations, increases in subsistence travel and access difficulties, shifts in migration patterns, and changes to seasonal availability of subsistence resources (MMS 2008).

Through the traditional knowledge gathering process, the following observations regarding changes in ice conditions and effects on wildlife and subsistence activities were shared (SRB&A 2011):

- Marine mammals such as seals and walrus are congregating in large groups because of lack of ice, becoming skinnier because of having to travel farther, and more frequently coming to shore when no offshore ice is available on which to rest.
- Changes in timing and nature of break up (earlier) and freeze up (later) have caused the hunting season to be shorter and residents to have fewer opportunities, such as increased difficulty harvesting from the ice. Additionally, hunters might have to travel farther, which increases overall risks and costs, and increased dangers because of soft ice.
- Warming of the temperatures and permafrost has contributed to spoiling of harvested meat.
- At the same time, some subsistence activities in certain areas have become easier because of open leads closer to shore than in the past.
- Lack of ice and the habitat it provides affects marine mammal distribution, particularly bearded seals, walruses, and polar bears.

6. DETERMINATION OF UNREASONABLE DEGRADATION

This section presents a discussion of EPA's evaluation for the 10 ocean discharge criteria and EPA's determinations regarding unreasonable degradation.

Under the ODC regulations, no NPDES permit may be issued if it is determined to cause unreasonable degradation of the marine environment. EPA considers the 10 ocean discharge criteria and other factors specified in 40 CFR 125.122(a)-(b) when evaluating the potential for unreasonable degradation. Unreasonable degradation of the marine environment means the following:

- Significant adverse changes in ecosystem diversity, productivity and stability of the biological community in the area of discharge and surrounding biological community;
- Threat to human health through direct exposure to pollutants or through consumption of exposed aquatic organisms; or
- Loss of aesthetic, recreational, scientific or economic values that is unreasonable in relation to the benefit derived from the discharge.

Neither CWA section 403 nor EPA's implementing regulations require the Agency to ensure that there is no degradation before issuing a permit. Nor do EPA's regulations require EPA to have complete knowledge of the potential impacts of a discharge before permit issuance. Rather, EPA must make its determination on the basis of available information and information supplied by a permit applicant. In addition, EPA must exercise reasonable judgment when making a determination about unreasonable degradation.

According to EPA's regulations, when conducting its evaluation, EPA may presume that discharges in compliance with CWA section 301(g), 301(h), or 316(a), or with state water quality standards, do not cause unreasonable degradation of the marine environment, 40 CFR 125.122(b). In addition, EPA may impose additional permit conditions to ensure that a discharge will not result in unreasonable degradation.

In cases where sufficient information is available to determine whether unreasonable degradation of the marine environment will occur, 40 CFR 125.123(a) and (b) govern EPA's actions. Discharges that cause unreasonable degradation will not be permitted. Other discharges may be authorized with necessary permit conditions to ensure that unreasonable degradation will not occur.

In circumstances where there is insufficient information to determine, before permit issuance, that a discharge will not result in unreasonable degradation, EPA may permit the discharge if EPA determines on the basis of available information that:

- Such discharges will not cause irreparable harm to the marine environment during the period in which monitoring is undertaken;
- There are no reasonable alternatives to the on-site disposal of these materials; and
- The discharge will be in compliance with all permit conditions established pursuant to 40 CFR 125.123(d).

Based on the information provided Sections 1–5 above and the evaluation provided below, EPA has determined that the discharges authorized by the Beaufort general permit will not cause unreasonable

degradation of the marine environment. EPA's ocean discharge criteria evaluations, related findings and determinations are discussed in this section.

6.1. Criterion 1

The quantities, composition, and potential for bioaccumulation or persistence of the pollutants to be discharged.

EPA estimates that a maximum total of 18–34 exploration and delineation wells will be drilled within the Beaufort Sea Area of Coverage during the 5-year term of the general permit. That number was derived from the current available information, including the NOI submitted to EPA by Shell, and the recently released DEIS from NMFS and BOEM (NMFS 2011). Section 3 of the ODCE characterizes the types and quantities of discharges that would occur during the drilling process. Drilling fluids and cuttings are major components of discharges associated with exploratory operations; the potential impacts of those discharges are the focus of this section.

To date, 31 exploratory wells have been drilled in the Beaufort Sea, and discharge data are either very limited, or not available, from those historical wells. Where available, EPA has compiled the discharge data and evaluated the reported volumes with the maximum estimated volumes estimated in the NOIs. In most cases, the maximum volumes estimated in the NOIs are higher than the actual reported volumes from the Discharge Monitoring Reports, thus for consistency, EPA used the volumes from Shell's NOIs in the ODCE analysis. Note that Shell has agreed, through a separate agreement with the Alaska Eskimo Whaling Commission and the North Slope Borough, to collect water-based drilling fluids and drill cuttings (Discharge 001) during drilling activities at the Sivulliq and Torpedo prospects in Camden Bay and transported for disposal at an approved facility outside Alaska. Because of this agreement, Shell did not include this waste stream in its NOI submittals for the lease blocks in Camden Bay.

Modeling and studies show that the maximum deposition thicknesses of deposition of the solids materials discharged range from 0.03 to 0.13 cm (0.01 to 0.05 in) for a 5,000 bbl discharge of drilling fluid. The maximum deposition for a slower current speed (0.1 m/s [0.32 ft/sec]) occurs from 100 to 500 m (328 to 1,640 ft) from the discharge point while the maximum deposition occurs 800 to 1,400 m (2,624 to 4,600 ft) from the discharge point for a higher current speed of (0.3 m/s [1 ft/sec]). Under most conditions, the majority of the solids are deposited within 1,000 m (3,280 ft) of the discharge.

The modeling results showed that most cuttings would settle within 100 meters of the discharge point under all scenarios. At a distance of 10 meters from the outfall, a cuttings discharge of 1,000 bbl is predicted to deposit cuttings at depths ranging from 0.4 cm to 113 cm. For a 2,500 bbl cuttings discharge, these deposits would be a factor of 2.5 higher (linear scaling). At a distance of 100 meters, a 2,500 bbl discharge is predicted to result in cuttings deposits ranging from 0 cm (coarse cuttings) to 10 cm (medium coarseness cuttings).

Other components of concern in drilling fluids include trace metals and specialty additives used in the drilling fluid systems (see Section 3.3.3). Mass loadings of the additives depend on the concentrations, frequency of usage, and conditions encountered during drilling.

Limitations and conditions of the permit ensure that drilling fluids and drill cuttings do not contain persistent or bioaccumulative pollutants. For example, mercury and cadmium in stock barite must meet the limitation of 1 mg/kg and 3 mg/kg, respectively. Discharges that fail the static sheen test are

prohibited. In addition, the Beaufort general permit requires an inventory and reporting of all chemicals added to the system, including limitations on chemical additive concentrations. Discharges other than drilling fluids and cuttings (i.e., sanitary and domestic wastes, deck drainage, blowout preventer fluid, desalination unit waste, fire control system test water, non-contact cooling water, ballast water, bilge water, boiler blowdown, excess cement slurry, and drilling fluid, cuttings, and cement at seafloor) are not expected to carry pollutants that are bioaccumulative or persistent. The pollutants of concern in the non-drilling fluid/non-cuttings discharge category are discussed in Section 6.10.

6.1.1. Seafloor Sedimentation

The aerial extent of drilling fluid accumulation on the seafloor is inversely related to the energy dynamics of the receiving water. In low energy environments, currents do not play a role in moving deposited material from the bottom or mixing it into sediments. The deposited drilling fluid can be mixed vertically with natural sediments by physical resuspension processes and by biological reworking of sediments by benthic organisms or marine mammals. Ice gouging could also mix deposited materials into seafloor sediments. The relative contribution of those processes to sediment mixing has not been quantified. However, studies that have evaluated sediment mixing are discussed below.

Currie and Isaacs (2005) examined changes to benthic infauna caused by exploratory gas drilling operations in the Minerva field in Port Campbell, Australia at 2 weeks, 4 months and 11 months after drilling. They found the abundances of two common species (*Apseudes* sp. 1 and *Prionospio coorilla*) decreased significantly at the wellhead site immediately after drilling. Population reduction ranged between 71 and 88 percent, and recovery taking less than 4 months after drilling. The distribution of benthic communities persisted at the wellhead for more than 11 months after exploratory drilling, likely a result of the physical modification of sediment at the site. Changes in the population of species (aggregated by phylum) varied, but significant declines—45 to 73 percent—in the most abundant phyla (crustaceans and polychaetes) were observed at all sites within a 100-m (328-ft) radius of the wellhead following drilling. In most cases, those changes became undetectable 4 months after drilling following species recruitments.

Trannum et al. (2010) conducted a laboratory study on the effects of sedimentation on benthic macrofauna community structure. Trannum compared natural sediment collected in the Oslofjord of southern Norway and drill cuttings originating from a drilling operation in the Barents Sea. The study used cuttings where ilmenite served as the weighting agent and glycol as a lubricant. Ilmenite has a higher specific gravity than barite and is less likely to contain trace metals. The study investigated sediment accumulation up to 2.4 cm (0.94 in). The results indicated that drill cuttings added at the same rate as natural sediment reduced the number of taxa, abundance, biomass and diversity of fauna with increasing layer thickness (up to 2.4 cm) compared to the addition of natural sediments. Trannum concluded that cuttings affected fauna through mechanisms other than sedimentation. The results suggest organic additives (glycol) in the cuttings as the cause for increased oxygen depletion, which caused the reduction in benthic structure and number. The Beaufort general permit allows only residual amounts of mineral oil pills to be discharged, used as spotting agent and lubricant, and drilling cuttings are not expected to contain appreciable amounts of organic additives. The blowout preventer fluid could contain glycol, but the volumes are negligible such that any potential effects would be imperceptible.

Dunton et al. (2009) investigated benthic habitats in Camden Bay in the Beaufort Sea to characterize baseline conditions at a future exploratory drill location (Sivulliq Prospect) and recovery at a former

exploratory drill site (Hammerhead). At 45 sites (10 of which were in the area of the Hammerhead former drill site), the species composition of the infaunal community along with density, biomass, and stable isotopic composition (C-13 and N-15) were determined through sediment grab samples. Comparison of results from the other 35 Sivulliq sites to the 10 Hammerhead sites indicated that previous drilling activities (which were conducted in 1985) did not have a measurable impact on the occurrence or trophic structure of the infaunal community after 23 years.

The Beaufort general permit limits the amount of organic additives that will be discharged in drilling fluids and drill cuttings. In addition, past studies that evaluated benthic communities after exploratory drilling has completed indicate that sedimentation is not expected to cause persistent or irreversible effects on benthic structure and diversity.

6.1.2. Trace Metals

Several studies have evaluated the solubility of trace metals found in barite, a key ingredient in drilling fluids. Crecelius et al. (2007) evaluated the release of trace components from barite to the marine environment, including seawater and sediment pore water, under varying redox conditions. Solubility of barium and other metals in barite were tested under specific laboratory conditions, where salinity was 30 parts per thousand (ppt); temperature was 4 and 20 °C (40 to 68 °F); pH ranged from 7 to 9; and pressure was 14 and 500 psi. In containers with static seawater from the Gulf of Mexico, concentrations of cadmium, copper, mercury manganese, and zinc gradually increased through leaching over time. Results showed that temperature and pressure had little effect on solubility; however, pH had the greatest effect on concentrations of mercury and zinc, which increased as pH increased. When exposed to flowing seawater (by passing seawater through the containers at a constant rate), at pH 8 for 24 hours, the release rate of cadmium, copper, mercury, lead and zinc were greatest during the first several hours. Dissolved concentrations of the metals in the flowing seawater approached concentrations found in coastal seawater after 24 hours. The addition of natural sediment, however, reduced the release of metals to the static water column compared to barite alone, indicating that organisms living on or near the sediment would not be exposed to the elevated concentrations of dissolved metals. Crecelius also notes that the static experiments are worse-case scenarios because in open water, natural systems field currents and diffusion would further dilute metals.

Crecelius et al. (2007) also investigated leaching of metals from barite in anoxic sediment. Barium, iron, manganese, and zinc were found to be more soluble under anoxic conditions in pore water, but concentrations of cadmium, copper, mercury, methylmercury, and lead were not significantly different from un-amended sediment. The results suggest that metals would form insoluble sulfide minerals under anoxic conditions and, therefore, would not be bioavailable to benthic organisms.

Neff (2008) used the results from Crecelius et al. (2007) to determine the bioavailable fraction of metals. Neff used a distribution coefficient, which is the factor that predicts partitioning of the metal between the solid phase and dissolved in a liquid phase, for each metal between barite and seawater, and barite and pore water. The distribution coefficients indicate that metals (barium, cadmium, chromium, copper, mercury, lead, and zinc) are more likely to remain associated with barite by a minimum of 2.5 orders of magnitude than to dissolve in seawater. Distribution coefficients for metals between barite and pore water, at pH levels similar to the pH of digestive fluids of benthic organisms, show that all metals other than cadmium were more likely to remain associated with barite particles. Cadmium was the most bioavailable metal for bottom-dwelling organisms that might ingest barite particles. Likewise,

MacDonald (1982) also concluded that metal solubility from barite is low on the basis of thermodynamics; and that low solubility results in metal concentrations are comparable to coastal ocean dissolved metal concentrations.

These studies demonstrate that trace metals are generally not bioavailable to marine organisms, and therefore, not accessible for bioaccumulation. Furthermore, the studies suggest that trace metal concentrations in a mixture of barite and seawater are close to natural coastal concentrations, although a number of metals precipitate out as insoluble metal sulfides.

6.1.3. Persistence

Snyder-Conn et al. (1990) studied the persistence of trace metals in low-energy, shallow Arctic marine sediments. In that study, sediment samples were collected at three exploratory well sites in the shallow, nearshore Beaufort Sea, and compared to four control locations. Exploratory drilling had occurred at the experimental sites between 1981 and 1983, and sediment samples were collected in 1985. Samples were collected at five stations approximately 25-m (82-ft) intervals along three to four transects established at sites where drilling fluids and cuttings had been discharged. Average sediment concentrations for aluminum, arsenic, barium, chromium, lead, and zinc were elevated compared to the average reference station concentrations. The author suggested that the persistence resulted from poor dispersion because of the low energy of the marine environment in those locations.

Long et al. (1995) applied the sediment guidelines to the concentration samples obtained in the Snyder-Conn study. Long concluded that concentrations for chromium, lead and zinc were below the effects range median, and arsenic was below the effects range low. Concentrations below the effects range low represent a low risk for aquatic toxicity, and an effects range median concentration means concentrations greater than the effects range low, which could result in adverse effects.

In order to help establish a baseline data set in advance of proposed offshore oil and gas exploration and production, Trefry and Trocine (2009) collected samples at a total of 46 stations. These included surface and subsurface sediment samples as well as water samples. Samples were collected at 10 locations near the former Hammerhead exploratory well drilled in 1985 and 1986 in the Beaufort Sea, 19 random background stations collected north and south of the former Hammerhead drill site, 12 locations in the areas of the Sivulliq drill site and 5 locations along a possible pipeline corridor. Surface sediment samples were collected at all 46 locations and analyzed for total trace metals and polynulear aromatic hydrocarbons (PAHs). Additionally, 19 samples from 4 sediment cores were analyzed for total trace metals. Results indicate surface and subsurface sediment concentrations of aluminum, iron, cadmium, mercury, vanadium and zinc were at background values at all 10 locations near the former Hammerhead exploratory well, whereas maximum concentrations of silver (0.40 ug/g), chromium (135 ug/g), copper (58.3 ug/g), lead (49.2 ug/g), and selenium (2.0 ug/g) were above background concentrations at one surface sediment Hammerhead station. Sediment concentrations for cadmium, mercury, zinc and silver were all below the minimum recommended sediment quality guidelines (effects range low).

Concentrations of barium were at background levels for 42 of the 46 stations. However, concentrations from four surface samples collected within ~100 meters of the former Hammerhead drill site, plus samples from sediment cores at two stations at the former drill site contained elevated barium concentrations. It was concluded that the barium enrichment was most likely due to the presence of barite from residual drilling mud and cuttings.

