Winston H. Hickox
Secretary for Environmental Protection

California Regional Water Quality Control Board
Lahontan Region

Gray Davis
Governor

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June 7, 2001

File: Mojave Wetlands General File

Elizabeth Parmenter, Environmental Technician
San Bernardino County Fire Department
Division of Hazardous Materials
385 N. Arrowhead Ave., Second Floor
San Bernardino, CA 92415-0153

SPRING VALLEY LAKE SAMPLING RESULTS, SAN BERNARDINO COUNTY

This correspondence is provided as a courtesy to inform you of the results of water quality analyses of samples obtained by California Regional Water Quality Control Board staff (Board staff).

Board staff sampled surface water from Spring Valley Lake on August 29, 2000. Surface water samples were obtained at the western edge of the Lake from a pier within a housing development (See attached figure). As depicted in Table 1, methyl tertiary butyl ether (MTBE) was detected at a concentration of 9.7 μg/L. The primary maximum contaminant level for MTBE, as established by the California Department of Health Services, is 13 μg/L. No other constituents were detected during this sampling event.

TABLE 1

Sample I.D.	Benzene	Toluene	Ethyl-Benzene	Total Xylenes	MTBE
Spring Valley Lake	ND	ND	ND	ND	9.7μg/L
Test Method: EPA 8260B Detection Limits for Benzene, Toluene, MTBE: 2.5μg/L Detection Limit for Total Xylenes: 5μg/L					

Spring Valley Lake, in conjunction with other monitoring activities on the Mojave River, is scheduled to be sampled by Board staff later this quarter. The sampling results will be forwarded to your office.

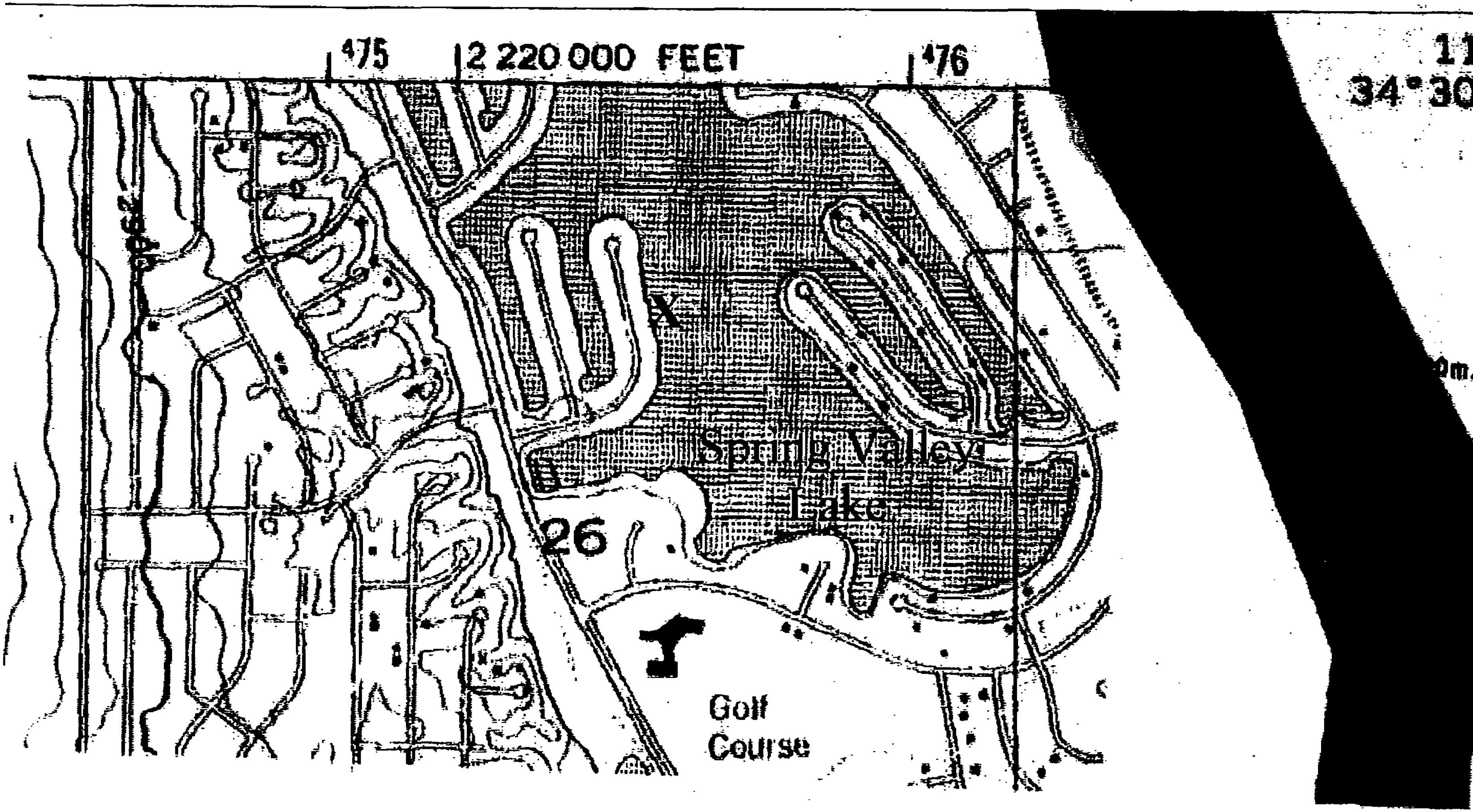
If you have any questions regarding this matter, please call Steve Fischenich at (760) 241-7408 or me at (760) 241-7358.

Sincerely,

Mike Plaziak, AEG
Unit Lead, Mojave Unit

Enclosure: Map of Spring Valley Lake with sample location

SF/rc/SBC SVL MTBE notification



X = Sampling Location

USGS Hesperia Quadrangle
San Bernardino, California

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

AMENDED CLEANUP AND ABATEMENT ORDER NO. 6-00-64A1
WDID NOs.: 6B368020001, 6B368905004, and 6B368905005

REQUIRING IMC CHEMICALS AND THE U.S. DEPARTMENT OF THE INTERIOR, BUREAU OF LAND MANAGEMENT TO CLEAN UP AND ABATE THE EFFECTS OF WASTE DISCHARGES TO SEARLES LAKE FROM THE TRONA, ARGUS, AND WESTEND FACILITIES

San Bernardino County

The California Regional Water Quality Control Board, Lahontan Region (Regional Board) finds:

1. Discharger

   IMC Chemicals Inc. (IMCC) owns and operates the Trona, Argus, and the Westend Plants. IMCC owns the land on which the three plants are located and portions of Searles Lake where the discharge occurs. The U.S. Department of the Interior, Bureau of Land Management (BLM) owns the remainder of Searles Lake where the discharge occurs. For the purposes of this Regional Board Order (Order), IMCC and the BLM are referred to collectively as the "Discharger."

2. Facility

   The Trona, Argus, and Westend Plants in Searles Valley are located adjacent to Searles (Dry) Lake. Searles Lake covers approximately 70 square miles and contains historical and active dredging and mining operations. These operations include features such as solar ponds, percolation ponds, dredge ponds, salt mining facilities, new and old oil skimmer devices, brine conveyance channels, inactive and active equipment yards, unregulated waste debris areas and other industrial facilities. Partially depleted brines from plant processes are discharged to the surface and subsurface of Searles Lake, which are waters of the State.

3. Regional Board Orders

   Discharge of wastes from the Argus, Trona, and Westend Plants are regulated by Waste Discharge Requirements (WDRs) adopted by the Regional Board. The Board also adopted Cease and Desist Order No. 6-00-61 for violations and threatened violations of WDRs. On July 7, 2000, Cleanup and Abatement Order (CAO) No. 6-00-64 was adopted to cleanup and abate the effects of waste discharges to Searles Lake.

   CAO No. 6-00-64 requires submittal of: 1) a technical report describing methods implemented to reduce waterfowl deaths, 2) a work plan to identify and cleanup the areal extent of contaminants in Searles Lake surface waters and sediments, and 3) weekly status reports containing data of daily sampling and inspections. The CAO also requires actions to clean up oil from Searles Lake.

IMCC has submitted the requested reports and work plans; however due to negotiations regarding the type of site characterization necessary for cleanup of Searles Lake and the complexity of the site, further site characterization is needed prior to implementation of site cleanup. Regional Board staff has reviewed the analytical research conducted by IMCC regarding achievable detection limits of constituents in the brine matrix and has requested further research regarding the best laboratory analytical method to achieve the lowest detection limits for the brine matrix.

CAO No. 6-00-64 requires IMCC to eliminate all visible petroleum hydrocarbons from surface waters of Searles Lake and remove, or remediate to non-detectable levels, all visible petroleum hydrocarbon contaminated surface soils and sediments by January 30, 2001. IMCC has requested that the date for compliance with this requirement be extended. The reasons for the extension request are that not all sources of contaminants have been determined. Also, while many areas of hydrocarbon contaminated surface soils have been identified and cleaned up, the full extent of contaminants in sediments and surface soils has not been delineated. Additional testing and characterization of contaminated surface soils and sediments is necessary to effectively remediate sources of contaminants to Searles Lake.

4. <u>Reason for Action</u>

The CAO is being amended to allow the Discharger additional time to further characterize and cleanup contaminated surface soils and sediments and implement best available treatment technologies and/or process changes to eliminate ongoing sources of contaminants to Searles Lake. The CAO amendment requires elimination and remediation of visible petroleum hydrocarbons from surface waters.

IMCC has implemented control measures and best management practices to reduce bird contact with the partially depleted brine discharge, and reduce contaminant concentrations in its effluent discharge. IMCC has also identified and conducted interim cleanup of several contaminated soil sites. IMCC has evaluated the effect of the brine matrix on detection levels using traditional laboratory analytical methods for detecting the lowest concentration of constituents in the brine matrix.

The results of the laboratory methods study indicate that site specific laboratory methods may provide more representative analysis of the brine matrix. IMCC needs to conduct further research to further develop and test site specific laboratory methods. Because initial tests were not conclusive, IMCC also needs to conduct further tests of the potential contribution of contaminants identified in soils and sediments to Searles Lake. Therefore, all the sources of contaminant loading to the lake have not been identified, not all areas have been fully characterized and cleaned up, and additional research is needed to develop site-specific methods for laboratory analyses.

The CAO amendment requires interim cleanup to continue and establishes a schedule to complete the steps described above.

5. California Environmental Quality Act

This enforcement action is being taken by this regulatory agency to enforce provisions of the California Water Code and as such is exempt from the provisions of the California Environmental Quality Act (Public Resources Cod, Section 21000 et seq.) in accordance with Section 15321, Chapter 3, Title 14, California Code of Regulations.

IT IS HEREBY ORDERED that pursuant to Sections 13304 and 13267 of the California Water Code, the Discharger shall comply with the following:

1. Comply immediately with the following interim numeral effluent limits (described in Table 1 below) in Board Order Nos. 6-00-52A1, 6-00-53A1, and 6-00-54A1.

Table 1

Parameter	Effluent Limits Argus[1]	Effluent Limits Trona[2]	Effluent Limits Westend[3]
Total Petroleum Hydrocarbons (TPH) as Kerosene	1.0 mg/l	6.1 mg/l	1.0 mg/l
Total Recoverable Petroleum Hydrocarbons (TRPH)	4.5 mg/l	8.6 mg/l	2.9 mg/l
Phenols	1.0 mg/l	1.0 mg/l	1.0 mg/l

[1] Board Order No. 6-00-52A1 Discharge Specification I.B.
[2] Board Order No. 6-00-53A1 Discharge Specification I.B.
[3] Board Order No. 6-00-54A1 Discharge Specification I.B.

2. Visible petroleum hydrocarbons shall be immediately (within the same day) removed from surface waters of Searles Lake. Inspections of surface waters of Searles Lake shall be conducted twice daily.

3. Forthwith continue interim cleanup of identified contaminated surface soils. All sites cleaned up shall be clearly delineated on a map of suitable scale, and cleanup activities including any sampling shall be documented. The map, summary of sampling data, and description of the area cleaned up shall be provided with the bi-weekly reports.

4. Beginning **May 15, 2001**, submit **Twice-monthly Cleanup Progress Reports** (due by the 1st and 15th of each month). These reports shall include, but not be limited to, the following:

   a. Volume of oil cleaned up from surface water,
   b. Quantity of contaminated soil and/or sediment removed and/or treated,
   c. Daily evaluation of surface water sheen, with map indicating where observed,

d. Documentation of the presence of dead or affected wildlife (by date and map location),
e. Quantity and location of material disposed offsite (include manifests) or treated and disposed onsite (material disposed onsite must include sampling data),
f. Daily log of person-hours, location of cleanup effort, distribution of equipment and cleanup methods used,
g. Maps, sample locations and analytical results and photos of cleanup activities,
h. Progress of the cleanup and a statement regarding the status of compliance with this Order, and
i. Problems encountered and proposed solutions.

5. By **May 25, 2001**, submit a report summarizing the interim surface soils cleanup activities completed prior to May 1, 2001. The report shall include a site map(s), description of each site, source of contaminants, volume and nature of material removed or remediated, and cleanup verification sampling results.

6. By **May 25, 2001**, submit a Site Characterization Work Plan for addressing areas of contamination identified and numbered in the January 31, 2001 IMCC report "*Documentation of Known Prior Spill Sites of Searles Dry Lake*", and characterizing potential sources of contaminants on the lakebed. The Site Characterization Work Plan shall include, but not be limited to, the following.

   a. Recommended prioritization of previously identified sites,
   b. Additional activities proposed, such as verification sampling, at interim cleanup sites,
   c. Identifying all potential source(s) of contaminants; including, but not limited to, equipment, formerly used facilities, waste disposal areas, contaminated soils and/or sediments, and any other potential source of contaminants to Searles Lake,
   d. Sampling of sites to characterize the nature and lateral and vertical extent of contamination,
   e. A Sampling and Analysis Plan, including proposed sampling locations, sampling handling and analytical procedures, data quality objectives and data management procedures,
   f. Methods to determine any continuing sources of contaminants such as potential leachability of contaminants at each site, and
   g. Discussion of potential threat to water quality from contaminant sources.

7. **September 30, 2001**, submit a Site Characterization Report describing the results of the field investigation. The report shall include maps of appropriate scale, the information required in Item 6, above, summarized data results as well as raw data sheets, and any other pertinent information.

8. By **November 30, 2001**, submit a Site Cleanup Work Plan. This Work Plan shall include, but not limited to, the following.

a. Summary of information on sites that have been cleaned up since May 1, 2001, and the current status of all sites,
b. Methods proposed for contaminant recovery and disposal,
c. Evaluation and description of proposed cleanup alternatives,
d. Proposed contaminant cleanup concentrations (cleanup levels) for both soils and surface and ground waters,
e. Recommended remedial action alternative(s),
f. Estimated cleanup time to restore the lake to cleanup levels, and
g. Verification monitoring plan.

9. By **January 30, 2002**, upon approval of the Cleanup Work Plan, implement the Cleanup Work Plan.

Cleanup actions shall conform to the provisions of State Water resources Control Board Resolution Nos. 68-16, and 92-49. Justifications for any proposed cleanup level(s) that are greater than background levels must be included in the Work Plan.

All findings and orders of Cleanup and Abatement Order No. 6-00-64 not amended by this Order remain in force.

Failure to comply with the terms and conditions of this Cleanup and Abatement Order may result in further enforcement action including but not limited to assessment of civil liability pursuant to the California Water Code or referral to the Attorney General of the State of California for such legal action, as he or she deems appropriate.