Concentrations of total petroleum hydrocarbons (TPH) and total polycyclic aromatic hydrocarbons (TPAH) in surface sediments were at background levels for 45 of the 46 locations, although elevated TPH and TPAH were found in one location at the former drill site. The elevated TPH was believed to have been introduced from a trace amount of petroleum input at some time during the past 20 years and it is equivalent to <1% of the background levels of naturally occurring organic matter.

This data is important to the understanding the persistence of metals at historical drill sites. Based on these results, EPA concludes while sediment concentrations will be elevated within the vicinity of the drill sites as a result of the discharges of drilling fluids and drill cuttings, they are unlikely to be persistent.

6.1.4. Bioaccumulation

Heavy metals, such as mercury, cadmium, arsenic, chromium, and lead can bioaccumulate depending on their chemical speciation. Existing data are not adequate to quantify the potential bioaccumulation effects from exposure to exploratory oil drilling operations. Available data suggest, however, that because the bioavailability of trace metals from barite is quite low, the bioaccumulation risks are also expected to be low (Crecelius et al. 2007; Neff 2008, 2010). Because the drilling fluid chemicals are generally not bioaccumulated, they are not transferred through the marine food web by trophic transfer (predator eating contaminated prey). There is limited evidence of bioaccumulation, but none of trophic transfer or biomagnifications (increase in concentration from one trophic level to the next) of metals or hydrocarbons in the field and laboratory studies performed to date on effects of water-based drilling fluids and drill cuttings to temperate and Arctic marine environments (Neff 2010). However, where trace metals are bioavailable, they do show bioaccumulative properties, such as copper and lead, which appear to be reversible. The literature review indicates that bioaccumulation of chromium—primarily lignosulfonate (an additive to drilling fluids)—could occur locally from drilling-related discharges. Nevertheless, adequate information is not available to quantify the potential bioaccumulation of trace metals from exploratory oil drilling operations.

Studies conducted with cold-water amphipods evaluated their absorption of metals when exposure to water-based fluids for 5 days (Neff 2010). In that study, Neff removed one-half of the amphipods for analysis after 5 days of exposure; the remaining half were placed in clean flowing seawater for 12 hours. All the exposed amphipods accumulated small amounts of copper and lead; but those placed in clean salt water quickly reduced their levels of copper and lead. That suggests that bioaccumulation of metals from water-based drilling fluids is low and reversible. Neff (2010) cited bioaccumulation studies conducted by Northern Technical Services in 1981 using species present in the Beaufort Sea, which showed a small amount of accumulation of chromium and iron in fourhorn sculpin, and a small amount of iron in saffron cod that were exposed to mixtures of water-based drilling fluids at concentrations of 4 to 17 percent. Also, organic carbon from either primary production or in runoff from land is present in sea bottom sediments, sequesters metals, and lowers their bioavailability (Neff 2010).

6.1.5. Control and Treatment

The Beaufort general permit incorporates the technology-based effluent limitations required by the ELGs in 40 CFR Part 435, Subpart A, which apply to drilling fluids and cuttings. These ELGs include an acute (96-hour) effluent toxicity limit of a 50 percent lethal concentrations (LC_{50}) of a minimum 30,000 parts per million (ppm) suspended particulate phase (SPP) on discharged drilling fluids. The 30,000 ppm SPP

concentration (3 percent by volume) would be lethal to 50 percent of organisms exposed to that concentration. That limit is a technology-based control on the toxicity of drill cuttings and fluids, as well as control on toxic and nonconventional pollutants. The 30,000 ppm SPP limitation is both technologically feasible and economically achievable, and it is the best available technology established nationally (USEPA 1993). Under this ELG, if an SPP concentration of less than 30,000 ppm results in an LC_{50} response, additives to drilling fluids would be substituted to ensure a less toxic discharge.

The permit also establishes the ELG limits for mercury and cadmium concentrations (1 mg/kg and 3 mg/kg, respectively) in stock barite. EPA has determined that the limitation indirectly controls the levels of toxic pollutant metals because barite that meets the mercury and cadmium limits is also likely to have reduced concentrations other metals (USEPA 1993). Additional permit requirements include monitoring for TAH, TAqH, and pH. The Beaufort general permit also establishes discharge rates on the basis of the depths of discharge to ensure that unreasonable degradation will not occur.

6.1.6. Mitigation

While the federal effluent guidelines allow the discharge of synthetic-based drilling fluids and cuttings, as well as cuttings associated with oil-based fluids, the Beaufort general permit would not authorize these discharges. It is generally acknowledged that the use of water-based drilling fluids is less harmful than synthetic- or oil-based fluids. Barite is the most frequently used weighting material, and might contain trace elements in concentrations that might leach in seawater after discharge. As noted above, the Beaufort general permit contains a limit on the mercury and cadmium content of the stock barite, which is intended to limit the concentrations of other trace metals that might also be present. The permit also implements the national guidelines by requiring SPP toxicity testing of drilling fluids and drill cuttings.

The Beaufort general permit includes an Environmental Monitoring Program to be implemented before, during, and after drilling activities, with sediment sampling and bioaccumulation study requirements if the discharges of drilling fluids and drill cutting are authorized. The permit also restricts the discharges of water-based drilling fluids and drill cuttings during bowhead whale hunting activities by the communities of Nuiqsut and Kaktovik. Operators must cease discharges of drilling fluids and drill cuttings on August 25 and may not resume until bowhead whale hunting activities have ceased, as determined by coordination with the respective Whaling Associations.

Finally, the permit and restricts discharges of drilling fluids and drill cuttings, and sanitary and domestic wastes onto stable ice. Operators seeking to discharge these waste streams onto stable ice must submit to EPA written evaluations regarding the availability and feasibility of storage capabilities on the drilling facility and/or off-site disposal alternatives. Additionally, local communities have expressed the concern that the presence of drilling fluids and drill cuttings onto stable ice pose a concern of potential direct contact by animals, birds, and possibly humans, particularly at nearshore locations.

These requirements will restrict the quantities to be discharged assist with gathering site-specific discharge data for future agency decision-making.

6.2. Criterion 2

The potential transport of such pollutants by biological, physical, or chemical processes.

6.2.1. Biological Transport

Biological transport processes include bioaccumulation in soft or hard tissues, biomagnification, ingestion and excretion in fecal pellets, and physical reworking to mix solids into the sediment (bioturbation). Biological transport processes occur when an organism performs an activity with one or more of the following results:

- An element or compound is removed from the water column;
- A soluble element or compound is relocated within the water column;
- An insoluble form of an element or compound is made available to the water column; or
- An insoluble or particulate form of an element or compound is relocated.

The ODCE supporting the previous Arctic general permit provides a detailed literature review of bioaccumulation, biomagnifications, and bioturbation (USEPA 2006). Little information is available to assess the biomagnification of drilling fluid discharge components; however, one study suggests that barium and chromium could biomagnify. In an *in vitro* experiment, the mean barium level in contaminated sea worms was 22 µg/g whereas the controls contained 7.1 µg/g. Chromium levels were 1.02 µg/g in contaminated worms and 0.62 µg/g in controls. In both cases, concentrations in depurated worms were not significantly different from controls (Neff et al. 1984). Studies on biological transport show that depuration (removal of the organism from the contaminate source) can reduce concentrations of contaminants in tissue.

Bioturbation, the process of benthic organisms reworking sediment and mixing surface material into deeper sediment layers is another mode of biological transport. While sea worms and other benthic organisms have the ability to move material on a localized basis, gray whales and walrus move tremendous amounts of sediment in the Beaufort Sea. Nelson et al. (1994) analyzed feeding pits created by gray whales and furrows created by walruses. Combined, the two species are estimated to move more than 700 million tons per year of sediment in the Beaufort on the basis of current population estimates. The study acknowledges some limitations in the analysis, but estimates that walruses disturb between 24 and 36 percent of the floor of the Beaufort Sea annually (Nelson et al. 1994). No research was identified to quantify the extent of effects resulting from bioturbation of discharges associated with exploration drilling.

6.2.2. Physical Transport

Physical transport processes include currents, mixing and diffusion in the water column, particle flocculation, and settling of discharged material to the seafloor. Pacific Ocean currents dictate the direction of transport in the Arctic Ocean: generally moving northward from the Bering Sea through the Chukchi Sea (Weingartner et al. 2009). Flow is divided along the nearshore, the Central Channel (between Herald and Hanna shoals), and the Herald Canyon (Woodgate et al. 2005). Water temperature factors into the localized effects of mixing and diffusion. The effects of changes of temperature associated with large-scale currents are beyond the scope of this document. Localized diffusion and mixing of the discharges covered under the Beaufort general permit are driven by the depth of the receiving water, rate of discharge, speed of local currents, and depth of the outfall beneath the surface.

The depth, rate, and method of the individual discharges influence their physical transport in the environment. Because of BOEM lease stipulations, exploration activities in the OCS of the Beaufort Sea

are likely to occur during the summer. As a result, discharges authorized in the Beaufort general permit will likely occur during open water or in water with unstable and broken ice conditions. However, it is reasonable to anticipate that drilling in nearshore waters of the Beaufort Sea could occur during the winter months when ice roads are available. Modeling targeted at determining the dispersion pattern and dilution of discharges authorized under the Beaufort general permit focused on the transport of discharged materials in the water column and settling on the seafloor. The results of the analysis are summarized in Section 3.6 and in the Modeling Technical Memo.

The particulate fraction of discharged drilling fluids and drill cuttings tend to settle on the seafloor so that its drift, dispersion, and dilution are generally lower than those of dissolved discharges (MMS 2007). Recent studies show that drilling materials flocculate in seawater to form aggregates on the order of 0.5–1.5 mm in diameter with high settling velocities (Hurley and Ellis 2004 cited in MMS 2007). Consequently, the bulk of drilling fluid discharges settle rapidly and accumulate on the seabed.

Resuspension or deposition processes tend to occur near the seabed with some particles gradually being dispersed by currents and waves (Hurley and Ellis 2004 cited in MMS 2007). Regional and temporal variations in physical oceanographic processes that determine the degree of initial dilution and waste suspension, dispersion, and drift, have a large influence on the potential zone of influence of discharged drilling fluids and drill cuttings.

Ice gouging occurs by the grounding of sea ice against the seafloor. The amount and effect of ice gouging activity within the Area of Coverage is not well documented. However, a study in the Beaufort Sea shows that ice gouging plays a greater role in the reworking of bottom sediments than depositional processes. Reimnitz et al. (1977); found that portions of their study area experienced a complete reworking of sediments to a depth of 20 cm (7.9 in) over a 50-year period. A study of ice gouging in the Beaufort Sea showed that the maximum number of gouges occur in the 20 to 30 m (66 to 99 ft) water-depth range (NMFS 2011). Ice gouging is not expected to play a substantial role in transporting sediments resulting from discharges authorized under the Beaufort general permit because of the ocean depth at the locations of the expected discharges in the outer continental shelf.

In summary, large-scale physical transport of drilling fluids and drill cuttings discharges is not anticipated according to the conditions of the receiving environment and modeling predictions. EPA has determined that the deposition of drilling-related materials on the seafloor associated with drilling fluids and drill cuttings discharges from short-term exploration operations will have little effect on the environment.

6.2.3. Chemical Transport

Chemical processes related to drilling discharges are the dissolution of substances in seawater, the complexing of compounds that might remove them from the water column, redox/ionic changes, and adsorption of dissolved pollutants on solids. Chemical transport of drilling fluids is not well described in the literature. However, despite limitations in quantitative assessment, some studies of other related materials suggest broad findings that are relevant to drilling fluids. Those studies show that chemical transport will most likely occur through oxidation/reduction reactions in native sediments. And in particular, changes in redox potentials will affect the speciation and physical distribution (i.e., sorption-desorption reactions) of drilling fluid constituents.

6.2.3.1. Metals

Most research on chemical transport processes affecting offshore oil and gas discharges focuses on trace metal and hydrocarbon components. The trace metals of interest in drilling fluids include barium, chromium, lead, and zinc. The source of barium in drilling fluids is barite, which can contain several metal contaminants, including arsenic, cadmium, lead, mercury, zinc, and other substances (Table 3-10). Those trace metals are discussed below as they pertain to chemical transport processes.

Barite solubility in the ocean is controlled by the sulfate solubility equilibrium. And in particular, the calculated saturation levels for barium sulfate in seawater range from concentrations of 40 to 60 micrograms per liter (µg/L) at temperatures from 34 to 75 °F (Houghton et al. 1981; Church and Wolgemuth 1972). Background sulfate concentrations in seawater are generally high enough for discharged barium sulfate to remain a precipitate and settle to the sea bottom.

Kramer et al. (1980) and MacDonald (1982) found that seawater solubilities for trace metals associated with powdered barite generally result in concentrations comparable to coastal ocean dissolved metal levels. Exceptions were lead and zinc sulfides, which could be released at levels sufficient to raise concentrations in excess of ambient seawater levels. MacDonald (1982) found that less than 5 percent of metals in the sulfide phase are released to seawater. Other trace metals are associated with the metal sulfides inclusions within the barite solids (Neff 2008). Neff (2008) estimated partitioning coefficients (the ratio of concentrations of a substance in two separate components of a mixture) for metals between barite and seawater, which suggest that cadmium and zinc were the most soluble metals in seawater; however, those metals were still relatively unavailable with the dissolved fraction being nearly 2.5 orders of magnitude more likely to be associated with barite solids than dissolved, therefore not available for chemical transport.

Chromium discharged in drilling fluids is primarily adsorbed on clay and silt particles, although some exists as a free complex with soluble organic compounds. Chromium is added to the drilling fluids system predominantly in a trivalent state as chrome or ferrochrome lignosulfonate, or chrome-treated lignite. It can also be added in a hexavalent state as a lignosulfonate extender, in the form of soluble chromates. The hexavalent form is believed to be largely converted to the less toxic trivalent form by reducing conditions downhole. The most probable environmental fate of trivalent chromium is precipitation as a hydroxide or oxide at pH higher than 5. Transformation from trivalent to hexavalent chromium in natural waters is likely only when there is a large excess of manganese dioxide. Simple oxidation by oxygen to the hexavalent state is very slow and not significant in comparison with other processes (Shroeder and Lee 1975). As such, chromium, attached to clay and silt particles, will likely settle to the seafloor.

Dissolved metals tend to form insoluble complexes through adsorption on fine-grained suspended solids and organic matter, both of which are efficient scavengers of trace metals and other contaminants. Laboratory studies indicate that a majority of trace metals are associated with settleable solids smaller than 8 µm (Houghton et al. 1981).

Trace metals, adsorbed to clay and silt particles and settling to the bottom, are subject to different chemical conditions and processes than metals suspended in the water column. Adsorbed metals can be in a form available to bacteria and other organisms if located at a clay lattice edge or at an adsorption site (Houghton et al. 1981). If the sediments become anoxic, conversion of metals to insoluble sulfides is the most probable reaction, and the metals are then removed from the water column. Metal sulfides are highly insoluble; therefore, they are highly likely to remain as a solid precipitate. Metals can become more

bioavailable when ingested by benthic organisms. Digestive fluids in benthic organisms have a lower pH than the surrounding seawater; consequently, metal sulfides become more soluble and the dissolved form of the metal becomes available for uptake by aquatic organisms (Neff 2008). The discharges from oil and gas exploration activities are short term and intermittent, and the majority of the trace metals are expected to adsorb to fine sediment particles, and settle on the seafloor.

6.2.3.2. Organics

Organic substances, such as oil and grease or petroleum hydrocarbons, are not expected to be present in the marine environment as a result of discharges from oil and gas exploration activities. The Beaufort general permit does not authorize discharges of free oil, requires treatment through an oil-water separator for certain discharges, and it prohibits discharges that create a visual sheen or that do not comply with the static sheen test. The permit also establishes limits or monitoring requirements for all discharges, thus ensuring they do not enter the marine environment in concentrations that could be transported through biological, physical, or chemical processes.

6.3. Criterion 3

> **The composition and vulnerability of the biological communities which may be exposed to such pollutants, including the presence of unique species or communities of species, the presence of species identified as endangered or threatened pursuant to the Endangered Species Act, or the presence of those species critical to the structure or function of the ecosystem, such as those important for the food chain.**

There is potential for discharges authorized under the Beaufort general permit to produce either acute or chronic localized effects through exposure either in the water column or in the benthic environment. The following discussion addresses potential effects in the water column and the seafloor.

6.3.1. Water Column Effects

The solid component of drilling fluids and cuttings would increase turbidity in the immediate vicinity of the discharge across the entire water depth (from the outfall to the seafloor). As discussed in Section 3.5, most cuttings would settle within approximately 100 m (328 ft) of the discharge point. Solids associated with the drilling fluids would settle farther from the discharge location; depending on current speed, the thickest deposition of drilling fluids (0.4 mm [0.16 in]) could settle as far as 1,400 m (4,600 ft) from the discharge point, based on conservative modeling scenarios. Increased water column turbidity from discharge of drilling fluids and cutting could affect the amount of sunlight available for photosynthetic activity by phytoplankton. As discussed in Section 5.1, phytoplankton are free-floating organisms that form an important component of the food chain. While the photosynthetic capacity of these organisms could be reduced when passing through a discharge plume, the areal extent of the plume is limited. Likewise, time spent in the plume is brief (approximately 34 minutes in a current speed of 0.16 ft/sec). Exposure to suspended sediments by salmonids has the potential to cause short and long-term irritation to fish gills, but fish could avoid the plume altogether (Bash et al. 2001). Again, the limited size of the plume, estimated on the basis of the maximum discharge volumes would result in very limited, short-term exposure. Therefore, the effects of solids from the discharges within the water column are not expected to result in unreasonable degradation of the marine environment.

Water quality in the water column would improve with increasing distance from the discharge point. All applicable acute and chronic water quality criteria are expected to be met at 100 m. As shown in Table 6-1, several parameters exceed acute water quality criteria within 100 m of the discharge. The projected dissolved copper concentration at the discharge point is approximately 60 times the acute criterion; that is the highest ratio of discharge concentration to the criterion. However, because the calculated copper concentration at the mixing zone boundary is more than 27 times lower than the criterion, the actual area where the criterion is exceeded will be very small (within a few meters of the discharge point). Because acute criteria are based on lethality over an extended period, the discharges are not expected to cause lethal effects on organisms passing through the plume. As shown in Table 6-1, the concentrations of some dissolved constituents could also exceed levels where chronic effects could occur. Chronic criteria are generally based on effects over 4 days (96 hours) of continuous exposure to a discharge plume. Because the nature of drilling operations produce intermittent discharges, conditions that could produce a 4-day continuous exposure period are unlikely. As such, there is minimal potential to cause chronic effects on passing organisms where the duration of exposure will be very limited.

Table 6-1. Modeled constituent concentrations for drilling fluid discharges

Metal	Maximum whole fluid (µg/kg)	Estimated dissolved concentration at the discharge point (µg/L)a	Acute Marine Alaska Water Quality Criteria (AWQC) (µg/L)	Chronic AWQC (µg/L)	Estimated concentration after mixing at 100 m	
					Case number	
					Water depth = 40 m	Water depth = 50 m
					Discharge depth - 0.3 m, Rate – 1,000 bbl/hr	
					Current speed (cm/s)	
					40	40
	Dilution (Dm)				1,600	1,600
Arsenic	7,100	58	69	36	0.036	0.036
Barium	359,747,000	2,122,507	NA	NA	1,325.738	1,325.738
Cadmium	1,100	264	40	8.8	0.165	0.165
Chromium	240,000	15,360	1,100	50	9.594	9.594
Copper	18,700	281	4.8	3.1	0.176	0.176
Iron	15,344,300	7,365,264	NA	NA	4,600.415	4,600.415
Lead	35,100	1,193	210	8.1	0.745	0.745
Mercury	100	6.4	1.8	0.94	0.004	0.004
Nickel	13,500	1,188	74	8.2	0.742	0.742
Zinc	200,500	1,123	90	81	0.701	0.701

Note:
[a] Dissolved metal concentrations estimated from maximum trace metal leach results for drilling fluid

6.3.2. Benthic Habitat Effects

Solids in the discharge would accumulate on the seafloor with most settling within 100 m (328 ft) of the discharge point. As explained in Section 3.6, the depths of the solids resulting from the discharge would vary depending on currents and rates of discharge but could affect fish with demersal eggs and would have an adverse effect on benthic communities (algae, kelp, invertebrates) within the immediate area of the discharge.

While no specific demersal fish spawning locations have been identified in the Area of Coverage, a number of important species, including most cottids and eelpout, possess demersal eggs. Traditional knowledge interviews in Nuiqsut identified Fish Creek and the Colville, Kachemach, Itkillik, Sagavanirktok, and Kuparuk Rivers as spawning or otherwise important habitat areas. At least two participants noted the significance of the nearshore habitat in the Colville River Delta for spawning of broad whitefish and Arctic cisco. Barter Island was also an area identified for spawning of Arctic cisco (SRB&A 2011). Smith and Admiralty Bays were identified as important habitat areas by traditional knowledge workshops in both Barrow and Nuiqsut (SRB&A 2011).

Because of the relatively shallow waters located in nearshore waters in which exploratory activities in the Area of Coverage could occur, demersal eggs could be smothered if discharge in a spawning area coincided with the period of egg production. Drilling fluids and cuttings could smother demersal fish eggs within the areas of deposition, however, the permit restricts the rates of discharge relative to water depths, which minimizes the smothering effect in shallow waters.

Lethal and sub-lethal adverse effects on benthic organisms would generally result from burial under the rapidly accumulating sediments. Trannum et al. (2010) compared natural sediment deposition compared to drill cuttings at similar levels and found reductions in the number of species, species abundance, biomass, and diversity with increasing thickness of the cuttings. While the specific cause for those changes was not identified, the authors suggest the cause as an increase in oxygen demand resulting from an organic component (particularly glycol) in drilling fluids, or less likely, the effect of chemical toxicity or exposure to trace metals (Trannum et al. 2010). Dunton et al. (2009) investigated the benthic environment near the Sivulliq property in the Beaufort Sea, an area that experienced exploratory drilling in 1985. Their study found that after 20 years, the benthic communities and sediment characteristics in the area affected by drill cuttings generally resembled the surrounding area in terms of biological and chemical characteristics, although some study plots did display elevated concentrations of some metals. Another study on the recovery of benthic organisms after exploration drilling found recovery likely to within 4 to 24 months after discharges ended (Currie and Isaacs 2005).

The available literature indicates that effects are likely to occur in a limited area and that the extent and duration of effects would be limited. The severity of effect would reflect the population of organisms in the prevailing current direction and the discharge rate, and distance between the discharge location and the seafloor.

Demersal- and bottom-feeding sea ducks and guillemots occur in dispersed flocks in the region and might feed within the Area of Coverage. The areas affected by the discharges are in the depths reached in the normal process of feeding by those species. Again, on the basis of the limited size of the affected areas and the extent and duration of effects, relatively few birds are expected to feed on or rely specifically on prey potentially affected or buried by drilling discharges.

Gray whales are seasonal feeders in the Area of Coverage and forage in the benthic environment by creating pits in the seafloor (Nelson et al. 1994). Gray whales are responsible for relatively large-scale disturbances of the seafloor, although in the Beaufort Sea, their feeding is concentrated in Smith Bay. If discharges were to occur in that area, gray whales could eventually feed through or in the sediments created by the authorized discharges. The consumption of contaminated prey in the sediments could result in the ingestion by individual animals of metals (i.e., cadmium or chromium) present in the sediments themselves. On the basis of the discussion of bioaccumulation and persistence in Section 6.1 and of

transport modes in Section 6.2, feeding in the areas is unlikely to result in any adverse effects on those species, even at the individual level.

6.3.3. Threatened and Endangered Species

Four threatened or endangered species occur in the Area of Coverage: one cetacean species (bowhead whale), one carnivore (polar bear) and two birds (spectacled and Steller's eiders). Two seals, ringed and bearded, Pacific walrus, and Yellow-billed loons are proposed or are candidate species for coverage under the Endangered Species Act. Those species spend portions of their lives in the Area of Coverage. Bowhead whales migrate through the area between summer feeding grounds in the Canadian Beaufort Sea and wintering areas in the Bering Sea. The occurrences of polar bear and ringed and bearded seals are tied closely to the pack ice and would tend to be found to be farther north during the anticipated periods of operations (open-water season). Spectacled and Steller's eiders nest onshore in the summer and could spend time in the shallow near-shore waters immediately following the breeding period; the area is not listed as critical habitat for either species. The potential effects on those species include behavioral changes resulting from the permitted discharges, physical presence of exploration rigs, drilling support activities, and potential limited exposure to contaminants from preying on species that might be exposed to contaminants. This ODCE and the BE developed in support of the permit address the potential impacts. As discussed under Criterion 1, bioaccumulation within prey is not expected to be an exposure pathway to those species. On the basis of the transient use of the area by the species, the limited areal extent of the potential impacts, and the overall mobility of the species, impacts from oil and gas exploration will not cause unreasonable degradation of the marine environment.

6.4. Criterion 4

The importance of the receiving water area to the surrounding biological community, including the presence of spawning sites, nursery/forage areas, migratory pathways, or areas necessary for other functions or critical stages in the life cycle of an organism.

The Area of Coverage provides foraging habitat for a number of species including marine mammals and birds. Bowhead whale migrations occur through the area with whales following leads in the shear zone as they move from wintering in the Bering Sea to summer feeding areas in the Canadian Beaufort (Figure 6-1). Participants in traditional knowledge workshops in Barrow noted a boundary between brown or gray water and *green water* in which marine species travel and feed along the shoreline (SRB&A 2011). Participants in the traditional knowledge workshops in Barrow identified an important bowhead feeding habitat area in the Beaufort Sea area north of the barrier islands, Cooper Island, Nuwuk, Tulimanik Island and the area northeast of Barrow (SRB&A 2011). Workshops participants in Barrow noted important habitat for beluga feeding areas closer to shore and concentrated in Kugrua Bay, Smith Bay, the Big Colville River, and Elson Lagoon (SRB&A 2011). Kaktovik workshop participants identified important habitat and migratory paths in Simpson Cove, Camden Bay, Kaktovik Lagoon, Bernard Harbor, Griffin Point and Demarcation Bay for beluga, bowhead, orca, narwhal, and gray whales (SRB&A 2011). Ice patterns are a major determinant of the distribution of marine mammals in the Area of Coverage. The importance of pack ice (which extends poleward), fast ice (which is attached to shore), and the flaw zone (between the pack and fast ice) changes seasonally. Polar bear dens are found near shorefast ice and pack ice. Shorefast ice provides optimum habitat for ringed seal lair construction and supports the most productive pupping areas. Activities associated with the discharges would be limited to open-water seasons and would not occur in the presence of shorefast ice.

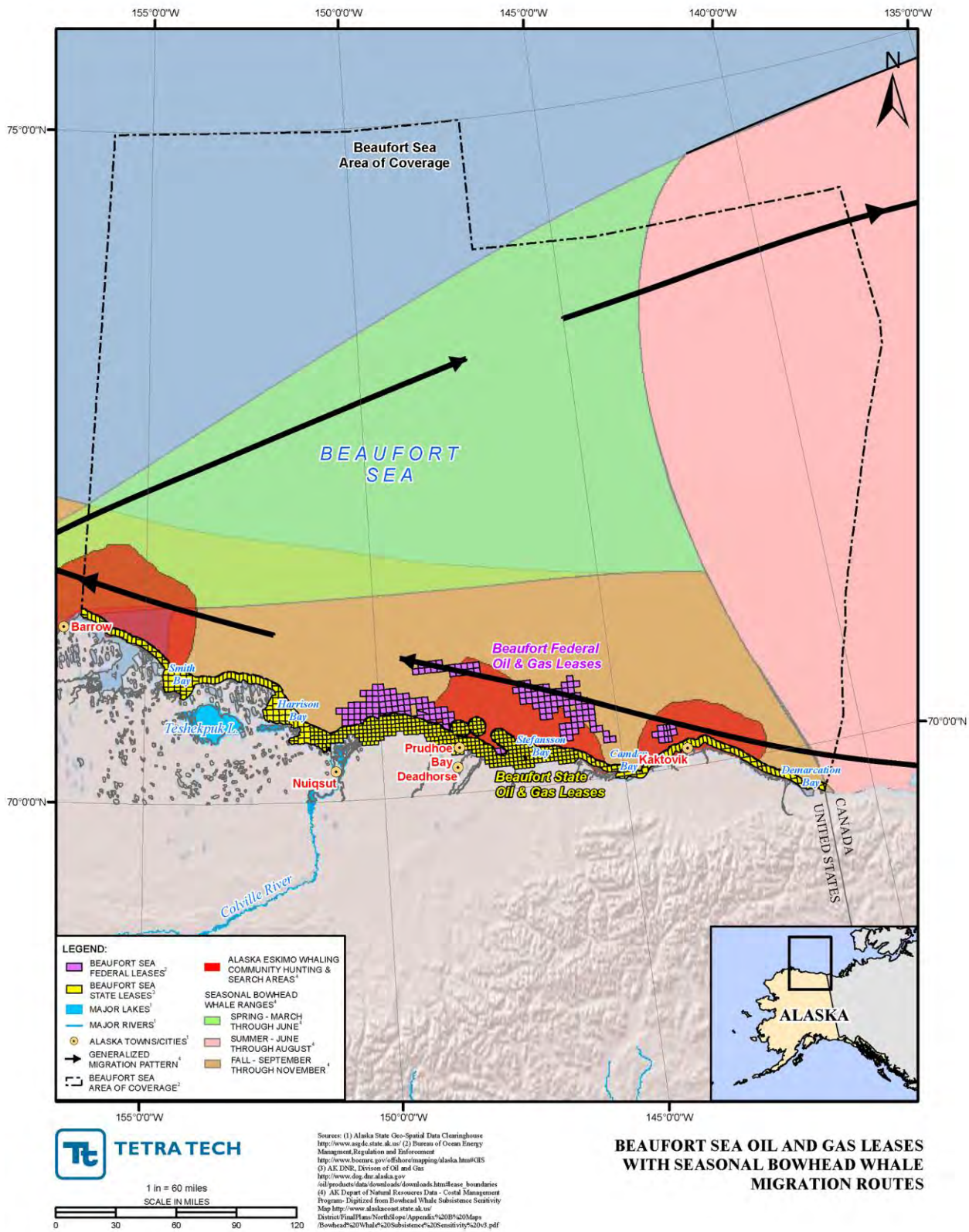


Figure 6-1. Federal and State ODCE Lease in the Beaufort Sea with Seasonal Bowhead Whale Migration Routes.

Alaska's Beaufort Sea shelf is typically characterized by silty sands and mud with an absence of macroalgal beds and associated organisms (Barnes and Reimnitz 1974). A diverse kelp and invertebrate community was found in the Boulder Patch near Prudhoe Bay in Stefansson Sound. Several species of red and brown algae, and one species of green algae have been documented. The algaes are an important food source for many epibenthic and benthic organisms. Differences in biomass between surrounding sediment areas and the Boulder Patch demonstrate the importance of this biologically unique area (Konar 2006). The Beaufort general permit prohibits the discharge of drilling fluids and drill cuttings within 1000 meters of the Stefansson Sound Boulder Patch (near the mouth of the Sagavanirktok River) or between individual Boulder Patches where the distance between those patches is greater than 2000 meters but less than 5000 meters.

The coastal waters are primary habitat for nesting, molting, feeding, and resting activities of migratory marine birds. Coastal tundra and delta areas are also important nesting areas for these species. Eiders, brants, terns, gulls, and guillemots nest on barrier islands. The region surrounding Barrow has been identified as being important to the survival and recovery of the Alaska-breeding population for Steller's eiders; however, the area is not designated as critical habitat.