Ordered by: Harold J. Singer
HAROLD J. SINGER
EXECUTIVE OFFICER

Dated: May 8, 2001

MO/rp
00-064A1/x:Enforcement2001/ IMCC CAO 00-64A1rp/ar4-25-01

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

CLEANUP AND ABATEMENT ORDER NO. 6-00-64
WDID NO. 6B368020001, 6B368905004 and 6B368905005

REQUIRING IMC CHEMICALS TO CLEAN UP AND ABATE THE EFFECTS OF WASTE DISCHARGES TO SEARLES LAKE FROM THE IMCC TRONA, ARGUS AND WESTEND FACILITIES

San Bernardino County

The California Regional Water Quality Control Board, Lahontan Region (Regional Board) finds:

1. Discharger

IMC Chemicals (IMCC) operates the Trona, Argus and Westend Plants (Facilities) in Searles Valley, Trona, California. IMCC owns the Trona, Argus and the Westend Plants, the land on which they are located and portions of Searles Lake where the discharge occurs. The Bureau of Land Management (BLM) owns the remainder of Searles Lake where the discharge occurs. For purposes of this Regional Board Order (Order), IMCC and the BLM are referred to collectively as the "Discharger".

2. Facilities and Location

The Facility is an active mineral processing operation located approximately twenty (20) miles east of Ridgecrest, in the Community of Trona in San Bernardino County, T25S, R43E, MDB&M, adjacent to Searles Lake.

Searles Lake covers approximately 70 square miles and contains historical and active dredging and mining operations. These operations include solar ponds, percolation ponds, dredge ponds, a Warm Solution Mining pond (WSM), Lake Garage facilities, salt processing/mining facilities, new and old oil skimmer devices (old serpentine channel, Trona skimmer, temporary skimmers), brine drainage channels, inactive and active equipment yards, unregulated waste debris areas and other industrial facilities. Process waste brines are discharged to areas within the Searles Lake boundary.

3. Apportionment of Primary and Secondary Responsibility

As a landowner of portions of Searles Lake on which IMCC disposal operations occur, BLM is a discharger and is responsible for the discharge and any condition or threatened condition of pollution or nuisance resulting from the discharge as it affects surface or ground waters on BLM managed land. Naming BLM as a Discharger in this Order is consistent with past determinations by Regional Boards and the State Water Resources Control Board (SWRCB) in naming landowners as Dischargers. If IMCC fails to meet the requirements of this Order, or future enforcement Orders, the Regional Board will look to BLM to meet and/or complete the requirements. Before BLM is required to meet and/or complete such requirements, BLM will be informed in writing by the Regional Board Executive Officer, and a new compliance time schedule will be formally established.

Hereinafter, the term "Dischargers" will incorporate the scheme of primary responsibility for IMCC and secondary responsibility for BLM for compliance actions specified in this Order as they affect surface or ground waters on BLM managed lands.

4. Waste Discharge Requirements

Waste Discharge Requirements (WDRs) for the Facilities were established in Board Orders No. 6-00-53 (Trona), 6-00-52 (Argus) and 6-00-54 (Westend) on June 14, 2000.

5. History

IMCC discharges chemical process waste and spent brine to Searles Lake. IMCC utilizes a petroleum hydrocarbon based solvent similar to kerosene in the extraction process. Kerosene is then recycled. However, some of it can escape the unit process and be included in the effluent of the Trona Plant. The Argus Plant effluent also contains non-kerosene type hydrocarbons originating from machine oil drippings. IMCC has used other chemicals such as Monoethanolamine (MEA), formaldehyde and phenols. These compounds are probably non-native and are present in Searles Lake brines. WDRs Board Order Nos. 6-00-53 (Trona) and 6-00-52 (Argus) adopted by the Regional Board, contain a time schedule to achieve effluent limits for the above-mentioned constituents at non-detectable concentrations. Until then, the WDRs for Trona and Argus facilities allow kerosene and non-kerosene total petroleum hydrocarbons (TPH) to be discharged at 10 mg/L each, consistent with previous WDRs. There have been numerous spills of kerosene and non-kerosene hydrocarbon from the facilities to Searles Lake, which is in a hydrologically closed basin. Any discharge of petroleum hydrocarbons and other non-native constituents accumulates in the lake. Specifically, petroleum hydrocarbon constituents have concentrated to a point that a visible oily sheen is periodically present in the Searles Lake waters. At times, oily globules coat the bank of the lake. Observations by both Regional Board staff and California Department of Fish and Game (DFG) staff during site inspections have confirmed numerous dead waterfowl that were encrusted with brine and oil. These conditions indicate that discharges from the IMCC facilities have created a condition of pollution in Searles Lake waters and impaired its beneficial uses.

6. Water Quality Control Plan (Basin Plan)

The Regional Board adopted an amended Water Quality Control Plan for the Lahontan Region (Basin Plan), on March 31, 1995. This Order implements that Basin Plan.

7. Conditions of Pollution

The Discharger has caused a condition of pollution or threatened pollution as defined in Section 13050(d) of the California Water Code (CWC). "Pollution" means an alteration of the quality of the waters of the State by waste to a degree which unreasonably affects either of the following: (a) The waters for beneficial uses or (b) Facilities which serve these beneficial uses and may include "contamination."

During numerous site inspections since February 17, 2000 (total of 13 inspections up to June 23, 2000), Board staff observed visible black floating oil on the discharge channels, dredge pond and percolation ponds of Searles Lake. Board staff collected samples of the floating oil, and analysis revealed the material had 156,000 ppm of TPH. Additionally, Board staff inspected two separate areas (north of Mexican Central Road and south of the Southern Solar Pond) where visible oil/tar was present at the surface of the Searles Lakebed. Board staff has observed numerous dead waterfowl encrusted with brine and oil, which the DFG has collected. The DFG testified during the June 2000 Regional Board meeting that oil was found

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

CLEANUP AND ABATEMENT ORDER NO. 6-00-64
WDID NO. 6B368020001, 6B368905004 and 6B368905005

REQUIRING IMC CHEMICALS TO CLEAN UP AND ABATE THE EFFECTS OF WASTE DISCHARGES TO SEARLES LAKE FROM THE IMCC TRONA, ARGUS AND WESTEND FACILITIES

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2. Facilities and Location

   The Facility is an active mineral processing operation located approximately twenty (20) miles east of Ridgecrest, in the Community of Trona in San Bernardino County, T25S, R43E, MDB&M, adjacent to Searles Lake.

   Searles Lake covers approximately 70 square miles and contains historical and active dredging and mining operations. These operations include solar ponds, percolation ponds, dredge ponds, a Warm Solution Mining pond (WSM), Lake Garage facilities, salt processing/mining facilities, new and old oil skimmer devices (old serpentine channel, Trona skimmer, temporary skimmers), brine drainage channels, inactive and active equipment yards, unregulated waste debris areas and other industrial facilities. Process waste brines are discharged to areas within the Searles Lake boundary.

3. Apportionment of Primary and Secondary Responsibility

   As a landowner of portions of Searles Lake on which IMCC disposal operations occur, BLM is a discharger and is responsible for the discharge and any condition or threatened condition of pollution or nuisance resulting from the discharge as it affects surface or ground waters on BLM managed land. Naming BLM as a Discharger in this Order is consistent with past determinations by Regional Boards and the State Water Resources Control Board (SWRCB) in naming landowners as Dischargers. If IMCC fails to meet the requirements of this Order, or future enforcement Orders, the Regional Board will look to BLM to meet and/or complete the requirements. Before BLM is required to meet and/or complete such requirements, BLM will be informed in writing by the Regional Board Executive Officer, and a new compliance time schedule will be formally established.

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in the internal organs of the waterfowl. To date, the DFG has collected over 150 dead waterfowl.

The DFG staff also testified that bird mortality due to oil is consistent with other instances where oil was confirmed to be the cause of waterfowl death.

8. Beneficial Uses

The Basin Plan contains the beneficial uses for water at Searles Lake as follows.

Surface Water

The beneficial uses of the surface waters of Searles Lake of the Searles Valley Hydrologic Area of the Trona Hydrologic Unit as set forth and defined in the current Basin Plan are as follows:

1) Industrial service supply (IND)
2) Contact water recreation (REC-1)
3) Non-contact water recreation (REC-2)
4) Agricultural supply (AGR)
5) Saline water habitat (SAL)
6) Wildlife habitat (WILD).

9. Water Quality Objectives

Pursuant to Chapter 3 of the Basin Plan, discharges which cause a violation of the Water Quality Objectives (WQOs) are prohibited. The Basin Plan includes the following narrative WQOs, which apply to surface and/or ground water in the Searles Valley.

a. Chemical Constituents – *"Waters shall not contain concentrations of chemical constituents in amounts that adversely affect the water for beneficial uses."*

b. Floating Material – *"Waters shall not contain floating material, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect the water beneficial uses."*

c. Oil and Grease – *"Waters shall not contain oils, greases, waxes or other materials in concentrations that result in a visible film or coating on the surface of the water or on objects in the water, that cause nuisance, or that otherwise adversely affect the water for beneficial uses."*

d. Toxicity – *"All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life."*

10. Basin Plan Violations

The concentrations of petroleum hydrocarbons detected and observed in surface water of Searles Lake exceed WQOs established for the protection of beneficial uses specified in the 1995 Basin Plan. The beneficial uses specifically affected are non-contact water recreation (REC-2), contact water recreation (REC-1), wildlife habitat (WILD), and saline water habitat (SAL). The levels of

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7. Conditions of Pollution

The Discharger has caused a condition of pollution or threatened pollution as defined in Section 13050(d) of the California Water Code (CWC). "Pollution" means an alteration of the quality of the waters of the State by waste to a degree which unreasonably affects either of the following: (a) The waters for beneficial uses or (b) Facilities which serve these beneficial uses and may include "contamination."

During numerous site inspections since February 17, 2000 (total of 13 inspections up to June 23, 2000), Board staff observed visible black floating oil on the discharge channels, dredge pond and percolation ponds of Searles Lake. Board staff collected samples of the floating oil, and analysis revealed the material had 156,000 ppm of TPH. Additionally, Board staff inspected two separate areas (north of Mexican Central Road and south of the Southern Solar Pond) where visible oil/tar was present at the surface of the Searles Lakebed. Board staff has observed numerous dead waterfowl encrusted with brine and oil, which the DFG has collected. The DFG testified during the June 2000 Regional Board meeting that oil was found

in the internal organs of the waterfowl. To date, the DFG has collected over 150 dead waterfowl.

The DFG staff also testified that bird mortality due to oil is consistent with other instances where oil was confirmed to be the cause of waterfowl death.

8. Beneficial Uses

The Basin Plan contains the beneficial uses for water at Searles Lake as follows.

Surface Water

The beneficial uses of the surface waters of Searles Lake of the Searles Valley Hydrologic Area of the Trona Hydrologic Unit as set forth and defined in the current Basin Plan are as follows:

1) Industrial service supply (IND)
2) Contact water recreation (REC-1)
3) Non-contact water recreation (REC-2)
4) Agricultural supply (AGR)
5) Saline water habitat (SAL)
6) Wildlife habitat (WILD).

9. Water Quality Objectives

Pursuant to Chapter 3 of the Basin Plan, discharges which cause a violation of the Water Quality Objectives (WQOs) are prohibited. The Basin Plan includes the following narrative WQOs, which apply to surface and/or ground water in the Searles Valley.

a. Chemical Constituents – "*Waters shall not contain concentrations of chemical constituents in amounts that adversely affect the water for beneficial uses.*"

b. Floating Material – "*Waters shall not contain floating material, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect the water beneficial uses.*"

c. Oil and Grease – "*Waters shall not contain oils, greases, waxes or other materials in concentrations that result in a visible film or coating on the surface of the water or on objects in the water, that cause nuisance, or that otherwise adversely affect the water for beneficial uses.*"

d. Toxicity – "*All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life.*"

10. Basin Plan Violations

The concentrations of petroleum hydrocarbons detected and observed in surface water of Searles Lake exceed WQOs established for the protection of beneficial uses specified in the 1995 Basin Plan. The beneficial uses specifically affected are non-contact water recreation (REC-2), contact water recreation (REC-1), wildlife habitat (WILD), and saline water habitat (SAL). The levels of petroleum hydrocarbons detected in Searles Lake therefore constitute a pollution as defined in Section 13050 of the CWC and a violation of waste discharge prohibitions as established in the Basin Plan.

Based on site inspections, IMCC has violated narrative WQOs (chemical constituents, floating material, oil and grease and toxicity) for the surface waters of Searles Lake and caused a pollution.

11. Violations and Threatened Violations of Board Orders No. 6-00-52 (Argus) and 6-00-53 (Trona)

The Discharger has violated or threatened to violate WQOs for protection of beneficial uses in the Basin Plan, which are also included in Board Order Nos. 6-00-52 (Argus) and 6-00-53 (Trona). WILD is the most sensitive beneficial use of surface water in the vicinity of Searles Lake.

The violations and threatened violations are:

a. The concentration of non-kerosene TPH constituents in the depleted brine discharge shall not exceed 10 mg/L. The following data are derived from the daily sampling conducted by the Discharger, as requested in the March 8, 2000 letter from the Regional Board.

	TPH			
Plant	**TPH Limits (mg/L)**	**Number of Days over limit (March/April/May 2000)**	**Maximum Daily Concentration (March/April/May 2000)**	**Average Monthly Concentration (March/April/May 2000)**
Trona	10	7 / 6 / 16	170 / 38 / 52	33 / 5 / 10
Argus	10	3 / 1 / 2	48 / 13 / 16	4 / 2 / 6

b. The concentration of kerosene in the depleted brine discharge shall not exceed 10 mg/L. The following data are derived from the daily sampling conducted by the Discharger, as requested in the March 8, 2000 letter from the Regional Board.

	Kerosene			
Plant	**Kerosene Limits (mg/L)**	**Number of Days over limit (March/April/May 2000)**	**Maximum Daily Concentration (March/April/May 2000)**	**Average Monthly Concentration (March/April/May 2000)**
Trona	10	17 / 14 / 18	54 / 33 / 31	15.6 / 11 / 12

12. California Department of Fish and Game Cleanup and Abatement Order

The DFG issued a Cleanup and Abatement Order (CAO) on February 18, 2000. Pursuant to Section 5655 of the California Fish and Game Code, "*A regional water quality control board shall incorporate the department's order into the cleanup and abatement order issued pursuant to Section 13304 of the Water Code, unless the department's order is inconsistent with any more stringent requirement established in the cleanup and abatement order. Any action taken in compliance with the department's order is not a violation of any subsequent regional water quality control board cleanup and abatement order issued pursuant to Section 13304 of the Water Code.*"

13. Discharger Responsibility Under Section 13304 of the California Water Code

The Dischargers, IMCC and BLM are responsible for actions of cleanup and abatement under Section 13304 of the CWC. SWRCB Resolution No. 92-49 (Policies and Procedures for Investigation and Cleanup and Abatement of Discharges under Water Code Section 13304) establishes a process that must be followed for cleanup activities. Clean up should be complete when there is no sheen, floating product or visible soil staining present and sediment and water samples indicate at or below detection levels for kerosene and petroleum hydrocarbons. Interim cleanup is in progress and should continue as necessary to protect waterfowl.

14. Reason for Action

The Discharger has caused or permitted waste to enter waters of the State and has created and threatens to further create a condition of pollution, which affects the water for beneficial uses.

15. Statutory Authority

Section 13304 of the CWC states in part: "*Any person ... who has caused or permitted...or threatens to cause or permit any waste to be discharged or deposited where it is, or probably will be, discharged into the waters of the State and creates, or threatens to create, a condition of pollution or nuisance, shall upon order of the Regional Board clean up such waste or abate the effects thereof or, in case of threatened pollution or nuisance, take other necessary remedial action.*"

16. California Environmental Quality Act

This enforcement action is being taken by this regulatory agency to enforce provisions of the CWC and, as such, is exempt from the provisions of the California Environmental Quality Act (Public Resources Code, Section 21000 et seq.) in accordance with Section 15321, Chapter 3, Title 14, California Code of Regulations.

THEREFORE, IT IS HEREBY ORDERED, pursuant to California Water Code Sections 13267 and 13304, and as required in State Board Resolution No. 92-49, the Discharger shall comply with the following.

1. Clean up and abate the effects of petroleum hydrocarbon discharges forthwith and in accordance with the schedule outlined herein.

2. By **July 17, 2000**, submit a technical report describing methods implemented or proposed to significantly reduce the number of waterfowl deaths. Such measures may include, but are not limited to providing additional habitat for wildlife in another portion of Searles Valley, hazing methods, netting to limit waterfowl from landing on surface waters containing floating oil, or other effective measures.

3. By **August 1, 2000**, upon approval of the July 17, 2000 submittal, implement any additional methods identified in Item No. 2 above.

4. By **January 30, 2001**, eliminate all visible petroleum hydrocarbons from surface waters of Searles Lake and remove or remediate to non-detectable levels, all visible petroleum hydrocarbon contaminated surface soils and sediments.

5. By **July 31, 2000**, submit a Work Plan for addressing areal extent of petroleum hydrocarbon contamination of Searles Lake including sediments and surface waters. The Work Plan shall include, but not be limited to the following.

   a. Criteria for selection of areas to be evaluated,
   b. Schedule for identification of these areas,
   c. Work Plan for cleanup,
   d. Method for sampling and analytical procedures,
   e. Methods proposed for oil and contaminated soil recovery and disposal,
   f. Description of feasible cleanup alternatives,
   g. Estimated cleanup time to restore the lake to background levels, and
   h. Verification monitoring plan.

6. Justifications for any cleanup level(s) proposed that are greater than background or proposals that do not fully restore beneficial uses must also be included in the Work Plans. Any proposal shall comply with the provisions of:

   a. Basin Plan (Pages 4.2-4 and 4.2-5)
   b. State Board Resolution No. 68-16 (Statement of Policy with Respect to Maintaining High Quality of Waters in California)
   c. State Board Resolution No. 92-49 III.G.

7. By **August 15, 2000**, upon approval of the July 31, 2000 Work Plan submittal, initiate the work effort identified in Item No. 5 above.

8. **Each Tuesday,** following the effective date of this Order, submit a Cleanup Progress Report to the Regional Board and the Department of Fish and Game. These reports shall cover the prior week (Sunday – Saturday) and include, but not be limited to, the following:

   a. Volume of oil cleaned up from the surface water,
   b. Quantity of sediment from the shoreline removed and/or treated,
   c. Daily evaluation of surface water sheen at set time, with map indicating where observed,
   d. Number of dead/affected wildlife (by date and map location),
   e. Location of material sent offsite (include manifests) or treated and disposed onsite,
   f. Daily log of person-hours, location of cleanup effort, distribution of equipment and cleanup methods used,
   g. Maps and photos of cleanup activities,
   h. Progress of cleanup demonstrating continued compliance with this Order, and
   i. Problems encountered and proposed solutions.

9. Comply with the requirements specified in Attachment 1, which is made a part of this Order, pursuant to California Fish and Game Code Section 5655.

All work plans and technical reports are to be reviewed and signed by a California Licensed Civil Engineer or Registered Geologist. Additionally, all of the field activities are to be conducted under responsible charge of a registered professional. All data shall be prepared in tabulated form, shown on scaled maps as appropriate, and include copies of laboratory results.

Failure to comply with the terms and conditions of this Cleanup and Abatement Order may result in further enforcement action including, but not limited to, assessment of civil liability pursuant to Sections 13323, 13268 and 13350 of the California Water Code, or referral to the Attorney General of the State of California for such legal action as he or she may deem appropriate.

Ordered by: Harold J. Singer
HAROLD J. SINGER
EXECUTIVE OFFICER

Dated: July 7, 2000

Attachment 1 – DFG Requirements

2000 Enf disk IMCC-CAO4

Attachment 1

Requirements specified in DFG Cleanup and Abatement Order for IMC Chemicals Inc. dated February 18, 2000

Following are the requirements specified in the above referenced DFG CAO.

1. Follow all directions of the DFG as related to clean up, abatement, and mitigation activities resulting from the discharge.

2. Employ forthwith whatever lawful actions are necessary to clean up and abate the effects of the petroleum product discharge, which is injurious to or poses a threat to wildlife.

3. Prevent any further discharges of petroleum products into State waters which is injurious to or possess a threat to wild life.

4. Utilize personnel that are properly trained and equipped to perform the necessary clean up, abatement, and mitigation activities.

5. Properly dispose of all petroleum and other pollutants recovered during the clean up, abatement, and mitigation activities.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

AMENDED CEASE AND DESIST ORDER NO. 6-00-61A1
WDID: 6B368020001/6B368905004

CONSIDERATION OF AN AMENDED CEASE AND DESIST ORDER – IMC CHEMICALS, INC. AND THE U.S. DEPARTMENT OF INTERIOR, BUREAU OF LAND MANAGEMENT, TRONA AND ARGUS OPERATIONS, SEARLES LAKE

San Bernardino County

The California Regional Water Quality Control Board, Lahontan Region (Regional Board) finds:

1. Discharger

IMC Chemicals, Inc. (IMCC) owns and operates the Argus and Trona Facilities. The two facilities are located about 20 miles east of Ridgecrest in the City of Trona, within T25S, R43E, MDB&M, in the Searles Valley Hydrologic Area. The U.S. Department of the Interior, Bureau of Land Management (BLM) is the owner of portions of Searles Lake where the brine extraction wells, depleted brine injection wells, and effluent disposal (percolation) ponds are located. For the purposes of this Order IMCC and BLM are considered the "Discharger".

2. Facility Description

Processing of the brine at the Argus and Trona facility began in 1978 and 1916 respectively. Various Companies have owned the facilities. Most recently, in 1998, IMC Global purchased North American Chemical Company (NACC) and renamed the company IMC Chemicals. Previously, NACC purchased the facility from Kerr-McGee Chemical Corporation in 1990. Presently, the facility is continuing to process brine pumped from beneath Searles Lake. All of the waste subject to this Order from the facilities is discharged either by percolation at the surface of Searles Lake or is re-injected to the subsurface brine under Searles Lake. At Trona, the brine is extracted from wells and contacted with a solvent (similar to kerosene), which contains a proprietary halogenated organic, the chemicals are processed to form boric acid, then the partially depleted brine is discharged to the surface of Searles Lake. At Argus, the partially depleted brine, after production of soda ash, is returned to the surface and subsurface of Searles Lake.

3. Waste Discharge Requirements

Discharge of waste from the Argus and Trona Facilities is regulated under Waste Discharge Requirements (WDRs). The Argus Facility is regulated under Board Order No. 6-00-52 and 6-00-52A1. The Trona Facility is regulated under Board Order No. 6-00-53 and 6-00-53A1. Board Orders 6-00-52, 6-00-52A1, and 6-00-53 and 6-00-53A1 contain more restrictive interim and final effluent limits than previous WDRs, require additional monitoring and implementation of additional treatment and control measures by the Company to meet the requirements.

4. Reason for Action

IMCC has implemented control measures and certain best management practices (BMPs) to reduce contaminant concentrations in its effluent discharge. IMCC has also conducted a series of studies and pilot tests to develop technologies to further reduce contaminants in the brine effluent. While the measures implemented to date have reduced contaminants in the discharge, these measures have not achieved concentrations in compliance with final effluent limits. Additional time is needed to fully develop the best available technology for controlling contaminant discharge in the effluent and meet final effluent limits. The Discharger has requested that the Regional Board extend certain compliance dates to allow the Discharger to complete more work towards reducing contaminant concentrations in the discharge. The Regional Board is amending Cease and Desist Order (CDO) No. 6-00-61 to allow the Discharger additional time to implement best available treatment technologies and/or process changes to meet the final effluent limits contained in WDRs.

5. California Environmental Quality Act

This enforcement action is being taken by this regulatory agency to enforce provisions of the California Water Code and as such is exempt from the provisions of the California Environmental Quality Act (Public Resources Code, Section 21000 et seq.) in accordance with Section 15308, Chapter 3, Title 14, California Code of Regulations.

6. Notification of Interested Parties

The Regional Board has notified the Dischargers and interested parties of its intent amend CDO No. 6-00-61. During a public hearing, the Regional Board heard and considered all comments related to the proposed Order.

IT IS HEREBY ORDERED THAT in accordance with Sections 13267 and 13301 of the California Water Code (CWC), IMC Chemicals, Inc. shall:

1. Comply forthwith to meet the following interim numeral effluent limits (described in Table 1 below) in Board Order Nos. 6-00-52A1 and 6-00-53A1.

Table 1

Parameter	Effluent Limits Argus[1]	Effluent Limits Trona[2]
Total Petroleum Hydrocarbons (TPH) as Kerosene	1.0 mg/l	6.1 mg/l
Total Recoverable Petroleum Hydrocarbons (TRPH)	4.5 mg/l	8.6 mg/l
Phenols	1.0 mg/l	1.0 mg/l

[1] Board Order No 6-00-52A1 Discharge Specification I.B.
[2] Board Order No 6-00-53A1 Discharge Specification I.B.

Bi-weekly status reports (due the 1st and 15th of each month) shall be submitted beginning **April 15, 2001**, regarding compliance at the Argus and Trona facilities until compliance is achieved. These status reports shall include all measures taken to achieve compliance including but not limited to, source control measures, housekeeping, implementation of BMPs, improved maintenance procedures, plant process changes and piping modifications. This information will be evaluated and appropriate recommendations made to the Regional Board if compliance is not achieved.

2. **In accordance with the following time schedules**, submit reports and meet deadlines specified below to meet the final numerical effluent limits described in Board Order Nos. 6-00-52A1 (Argus) and 6-00-53A1 (Trona) (Table 2 below).

   a. By **September 15, 2001** submit a supplemental Analytical Methods Study Report evaluating detection limits for total petroleum hydrocarbons as kerosene, total recoverable petroleum hydrocarbons, formaldehyde and phenols.

   b. By **July 30, 2001** submit a report of BMP implementation and conceptual treatment design plans for the selected contaminant control technology or technologies for the Argus Facility.

   c. By **January 30, 2002** achieve full compliance with the following discharge specifications (Table 2, below) and submit a report of full compliance for the Argus Facility.

   d. By **March 31, 2002** submit a report of the evaluation of potential process modifications and treatment technologies to achieve final effluent limits for the Trona Facility.

   e. By **December 1, 2002** achieve full compliance with the following discharge specifications (Table 2, below) and submit a report of full compliance for the Trona Facility.

Table 2

Parameter	Effluent Limits Argus[1]	Effluent Limits Trona[2]
Total Petroleum Hydrocarbons (TPH) as Kerosene	0.5 mg/l	0.5 mg/l
Total Recoverable Petroleum Hydrocarbons (TRPH)	1.0 mg/l	1.0 mg/l
Formaldehyde	0.01 mg/l	0.01 mg/l
Phenols	0.1 mg/l	0.1 mg/l

[1] Board Order No 6-00-52A1 Discharge Specification I.C.
[2] Board Order No 6-00-53A1 Discharge Specification I.C.

3. All Findings of CDO 6-00-61 remain in force and unchanged.

The Discharger may submit to the Regional Board information to complete an analysis according to State Water Resources Control Board Resolution 68-16 (Statement of Policy with Respect to Maintaining High Quality of Waters in California) and the non-degradation objective contained in the Water Quality Control Plan for the Lahontan Region. The Regional Board will also consider changes to the final effluent limits described in Discharge Specification I.C. that are based upon the lowest effluent limits that can be consistently achieved through the application of the best technology that is economically feasible. If justified based on the above analyses, the Regional Board may consider changes to the final effluent limits in the Orders.

Failure to comply with the terms or conditions of the Order may result in additional enforcement action by the Regional Board. The Executive Officer is authorized to initiate, as needed, referral of this matter to the Attorney General of the State of California for the imposition of Administrative Civil Liability for failure to comply with this Order, injunctive relief, or for any other legal action as he may deem appropriate.

I, Harold J. Singer, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Lahontan Region, on April 11, 2001.

for HAROLD J. SINGER
EXECUTIVE OFFICER

MO/rp IMCC CDOAMD 4/2001 #1

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

CEASE AND DESIST ORDER NO. 6-00-61
WDID: 6B368020001/6B368905004

CONSIDERATION OF A CEASE AND DESIST ORDER – IMC CHEMICALS, INC. AND THE U.S. DEPARTMENT OF INTERIOR, BUREAU OF LAND MANAGEMENT, TRONA AND ARGUS OPERATIONS, VIOLATIONS OF WASTE DISCHARGE REQUIREMENTS, BOARD ORDER NOS. 6-91-910 (TRONA) AND 6-91-909 (ARGUS) AND 6-00-52 (ARGUS) AND 6-00-53 (TRONA)

San Bernardino County

The California Regional Water Quality Control Board, Lahontan Region hereinafter (Regional Board) finds that:

1. Discharger

IMC Chemicals, Inc. (IMCC) owns and operates the Argus and Trona Facilities (Attachment A). The Trona Facility is a brine processing facility that produces anhydrous borax and boric decahydrate from influent brine. The Argus Facility also processes brine and produces soda ash. The two facilities are located about 20 miles east of Ridgecrest in the City of Trona, within T25S, R43E, MDB&M, in the Searles Valley Hydrologic Area. The U.S. Department of the Interior, Bureau of Land Management is the owner of portions of Searles Lake where the brine extraction wells, spent brine injection wells, and effluent disposal (percolation) ponds are located.

2. Facility Description

Processing of the brine at the Argus and Trona facility began in 1978 and 1916 respectively. Various Companies have owned the facilities. Most recently, in 1998, IMC Global purchased North American Chemical Company (NACC) and renamed the company IMC Chemicals. Previously, NACC purchased the facility from Kerr-Mcgee Chemical Corporation in 1990. Presently, the facility is continuing to process brine pumped from beneath Searles Lake. All of the waste subject to this Order from the facilities is discharged either by percolation at the surface of Searles Lake or is re-injected to the subsurface brine under Searles Lake. At Trona, the brine is extracted from wells, a proprietary non-halogenated petroleum solvent (similar to kerosene) is added, the chemicals are processed to form boric acid, then the partially depleted brine is discharged to the surface and subsurface of Searles Lake (Attachment B). At Argus, the partially depleted brine, after beneficiation to produce soda ash, is returned to the surface and subsurface of Searles Lake.

3. Waste Discharge Requirements

Discharge of certain waste from the Argus and Trona Facilities is regulated under Waste Discharge Requirements (WDRs). In a separate action preceding this item, the Regional Board considered revising WDRs for these facilities, in addition to the Westend Facility (not a subject of this item). The Argus Facility was regulated under Board Order No. 6-91-909, which has been revised, rescinded and replaced with Board Order No. 6-00-52 (Argus). The Trona Facility was regulated under Board Order No. 6-91-910, which has been revised, rescinded and replaced with Board Order No. 6-00-53 (Trona). The revised WDRs require monitoring of the injection brine, as well as lowering the effluent limits to address oil buildup, which may be causing mortality to wildlife, and to reflect the 1995 Basin Plan. The following sections include information on past violations of Board Order Nos. 6-91-909 (Argus) and 6-91-910 (Trona) and threatened violations of Board Order Nos. 6-00-52 (Argus) and 6-00-53 (Trona).

In accordance with the revised WDRs for these facilities, IMCC is required to collect daily effluent samples. The effluent contains kerosene in the depleted brine discharge and other non-kerosene total petroleum hydrocarbons (TPH).

4. Current Cleanup Activities at Searles Lake

A number of recent oil spills have resulted in oil present on the surface of the Searles Lake percolation pond. In late January 2000, a number of dead wildfowl were discovered on the lakebed surface, covered with oil and encrusted with lake brine. Cleanup of floating oil is being conducted on Searles Lake and the Argus and Trona channels. The California Department of Fish and Game required IMCC to begin cleanup of Searles Lake and the Argus and Trona channels. Three new oil skimmers are in operation on the Argus and Trona channels leading to the effluent disposal pond. The Regional Board issued a Notice of Violation to the Discharger on February 29, 2000, and requested daily sampling of the effluent on March 8, 2000. Daily sampling conducted during the months of March and April 2000 indicated that the facilities are not in compliance with the effluent requirements contained in Board Order Nos. 6-91-909 (Argus) and 6-91-910 (Trona). IMCC has retained a consultant to investigate the in-plant processes that may be the cause of the effluent limit violations. Regional Board staff required IMCC to conduct a 24-hour sampling event to determine compliance. The results of this sampling event are discussed in Finding No. 7.