EPA has studied the nearshore zone of the Alaskan Beaufort Sea in several previous ODCEs. Those evaluations have shown that the nearshore areas provide important feeding and migratory habitat for a large number of species including fish, waterfowl, and mammals. Further, those areas provide essential feeding and preferred habitat for species of major importance for subsistence and commercial fisheries.

To protect the regional biological communities, the Beaufort general permit prohibits discharges of water-based drilling fluids and drill cuttings in the following areas. The permit also prohibits all discharges to waters less than 5 meters and contains prohibitions on the discharges of water-based drilling fluids and drill cuttings, including area restrictions, seasonal restrictions, stable ice restrictions, and no discharge during fall bowhead whale hunting activities by the communities of Nuiqsut and Kaktovik. Below is a summary of the permit restrictions:

- Area Restrictions. The permittee is prohibited from discharging at or within the following locations:
  - in areas where the water depth is less than 5 meters, as measured from mean lower low water (MLLW);
  - within 1000 meters of the Stefansson Sound Boulder Patch (near the mouth of the Sagavanirktok River) or between individual Boulder Patches where the distance between those patches is greater than 2000 meters but less than 5000 meters; and
  - within State waters unless a zone of deposit (ZOD) has been authorized for the discharge by DEC.
- Seasonal Restrictions
  - Open-Water, Unstable, or Broken Ice Restrictions. The permittee is prohibited from discharging at or within the following locations:
    - at depths greater than 1 meter below the surface of the receiving water between the 5 and 20 meters isobaths as measured from the MLLW during open-water conditions;
    - within 1000 meters of river mouths or deltas; and

    - shoreward of 20 meter isobath as measured from the MLLW during unstable or broken ice conditions except when the discharge is prediluted to a 9:1 ratio of seawater to drilling fluids and cuttings.

- During Fall Bowhead Whale Hunting Restrictions. The permittee is prohibited from discharging water-based drilling fluids and drill cuttings (i.e., Discharge 001) during fall bowhead whale hunting in the Beaufort Sea by the Nuiqsut and Kaktovik communities.
    - The permittee must cease Discharge 001 discharges starting on August 25, and may not resume discharging until after whaling activities are completed, as determined by coordination with the respective Whaling Captains Associations. Discharges may be resumed upon receipt of notice of completion of whale hunting.
    - The permittee, in coordination with the respective Whaling Captains Associations, must submit documentation to EPA and the Alaska Department of Environmental Conservation (DEC) identifying the dates and times that (1) Discharge 001 was ceased and restarted, and (2) the bowhead whale hunt by the respective communities began and was completed.
- The permittee is prohibited from discharging water-based drilling fluids and drill cuttings (Discharge 001), sanitary wastes (Discharge 003) and domestic wastes (Discharge 004) to stable ice unless authorized in writing by EPA or DEC. While studies have found that the maximum drilling fluids and drill cuttings concentration entering the marine environment from above-ice disposal sites are less than the concentration introduced by below-ice discharge (USEPA 2006), due to the existence of alternative disposal locations onshore that are accessible by truck transport during the winter months, and the potential for direct contact with the discharge materials by birds and wildlife, EPA requires a detailed written alternatives analysis to EPA and DEC.
- Stable Ice Restrictions. Unless authorized by the EPA or DEC, as appropriate, the permittee is prohibited from discharging as follows:
    - below the ice, and must avoid to the maximum extent possible areas of sea ice cracking or major stress fracturing;
    - below the ice within State waters unless a Zone of Deposit (ZOD) has been authorized for the discharge by DEC and the ZOD authorization is incorporated into the discharge authorization letter; and/or
    - onto any stable ice surface unless authorized in writing by EPA or DEC in accordance with the Alternatives Analysis submission and review requirements under the Beaufort general permit.

Finally, DNR has identified the following areas and periods as sensitive areas that require special consideration when proposing leasing activities:

- The Boulder Patch in Stefansson Sound, year-round;
- The Canning River Delta, January–December;
- The Colville River Delta, January–December;
- The Cross, Pole, Egg, and Thetis Islands, June–December;

- The Flaxman Island waterfowl use and polar bear denning areas, including the Leffingwell Cabin national historic site on Flaxman Island;
- The Jones Island Group (Pingok, Spy, and Leavitt Islands) and Pole Island are known polar bear denning sites, November–April;
- The Sagavanirktok River delta, January–December; and
- Howe Island supports a snow goose nesting colony, May–August.

Overall, sensitive areas and biological communities are generally associated with shallow waters in the nearshore environment. The intermittent nature and limited extent of exploratory discharges, combined with the areal and depth restrictions established in the permit, will prevent unreasonable degradation of these areas and communities.

6.5. Criterion 5

The existence of special aquatic sites including, but not limited to, marine sanctuaries and refuges, parks, national and historic monuments, national seashores, wilderness areas, and coral reefs.

No marine sanctuaries or other special aquatic sites, as defined by 40 CFR 125.122, are in or adjacent to the Beaufort general permit Area of Coverage. The nearest special aquatic site—the Alaska Maritime National Wildlife Refuge, is managed by the USFWS as a unit of the National Wildlife Refuge System. Within the Alaska Maritime Refuge system, the Chukchi Sea Unit includes more mainland and barrier island acreage than any of the other units. The Chukchi Sea Unit extends nearly from Barrow to just north of Cape Prince of Wales in the Bering Strait, a distance of more than 360 miles. Both the northern and southern ends of the unit are dominated by several large lagoons and low-lying barrier islands and are relatively shallow with an extensive continental shelf. No other marine sanctuaries or other special aquatic sites are known to be in or adjacent to the Area of Coverage.

Based on the analysis of criteria 1, 2, and 3 (Sections 6.1, 6.2, and 6.3), the Alaska Maritime National Wildlife Refuge would not be affected by authorized discharges.

6.6. Criterion 6

The potential impacts on human health through direct and indirect pathways.

Human health within the North Slope Borough is directly related to the subsistence lifestyle practiced by the residents of the villages along the Beaufort Sea coast. In addition to providing a food source, subsistence activities support important cultural and social connections. While a wide variety of species are harvested, marine mammals compose an essential part of the diet providing micronutrients, omega-3 fatty acids, and anti-inflammatory substances (MMS 2008). A number of studies have documented the increase in adverse health effects with the reduction in subsistence foods and subsequent increases in store-bought food. Under such circumstances, residents of the communities demonstrate increased risks of metabolic disorders, including hypertension, diabetes, and high cholesterol (MMS 2008).

The *Report of Traditional Knowledge Workshops – Point Lay, Barrow, Nuiqsut and Kaktovik* (SRB&A 2011) describes the subsistence use areas for marine resources for each of these villages and Figure 6-2

through Figure 6-4 illustrate the subsistence use areas for marine resources for the villages of Barrow, Nuiqsut, and Kaktovik, respectively. The Area of Coverage includes portions of subsistence use areas for the three communities. Even if discharges occur outside the use areas, it does not preclude the possibility of effects on subsistence resources. For example, during subsistence interviews in Point Lay, one participant indicated that drilling activities in the 1980s resulted in the ocean turning brown over a large area (~~"t~~he whole ocean") (SRB&A 2011).

Exposure to contaminants through consumption of subsistence foods and through other environmental pathways is a well-documented concern. Concern has also been expressed over animals swimming through domestic or sanitary wastes, and discharge plumes containing drilling fluids, cuttings, and other effluent (SRB&A 2011). Concerns have also been voiced about krill and other small species taking up drilling fluids and then passing contaminants up the food chain (SRB&A 2011).

O'Hara et al. (2006) reported on the essential and non-essential trace element status of eight bowhead whale tissue samples that were collected during 2002-2003. This study focused on comparing whale tissue metal concentrations to published national and international food consumption guidelines. Using these guidelines, calculations of percent (%) "Recommended Daily Allowance) of essential elements in 100 g portion of bowhead tissues were provided. Results were also compared to element concentrations from store purchased food.

Three non-essential metals important for toxicological assessment in the arctic food chain include cadmium (Cd), mercury (Hg), and lead (Pb). For most arctic residents Hg is a major concern in fish and seals. However, Hg concentrations in bowheads are relatively small compared to other marine mammals, and are below levels used by regulatory agencies for marketed animal products. Compared to other species of northern Alaska, bowhead whale tissue samples from this study had similar or lower concentrations of Hg. Liver and kidney are rich in essential and non-essential elements and have the greatest concentration of Cd among the tissues studied, while Hg, Pb, and arsenic (As) are relatively low. The kidney of the bowhead whale is consumed in very limited amounts (limited tissue mass compared to muscle and *maktak);* and liver is consumed rarely.

The study concluded that, as expected, most of the tissues from bowhead whales used as foods are rich in many elements, with the exception of blubber. While a broad range of Cd was found in kidney and liver samples, data is lacking with respect to bioavailability of Cd and the effects of food preparation techniques on Cd concentrations. Lastly, the bowhead tissues studied had element concentrations similar to those found in store-bought meat products.

Domestic and sanitary discharges account for a very small proportion of the overall discharge volume and are treated using marine sanitation devices (MSDs) (Section 3 summarizes the discharges). Such discharges would essentially be undetectable beyond 100 m from the discharge point. Species of interest from a subsistence standpoint are expected to spend minimal amounts of time, if any, in the discharge plume because of its relatively small size, i.e., 100m, and the proximity to the drilling operations. Based on the preceding discussions on the effects of drilling fluids and cuttings, including those on bioaccumulation, persistence, and effects on biological resources, as well as the other waste streams, the discharges under the Beaufort general permit are unlikely to create pathways that could result in direct or indirect human health impacts. However, additional monitoring of site-specific exploratory drilling operations is needed to substantiate past data regarding potential bioaccumulation effects in benthic communities. The Beaufort general permit requires environmental monitoring at each drill site before, during, and after drilling activities, to add to existing data sets.

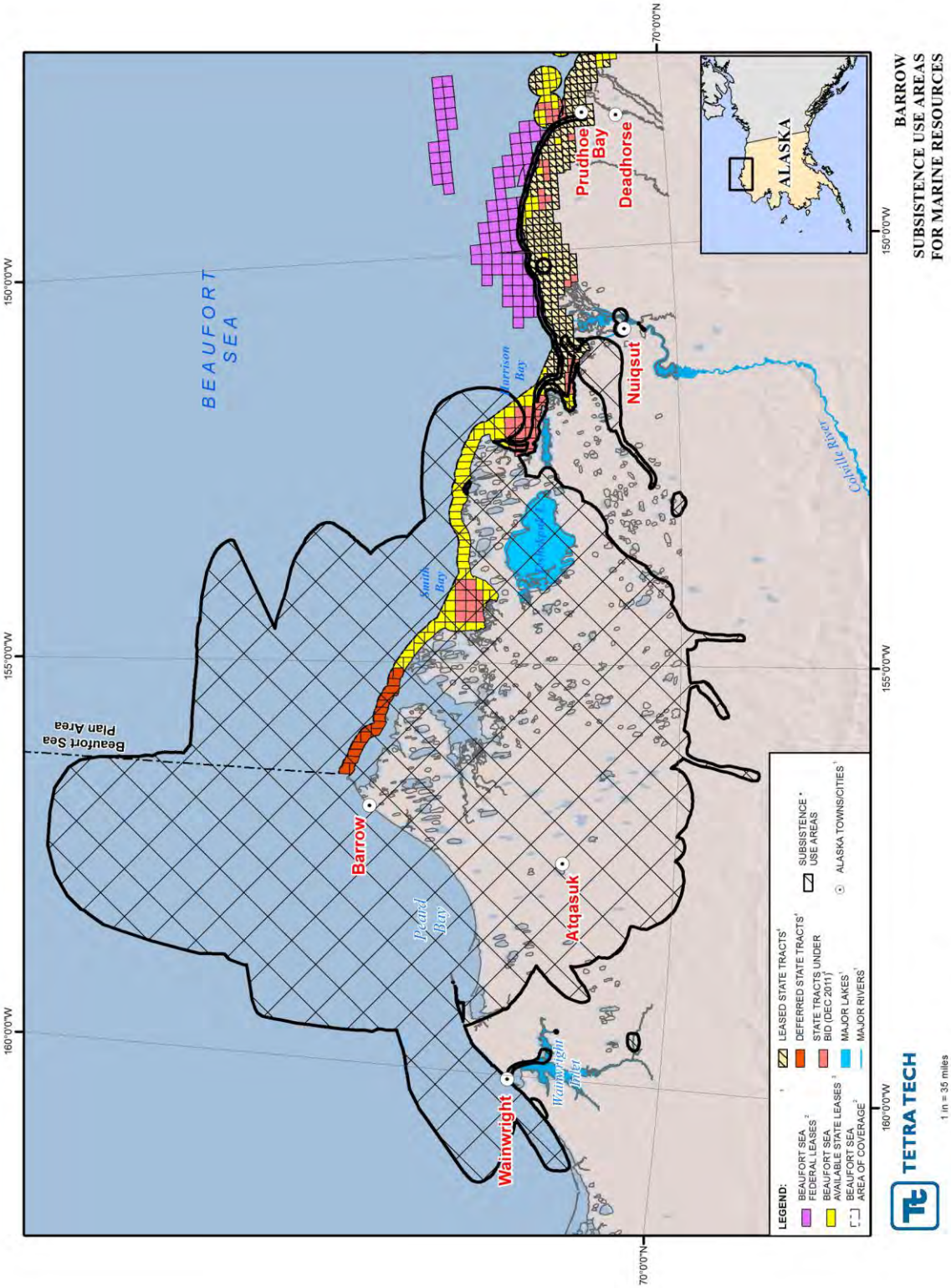


Figure 6-2. Barrow subsistence use areas for marine resources. (source information is on page following Figure 6-4)

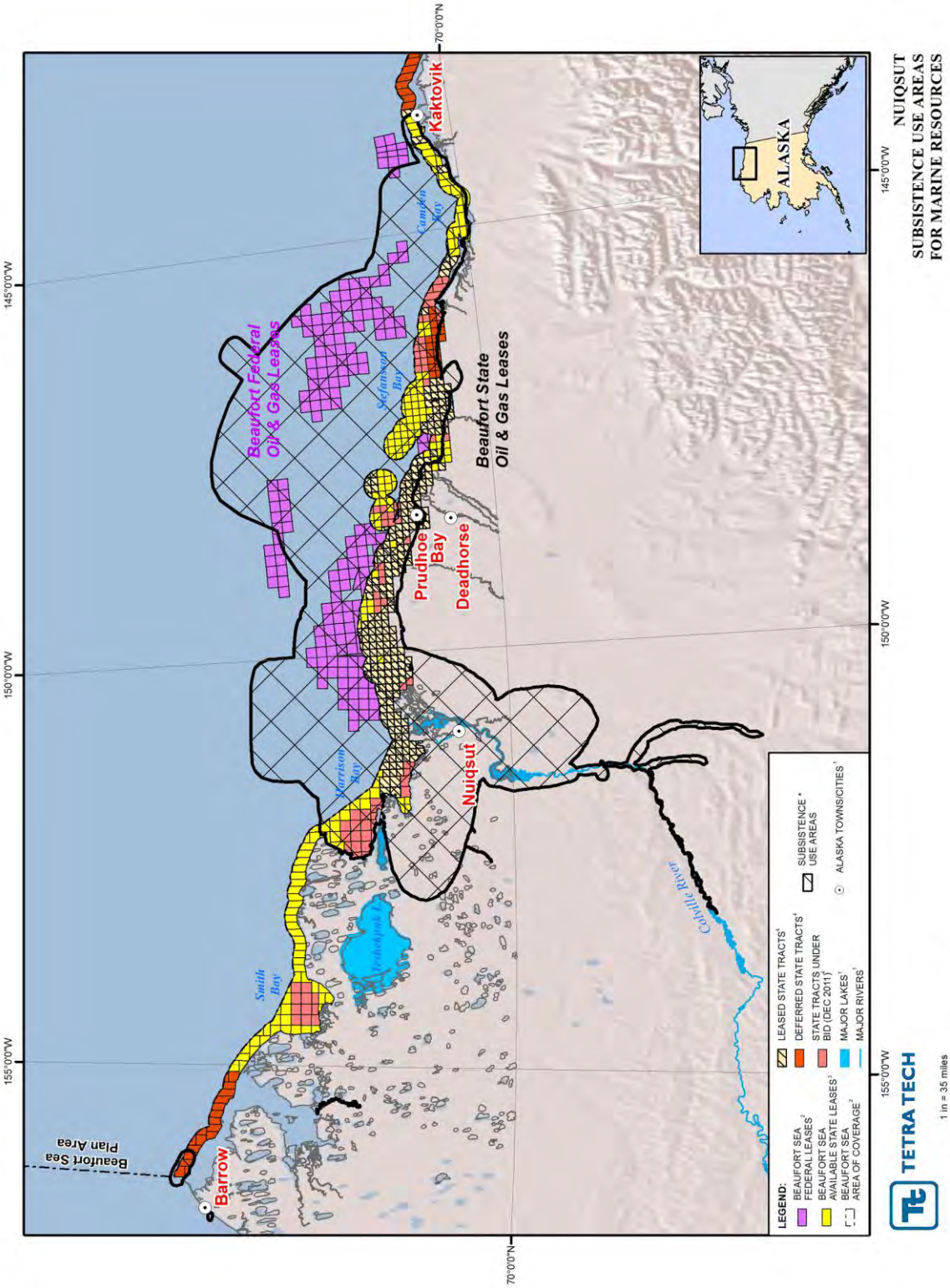


Figure 6-3. Nuiqsut subsistence use areas for marine resources. (source information is on page following Figure 6-4)