5. Previous Violations

Previous violations of Board Order Nos. 6-91-909 (Argus) and 6-91-910 (Trona) are listed below. These previous violations establish that IMCC threatens to violate effluent limits prescribed in Board Order Nos. 6-00-52 (Argus) and 6-00-53 (Trona).

a. Total Petroleum Hydrocarbons (TPH)

Board Order No. 6-91-909 (Argus) Provision I. A.1., and Board Order No. 6-91-910 (Trona), Provision I. A. 2, states that *"The concentration of non-kerosene total petroleum hydrocarbon constituents in the depleted brine discharge shall not exceed 10 mg/L."*

IMCC has conducted daily sampling from the Argus and Trona effluent as requested by Regional Board staff, and the results indicate that the discharge requirement is not consistently being met for either of the two facilities. The average Argus and Trona effluent concentrations for the month of March 2000 for the non-kerosene petroleum hydrocarbon constituents are 4 mg/L and 33 mg/L, respectively. The average Argus and Trona effluent concentrations for the month of April 2000 for the non-kerosene petroleum hydrocarbon constituents are 2 mg/L and 5 mg/L, respectively. Table 1 below summarizes the analytical values from the Argus and Trona effluent sampling and indicates that the numerical effluent limits specified in Board Order Numbers 6-91-909 (Argus) and 6-91-910 (Trona) were not consistently met during March and April 2000.

Table 1

	Total Petroleum Hydrocarbons (TPH)			
Plant	**TPH Limits (mg/L) Note 1**	**Number of Days over limit (March/April 2000) Note 2**	**Maximum Daily Concentration (March/April 2000)**	**Average Monthly Concentration (March/April 2000) Note 2**
Trona	10	7 / 6	170 / 38	33 / 5
Argus	10	3 / 1	48 / 13	4 / 2

Note 1 – Limits in Board Orders 6-91-909 (Argus) and 6-91-910 (Trona) are specified for non-kerosene TPH.
Note 2 - During this time period, the analytical laboratories had difficulty in determining the correct Total Petroleum Hydrocarbons (TPH) value. Because kerosene is a subset of TPH, the kerosene value should be lower than TPH. However for a number of days during March and April 2000 a negative value was obtained for the non-kerosene fraction. Only positive values were used to obtain averages. To obtain the non-kerosene TPH fraction, kerosene is subtracted from TPH.

b. Kerosene

Board Order No. 6-91-910 (Trona), Provision I. A. 1, states that *"The concentration of kerosene in the depleted brine discharge shall not exceed 10 mg/L."*

The average Trona effluent concentrations for the month of March, 2000 for the kerosene constituents is 15.6 mg/L. The average Trona effluent concentration for the month of April 2000 for the kerosene constituents is 11 mg/L. Table 2 below summarizes analytical values from the Trona effluent sampling indicates that the numerical effluent limits specified in Board Order 6-91-910 (Trona) was not consistently met during March and April 2000.

Table 2

	Kerosene			
Plant	**Kerosene Limits (mg/L)**	**Number of Days over limit (March/April 2000)**	**Maximum Daily Concentration (March/April 2000)**	**Average Monthly Concentration (March/April 2000)**
Trona	10	17 / 14	54 / 33	15.6 / 11

c. Best Management Practices (BMP)

Board Order No. 6-91-909 (Argus) Provision I. A. 4., and Board Order No 6-91-910 (Trona), Provision I. A. 5, states that *"Best Management Practices (BMP) shall be used to contain and properly dispose of, to the extent practicable, all drippings, leaks, seepages and similar flows of materials non-native to Searles Dry Lake, including native materials which have been concentrated to levels exceeding those naturally occurring in Searles Dry Lake, from all plant equipment, vehicles, unit benefication process, piping, storage and treatment facilities. These materials shall not be routinely discharged to the depleted brine discharge system."*

Petroleum hydrocarbons were visually detected in Searles Lake during February 2000, and confirmed with sampling. The floating petroleum hydrocarbon was sampled and 156,000 mg/l of TPH was confirmed. On March 8, 2000 Board staff observed and documented with photographs that visible oil was discharged and present on Searles Lake. Board staff observed that the mechanically operated oil skimmer used to remove excess oils before discharge was not maintained properly because the oil skimmer suction device was plugged up due to the accumulation of the thick petroleum hydrocarbons. Board staff also observed oil particles in the discharge pipe (below the Trona skimmer) while sampling the effluent. BMP were not used for routine maintenance and skimmer operation to ensure that oil was not discharged to Searles Lake.

d. Detrimental Physiological Responses

Board Order No. 6-91-909 (Argus) Provision I. B. 1., and Board Order No. 6-91-910 (Trona), Provision I. B. 1., states that *"The discharge shall not cause the presence of the following substances or conditions in ground or surface waters of the Trona Hydrologic Unit: a) Non-native toxic substances in concentrations that individually, collectively, or cumulatively cause detrimental physiological responses in humans, plants, animals, or aquatic life."*

The California Department of Fish and Game has collected approximately sixty dead waterfowl on the surface and around the shoreline of Searles Lake that are coated with oil and brine. Although cause of the bird mortality is not known, the oil could be contributing to their mortality.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

CEASE AND DESIST ORDER NO. 6-00-61
WDID: 6B368020001/6B368905004

CONSIDERATION OF A CEASE AND DESIST ORDER – IMC CHEMICALS, INC. AND THE U.S. DEPARTMENT OF INTERIOR, BUREAU OF LAND MANAGEMENT, TRONA AND ARGUS OPERATIONS, VIOLATIONS OF WASTE DISCHARGE REQUIREMENTS, BOARD ORDER NOS. 6-91-910 (TRONA) AND 6-91-909 (ARGUS) AND 6-00-52 (ARGUS) AND 6-00-53 (TRONA)

San Bernardino County

The California Regional Water Quality Control Board, Lahontan Region hereinafter (Regional Board) finds that:

1. Discharger

IMC Chemicals, Inc. (IMCC) owns and operates the Argus and Trona Facilities (Attachment A). The Trona Facility is a brine processing facility that produces anhydrous borax and boric decahydrate from influent brine. The Argus Facility also processes brine and produces soda ash. The two facilities are located about 20 miles east of Ridgecrest in the City of Trona, within T25S, R43E, MDB&M, in the Searles Valley Hydrologic Area. The U.S. Department of the Interior, Bureau of Land Management is the owner of portions of Searles Lake where the brine extraction wells, spent brine injection wells, and effluent disposal (percolation) ponds are located.

2. Facility Description

Processing of the brine at the Argus and Trona facility began in 1978 and 1916 respectively. Various Companies have owned the facilities. Most recently, in 1998, IMC Global purchased North American Chemical Company (NACC) and renamed the company IMC Chemicals. Previously, NACC purchased the facility from Kerr-Mcgee Chemical Corporation in 1990. Presently, the facility is continuing to process brine pumped from beneath Searles Lake. All of the waste subject to this Order from the facilities is discharged either by percolation at the surface of Searles Lake or is re-injected to the subsurface brine under Searles Lake. At Trona, the brine is extracted from wells, a proprietary non-halogenated petroleum solvent (similar to kerosene) is added, the chemicals are processed to form boric acid, then the partially depleted brine is discharged to the surface and subsurface of Searles Lake (Attachment B). At Argus, the partially depleted brine, after beneficiation to produce soda ash, is returned to the surface and subsurface of Searles Lake.

3. Waste Discharge Requirements

Discharge of certain waste from the Argus and Trona Facilities is regulated under Waste Discharge Requirements (WDRs). In a separate action preceding this item, the Regional Board considered revising WDRs for these facilities, in addition to the Westend Facility (not a subject of this item). The Argus Facility was regulated under Board Order No. 6-91-909, which has been revised, rescinded and replaced with Board Order No. 6-00-52 (Argus). The Trona Facility was regulated under Board Order No. 6-91-910, which has been revised, rescinded and replaced with Board Order No. 6-00-53 (Trona). The revised WDRs require monitoring of the injection brine, as well as lowering the effluent limits to address oil buildup, which may be causing mortality to wildlife, and to reflect the 1995 Basin Plan. The following sections include information on past violations of Board Order Nos. 6-91-909 (Argus) and 6-91-910 (Trona) and threatened violations of Board Order Nos. 6-00-52 (Argus) and 6-00-53 (Trona).

In accordance with the revised WDRs for these facilities, IMCC is required to collect daily effluent samples. The effluent contains kerosene in the depleted brine discharge and other non-kerosene total petroleum hydrocarbons (TPH).

4. Current Cleanup Activities at Searles Lake

A number of recent oil spills have resulted in oil present on the surface of the Searles Lake percolation pond. In late January 2000, a number of dead wildfowl were discovered on the lakebed surface, covered with oil and encrusted with lake brine. Cleanup of floating oil is being conducted on Searles Lake and the Argus and Trona channels. The California Department of Fish and Game required IMCC to begin cleanup of Searles Lake and the Argus and Trona channels. Three new oil skimmers are in operation on the Argus and Trona channels leading to the effluent disposal pond. The Regional Board issued a Notice of Violation to the Discharger on February 29, 2000, and requested daily sampling of the effluent on March 8, 2000. Daily sampling conducted during the months of March and April 2000 indicated that the facilities are not in compliance with the effluent requirements contained in Board Order Nos. 6-91-909 (Argus) and 6-91-910 (Trona). IMCC has retained a consultant to investigate the in-plant processes that may be the cause of the effluent limit violations. Regional Board staff required IMCC to conduct a 24-hour sampling event to determine compliance. The results of this sampling event are discussed in Finding No. 7.

5. Previous Violations

Previous violations of Board Order Nos. 6-91-909 (Argus) and 6-91-910 (Trona) are listed below. These previous violations establish that IMCC threatens to violate effluent limits prescribed in Board Order Nos. 6-00-52 (Argus) and 6-00-53 (Trona).

a. Total Petroleum Hydrocarbons (TPH)

Board Order No. 6-91-909 (Argus) Provision I. A.1., and Board Order No. 6-91-910 (Trona), Provision I. A. 2, states that *"The concentration of non-kerosene total petroleum hydrocarbon constituents in the depleted brine discharge shall not exceed 10 mg/L."*

IMCC has conducted daily sampling from the Argus and Trona effluent as requested by Regional Board staff, and the results indicate that the discharge requirement is not consistently being met for either of the two facilities. The average Argus and Trona effluent concentrations for the month of March 2000 for the non-kerosene petroleum hydrocarbon constituents are 4 mg/L and 33 mg/L, respectively. The average Argus and Trona effluent concentrations for the month of April 2000 for the non-kerosene petroleum hydrocarbon constituents are 2 mg/L and 5 mg/L, respectively. Table 1 below summarizes the analytical values from the Argus and Trona effluent sampling and indicates that the numerical effluent limits specified in Board Order Numbers 6-91-909 (Argus) and 6-91-910 (Trona) were not consistently met during March and April 2000.

Table 1

	Total Petroleum Hydrocarbons (TPH)			
Plant	**TPH Limits (mg/L) Note 1**	**Number of Days over limit (March/April 2000) Note 2**	**Maximum Daily Concentration (March/April 2000)**	**Average Monthly Concentration (March/April 2000) Note 2**
Trona	10	7 / 6	170 / 38	33 / 5
Argus	10	3 / 1	48 / 13	4 / 2

Note 1 – Limits in Board Orders 6-91-909 (Argus) and 6-91-910 (Trona) are specified for non-kerosene TPH.
Note 2 - During this time period, the analytical laboratories had difficulty in determining the correct Total Petroleum Hydrocarbons (TPH) value. Because kerosene is a subset of TPH, the kerosene value should be lower than TPH. However for a number of days during March and April 2000 a negative value was obtained for the non-kerosene fraction. Only positive values were used to obtain averages. To obtain the non-kerosene TPH fraction, kerosene is subtracted from TPH.

b. Kerosene

Board Order No. 6-91-910 (Trona), Provision I. A. 1, states that *"The concentration of kerosene in the depleted brine discharge shall not exceed 10 mg/L."*

The average Trona effluent concentrations for the month of March, 2000 for the kerosene constituents is 15.6 mg/L. The average Trona effluent concentration for the month of April 2000 for the kerosene constituents is 11 mg/L. Table 2 below summarizes analytical values from the Trona effluent sampling indicates that the numerical effluent limits specified in Board Order 6-91-910 (Trona) was not consistently met during March and April 2000.

Table 2

	Kerosene			
Plant	**Kerosene Limits (mg/L)**	**Number of Days over limit (March/April 2000)**	**Maximum Daily Concentration (March/April 2000)**	**Average Monthly Concentration (March/April 2000)**
Trona	10	17 / 14	54 / 33	15.6 / 11

c. Best Management Practices (BMP)

Board Order No. 6-91-909 (Argus) Provision I. A. 4., and Board Order No 6-91-910 (Trona), Provision I. A. 5, states that *"Best Management Practices (BMP) shall be used to contain and properly dispose of, to the extent practicable, all drippings, leaks, seepages and similar flows of materials non-native to Searles Dry Lake, including native materials which have been concentrated to levels exceeding those naturally occurring in Searles Dry Lake, from all plant equipment, vehicles, unit benefication process, piping, storage and treatment facilities. These materials shall not be routinely discharged to the depleted brine discharge system."*

Petroleum hydrocarbons were visually detected in Searles Lake during February 2000, and confirmed with sampling. The floating petroleum hydrocarbon was sampled and 156,000 mg/l of TPH was confirmed. On March 8, 2000 Board staff observed and documented with photographs that visible oil was discharged and present on Searles Lake. Board staff observed that the mechanically operated oil skimmer used to remove excess oils before discharge was not maintained properly because the oil skimmer suction device was plugged up due to the accumulation of the thick petroleum hydrocarbons. Board staff also observed oil particles in the discharge pipe (below the Trona skimmer) while sampling the effluent. BMP were not used for routine maintenance and skimmer operation to ensure that oil was not discharged to Searles Lake.

d. Detrimental Physiological Responses

Board Order No. 6-91-909 (Argus) Provision I. B. 1., and Board Order No. 6-91-910 (Trona), Provision I. B. 1., states that *"The discharge shall not cause the presence of the following substances or conditions in ground or surface waters of the Trona Hydrologic Unit: a) Non-native toxic substances in concentrations that individually, collectively, or cumulatively cause detrimental physiological responses in humans, plants, animals, or aquatic life."*

The California Department of Fish and Game has collected approximately sixty dead waterfowl on the surface and around the shoreline of Searles Lake that are coated with oil and brine. Although cause of the bird mortality is not known, the oil could be contributing to their mortality.