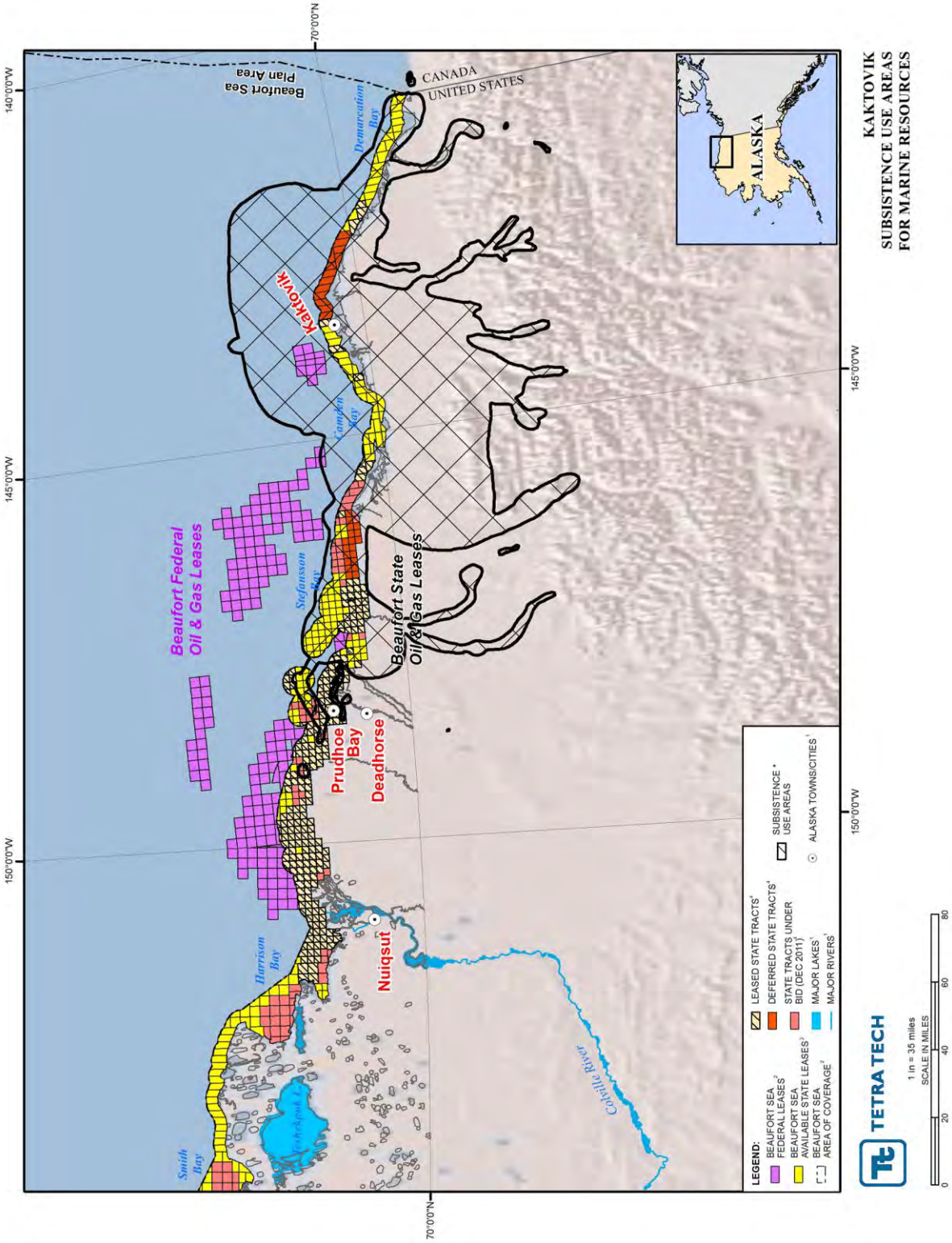


Figure 6-4. Kaktovik subsistence use areas for marine resources. (source information is on the next page)

Figure 6-2 Sources:

(1) Alaska State Geo-Spatial Dam Clearinghouse (2010) http://iwww.asgdc.state.ak.us/

(2) Bureau of Ocean Energy Management, Regulation and Enforcement http://www.boemre.gov/offshore/mapping/alaska.htm#GIS

(3) AK DNR, Division of Oil and Gas http://www.dog.dnr.alaska.gov/oil/products/data/downloads.htm#lease_boundaries

(4) State of Alaska Depart of Nat Res Division of Oil and Gas - PDF Figure "Oil and Gas Lease Sale Beaufort Sea Areawide 2011W Lease Sale" Dated December 7, 2011.

* Subsistence use areas derived from the following sources:

Pedersen 1979 (lifetime to 1979 - fish, marine invertebrates, polar bear, seat, walrus, whale, wildfowl)

Braund and Burnham 1984 (time frame of 1979-1983 - bearded seal, beluga, bowhead, fish, migratory birds, walrus)

SRB&A, ISER 1993 (time frame of 1987-1989 - Arctic cisco, Arctic char/Dolly Varden, bearded seal bowhead, broad whitefish, burbot, eider, geese, ringed seal, walrus)

SRB&A n.d. (time frame of 1987-1989 - Arctic cisco, Arctic char/Dolly Varden, bearded seal, bowhead, broad whitefish, burbot, eider, geese, ringed seal, walrus)

SRB&A 2010 (time frame of 1997-2006 - Arctic cisco, Arctic char/Dolly Varden, bearded seal, bowhead, broad whitefish, burbot, eider, geese, ringed seal, walrus)

Figure 6-3 Sources:

(1) Alaska State Geo-Spatial Dam Clearinghouse (2010) http://iwww.asgdc.state.ak.us/

(2) Bureau of Ocean Energy Management, Regulation and Enforcement http://www.boemre.gov/offshore/mapping/alaska.htm#GIS

(3) AK DNR, Division of Oil and Gas http://www.dog.dnr.alaska.gov/oil/products/data/downloads.htm#lease_boundaries

(4) State of Alaska Depart of Nat Res Division of Oil and Gas - PDF Figure "Oil and Gas Lease Sale Beaufort Sea Areawide 2011W Lease Sale" Dated December 7, 2011.

* Subsistence use areas derived from the following sources:

Pedersen 1979 (lifetime to 1979 - fish. seal, whale, wildfowl)

Pedersen 1986 (time frame of 1973-1986 birds, fish, polar bear, seal, whaling)

SRB&A 2003 (time frame of 1994-2003 - bowhead, eider, fish, geese, seal)

SRB&A 2010 (time frame of 1995-2006 - Arctic cisco, Arctic char/Dolly Varden, bearded seal, bowhead, broad whitefish, burbot, eider, geese, ringed seal)

Figure 6-4 Sources:

(1) Alaska State Geo-Spatial Dam Clearinghouse (2010) http://iwww.asgdc.state.ak.us/

(2) Bureau of Ocean Energy Management, Regulation and Enforcement http://www.boemre.gov/offshore/mapping/alaska.htm#GIS

(3) AK DNR, Division of Oil and Gas http://www.dog.dnr.alaska.gov/oil/products/data/downloads.htm#lease_boundaries

(4) State of Alaska Depart of Nat Res Division of Oil and Gas - PDF Figure "Oil and Gas Lease Sale Beaufort Sea Areawide 2011W Lease Sale" Dated December 7, 2011.

* Subsistence use areas derived from the following sources:

Pedersen 1979 (lifetime to 1979 - fish, polar bear, seal, walrus, whale, wildfowl)

SRB&A 2010 (time frame of 1996-2006 - Arctic cisco, Arctic char/Dolly Varden, bearded seal, bowhead, broad whitefish, burbot, eider, geese, ringed seal)

Community members from four North Slope villages provided traditional knowledge observations and comments about nearshore physical and biological habitats, marine resources, and subsistence use areas. Community members also shared their concerns about the potential effects of oil and gas related discharges to subsistence areas. The concerns are in several broad categories: (1) effects of discharges on the health and availability of marine resources (e.g., marine mammals); (2) ramifications of multiple

stressors, including discharges, on the sustainability of the subsistence areas and potential effects in the food chain; (3) whether EPA would adopt a zero-discharge policy regarding potentially harmful discharges; and (4) how EPA would monitor potential marine impacts resulting from exploration facilities operating under the Beaufort general permit. A number of participants called for the permit to require zero discharge of effluent; others suggested that the permit prohibit discharges within 25 miles of the shoreline to adequately protect the subsistence resources (SRB&A 2011). As outlined below, EPA has included several permit provisions to address the community concerns and input.

EPA acknowledges the importance of clearly articulating the risk related to these discharges as even the perception of contamination could produce an adverse effect by causing hunters to avoid harvesting some species or from some areas. Local understanding about drilling activities might result in reduced consumption of subsistence resources. Reduction in the harvest or consumption of subsistence resources could produce an adverse effect on human health. However, EPA is including the following permit requirements to ensure that the discharges authorized under the Beaufort general permit would not pose a threat to human health:

- No discharge of non-aqueous drilling fluids and associated drill cuttings (i.e., only water-based drilling fluids and drill cuttings are authorized);
- No discharge of test fluids;
- Meet effluent limitations and monitoring requirements for all discharge waste streams;
- Conduct toxicity screening of certain waste streams for and conducting WET testing if those waste streams exceed initial toxicity threshold screening, or once per well, if the discharges exceed a volume limit of 10,000 gallons per 24-hour period and if chemicals are added to the system;
- Conduct Environmental Monitoring Programs at each drilling site for four phases of exploration activity (before, during, and two phases after drilling), including additional metals analyses and bioaccumulation studies for the discharges of drilling fluids and drill cuttings;
- Inventory chemical additive use and report for all discharges, including limitations on chemical additive concentrations;
- No discharge of water-based drilling fluids and drill cuttings during bowhead whaling activities by Nuiqsut and Kaktovik in the Beaufort Sea;
- Perform an alternatives analysis before authorization is granted for discharge of water-based drilling fluids and drill cuttings, sanitary, and domestic wastes to stable ice in the Beaufort Sea Area of Coverage.
- Based on the requirements and prohibitions established in the general permit and analysis of bioaccumulation and pollutant transport, EPA concludes that the discharges will not result in human health impacts from direct and indirect exposure pathways. Additionally, EPA will request ATSDR review the environmental monitoring data conducted at site-specific drill sites to inform ongoing and future permit decisions.

6.7. Criterion 7

Existing or potential recreational and commercial fishing, including finfishing and shellfishing.

The Northwest Pacific Fishery Management Council developed a fishery management plan (FMP) for fish resources in the Arctic Management Area in 2009. The FMP governs all commercial fishing including finfish, shellfish, and other marine resources with the exception of Pacific salmon and Pacific halibut (NPFMC 2009). The FMP prohibits commercial fishing in the area until sufficient information is available to enable a sustainable commercial fishery to proceed (74 FR 56734). The FMPs applicable to salmon and Pacific halibut fisheries likewise prohibit the harvest of those species in the Arctic Management Area; Amendment 29 to the Bering Sea/Aleutian Islands King and Tanner Crabs FMP prohibits the harvest of crabs in the area as well (74 FR 56734). Because commercial fishing is not permitted in the Beaufort Sea Area of Coverage, that aspect of Criterion 7 would not be affected by the discharges authorized under the permit.

Subsistence fishing, defined as —noncommercial, long-term, customary and traditional use necessary to maintain the life of the taker or those who depend upon the taker to provide them with such subsistence," is not affected by the FMP. The most recent (2007) subsistence data available in the ADF&G Community Subsistence Information System for North Slope Borough communities indicate that subsistence fishing occurred in the past (and could be ongoing) with the harvest of salmon species, flounder, cod, and smelt. Participants in the traditional knowledge workshops in Barrow expressed concern for important habitat along the coast, particularly areas with clams and other small organisms that feed fish and larger marine wildlife. Additionally respondents voiced concern over the direct effect on their subsistence resources because of exploration activities in the Area of Coverage (SRB&A 2011). Seasonal and permanent restrictions discussed in Criterion 4 above of important fishing and habitat areas in the Beaufort general permit should limit the duration of any potential effects on subsistence fishing to the period that explorations operations are active.

- The Magnuson-Stevens Fishery Conservation and Management Act (January 21, 1999) requires EPA to consult with the NMFS when a proposed discharge has the potential to adversely affect (reduce quality or quantity or both of) EFH. The EFH assessment conducted for the Beaufort general permit concluded that the discharges will not adversely affect EFH.

Because the discharges would meet water quality objectives, and with the findings presented for criteria 1 through 4, EPA does not anticipate unreasonable degradation of recreational, commercial, or subsistence fishing resulting from the discharges.

6.8. Criterion 8

Any applicable requirements of an approved Coastal Zone Management Plan.

The Alaska Coastal Management Program expired on June 30, 2011, by operation of Alaska Statutes 44.66.020 and 44.66.030. As of July 1, 2011, there is no longer a CZMA program in Alaska. Because a federally approved CZMA program must be administered by a state, the National Oceanic and Atmospheric Administration withdrew the Alaska Coastal Management Program from the National Coastal Management Program. See 76 FR 39,857 (July 7, 2011). As a result, the CZMA consistency

provisions at 16 U.S.C. 1456(c)(3) and 15 CFR Part 930 no longer apply in Alaska. Accordingly, federal agencies are no longer required to provide Alaska with CZMA consistency determinations.

6.9. Criterion 9

Such other factors relating to the effects of the discharge, as may be appropriate.

EPA has determined that, with respect to the discharge of pollutants, the discharges authorized by the Beaufort general permit will not have a disproportionately high or adverse human health or environmental effects on minority or low-income populations living on the North Slope, including coastal communities near the proposed exploratory operations. In making that determination, EPA considered the potential effects of the discharges on the communities, including subsistence areas, and the marine environment. EPA's evaluation and determinations are discussed in more detail in the Environmental Justice Analysis, which is included in the administrative record for the permit action.

Executive Order 12898 titled, *Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations states,* in part, that ~~"e~~ach Federal agency shall make achieving environmental justices part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations . . . ." The order also provides that federal agencies are required to implement the order consistent with and to the extent permitted by existing law. In addition, EPA Region 10 adopted its *North Slope Communications Protocol: Communications Guidelines to Support Meaningful Involvement of the North Slope Communities in EPA Decision-Making* in May 2009. Consistent with the order and EPA policies, EPA implemented a tribal outreach and involvement process that is described in detail in the Environmental Justice Analysis.