6. Threatened Violations

IMCC threatens to violate Discharge Specifications prescribed in Board Order Nos. 6-00-52 (Argus) and 6-00-53 (Trona) as described below.

a. Total Petroleum Hydrocarbons (TPH)

Board Order No. 6-00-52 (Argus) and Board Order No. 6-00-53(Trona) specify interim and final numerical effluent limits for TPH in Discharge Specification I.B. and I.C. as shown in Tables 3 and 4 below. Based on the information describe above IMCC can not consistently meet the interim numerical effluent limits and can not meet the final numerical effluent limits as the facilities are currently operated.

b. Kerosene

Board Order No. 6-00-52 (Argus) and Board Order No. 6-00-53 (Trona) specify interim and final numerical effluent limits for kerosene in Discharge Specification I.B. and I.C. as shown in Tables 3 and 4 below. Based on the information describe above IMCC can not consistently meet the interim numerical effluent limits and can not meet the final numerical effluent limits as the facilities are currently operated.

c. Best Management Practices (BMP)

Board Order No. 6-00-52 (Argus) Discharge Specification I.F. and Board Order No. 6-00-53 (Trona) Discharge Specification I.F. states that *"Best Management Practices (BMP) shall be used to contain and properly dispose of, to the extent practicable, all drippings, leaks, seepages and similar flows of materials non-native to Searles Dry Lake, and native materials which have been concentrated to levels exceeding those naturally occurring in Searles Dry Lake, from all plant equipment, vehicles, unit benefication process, in plant industrial wash water use, piping, storage and treatment facilities. These materials shall not be routinely discharged to the depleted brine discharge system."*

d. Detrimental Physiological Responses

Board Order No. 6-00-52 (Argus) Discharge Specification I.E.2.n., and Board Order No. 6-00-53 (Trona), Discharge Specification I.E.2.n., states that *"All waters shall be maintained free of toxic substances, as a result of the discharge, in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life."*

e. Narrative Standards

Board Order No. 6-00-52 (Argus) Discharge Specification I.D., and Board Order No. 6-00-53 (Trona), Discharge Specification I.D., state that *"The industrial effluent discharged to surface and ground waters of Searles Lake shall not contain any of the following substances other than substances naturally occurring in Searles Lake:*

i. Chlorinated hydrocarbons
ii. Toxic substances
iii. *Harmful substances that any bioconcentrate or bioaccumulate*
iv. *Radioactive substances"*

f. Floating Materials

Board Order No. 6-00-52 (Argus) Discharge Specification I.E.2.e., and Board Order No. 6-00-53 (Trona), Discharge Specification I.E.2.e., states that *"Waters shall not contain floating material, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect the water for beneficial uses."*

g. Oil and Grease

Board Order No. 6-00-52 (Argus) Discharge Specification I.E.2.f., and Board Order No. 6-00-53 (Trona), Discharge Specification I.E.2.f., states that *"Waters shall not contain oils, greases, waxes or other materials in concentrations that result in a visible film or coating on the surface of the water or on objects in the water, that cause nuisance, or that otherwise adversely affect the water for beneficial uses."*

h. Visible Petroleum Hydrocarbons

Board Order No. 6-00-52 (Argus) General Requirements and Prohibitions, II.8., and Board Order No. 6-00-53 (Trona), General Requirements II.8., states that *"There shall be no discharge of visible petroleum hydrocarbons to Searles Lake."*

7. 24-Hour Effluent Sampling

On May 5 and 6, 2000 Board staff collected several samples on a hourly basis from the Trona and Argus effluent discharge points. The complete data package from this sampling event has not been received as of May 26, 2000. Preliminary data form the Trona Facility indicates a range of TPH of 4.2 to 5.9 mg/l, and Argus had a range of TPH from non-detect to 9.6 mg/l. Therefore, the preliminary data do not indicate a violation of numerical effluent limits for the time period sampled. During the on-site sampling event, Board staff noted visible oil in the effluent streams and floating oil on the effluent disposal pond which is a violation of narrative requirements.

8. California Water Code

California Water Code Section 13301 states, in part, *"When a regional board finds that a discharge of waste is taking place or threatening to take place in violation of requirements or discharge prohibitions prescribed by the regional board or the state board, the board may issue an order to cease and desist and direct that those persons not complying with the requirements or discharge prohibitions (a) comply forthwith, (b) comply in accordance with a time schedule set by the board, or (c) in the event of a threatened violation, take appropriate remedial or preventive action."*

9. California Environmental Quality Act

This enforcement action is being taken by this regulatory agency to enforce provisions of the California Water Code and as such is exempt from the provisions of the California Environmental Quality Act (Public Resources Code, Section 21000 et seq.) in accordance with Section 15308, Chapter 3, Title 14, California Code of Regulations.

10. Notification of Interested Parties

The Regional Board has notified the Dischargers and interested parties of a public hearing to be held at the Regional Board meeting on May 10, 2000. During the public hearing, the Regional Board heard and considered all comments related to the proposed Order.

IT IS HEREBY ORDERED THAT in accordance with Sections 13267 and 13301 of the California Water Code (CWC), IMC Chemicals, Inc. shall:

1. Comply **forthwith** to meet the following interim numeral effluent limits (described in Table 3 below) and all other Discharge Specifications described in Board Order Nos. 6-00-52 (Argus) and 6-00-53 (Trona).

Table 3

Parameter	Effluent Limits	Board Order No 6-00-52 (Argus) Discharge Specification Number	Board Order No 6-00-53 (Trona) Discharge Specification Number
Kerosene	10 mg/l	I.B.	I.B.
Non-kerosene Total Petroleum Hydrocarbons (TPH)	10 mg/l	I.B.	I.B.

Note: 1. Non-kerosene TPH = TRPH minus kerosene fraction

IMCC must comply immediately with the above limits for the Argus Plant on a continuous basis. IMCC must comply with the above limits for the Trona Plant on a continuous basis by **August 14, 2000**. Until **August 14, 2000**, IMCC must comply with the above limits for the Trona Plant calculated on a running 10-day average (the current day and prior 9 days). IMCC may collect more than one sample per day, however all data collected shall be used to determine this running average.

Weekly status reports shall be submitted beginning **June 22, 2000,** regarding compliance at the Trona facility until compliance is achieved. These status reports shall include all measures taken to achieve compliance including but not limited to, source control measures, housekeeping, implementation of BMP, improved maintenance procedures, plant process changes and piping modifications. This information will be evaluated and appropriate recommendations made to the Regional Board if compliance with the Interim Effluent Limits for the Trona Facility is not achieved.

2. **In accordance with the following time schedules**, submit reports and meet deadlines specified below for the construction of treatment facilities necessary to meet the following final numerical effluent limits described in Board Order Nos. 6-00-52 (Argus) and 6-00-53 (Trona) (Table 4 below).

   a. By **April 1, 2001** complete construction of facilities and implement any other identified source control measures.

   b. By **June 30, 2001** achieve full compliance with the following discharge specifications and submit a report of full compliance.

Table 4

Parameter	Effluent Limits	Board Order No 6-00-52 (Argus) Discharge Specification Number	Board Order No 6-00-53 (Trona) Discharge Specification Number
Kerosene	0.5 mg/l	I.C.	I.C.
Total Recoverable Petroleum Hydrocarbons	1.0 mg/l	I.C.	I.C.
Formaldehyde	10 µg/l	I.C.	I.C.
Phenol	0.1 mg/l	I.C.	I.C.

This compliance date is not based on any technical assurance that the Discharger will be able to comply by that date. This compliance date will be evaluated and revised, if appropriate, when more information is available regarding the Discharger's ability to comply after construction of facilities and implementation of other source control measures are complete as described in No. 3 above.

Any requested change in the compliance schedule of June 30, 2001 shall be submitted as soon as possible but not later than April 1, 2001 to be considered by the Regional Board at the next regular meeting following such request. The Regional Board retains the ability to determine whether to extend the deadline based on the information provided.

Failure to comply with the terms or conditions of the Order may result in additional enforcement action by the Regional Board. The Executive Officer is authorized to initiate, as needed, referral of this matter to the Attorney General of the State of California for the imposition of Administrative Civil Liability for failure to comply with this Order, injunctive relief, or for any other legal action as he may deem appropriate.

I, Harold J. Singer, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Lahontan Region, on June 14, 2000.

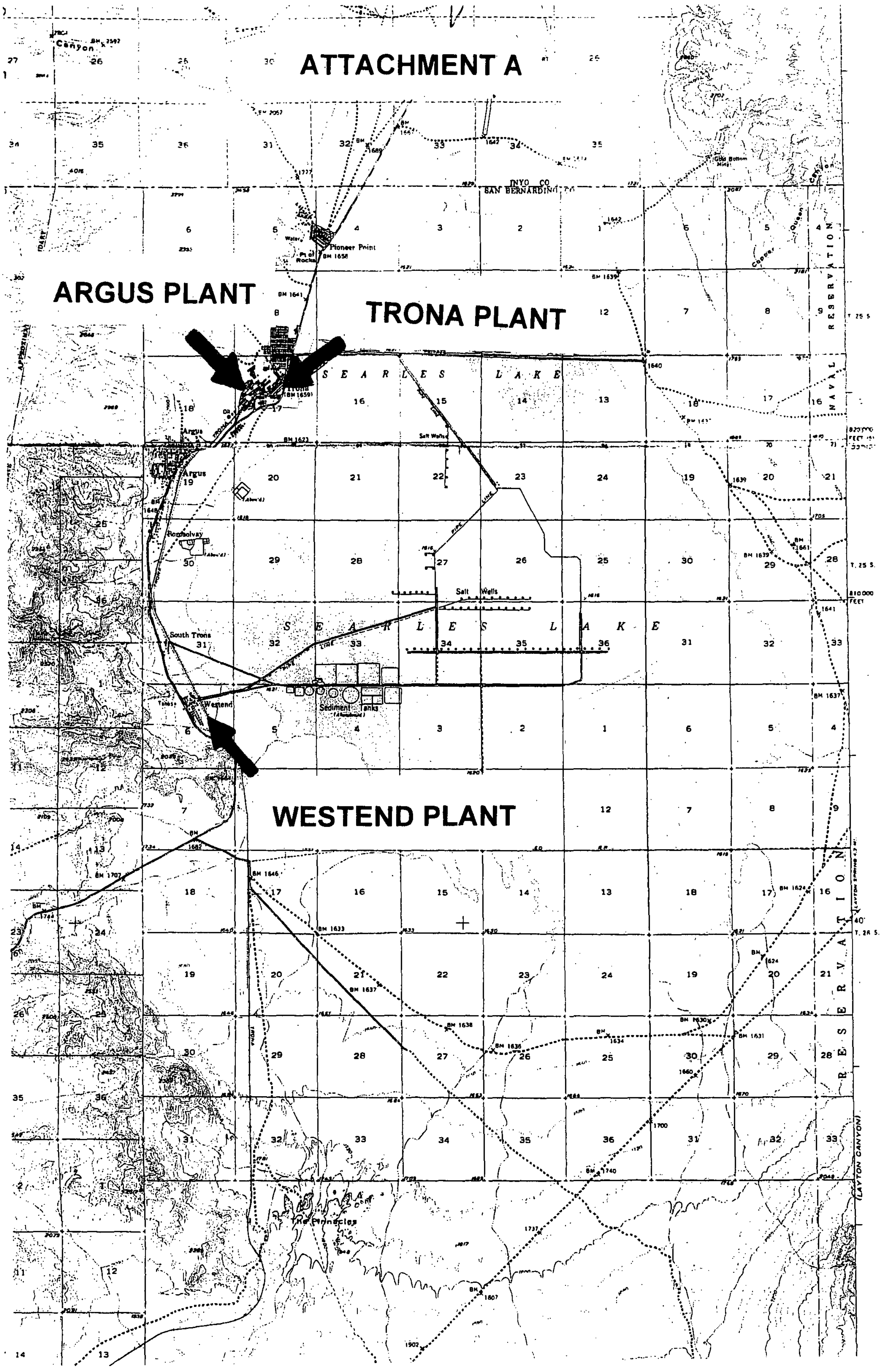
Harold J. Singer

HAROLD J. SINGER
EXECUTIVE OFFICER

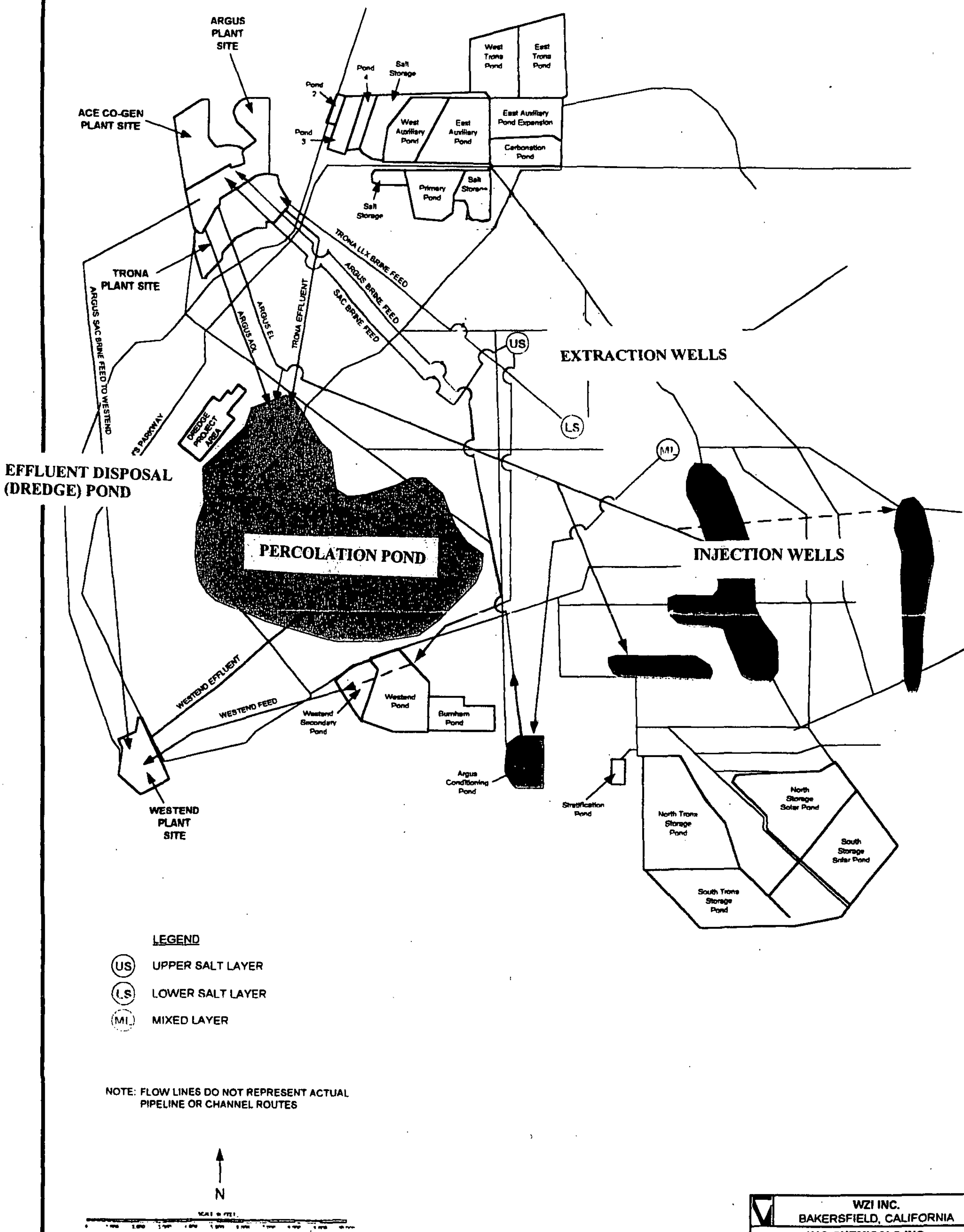
Attachments: A. Location Map
B. Brine Supply and Return Flow Diagram

6/200 #2 IMCC-CDO1

ATTACHMENT A



IMCC SEARLES LAKE OPERATIONS



ATTACHMENT B

WZI INC. BAKERSFIELD, CALIFORNIA	
IMC CHEMICALS INC. SEARLES VALLEY, CA	
BRINE SUPPLY AND RETURN FLOW DIAGRAM FOR TRONA, ARGUS AND WESTEND PLANTS	
DATE 3/99	0911.0010
EXHIBIT 10	

From: Craig Kibby
To: Unsicker, Judith
Date: 8/27/01 9:53AM
Subject: Update to Mojave River and D Street data from Friday

Judith,

I realized I forgot to mention in the previous e-mail that whenever you see 99999 in the data that it refers to Non Detect.

Let me know if you have any questions,

Craig

From: Craig Kibby
To: Unsicker, Judith
Date: 8/24/01 2:41PM
Subject: Mojave River & D Street Data

Judith,

Per Mike Plaziak, attached is the data from the Mojave River and D Street sampling for your analysis. If you have any questions please contact Mike at (760)241-7358 or me at (760)241-7307.