The Beaufort general permit implements existing water pollution prevention and control requirements, including applicable water quality standards, to ensure compliance with CWA requirements, including preventing unreasonable degradation of the marine environment. As discussed in this ODCE, EPA evaluated the potential for significant adverse changes in ecosystem diversity, productivity, and stability of the biological communities within the Area of Coverage.

The ODCE also evaluates the threat to human health through the direct physical exposure to discharged pollutants and indirectly through consumption of exposed aquatic organisms in the food chain (see Criterion 6). As a result of EPA's evaluations, changes were made to the Beaufort general permit as precautionary measures to ensure no unreasonable degradation occurs during the anticipated exploratory drilling activities. The general permit imposes an environmental monitoring program to gather additional, relevant information about potential effects of the discharges on Alaska's Arctic waters. Additionally, EPA has the authority to make modifications or revoke permit coverage if unreasonable degradation results from the wastewater discharges.

The Environmental Monitoring Program is also designed to obtain additional information that can be used during implementation of the permit and in future permit decisions. In summary, EPA carefully considered the potential environmental justice impacts related to the Beaufort general permit's authorized discharges, especially the potential for disproportionate effects on communities and residents that engage in subsistence activities. That analysis determined that, with respect to the discharges, there will not be disproportionately high or adverse human health or environmental effects on minority or low-income

populations residing on the North Slope and near the Area of Coverage. Please refer to EPA's Environmental Justice Analysis for more information.

6.10. Criterion 10

Marine water quality criteria developed pursuant to Section 304(a)(I)

In discharges from oil and gas exploration activities, parameters of concern for impacts on water quality include fecal coliform bacteria, metals, oil and grease, temperature, chlorine, turbidity, TSS, and settleable solids. Within 4.8 km (3 mi) of the Alaskan shoreline, where the Beaufort Sea is designated as state waters, the more stringent of the marine water quality criteria established at Title 18 of the Alaskan Administrative Code, Chapter 70 (Water Quality Standards, at http://www.dec.state.ak.us/regulations/pdfs/18%20AAC%2070.pdf) and EPA-recommended marine criteria established pursuant to CWA section 304(a)(1) are applicable water quality standards for the Beaufort Sea. Current EPA-recommended criteria are summarized in the table at http://water.epa.gov/scitech/swguidance/waterquality/standards/current/index.cfm. In general, beyond 4.8 km (3 mi) from the shoreline, the Beaufort Sea is designated as federal waters; however, EPA applied the same requirements to federal waters to ensure consistency. Discharges to the Beaufort Sea have been evaluated in reference to those objectives, with consideration of the dilution provided within the area of discharge of 100 m.

6.10.1. Oil and grease

Because of the nature of oil and gas exploration activities, discharges of oil and grease are of concern to water quality. Applicable water quality standards for oil and grease follow.

State Criteria

Water Supply – Aquaculture	Total aqueous hydrocarbons in the water column may not exceed 15 µg/L. Total aromatic hydrocarbons in the water column may not exceed 10 µg/L. There may be no concentrations of petroleum hydrocarbons, animal fats, or vegetable oils in shoreline or bottom sediments that cause deleterious effects to aquatic life. Surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen or discoloration.
Water Supply – Seafood Processing	May not cause a film, sheen or discoloration on the surface or floor of the water body or adjoining shorelines. Surface waters must be virtually free from floating oils. May not exceed concentrations that individually or in combination impart odor or taste as determined by organoleptic tests.
Water Supply – Industrial	May not make the water unfit or unsafe for use.
Water Recreation – Contact	May not cause a film, sheen, or discoloration on the surface or floor of the water body or adjoin shorelines. Surface waters must be virtually free from floating oils.

Federal Criteria: Levels of oils or petrochemicals in the sediment which cause deleterious effects to the biota should not be allowed; and Surface waters shall be virtually free from floating nonpetroleum oils of vegetable or animal origin, as well as petroleum derived oils.

For oil and grease, the permit contains requirements that prohibit the discharges if oil is detected through a static sheen test and/or visual observation. Furthermore, the permit requires treatment of certain

discharges, such as deck drainage and ballast water, through the oil-water separator before discharge. Therefore, the water quality criterion for oil and grease is expected to be met.

6.10.2. Fecal coliform bacteria

Fecal coliform (FC) bacteria in discharges of sanitary wastewater are of concern for water quality. The permit contains technology-based effluent limitations for fecal coliform based on the level of treatment possible through the use of marine sanitation devices. Under 33 CFR Part 159, marine sanitation devices are required to produce a fecal coliform bacterial count not more than 200 per 100 milliliters.

State Criteria

Water Supply – Aquaculture	For products normally cooked, the geometric mean of samples taken in a 30-day period may not exceed 200 FC/100 mL, and not more than 10 percent of the samples may exceed 400 FC/100 mL. For products not normally cooked, the geometric mean of samples taken in a 30-day period may not exceed 20 FC/100 mL and not more than 10 percent of samples may exceed 40 FC/100 mL.
Water Supply – Seafood Processing	In a 30-day period, the geometric mean of samples may not exceed 20 FC/100 mL and not more than 10 percent of the samples may exceed 40 FC/100 mL.
Water Supply – Industrial	Where worker contact is present, the geometric mean of samples taken in a 30-day period may not exceed 200 FC/100 m, and not more than 10 percent of the samples may exceed 400 FC/100 mL.
Water Recreation – Contact	In a 30-day period, the geometric mean of samples may not exceed 100 FC/100 mL, and not more than one sample, or more than 10 percent of the samples if there are more than 10 samples may exceed 200 FC/100 mL.
Water Recreation – Secondary Recreation	In a 30-day period, the geometric mean of samples may not exceed 200 FC/100 mL, and not more than 10 percent of the samples may exceed 400 FC/100 mL.
Harvesting for Consumption of Raw Mollusks or Other Raw Aquatic Life	Based on a 5-tube decimal dilution test, the fecal coliform median Most Probable Number may not exceed 14 FC/100 mL, and not more than 10 percent of the samples may exceed a fecal coliform median MPN of 43 FC/100 mL.

Federal Criteria

Marine Water Bathing	Based on a statistically sufficient number of samples (generally not less than 5 samples spaced evenly over a 30-day period), the geometric mean of enterococci densities should not exceed 35 per 100 mL.
Shellfish Harvesting Waters	The median fecal coliform bacterial concentration should not exceed 14 MPN/ 100 mL with not more than 10 percent of samples exceeding 43 MPN/100 mL for the taking of shellfish.

6.10.3. Metals

Metals are naturally present in drilling fluids and are, therefore, a concern for effects on water quality in discharges of the drilling fluids and drill cuttings. The source of metals is barite; the characteristics of raw barite will determine the concentrations of metals found in the drilling fluid. EPA evaluated concentrations of certain metals of concern (antimony, arsenic, cadmium, chromium, [VI], copper, lead, mercury, nickel, selenium, silver, and zinc) expected to leach from drill cuttings in sea water within 100 m (USEPA 2000). The results of the analysis showed that the projected water column pollutant concentrations did not exceed applicable federal or state water quality criteria or standards. To control the

concentration of heavy metals in drilling fluids, EPA established effluent limitations for mercury and cadmium in stock barite, which indirectly controls the other metal constituents present in the drilling fluids and drill cuttings discharge.

The table below summarizes the federal water quality criteria for metals.

Pollutant	Marine (Aquatic Life) Acute Criteria (µg/L)	Marine (Aquatic Life) Chronic Criteria (µg/L)	Human Health (Fish Consumption) Criteria Acute Criteria (µg/L)
Arsenic	60	36	.0175
Cadmium	43	9.3	NA
Lead	140	5.6	NA
Mercury	2.1	5.6	NA
Zinc	95	86	NA

6.10.4. Temperature

The permit authorizes discharges of non-contact cooling water, which has higher temperatures than the receiving water body.

State Criteria

Water Supply – Aquaculture; Growth and Propagation of Fish, Shellfish, Other Aquatic Life and Wildlife; and Harvesting for Consumption of Raw Mollusks or Other Raw Aquatic Life.	May not cause the weekly average temperature to increase more than 1°C. The maximum rate of change may not exceed 0.5°C per hour. Normal daily temperature cycles may not be altered in amplitude or frequency.
Water Supply – Seafood Processing	May not exceed 15°C.
Water Supply – Industrial	May not exceed 25°C.

Federal Criteria

In order to assure protection of the characteristic indigenous marine community of a water body segment from adverse thermal effects:

a. the maximum acceptable increase in the weekly average temperature resulting from artificial sources is 1° C (1.8 F) during all seasons of the year, providing the summer maxima are not exceeded; and
b. daily temperature cycles characteristic of the water body segment should not be altered in either amplitude or frequency.

It is expected that complete mixing will occur within a short distance from the discharge point and the temperature of the discharge will not exceed any temperature water quality objectives within 100 m.

6.10.5. Chlorine

Chlorine is a parameter of concern because it is used for disinfection of sanitary effluent. The applicable ELGs require that discharges of sanitary effluent from facilities that are continuously manned by 10 or more people meet the effluent limitation of 1 mg/L for residual chlorine, which should be maintained as

close as possible to this concentration. The Beaufort general permit applies this requirement for discharges of sanitary wastes to federal waters.

For state waters, the following criterion applies:

State Criteria

Acute	Chronic
13 µg/L	7.5 µg/L

The permit contains a daily maximum limitation of 1 mg/L, but it also contains an average monthly limitation of 0.5 mg/L, which are expected to meet applicable state water quality criteria at the edge of the mixing zone (if one is authorized by DEC).

6.10.6. Turbidity, TSS, and Settleable Solids

Discharges of drilling fluids and discharges of sanitary effluent are expected to contain solids, such as settleable solids and suspended solids, which contribute to turbidity.

State Criteria

	Sediment	Turbidity
Water Supply – Aquaculture	No imposed loads that will interfere with established water supply treatment levels.	May not exceed 25 NTU.
Water Supply – Seafood Processing	Below normally detectable levels.	May not interfere with disinfection.
Water Supply – Industrial	No imposed loads that will interfere with established water supply treatment levels.	May not cause detrimental effects on established levels of water supply treatment.
Water Recreation – Contact	No measurable increase in concentration of settleable solids above natural conditions, as measured by the volumetric Imhoff cone method.	May not exceed 25 NTU.
Water Recreation – Secondary Recreation	May not pose hazards to incidental human contact or cause interference with the use.	May not exceed 25 NTU.
Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife	No measurable increase in concentration of settleable solids above natural conditions, as measured by the volumetric Imhoff cone method.	May not reduce the depth of the compensation point for photosynthetic activity by more than 10 percent. May not reduce the maximum secchi disk depth by more than 10 percent.
Harvesting for Consumption of Raw Mollusks or Other Raw Aquatic Life	---	May not reduce the depth of the compensation point for photosynthetic activity by more than 10 percent. May not reduce the maximum secchi disk depth by more than 10 percent.

Federal Criteria: None Applicable

The permit contains effluent limitations for TSS that are based on secondary treatment standards for discharges of sanitary effluent. The permit also contains an effluent toxicity limitation for suspended particulate phase material in discharges of drilling fluids and drill cuttings.

6.11. Determinations and Conclusions

EPA has evaluated the 13 discharges for the Beaufort general permit against the 10 ocean discharge criteria. Based on this evaluation, EPA concludes that the discharges will not cause unreasonable degradation of the marine environment under the conditions, limitations, and requirements in the Beaufort general permit.

With regard to discharge of drilling fluids and drill cuttings, this ODCE identifies recent studies that show that trace metals commonly associated with water-based drilling fluids and drill cuttings are not readily absorbed by living organisms. See for example, Sections 6.1.4. In addition, data suggest that bioaccumulation risks are expected to be low because the bioavailability of trace metals in drilling fluid components (i.e., barite) is low. See Section 6.1.2. Furthermore, another study shows that amphipods exposed to metals that are bioavailable will accumulate small amounts of copper and lead; but copper and lead levels are quickly reduced in those individual amphipods exposed to 12 hours of seawater without elevated metal concentrations. Other studies show that bioaccumulation of barium and chromium can occur in benthic organisms; but pollutant accumulation decreases once organisms are removed from the contamination source. See Section 6.1.4. Together, those studies suggest that bioaccumulation of trace metals from water-based drilling fluids is low and reversible. See Section 6.1.

In addition, while increased sedimentation from drilling fluids and cuttings can affect benthic organisms in the discharge area, the effects are limited to the small discharge area (100-m) and have been shown to have few long-term impacts. Several studies document the resilience of affected benthic communities in reestablishing affected areas within months after discharges cease. Also, other studies of former offshore drilling locations show that trace metal concentrations in seafloor sediment are not persistent, and decrease to levels below risk-based sediment guideline concentrations. See Section 6.3.2. These studies demonstrate that discharge of drilling fluids and cuttings will not result in an unreasonable degradation of the marine environment during or after discharge activities. Finally, because discharges from exploratory facilities are relatively short in duration and intermittent during drilling operations, long-term widespread impacts are not anticipated.

The ODCE also addresses subsistence use within the current leased areas. See Figure 6-2, Figure 6-3, and Figure 6-4. As discussed above in sections 6.6 and 6.9 EPA acknowledges the concerns related to the consumption of subsistence resources and public health. EPA has evaluated the discharges and does not anticipate a threat to human health through either direct exposure to pollutants or consumption of exposed aquatic organisms. However, as a result of EPA's evaluations, additional changes were made to the Beaufort general permit to ensure that no unreasonable degradation occurs during the anticipated exploratory drilling activities.

In particular, EPA is mindful of concerns about human exposure to contaminants through consumption of subsistence foods and through other environmental pathways. EPA acknowledges the importance of assessing and clearly articulating the risk related to discharging drilling fluids and cuttings, because even the perception of contamination could produce adverse effects on subsistence hunters and their practices.

To address these concerns on an ongoing basis, and to ensure that no unreasonable degradation of the marine environment occurs, EPA requires additional environmental data to be collected and evaluated to assess the potential bioaccumulation of metals in benthic communities and other potential bioaccumulation effects.

EPA is also mindful of concerns about the potential changes in the behavior of subsistence-related marine resources, i.e., their avoidance of drilling discharges and deflection from traditional migratory paths might result in adverse effects on subsistence communities. For example, if the subsistence-related marine resources move farther away from subsistence-based communities, there is the potential for increased risks to hunter safety because of the additional time and farther distances traveled offshore in pursuit of the marine resources. Likewise, deflection of subsistence-related marine resources could reduce subsistence harvest and reduced consumption of subsistence resources, which could cause adverse effects on human health. To address these concerns on an ongoing basis and to ensure that no unreasonable degradation of the marine environment occurs, EPA requires additional environmental data to be collected and evaluated to assess the potential deflection and avoidance effects on marine resources during periods of high levels of discharging drilling fluids, drill cuttings, and non-contacting cooling water at each drill site location.

With regard to the non-contact cooling water discharge, available data show that operators use either large or small volumes of water through their cooling systems, which result in effluent streams with distinct temperature signature: large volumes result in a lower temperature differential as compared with ambient conditions, and small volumes have a higher temperature differential. Under either scenario, the ODCE and dilution modeling does not identify any acute or chronic effects of such temperature differences. Thermal plumes from the discharge of non-contact cooling water will disburse and disappear quickly after the discharges cease.

All other waste streams that will be authorized by the Beaufort general permit (e.g., sanitary and domestic wastes, deck drainage, blowout preventer fluid) do not contain pollutants that are bioaccumulative or persistent. The Beaufort general permit contains effluent limitations and requirements that ensure protection of the marine environment.

Importantly, the Beaufort general permit requires permittees to implement an Environmental Monitoring Program and imposes other conditions that assess the site-specific impacts of the discharges on water, sediment, and biological quality. The monitoring program includes assessments of pre-, during, and post-drilling conditions and evaluation of potential bioaccumulative and persistent impacts of drilling fluids and drill cuttings discharge on aquatic life. Permittees are required to assess the areal extent of cuttings deposition and conduct ambient measurements including temperature and turbidity measurements. Permittees are also required to evaluate the discharges for potential toxicity. Those additional permit conditions will assist EPA in determining whether and to what extent further limitations are necessary to ensure that the discharges do not cause unreasonable degradation.