Thanks,

Craig Kibby

StateID	Project	Area	Date	PCE	TCE
Beck Shell H-11	D Street	Mojave River	#######	99999	99999
Beck Shell MW-1	D Street	Mojave River	5/4/2000	38	99999
Beck Shell MW-1	D Street	Mojave River	#######	99999	99999
Beck Shell MW-1	D Street	Mojave River	#######	6.50	99999
Beck Shell MW-3	D Street	Mojave River	#######	0.57	99999
Beck Shell MW-3	D Street	Mojave River	#######	99999	99999
Beck Shell MW-3A	D Street	Mojave River	#######	99999	99999
Beck Shell MW-3B	D Street	Mojave River	#######	99999	99999
Beck Shell MW-3C	D Street	Mojave River	#######	99999	99999
Beck Shell MW-4	D Street	Mojave River	#######	99999	99999
Beck Shell MW-4	D Street	Mojave River	#######	18	99999
Beck Shell MW-4	D Street	Mojave River	#######	99999	99999
Beck Shell MW-4	D Street	Mojave River	5/4/2000	165	18
Beck Shell MW-4	D Street	Mojave River	#######	99999	99999
Beck Shell MW-4	D Street	Mojave River	#######	99999	99999
Beck Shell MW-4A	D Street	Mojave River	#######	99999	99999
Beck Shell MW-4A	D Street	Mojave River	#######	99999	99999
Beck Shell MW-4B	D Street	Mojave River	#######	99999	99999
Beck Shell MW-4B	D Street	Mojave River	#######	99999	99999
Beck Shell MW-4C	D Street	Mojave River	#######	99999	99999
Beck Shell MW-4C	D Street	Mojave River	#######	99999	99999
Beck Shell MW-5	D Street	Mojave River	#######	0.58	99999
Beck Shell MW-5	D Street	Mojave River	#######	99999	99999
Beck Shell MW-5	D Street	Mojave River	5/4/2000	190	10
Beck Shell MW-5	D Street	Mojave River	#######	99999	99999
Beck Shell MW-6	D Street	Mojave River	#######	360	21
Chevron MW-4	D Street	Mojave River	5/7/1997	99999	99999
Chevron MW-4	D Street	Mojave River	#######	99999	99999
Chevron MW-4	D Street	Mojave River	#######	99999	99999
Chevron MW-5	D Street	Mojave River	5/7/1997	19	99999
Chevron MW-5	D Street	Mojave River	#######	37	99999
Chevron MW-5	D Street	Mojave River	#######	45	99999
Chevron MW-5	D Street	Mojave River	#######	99999	99999
Chevron MW-5	D Street	Mojave River	#######	29	99999
Chevron MW-5A	D Street	Mojave River	#######	110	99999
Chevron MW-5B	D Street	Mojave River	#######	90	99999
Chevron MW-5C	D Street	Mojave River	#######	83	99999
Chevron MW-6 A,B,C	D Street	Mojave River	#######	99999	99999
Chevron MW-6A	D Street	Mojave River	#######	99999	99999
Chevron MW-6B	D Street	Mojave River	#######	99999	99999
Chevron MW-6C	D Street	Mojave River	#######	99999	99999
Chevron MW-7	D Street	Mojave River	5/7/1997	99999	99999
Chevron MW-7	D Street	Mojave River	#######	99999	99999
Chevron MW-7	D Street	Mojave River	#######	99999	99999
Chevron MW-7	D Street	Mojave River	#######	99999	99999
Chevron MW-7	D Street	Mojave River	#######	99999	99999
Chevron MW-7 Offsite	D Street	Mojave River	#######	99999	99999
Chevron MW-7 Offsite	D Street	Mojave River	#######	99999	99999
Chevron MW-7 Offsite	D Street	Mojave River	#######	99999	99999
Chevron MW-7 Offsite	D Street	Mojave River	#######	99999	99999
Chevron MW-7A	D Street	Mojave River	#######	99999	99999

Chevron MW-7A	D Street	Mojave River	#######	99999	99999
Chevron MW-7B	D Street	Mojave River	#######	99999	99999
Chevron MW-7B	D Street	Mojave River	#######	99999	99999
Chevron MW-7C	D Street	Mojave River	#######	99999	99999
Chevron MW-7C	D Street	Mojave River	#######	99999	99999
Chevron MW-8	D Street	Mojave River	5/7/1997	99999	99999
Chevron MW-8 Offsite	D Street	Mojave River	#######	99999	99999
E-1 Arco #1908	D Street	Mojave River	#######	4.9999	4.9999
E-1 Arco #1908	D Street	Mojave River	#######	4.9999	4.9999
E-1 Arco #1908	D Street	Mojave River	#######	1.70	0.4999
E-10 Arco #1908	D Street	Mojave River	#######	9.60	0.50
E-10 Arco #1908	D Street	Mojave River	#######	10	0.90
E-10 Arco #1908	D Street	Mojave River	#######	5.5	0.90
E-10 Arco #1908	D Street	Mojave River	#######	2.80	1.80
E-11 Arco #1908	D Street	Mojave River	#######	54	0.90
E-11 Arco #1908	D Street	Mojave River	6/2/1994	34	0.70
E-11 Arco #1908	D Street	Mojave River	9/2/1994	41	3.40
E-11 Arco #1908	D Street	Mojave River	#######	41	4.40
E-11 Arco #1908	D Street	Mojave River	#######	25	2.90
E-11 Arco #1908	D Street	Mojave River	#######	11	3.20
E-11 Arco #1908	D Street	Mojave River	6/8/1995	9.40	3.60
E-11 Arco #1908	D Street	Mojave River	#######	8.10	3.70
E-11 Arco #1908	D Street	Mojave River	#######	8.20	3.50
E-11 Arco #1908	D Street	Mojave River	#######	4.70	2.30
E-11 Arco #1908	D Street	Mojave River	#######		1.50
E-11 Arco #1908	D Street	Mojave River	9/5/1996		4.9999
E-11 Arco #1908	D Street	Mojave River	#######	1.60	2.20
E-11 Arco #1908	D Street	Mojave River	#######	2.30	1.60
E-11 Arco #1908	D Street	Mojave River	5/7/1997	1.60	1.30
E-11 Arco #1908	D Street	Mojave River	5/7/1997	1.20	1.10
E-11 Arco #1908	D Street	Mojave River	#######	2.70	1.20
E-12 Arco #1908	D Street	Mojave River	#######	0.4999	0.4999
E-12 Arco #1908	D Street	Mojave River	6/2/1994	0.4999	0.4999
E-12 Arco #1908	D Street	Mojave River	9/2/1994	0.4999	0.4999
E-12 Arco #1908	D Street	Mojave River	#######	0.4999	0.4999
E-12 Arco #1908	D Street	Mojave River	#######	0.4999	0.4999
E-12 Arco #1908	D Street	Mojave River	#######	0.4999	0.4999
E-12 Arco #1908	D Street	Mojave River	#######	0.4999	0.4999
E-12 Arco #1908	D Street	Mojave River	#######		0.4999
E-12 Arco #1908	D Street	Mojave River	#######	0.4999	0.4999
E-12 Arco #1908	D Street	Mojave River	#######	0.4999	0.4999
E-12 Arco #1908	D Street	Mojave River	5/7/1997	0.4999	0.4999
E-13 Arco #1908	D Street	Mojave River	#######	0.4999	0.4999
E-13 Arco #1908	D Street	Mojave River	#######	0.4999	0.4999
E-13 Arco #1908	D Street	Mojave River	#######	0.4999	0.4999
E-13 Arco #1908	D Street	Mojave River	#######	0.4999	0.4999
E-14 Arco #1908	D Street	Mojave River	#######	2	0.4999
E-14 Arco #1908	D Street	Mojave River	#######	1.80	0.4999
E-14 Arco #1908	D Street	Mojave River	#######	2	0.4999
E-14 Arco #1908	D Street	Mojave River	#######	2.70	0.4999
E-14 Arco #1908	D Street	Mojave River	#######	99999	99999
E-14 Arco #1908	D Street	Mojave River	#######	3.10	99999

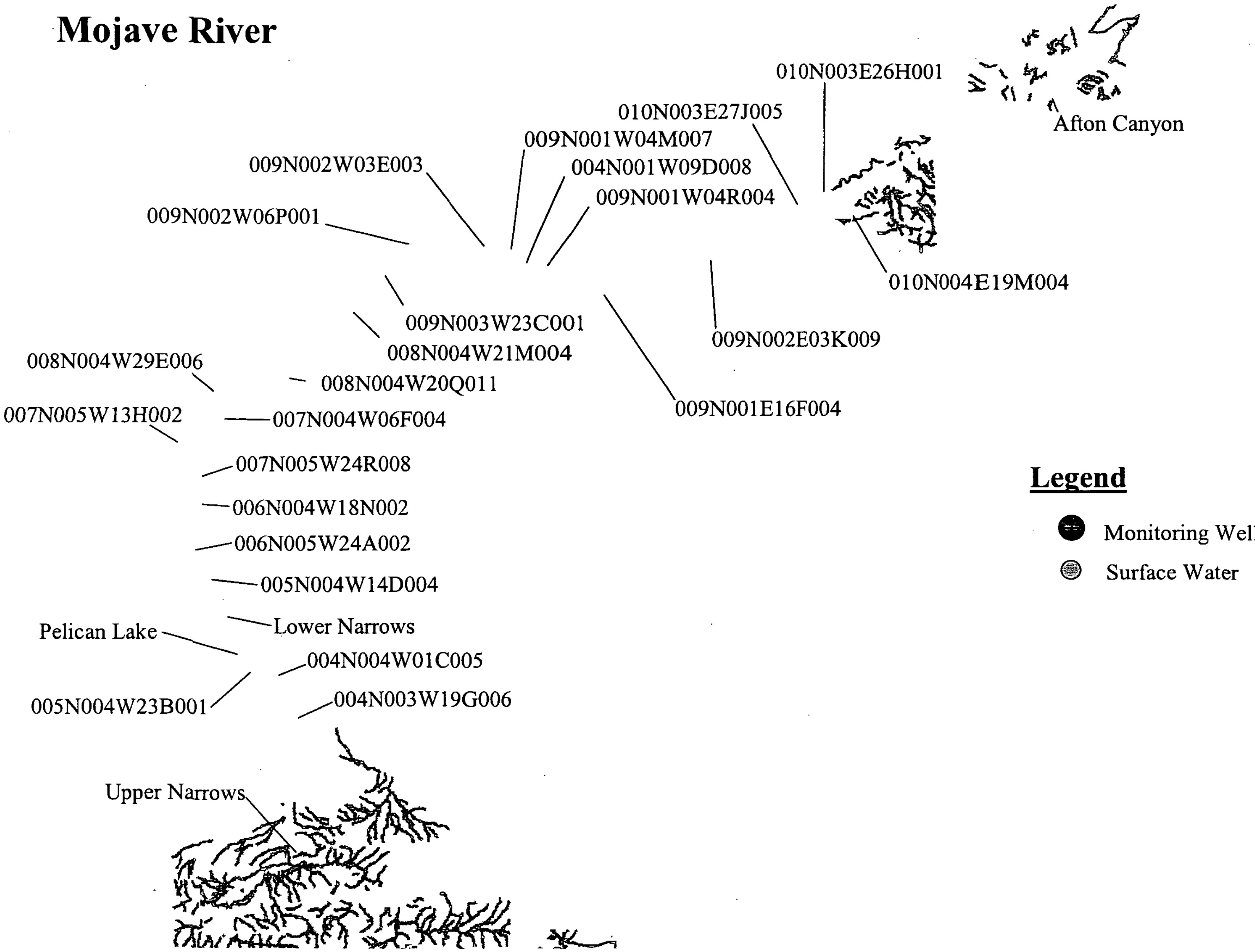
E-15 Arco #1908	D Street	Mojave River	#######	0.4999	0.4999
E-15 Arco #1908	D Street	Mojave River	#######	0.4999	0.4999
E-15 Arco #1908	D Street	Mojave River	#######	0.4999	0.4999
E-15 Arco #1908	D Street	Mojave River	#######	0.4999	0.4999
E-15A Arco #1908	D Street	Mojave River	#######	99999	99999
E-15B Arco #1908	D Street	Mojave River	#######	99999	99999
E-15C Arco #1908	D Street	Mojave River	#######	99999	99999
E-16 Arco #1908	D Street	Mojave River	#######	8	0.4999
E-16 Arco #1908	D Street	Mojave River	6/2/1994	2.40	0.4999
E-16 Arco #1908	D Street	Mojave River	9/2/1994	3.30	0.4999
E-16 Arco #1908	D Street	Mojave River	#######	2.60	5.50
E-16 Arco #1908	D Street	Mojave River	#######	3.10	0.50
E-16 Arco #1908	D Street	Mojave River	#######	2	0.4999
E-16 Arco #1908	D Street	Mojave River	#######	1.50	1.20
E-16 Arco #1908	D Street	Mojave River	#######	1.20	0.4999
E-16 Arco #1908	D Street	Mojave River	#######	1.70	0.4999
E-16 Arco #1908	D Street	Mojave River	#######		0.4999
E-16 Arco #1908	D Street	Mojave River	#######	0.4999	0.60
E-16 Arco #1908	D Street	Mojave River	#######	2.20	0.4999
E-16 Arco #1908	D Street	Mojave River	5/7/1997	1.90	99999
E-16 Arco #1908	D Street	Mojave River	#######	2.10	0.4999
E-16 Arco #1908	D Street	Mojave River	#######	4.30	99999
E-16 Arco #1908	D Street	Mojave River	#######	99999	99999
E-16 Arco #1908	D Street	Mojave River	#######	10	99999
E-16A Arco #1908	D Street	Mojave River	#######	1.50	99999
E-16B Arco #1908	D Street	Mojave River	#######	1.60	99999
E-16C Arco #1908	D Street	Mojave River	#######	1.60	99999
E-2 Arco #1908	D Street	Mojave River	#######	0.4999	0.4999
E-2 Arco #1908	D Street	Mojave River	6/2/1994	9.9999	9.9999
E-2 Arco #1908	D Street	Mojave River	9/2/1994	4.9999	4.9999
E-2 Arco #1908	D Street	Mojave River	#######	2.4999	2.4999
E-2 Arco #1908	D Street	Mojave River	6/8/1995	4.9999	4.9999
E-2 Arco #1908	D Street	Mojave River	#######	4.9999	4.9999
E-2 Arco #1908	D Street	Mojave River	#######	1.40	0.9999
E-2 Arco #1908	D Street	Mojave River	#######	0.50	0.4999
E-2 Arco #1908	D Street	Mojave River	#######		0.9999
E-2 Arco #1908	D Street	Mojave River	9/5/1996		2
E-2 Arco #1908	D Street	Mojave River	#######	2.4999	2.4999
E-2 Arco #1908	D Street	Mojave River	#######	0.4999	0.4999
E-2 Arco #1908	D Street	Mojave River	5/7/1997	99999	0.58
E-2 Arco #1908	D Street	Mojave River	#######	0.4999	0.4999
E-2 Arco #1908	D Street	Mojave River	#######	99999	99999
E-2 Arco #1908	D Street	Mojave River	#######	99999	99999
E-2 Arco #1908	D Street	Mojave River	#######	99999	99999
E-3 Arco #1908	D Street	Mojave River	#######	3.40	
E-3 Arco #1908	D Street	Mojave River	#######	8.80	0.60
E-3 Arco #1908	D Street	Mojave River	#######	3.30	0.4999
E-3 Arco #1908	D Street	Mojave River	#######	3.00	2
E-3 Arco #1908	D Street	Mojave River	#######	1.40	0.4999
E-5 Arco #1908	D Street	Mojave River	#######	0.4999	0.4999
E-5 Arco #1908	D Street	Mojave River	#######	0.4999	0.4999
E-5 Arco #1908	D Street	Mojave River	#######	0.4999	0.4999

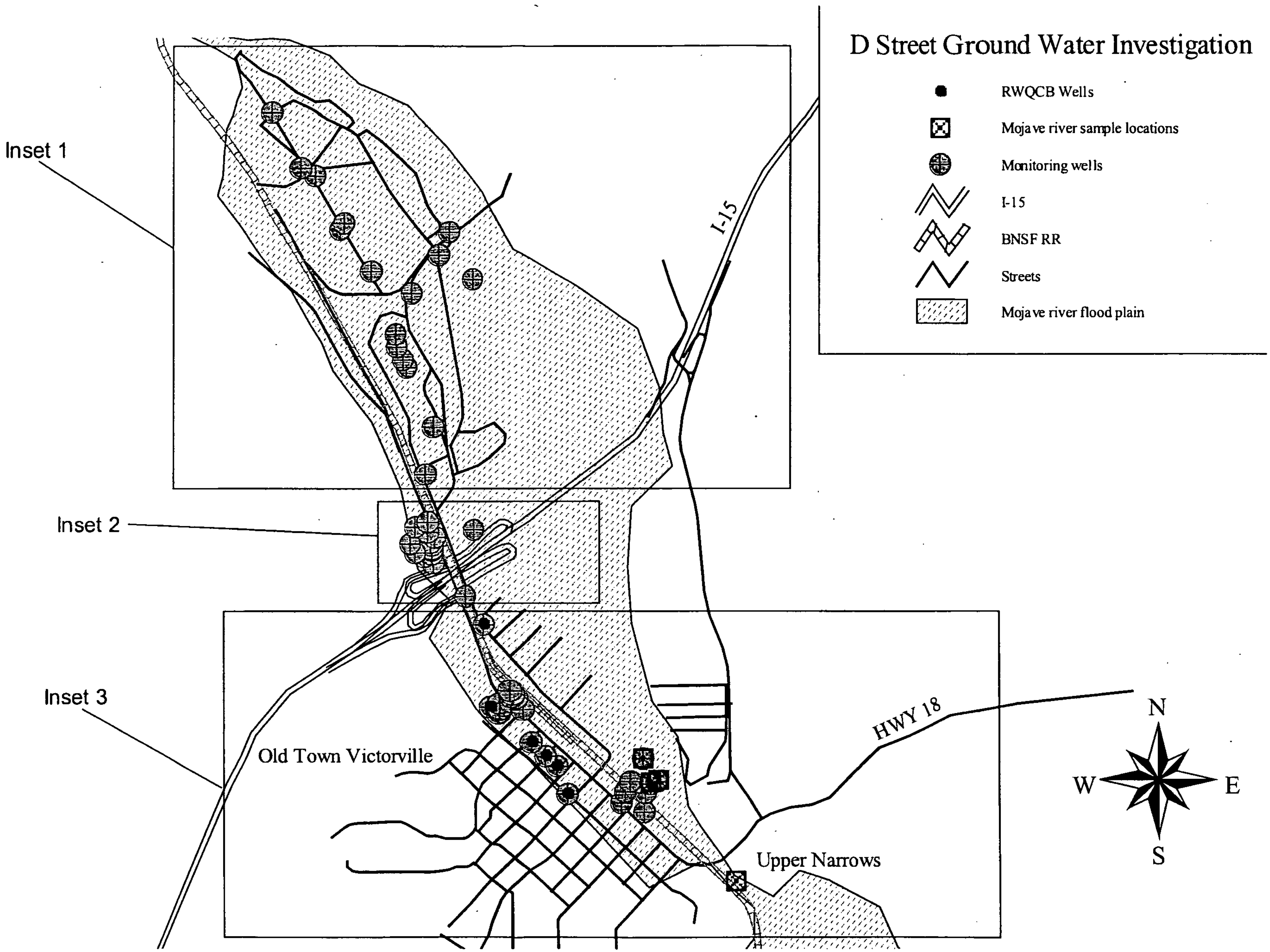
E-5 Arco #1908	D Street	Mojave River	#######	0.4999	0.4999
E-6 Arco #1908	D Street	Mojave River	#######	33	0.4999
E-6 Arco #1908	D Street	Mojave River	6/2/1994	14	0.4999
E-6 Arco #1908	D Street	Mojave River	9/2/1994	14	0.4999
E-6 Arco #1908	D Street	Mojave River	#######	17	2.10
E-6 Arco #1908	D Street	Mojave River	#######	7.80	1.10
E-6 Arco #1908	D Street	Mojave River	#######	7.50	0.4999
E-6 Arco #1908	D Street	Mojave River	6/8/1995	8.10	1.70
E-6 Arco #1908	D Street	Mojave River	#######	3.30	1.60
E-6 Arco #1908	D Street	Mojave River	#######	3.40	0.4999
E-6 Arco #1908	D Street	Mojave River	#######	2.10	1.60
E-6 Arco #1908	D Street	Mojave River	#######		1
E-6 Arco #1908	D Street	Mojave River	#######	1.20	1
E-6 Arco #1908	D Street	Mojave River	#######	1.20	0.4999
E-6 Arco #1908	D Street	Mojave River	5/7/1997	1.30	0.80
E-7 Arco #1908	D Street	Mojave River	#######	67	0.50
E-7 Arco #1908	D Street	Mojave River	6/2/1994	56	0.4999
E-7 Arco #1908	D Street	Mojave River	#######	41	2.20
E-7 Arco #1908	D Street	Mojave River	#######	47	1.70
E-7 Arco #1908	D Street	Mojave River	#######	26	0.4999
E-7 Arco #1908	D Street	Mojave River	6/8/1995	25	1.70
E-7 Arco #1908	D Street	Mojave River	#######	22	4.90
E-7 Arco #1908	D Street	Mojave River	#######	39	2.80
E-7 Arco #1908	D Street	Mojave River	#######	21	1.90
E-7 Arco #1908	D Street	Mojave River	#######		1
E-7 Arco #1908	D Street	Mojave River	#######	21	6.80
E-7 Arco #1908	D Street	Mojave River	#######	13	0.4999
E-7 Arco #1908	D Street	Mojave River	5/7/1997	13	0.80
E-7 Arco #1908	D Street	Mojave River	5/7/1997	13	1
E-7 Arco #1908	D Street	Mojave River	#######	40	3.10
E-7 Arco #1908	D Street	Mojave River	#######	8.10	99999
E-7 Arco #1908	D Street	Mojave River	#######	7.30	99999
E-7A Arco #1908	D Street	Mojave River	#######	13	1.20
E-7B Arco #1908	D Street	Mojave River	#######	13	1.30
E-7C Arco #1908	D Street	Mojave River	#######	13	1.40
E-8 Arco #1908	D Street	Mojave River	#######	0.4999	0.4999
E-8 Arco #1908	D Street	Mojave River	#######	3	0.80
E-8 Arco #1908	D Street	Mojave River	6/2/1994	2.40	0.4999
E-8 Arco #1908	D Street	Mojave River	9/2/1994	3.70	1.80
E-8 Arco #1908	D Street	Mojave River	#######	3.60	2.20
E-8 Arco #1908	D Street	Mojave River	#######	7.30	3.60
E-8 Arco #1908	D Street	Mojave River	#######	4.20	1.60
E-8 Arco #1908	D Street	Mojave River	6/8/1995	6.80	5.20
E-8 Arco #1908	D Street	Mojave River	#######	6.80	7.40
E-8 Arco #1908	D Street	Mojave River	#######	1.20	3.90
E-8 Arco #1908	D Street	Mojave River	#######		4.80
E-8 Arco #1908	D Street	Mojave River	#######	0.4999	3
E-8 Arco #1908	D Street	Mojave River	#######	0.4999	6
E-8 Arco #1908	D Street	Mojave River	5/7/1997	0.4999	3.10
E-8 Arco #1908	D Street	Mojave River	5/7/1997	99999	5.70
E-8 Arco #1908	D Street	Mojave River	#######	99999	4.60
E-8 Arco #1908	D Street	Mojave River	#######	99999	99999

E-8 Arco #1908	D Street	Mojave River	#######	99999	99999
E-8A Arco #1908	D Street	Mojave River	#######	1.10	5.30
E-8B Arco #1908	D Street	Mojave River	#######	99999	4.80
E-8C Arco #1908	D Street	Mojave River	#######	99999	5.10
E-9 Arco #1908	D Street	Mojave River	#######	4	0.4999
E-9 Arco #1908	D Street	Mojave River	6/2/1994	2	0.4999
E-9 Arco #1908	D Street	Mojave River	9/2/1994	3.60	0.4999
E-9 Arco #1908	D Street	Mojave River	#######	4.90	0.50
E-9 Arco #1908	D Street	Mojave River	#######	2	
E-9 Arco #1908	D Street	Mojave River	#######	3.20	0.4999
E-9 Arco #1908	D Street	Mojave River	6/8/1995	2.10	0.4999
E-9 Arco #1908	D Street	Mojave River	#######	2.20	1.30
E-9 Arco #1908	D Street	Mojave River	#######	2.90	0.90
E-9 Arco #1908	D Street	Mojave River	#######	2.70	0.60
E-9 Arco #1908	D Street	Mojave River	#######		0.4999
E-9 Arco #1908	D Street	Mojave River	#######	1.20	0.90
E-9 Arco #1908	D Street	Mojave River	#######	3.20	0.4999
E-9 Arco #1908	D Street	Mojave River	5/7/1997	2.50	0.4999
Moajve River-Chevron	D Street	Mojave River	#######	99999	99999
Mojave Outfall Surface 1	D Street	Mojave River	#######	99999	99999
Mojave River South	D Street	Mojave River	#######	99999	99999
Mojave Surface 1	D Street	Mojave River	#######	99999	99999
Mojave Surface 1	D Street	Mojave River	#######	99999	99999
Mojave Surface 2	D Street	Mojave River	#######	99999	99999
Mojave Surface 3	D Street	Mojave River	#######	99999	99999
Mojave Surface Outfall	D Street	Mojave River	5/7/1997	38	12
Mojave Surface Outfall	D Street	Mojave River	#######	99999	99999
RB Well DMW-1	D Street	Mojave River	#######	99999	99999
RB Well DMW-3	D Street	Mojave River	#######	99999	99999
RB Well DMW-4	D Street	Mojave River	#######	99999	99999
RB Well DMW-5	D Street	Mojave River	#######	99999	99999
RB Well DMW-5	D Street	Mojave River	#######	99999	99999
RB Well DMW-6	D Street	Mojave River	#######	99999	99999
RB Well DMW-6	D Street	Mojave River	#######	99999	99999
Southdown MW-17	D Street	Mojave River	#######	99999	99999
Southdown MW-17	D Street	Mojave River	#######	99999	99999
Southdown MW-23	D Street	Mojave River	5/7/1997	99999	99999
Southdown MW-23	D Street	Mojave River	#######	99999	99999
Southdown MW-23	D Street	Mojave River	#######	99999	99999
Southdown MW-25	D Street	Mojave River	5/7/1997	99999	99999
Southdown MW-25	D Street	Mojave River	#######	99999	99999
Southdown MW-25	D Street	Mojave River	#######	99999	99999
Southdown MW-25	D Street	Mojave River	#######	99999	99999
Southdown MW-25R	D Street	Mojave River	#######	99999	99999
Southdown MW-25R	D Street	Mojave River	#######	99999	99999
Southdown MW-26	D Street	Mojave River		99999	99999
Southdown MW-26	D Street	Mojave River	5/7/1997	99999	99999
Southdown MW-26	D Street	Mojave River	#######	99999	99999
Southdown MW23-3A	D Street	Mojave River	#######	99999	99999
Southdown MW23-3B	D Street	Mojave River	#######	99999	99999
Southdown MW23-3C	D Street	Mojave River	#######	99999	99999
Southdown MW25-4A	D Street	Mojave River	#######	99999	99999

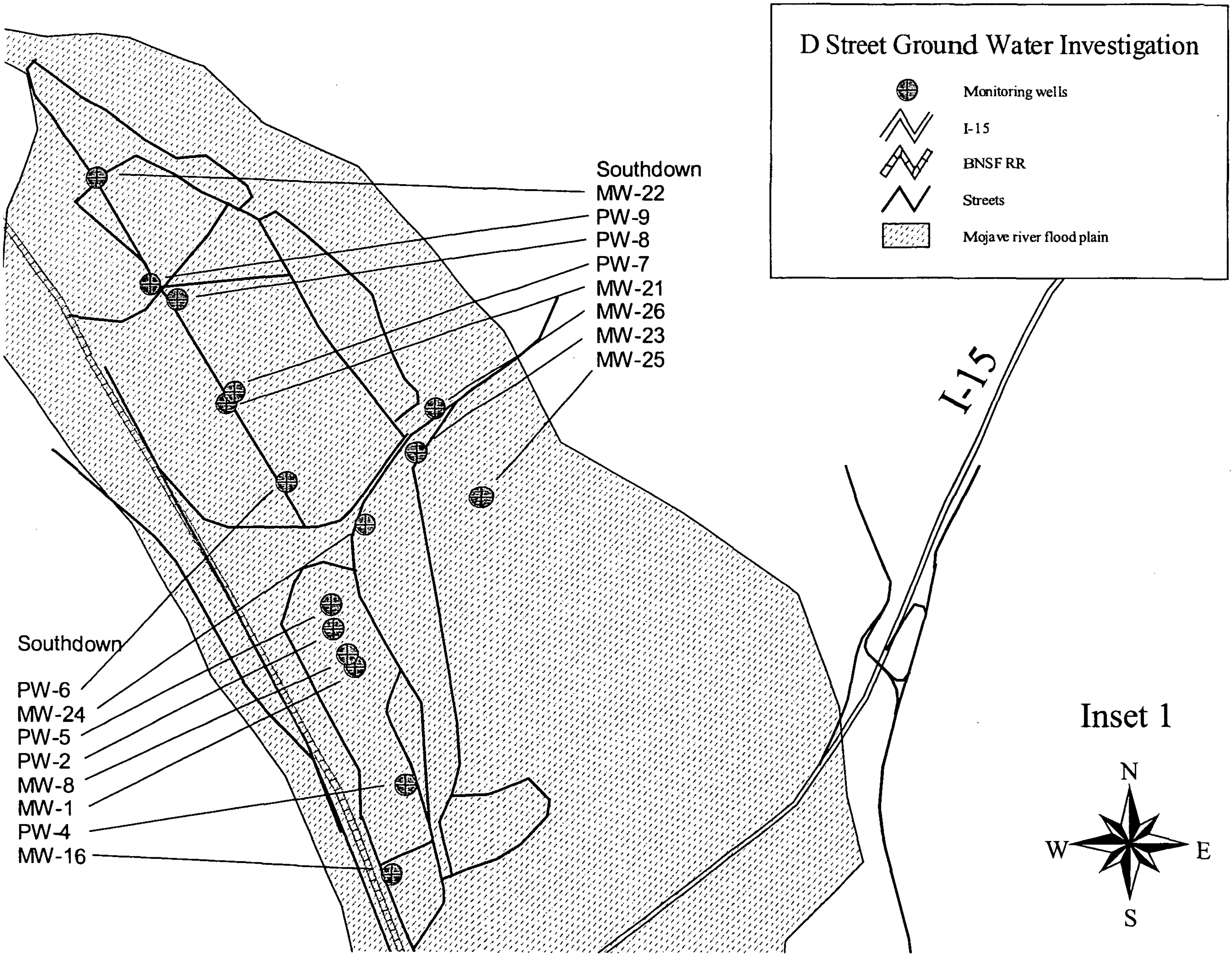
Southdown MW25-4B	D Street	Mojave River	#######	99999	99999
Southdown MW25-4C	D Street	Mojave River	#######	99999	99999
Southdown MW26-2A	D Street	Mojave River	#######	99999	99999
Southdown MW26-2B	D Street	Mojave River	#######	99999	99999
Southdown MW26-2C	D Street	Mojave River	#######	99999	99999
Southdown MWPW1-1A	D Street	Mojave River	#######	2.40	99999
Southdown MWPW1-1B	D Street	Mojave River	#######	2.40	99999
Southdown MWPW1-1C	D Street	Mojave River	#######	2.60	99999
Southdown N Pond	D Street	Mojave River	#######	2.20	99999
Southdown North Pond	D Street	Mojave River	#######	1.20	99999
Southdown North River	D Street	Mojave River	#######	99999	99999
Southdown PW--3	D Street	Mojave River	#######	11	3.70
Southdown PW-1	D Street	Mojave River	5/7/1997	2.10	99999
Southdown PW-1	D Street	Mojave River	#######	99999	99999
Southdown PW-3	D Street	Mojave River	5/7/1997	11	3.30
Southdown PW-3	D Street	Mojave River	#######	99999	99999
Southdown PW-4	D Street	Mojave River	5/7/1997	2.70	1.90
Southdown PW-4	D Street	Mojave River	#######	99999	99999
Southdown PW-5	D Street	Mojave River	#######	99999	99999
Southdown S-Pond Surface	D Street	Mojave River	#######	99999	99999
Southdown Surface 1	D Street	Mojave River	#######	99999	99999
Southdown Surface 2	D Street	Mojave River	#######	99999	99999
Unocal MW-1	D Street	Mojave River	#######	85	5.70
Unocal MW-1	D Street	Mojave River	5/7/1997	270	9.50
Unocal MW-1	D Street	Mojave River	#######	350	15
Unocal MW-1	D Street	Mojave River	#######	49	6.40
Unocal MW-1	D Street	Mojave River	#######	80	5.90
Unocal MW-2	D Street	Mojave River	#######	140	16
Unocal MW-4	D Street	Mojave River	5/7/1997	190	15
Unocal MW-4	D Street	Mojave River	#######	140	12
Unocal MW-4	D Street	Mojave River	#######	110	14
Unocal MW-4	D Street	Mojave River	#######	170	10
Unocal MW-5	D Street	Mojave River	#######	260	7.40
Unocal MW-5	D Street	Mojave River	5/7/1997	100	5.70
Unocal MW-5	D Street	Mojave River	#######	81	5.80
Unocal MW-5	D Street	Mojave River	#######	200	5.70
Unocal MW-5	D Street	Mojave River	#######	130	5.70
Unocal MW-6	D Street	Mojave River	5/7/1997	150	9.40
Unocal MW-6	D Street	Mojave River	#######	230	99999
Unocal MW-6	D Street	Mojave River	#######	110	6.40
Unocal MW-6	D Street	Mojave River	#######	190	7.90