Finally, in accordance with 40 CFR 125.123(d)(4), the Beaufort general permit states that EPA can modify or revoke permit coverage at any time if, on the basis of any new data, EPA determines that continued discharges might cause unreasonable degradation of the marine environment Thus, EPA will be able to assess new data that is submitted in the required monthly and annual reports for each operator as a means to continually monitor potential effects on the marine environment and to take precautionary actions that ensure no unreasonable degradation occurs during the permit term.

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8. GLOSSARY

accelerators. A chemical additive that reduces the setting time of cement.

advection patterns. The transfer of heat or matter by horizontal movement of water masses (Lincoln R.J., G.A. Boxshall, and P.F. Clark.. 1982. *A Dictionary of Ecology, Evolution, and Systematics*. Cambridge University Press.)

amphipods. A large group of crustaceans, most of which are small, compressed creatures (e.g., sand fleas, freshwater shrimps).

anadromous. Migrating from the sea to fresh water to spawn. Pertaining to species such as fish that live their lives in the sea and migrate to a freshwater river to spawn.

annulus. Space between drill-string and earthen wall of well bore, or between production tubing and casing.

anoxia. 1. Areas of seawater or fresh water that are depleted of dissolved oxygen. This condition is generally found in areas that have restricted water exchange. 2. A total decrease in the level of oxygen, an extreme form of hypoxia or *low oxygen*.

ballast water. 1. For ships, water taken onboard into specific tanks to permit proper angle of repose of the vessel in the water, and to ensure structural stability. 2. For mobile offshore drilling rigs, weight added to make the rig more seaworthy, increase its draft, or sink it to the seafloor. Seawater is usually used for ballast, but sometimes concrete or iron is used additionally to lower the rig's center of gravity permanently.

barite. Barium sulfate; a mineral frequently used to increase the weight or density of drilling mud. Its relative density is 4.2 (or 4.2 times denser than water).

bathymetric. Pertaining to the depth of a water body

benthic. Dwelling on, or relating to, the bottom of a body of water; living on the bottom of the ocean and feeding on benthic organisms

bilge water. Water that collects and stagnates in the lowest compartment on a ship where the two sides meet at the keel (bilge)

bioaccumulation. Used to describe the increase in concentration of a substance in an organism over time

biochemical oxygen demand (BOD). A measure of the quantity of oxygen used by microorganisms (e.g., aerobic bacteria) in the oxidation of organic matter

bioturbation. The stirring or mixing of sediment or soil by organisms, especially by burrowing or boring

blowouts. An uncontrolled flow of gas, oil, or other well fluids into the atmosphere or into an underground formation. A blowout, or gusher, can occur when formation pressure exceeds the pressure applied to it by the column of drilling fluid.

blowout preventer fluid. Fluid used to actuate hydraulic equipment on the blowout preventer.

boiler blowdown. The discharge of water and minerals drained from boiler drums.

borehole or well. A hole made by drilling or boring; a wellbore.

brackish. Mixed fresh and salt water.

Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE). Part of the Department of the Interior, responsible for overseeing the safe and environmentally responsible development of energy and mineral resources on the Outer Continental Shelf.

caisson. A steel or concrete chamber that surrounds equipment below the waterline of an Arctic drilling rig, thereby protecting the equipment from damage by moving ice.

carapace. A bony or chitinous case or shield covering the back or part of the back of an animal (as a turtle or crab).

caustic soda. Sodium hydroxide, used to maintain an alkaline pH in drilling mud and in petroleum fractions.

cement slurry. The material used to permanently seal annular spaces between casing and borehole walls. Cement is also used to seal formations to prevent loss of drilling fluid and for operations ranging from setting kick-off plugs to plug and abandonment.

cetacean. A group of marine mammals, including whales, dolphins, porpoises.

circumboreal. Around the northern hemisphere in the higher latitudes.

clay. 1. A term used for particles smaller than 1/256 millimeter (4 microns) in size, regardless of mineral composition. 2. A group of hydrous aluminum silicate minerals (clay minerals). 3. A sediment of fine clastics.

conductor casing. Generally, the first string of casing in a well. It can be lowered into a hole drilled into the formations near the surface and cemented in place; or it can be driven into the ground by a special pile drive (in such cases, it is sometimes called drive pipe); or it can be jetted into place in offshore locations. Its purpose is to prevent the soft formations near the surface from caving in and to conduct drilling mud from the bottom of the hole to the surface when drilling starts. Also called *conductor pipe*.

copepods. Any of a large subclass of minute crustaceans common in fresh and salt water, having no carapace, six pairs of thoracic legs but none on the abdomen, and a single median eye.

corrosion inhibitors. A chemical substance that minimizes or prevents corrosion in metal equipment.

cottids. A family of demersal fish in the order Scorpaeniformes, suborder Cottoidei (or sculpins), found in shallow coastal waters in the northern and Arctic regions.

critical habitat. A habitat determined to be important to the survival of a threatened or endangered species, to general environmental quality, or for other reasons as designated by the state or federal government.

cuttings. Small pieces of rock that break away because of the action of the drill bit teeth. Cuttings are screened out of the liquid mud system at the shale shakers and are monitored for composition, size, shape, color, texture, hydrocarbon content and other properties by the mud engineer, the mud logger, and other on-site personnel.

deck drainage. Waste resulting from platform washings, deck washings, spillage, rainwater, and runoff from curbs, gutters, and drains including drip pans and work areas within facilities subject to this permit.

delineation well. Drilled at a distance from a discovery well to determine physical extent, reserves and likely production rate of a new oil or gas field.

denitrification. The release of gaseous nitrogen or the reduction of nitrates to nitrites and ammonia by the breakdown of nitrogenous compounds, typically by microorganisms when the oxygen concentration is low; on a global scale, thought to occur primarily in oxygen deficient environments.

demersal fish. Fish found living on or near the bottom of the sea, feeding on benthic organisms, including cod, haddock, whiting, and halibut.

desalination unit wastes. Wastewater associated with the process of creating fresh water from seawater.

dessicated. Specimens that are completely dried.

directional drilling. Intentional deviation of a wellbore from the vertical. Although wellbores are normally drilled vertically, it is sometimes necessary or advantageous to drill at an angle from the vertical. Controlled directional drilling makes it possible to reach subsurface areas laterally remote from the point where the bit enters the earth. It often involves the use of turbodrills, Dyna-Drills, whipstocks, or other deflecting rods.

discovery well. An exploratory well that evaluates the occurrence of hydrocarbons.

Dispersants. A substance added to cement that chemically wets the cement particles in the slurry, allowing the slurry to flow easily without much water.

domestic waste. Materials discharged from sinks, showers, laundries, safety showers, eyewash stations, hand-wash stations, fish cleaning stations, and galleys.

drill bit. The part of the drilling tool that cuts through rock strata.

drilling fluid. Circulating fluid (mud) used in the rotary drilling of wells to clean and condition the hole and to counterbalance formation pressure. The classes of drilling fluids are water-based fluid and non-aqueous drilling fluid.

drilling mud. A special mixture of clay, water, or refined oil, and chemical additives pumped downhole through the drill pipe and drill bit. The mud cools the rapidly rotating bit; lubricates the drill pipe as it turns in the well bore; carries rock cuttings to the surface; serves as a plaster to prevent the wall of the borehole from crumbling or collapsing; and provides the weight or hydrostatic head to prevent extraneous fluids from entering the well bore and to control downhole pressures that might be encountered.

drillship. A self-propelled floating offshore drilling unit that is a ship constructed to permit a well to be drilled from it. Drill ships are capable of drilling exploratory wells in deep, remote waters. They might have a ship hull, a catamaran hull, or a trimaran hull.

drill string. The column, or string, of drill pipe with attached tool joints that transmits fluid and rotational power from the kelly to the drill collars and bit. Often, especially in the oil patch, the term is loosely applied to both drill pipe and drill collars.

echinoderms. Marine animals with a five-rayed symmetry, including sea lilies, feather stars, starfish, brittle stars, sea urchins, and sea cucumbers.

effluent. Wastewater, treated or untreated, that flows out of a treatment plant, sewer, or industrial outfall. Generally refers to wastes discharged into surface waters.

effluent guidelines. EPA technical and regulatory documents that set effluent limitations for given industries and pollutants.

effluent limitation. Restrictions established by a state or EPA on quantities, rates, and concentrations in wastewater discharges.

epibenthic. Living above the bottom. Also *demersal*.

epipelagic. The uppermost, normally photic layer of the ocean between the ocean surface and the thermocline, usually between depths of 0–200 meters; living or feeding on surface waters or at midwater to depths of 200 meters.

epontic. Used of an organism that lives attached to the substratum. (Lincoln R.J., G.A. Boxshall, and P.F. Clark. *A Dictionary of Ecology, Evolution, and Systematics*. Cambridge University Press, 1982.).

estuarine. Living mainly in the lower part of a river or estuary; coastlines where marine and freshwaters meet and mix; waters often brackish.

exploratory well. Any well drilled for the purpose of securing geological or geophysical information to be used in the exploration or development of oil, gas, geothermal, or other mineral resources, except coal and uranium, and includes what is commonly referred to in the industry as *slim hole tests, core hole tests, or seismic holes.*

fire control system test water. The water released during the training of personnel in fire protection and the testing and maintenance of fire protection equipment.

flocculation. The coagulation of solids in a drilling fluid, produced by special additives or contaminants.

flocculent. A chemical for producing flocculation of suspended particles, as to improve the plasticity of clay for ceramic purposes.

formation fluids. Any fluid that occurs in the pores of a rock. Strata containing different fluids, such as various saturations of oil, gas and water, might be encountered in the process of drilling an oil or gas well. Fluids found in the target reservoir formation are referred to as reservoir fluids.

fracture. A break in a rock formation due to structural stresses, e.g., faults, shears, joints, and planes of fracture cleavage.

heterotroph. An organism that uses organic compounds as its source of carbon.

hexavalent. A chemical valence of six.

hypoxia. Deficiency of oxygen; low levels of dissolved oxygen in water (~< 3 ppm) that are extremely stressful to most aquatic life. Stress applied to fish when measuring, e.g., oxygen consumption.

hysteresis. 1. The lag in response exhibited by a body in reacting to changes in the forces, especially magnetic forces, affecting it. 2. The phenomenon exhibited by a system, often a ferromagnetic or imperfectly elastic material, in which the reaction of the system to changes is dependent on its past reactions to change.

infauna. Benthic fauna living in the substrate and especially in a soft sea bottom.

intertidal (littoral) zone. Shallow areas along the shore and in estuaries that are alternately exposed and covered by the tides. Many juvenile fishes are regularly found in this area. Some amphibious fishes live permanently in this zone; others are occasional visitors.

isobath. A contour line on a map connecting points of equal depth in a body of water.

jack-up drilling rig. A mobile bottom-supported offshore drilling structure with columnar or open-truss legs that support the deck and hull. When positioned over the drilling site, the bottoms of the legs rest on the seafloor. A jack-up rig is towed or propelled to a location with its legs up. Once the legs are firmly positioned on the bottom, the deck and hull height are adjusted and leveled. Also called *self-elevating drilling unit*.

landfast ice. Ice adjacent to the coast and characterized by a lack of motion.

leads. Transient area of open water in sea ice that arises through the dynamical effects of oceanic and atmospheric stresses, such as tides, acting to pull the sea ice floes apart.

lignosulfonate. Drilling fluid. Highly anionic polymer used to deflocculate clay-based muds. Lignosulfonate is a by-product of the sulfite method for manufacturing paper from wood pulp. Sometimes it is called sulfonated lignin. Lignosulfonate is a complex mixture of small- to moderate-sized polymeric compounds with sulfonate groups attached to the molecule.

marine riser. The pipe and special fittings used on floating offshore drilling rigs to establish a seal between the top of the wellbore, which is on the ocean floor, and the drilling equipment, above the surface of the water. A riser pipe serves as a guide for the drill stem from the drilling vessel to the wellhead and as a conductor of drilling fluid from the well to the vessel. The riser consists of several sections of pipe and includes special devices to compensate for any movement of the drilling rig caused by waves.

marine sanitation devices (MSD). Any equipment for installation onboard a vessel that is designed to receive, retain, treat, or discharge sewage, and any process to treat such sewage.

methylmercury. A form of mercury that is most easily bioaccumulated in organisms. Methylmercury consists of a methyl group bonded to a single mercury atom, and is formed in the environment primarily by a process called biomethylation. Mercury biomethylation is the transformation of divalent inorganic mercury (Hg(II)) to CH_3Hg^+, and is primarily carried out by sulfate-reducing bacteria that live in anoxic (low dissolved oxygen) environments, such as estuarine and lake-bottom sediments.

microalgae. A classification of algae that are defined according to the size of the plant where the body of the plant is small enough that it requires magnification to observe.

mysids. Group of small, shrimp-like crustaceans characterized by a ventral brood pouch. Important food items for many fishes.

nearshore zone. The region of land extending between the backshore, or shoreline, and the beginning of the offshore zone. Water depth in this area is usually less than 10 m (33 ft).

nektonic. Actively swimming organisms able to move independently of water currents.

nitrification. The biological oxidation of ammonia with oxygen into nitrite followed by the oxidation of those nitrites into nitrates.

non-contact cooling water. Water used for cooling that does not come into direct contact with any raw material, product, by-product, or waste.

NPDES general permit. The discharge of pollutants into the state's surface waters is regulated through National Pollutant Discharge Elimination System (NPDES) permits. General permits are written to cover a category of dischargers instead of an individual facility.

Offshore Operators Committee (OOC). A nonprofit organization composed of persons, firms or corporations owning offshore leases and any person, firm or corporation engaged in offshore activity as a drilling contractor, service company, supplier, or other capacity.

pack ice. Ice that is not attached to the shoreline and drifts in response to winds, currents, and other forces; some prefer the generic term *drift ice,* and reserve pack ice to mean drift ice that is closely packed.

pelagic. Living and feeding in the open sea; associated with the surface or middle depths of a body of water; free swimming in the seas, oceans or open waters; not in association with the bottom. Many pelagic fish feed on plankton; referring to surface or mid water from 0 to 200 m depth.

petrochemicals. Chemicals made from crude oil through the refining process. Some petrochemicals can be made using coal or natural gas. The two main classes of petrochemical materials are olefins and aromatics.

phytoplankton. A plant plankton; a rapid buildup in abundance of phytoplankton, usually in response to nutrient buildup, can result in a *bloom*; microscopic plant life that floats in the open ocean.

pill. A gelled viscous fluid.

plugging and abandonment. The process of dismantling the wellhead, plugging cement plugs, production and transportation facilities, and restoring depleted producing areas in accordance with license requirements or legislation or both.

pockmarks. Craters in the seabed formed by the expulsion of gas or water from sediments. These features occur worldwide, in the ocean at all depths, and in lakes.

polychaetes. Segmented marine annelid worms that can be found living in the depths of the ocean, floating free near the surface, or burrowing in the mud and sand of the beach.

polynyas. An area of open water in sea ice.

pressure ridges. A ridge produced on floating ice by buckling or crushing under lateral pressure of wind or ice.

residual chlorine. The amount of measurable chlorine remaining after treating water with chlorine, i.e., amount of chlorine left in water after the chlorine demand has been satisfied.

rubble fields (ice). A jumble of ice fragments or small pieces of ice (such as pancake ice) that covers a larger expanse of area without any particular order to it. The height of surface features in rubble ice is often lower than in pressure ridges.

sanitary waste. Human body waste discharged from toilets and urinals.

Section 403(c) of the Clean Water Act. Section 403 of the CWA provides that point source discharges to the territorial seas, contiguous zone, and oceans are subject to regulatory requirements in addition to the technology- or water quality-based requirements applicable to typical discharges. Part (C) are guidelines for determining degradation of waters.

spudding. 1. To move the drill stem up and down in the hole over a short distance without rotation. Careless execution of this operation creates pressure surges that can cause a formation to break down, resulting in lost circulation. 2. To force a wireline tool or tubing down the hole by using a reciprocating motion. 3. To begin drilling a well; i.e., to spud in.

special aquatic sites. Identified in 40 CFR Part 230 Section 404 b. (1) guidelines, EPA identified six categories of special aquatic sites a. Sanctuaries and refuges. b. Wetlands. c. Mudflats. d. Vegetated shallows. e. Coral reefs. f. Riffle and pool complexes. They are geographic areas, large or small, possessing special ecological characteristics of productivity, habitat, wildlife protection, or other important and easily disrupted ecological values. The areas are generally recognized as significantly influencing or positively contributing to the general overall environmental health or vitality of the entire ecosystem of a region.

stratification. Separating into layers.

sublittoral zone. In lakes, the sublittoral zone extends from the lakeward limit of rooted vegetation down to about the upper limit of the hypolimnion; in the ocean, from the lower edge of the intertidal (littoral) zone to the outer edge of the continental shelf at 200 m.

surfactants. A soluble compound that concentrates on the surface boundary between two substances such as oil and water and reduces the surface tension between the substances. The use of surfactants permits

the thorough surface contact or mixing of substances that ordinarily remain separate. Surfactants are used in the petroleum industry as additives to drilling mud and to water during chemical flooding.

test fluids. The discharge that would occur if hydrocarbons are located during exploratory drilling and tested for formation pressure and content. This would consist of fluids sent downhole during testing along with water from the formation.

total suspended solids (TSS). A measure of the suspended solids in wastewater, effluent, or water bodies, determined by tests for *total suspended non-filterable solids.*

trivalent. Having a chemical valence of three.

water-based drilling fluid (WBF). Drilling fluid that has water as its continuous phase and the suspending medium for solids, whether or not oil is present.

weighting materials. A high-specific gravity and finely divided solid material used to increase density of a drilling fluid. (Dissolved salts that increase fluid density, such as calcium bromide in brines, are not called weighting materials.) Barite is the most common, with minimum specific gravity of 4.20 g/cm^3.

zooplankton. Animal plankton; animals (mostly microscopic) that drift freely in the water column.

Consideration of Radiation in Hazardous Waste Produced from Horizontal Hydrofracking

Report of E. Ivan White
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Radioactivity in the environment, especially the presence of the known carcinogen radium, poses a potentially significant threat to human health. Therefore, any activity that has the potential to increase that exposure must be carefully analyzed prior to its commencement so that the risks can be fully understood. Horizontal hydrofracking for natural gas in the Marcellus Shale region of New York State has the potential to result in the production of large amounts of waste materials containing Radium-226 and Radium-228 in both solid and liquid mediums.

A complete and thorough analysis of the potential environmental pathways for exposure of people to these radioactive materials is a prerequisite to any regulatory approval of activities involving their extraction, handling, transportation and storage.

> The guiding principle for this work is that ***radioactivity should never be released into the environment in an uncontrolled manner*** because of the potential for exposure from the many potential pathways that exist.

Over the past fifty years, the Atomic Energy Commission (AEC) and the Nuclear Regulatory Commission (NRC) have spent millions of dollars on research that has resulted in computer models of the transport of radioactivity through the environment to humans. These environmental transport and human uptake models, known as "RESidual RADiation," or "RESRAD," are designed to be incorporated into governmental regulatory guidelines to ensure that people are not exposed to levels of radiation and radioactivity that would result in negative health impacts.

In April of 1999, the New York State Department of Environmental Conservation's Division of Solid and Hazardous Materials, assisted by representatives from sixteen oil and gas companies, conducted an internal investigation entitled *An Investigation of Naturally Occurring Radioactive Materials (NORM) in Oil and Gas Wells in New York State.* The report concluded that drill cuttings and wastewater from oil and gas drilling operations "do not constitute a health risk for the State's residents nor present a potential degradation of the State's environment."

A similarly cavalier attitude towards human exposure to radioactive material pervades the NYS DEC's 2011 Draft Revised Supplemental Generic Environmental Impact Statement (rSGEIS). The document's superficial characterization of radiation risks has prompted warnings from radiation experts, including those at the EPA whose public comments on the rSGEIS reflect deep concerns about the DEC's understanding and appreciation of the actual risks posed by radiation.

The National Council on Radiation Protection (NCRP) is a Congressionally-chartered agency charged with the authority and responsibilty to coordinate public information on radiation protection and radiation measurements. In its 2010 NCRP Report #169, *Design of Effective Radiological Effluent Monitoring and Environmental Surveillance Programs*, we describe the required radiation detection equipment and state-of-the-art modeling approaches for determining radionuclide transport pathways in the atmosphere, surface water, groundwater, and soil. Methods are presented for estimating potential radiation dose to the public and natural ecosystems resulting from releases of radionuclides into the environment.

Based on my experience in assessing potential transport pathways for radiation and a review of the DEC's internal report, I find two serious flaws that must be addressed and corrected prior to any final determination related to hydrofracking in New York State. The first is that the report examined a very different type of drilling than that which is being proposed. The second is that the authors used RESRAD in a limited way, resulting in faulty conclusions.

The 1999 DEC report examines vertically-drilled oil and gas wells in New York State that have been hydrofracked. This is very different from the ***horizontal*** hydrofracking currently being proposed for New York State. Vertical wells of the type measured by the NYSDEC are typically 1500-3000 feet deep with minimal penetration into the Marcellus shale formation. Horizontal slickwater hydrofracking wells, on the other hand, reach depths of 6,000 feet before turning horizontally for an additional mile or so. These deeper, longer wells have a much greater overall exposure to the Marcellus Shale formation and the radioactive materials contained within it, and thus an increased likelihood of bringing that radioactivity to the surface. (See Figure 1)

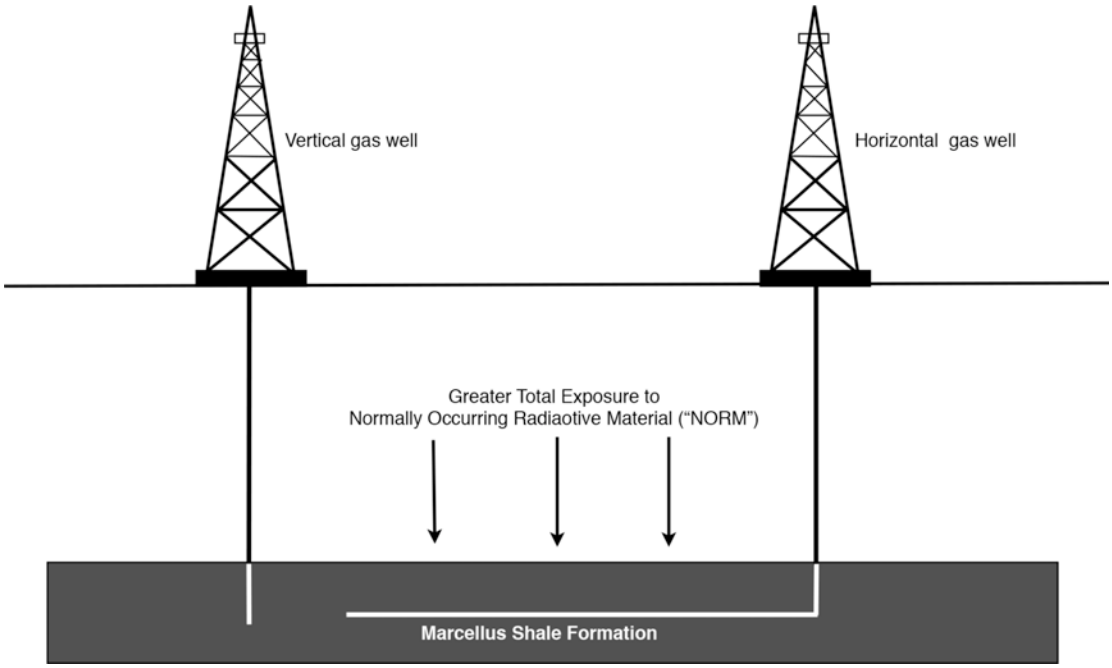

Figure 1: Comparison of Exposure to NORM in Marcellus Shale for Vertical Wells and Horizontal Wells

The second flaw is that RESRAD was not properly used to determine **all** of the potential pathways of the radiation. The following diagrams illustrate the potential pathways for radionuclides released into the environment in an uncontrolled manner, in air or in water.

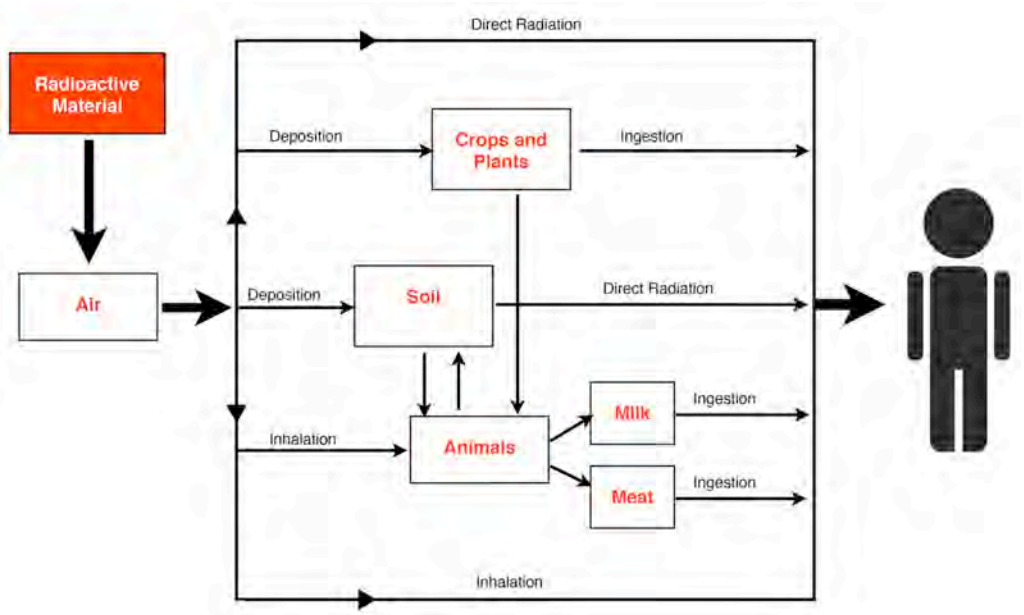

Figure 2: Pathways for Radiation Migration Through Air

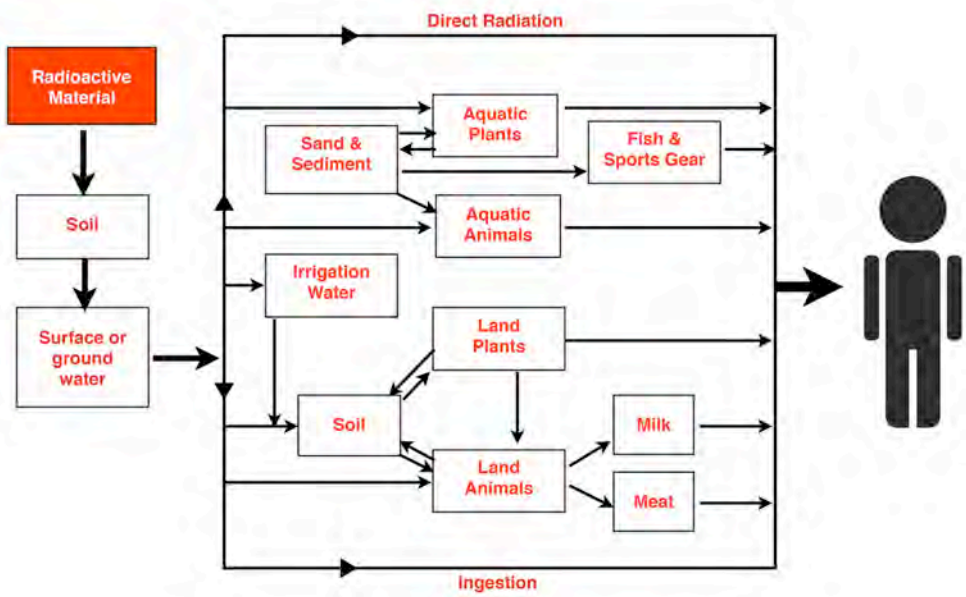

Figure 3: Pathways for Radiation Migration Through Soil and Water

For example, if radioactive wastewater from hydrofracking is spread on a road, there are two possible scenarios involving different pathways.

In one, the radioactive waste is spread on a paved road with a crown. Some of the waste will inevitably run off the road and find its way into a waterway or onto grazing fields or crops with the resulting pathways. The radioactivity in the waste remaining on the road will be resuspended by the traffic into the air with the resulting direct exposure to humans or biota.

In the second scenario, the waste spread on the dirt road is adsorbed by the dirt. When the dirt road dries out, the radioactive waste is resuspended in the dust from the road. The dust particle size and concentration is determined by the weight of a vehicle, the number of tires, and its speed. The dust is inhaled by humans and animals and deposited on the local vegetation, with the resulting pathways as illustrated above.

In both cases the cumulative impact of the radioactive waste will be determined by the amount of radiation contained in the waste, the number of vehicles and humans travelling on the road over years, proximity to residential or commercial areas, the amount of radiation migrating off road into streams or lakes or blowing onto agricultural land, and finally, the total potential dose to affected humans over time.

The radiation dose from a single truck travelling 40 miles per hour on a dirt road in rural New York State may appear to be insignificant, but the cumulative dose from 30 to 40 years of trucks could very easily be significant and needs to be rigorously calculated. Although there is considerable concern for the general population, exposed populations also include those most vulnerable; the old, the young and the ill.

Importantly, the type of radioactive material found in the Marcellus Shale and brought to the surface by horizontal hydrofracking is the type that is particularly long-lived, and could easily bio-accumulate over time and deliver a dangerous radiation dose to potentially millions of people long after the drilling is over.

Under the linear-no threshold hypothesis used in radiation protection, the goal is to limit the total radiation dose to large populations because of the increased probability of health effects. In the current case, the uncontrolled release of hazardous waste could result in the exposure of millions of people over decades.

Moreover, this scenario does not include any analysis of exposures to other hazardous chemicals used in the fracking process, which could have an unknown synergistic effect on the population.

SUMMARY CONCLUSIONS

1. Radioactive materials and chemical wastes do not just go away when they are released into the environment. They remain active and potentially lethal, and can show up years later in unexpected places. They bio-accumulate in the food chain, eventually reaching humans. Under the proposal for horizontal hydrofracking in New York State, there are insufficient precautions for monitoring potential pathways or to even know what is being released into the environment.

2. The NYS DEC has not proposed sufficient regulations for tracking radioactive waste from horizontal hydrofracking. By way of comparison, the nuclear industry has to rigorously account for all releases of radioactivity. No radioactive material leaves a nuclear facility without being carefully tracked to its safe final destination. Neither New York State nor the Nuclear Regulatory Commission would permit a nuclear power plant to handle radioactive material in this manner. (It is important to note that tracking of radioactive materials cannot be accomplished retrospectively; accurate accounting *must* be incorporated from the very beginning to ensure public safety.)

3. RESRAD was made precisely for situations like this, but it must be used properly to produce valid conclusions. Picking and choosing isolated scenarios and ignoring downstream exposures, as was done in the Report, is not a proper use of RESRAD and renders the conclusions invalid. All of the potential pathways over a span of decades as the hazardous material accumulates and the public's body burden build up must be considered to produce a valid RESRAD conclusion. This applies to both radioactive and chemical waste.

4. While this statement deals only with the radioactivity of waste produced by horizontal hydrofracking, the same principles of exposure pathways must be taken into account for all of the toxic chemicals used in the process. The EPA Pavillion Report demonstrates that there are hazardous chemicals in fracking fluid, and a recent review of the EPA report confirmed that it was valid.

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