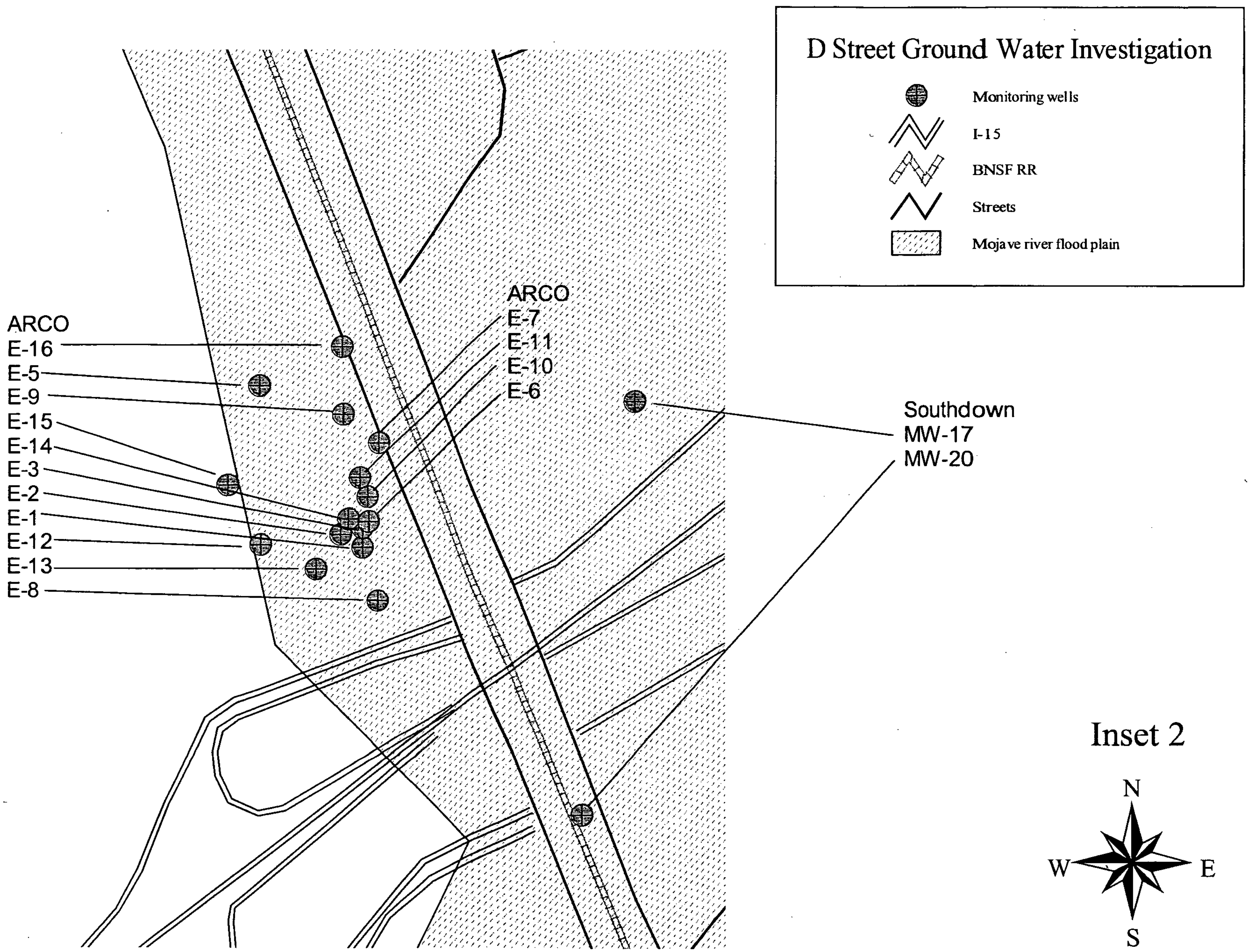
Mojave River

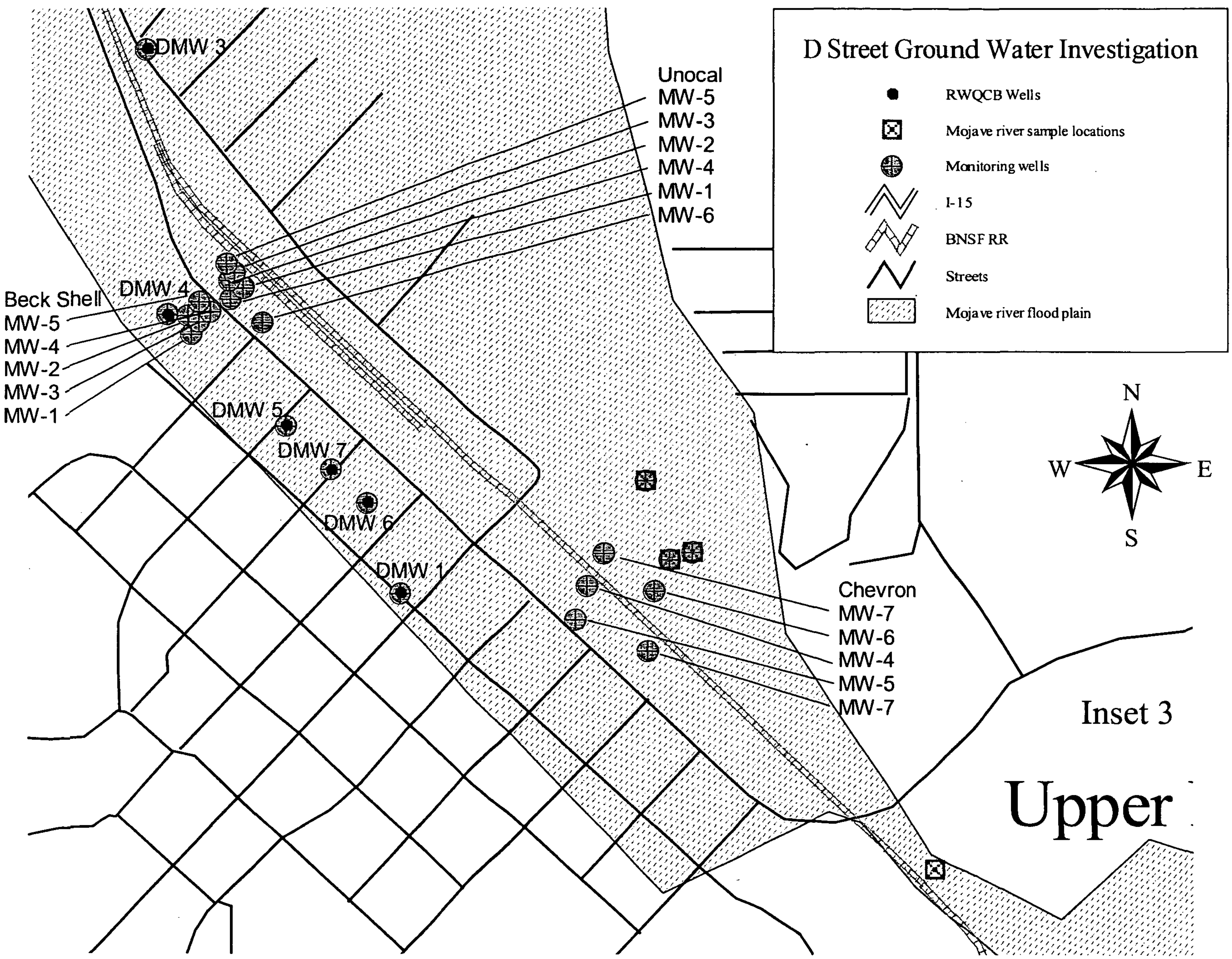




D Street Ground Water Investigation
RWQCB Wells
Mojave river sample locations
Monitoring wells
I-15
BNSF RR
Streets
Mojave river flood plain
Inset 1
Inset 2
Inset 3
I-15
HWY 18
Old Town Victorville
Upper Narrows
N
S
E
W


D Street Ground Water Investigation
Monitoring wells
I-15
BNSF RR
Streets
Mojave river flood plain
Southdown
MW-22
PW-9
PW-8
PW-7
MW-21
MW-26
MW-23
MW-25
I-15
Southdown
PW-6
MW-24
PW-5
PW-2
MW-8
MW-1
PW-4
MW-16
Inset 1
N
W
E
S


D Street Ground Water Investigation
Monitoring wells
I-15
BNSF RR
Streets
Mojave river flood plain
ARCO
E-16
E-5
E-9
E-15
E-14
E-3
E-2
E-1
E-12
E-13
E-8
ARCO
E-7
E-11
E-10
E-6
Southdown
MW-17
MW-20
Inset 2
N
W
E
S


D Street Ground Water Investigation
RWQCB Wells
Mojave river sample locations
Monitoring wells
I-15
BNSF RR
Streets
Mojave river flood plain
DMW 3
Unocal
MW-5
MW-3
MW-2
MW-4
MW-1
MW-6
Beck Shell
DMW 4
MW-5
MW-4
MW-2
MW-3
MW-1
DMW 5
DMW 7
DMW 6
DMW 1
Chevron
MW-7
MW-6
MW-4
MW-5
MW-7
N
W
E
S
Inset 3
Upper

StateID	Project	Date	TDS	Nitrate	Chloride	Sulfate
004N003W19G006	USGS	7/1/1993	169	0.22	9.70	31
004N003W19G006	USGS	#######		0.33	110	72
004N003W19G006	Mojave River	6/9/1999	180	0.44	22	20
004N004W01C005	USGS	#######	191	0.85	27	26
004N004W01C005	USGS	#######	99	0.65	8.20	7.30
004N004W01C005	Mojave River	2/3/1999	150	0.60	13	20
004N004W01C005	Mojave River	6/9/1999	150	0.44	13	17
004N004W01C005	Mojave River	#######	146	1.10	14	48
004N004W01C005	Mojave River	#######	140	1.20	15	15
004N004W01C005	Mojave River	8/7/2000	141	1.40	14	20
004N004W01C005	Mojave River	1/2/2001	160	1.10	14	26
004N004W01C005	Mojave River	#######	167	1.20	16	29
004N004W01C005	Mojave River	7/2/2001	119	1.20	16	32
005N004W14D004	USGS	#######	614	9.40	77	130
005N004W14D004	USGS	3/2/1993	619	9.00	76	140
005N004W14D004	Mojave River	2/3/1999	600	8.30	62	97
005N004W14D004	Mojave River	#######	600	8.80	71	120
005N004W14D004	Mojave River	4/5/2000	560	8.70	78	120
005N004W14D004	Mojave River	#######	530	10.00	69	180
005N004W14D004	Mojave River	8/2/2000	550	8.80	63	110
005N004W14D004	Mojave River	1/9/2001	550	9.40	65	100
005N004W14D004	Mojave River	4/4/2001	534	8.40	68	95
005N004W14D004	Mojave River	7/2/2001	513	8.20	71	110
005N004W23B001	Mojave River	#######	360	99999	24	3.90
005N004W23B001	Mojave River	#######	297	99999	21	0.58
005N004W23B001	Mojave River	#######	190	99999	18	18
005N004W23B001	Mojave River	8/7/2000	234	99999	14	17
005N004W23B001	Mojave River	#######	270	99999	14	9.80
005N004W23B001	Mojave River	1/9/2001	250	99999	18	8.10
005N004W23B001	Mojave River	#######	303	99999	18	7.30
005N004W23B001	Mojave River	7/2/2001	252	99999	16	18
006N004W18N002	USGS	2/4/1997			99999	
006N004W18N002	Mojave River	#######	380	99999	39	58
006N004W18N002	Mojave River	#######	350	99999	36	58
006N004W18N002	Mojave River	#######	328	99999	45	59
006N004W18N002	Mojave River	#######	350	99999	45	86
006N004W18N002	Mojave River	8/2/2000	410	0.12	73	140
006N004W18N002	Mojave River	1/9/2001	360	99999	51	69
006N004W18N002	Mojave River	4/4/2001	394	99999	49	74
006N004W18N002	Mojave River	#######	377	99999	44	68
006N005W01L002	USGS	#######	405	0.50	72	85
006N005W01L002	USGS	#######	424	0.0049	79	88
006N005W01L002	USGS	2/7/1997			99999	
006N005W01L002	Mojave River	7/1/1999	410	99999	67	68
006N005W24A002	USGS	2/4/1997			99999	
006N005W24A002	USGS	2/4/1997			99999	
006N005W24A002	Mojave River	#######	669	99999	79	220
006N005W24A002	Mojave River	#######	510	99999	65	160
006N005W24A002	Mojave River	8/2/2000	800	99999	94	590
006N005W24A002	Mojave River	1/9/2001	680	99999	70	210
006N005W24A002	Mojave River	4/4/2001	436	99999	54	98

007N004W06F004	Mojave River	7/1/1999	420	0.44	58	71
007N004W06F004	Mojave River	#######	410	0.25	77	120
007N004W06F004	Mojave River	8/2/2000	380	0.25	71	81
007N004W06F004	Mojave River	#######	400	99999	73	82
007N004W06F004	Mojave River	#######	371	1.30	88	75
007N004W06F004	Mojave River	#######	429	99999	72	76
007N005W13H002	USGS	#######	402	0.04999	72	85
007N005W13H002	USGS	#######	402	0.04999	71	86
007N005W13H002	USGS	8/2/1996	413	0.04999	71	92
007N005W13H002	Mojave River	#######	380	99999	66	73
007N005W13H002	Mojave River	#######	410	99999	71	73
007N005W13H002	Mojave River	#######	416	99999	76	76
007N005W13H002	Mojave River	#######	400	99999	77	180
007N005W13H002	Mojave River	8/2/2000	410	99999	81	81
007N005W13H002	Mojave River	1/2/2001	400	0.39	69	69
007N005W13H002	Mojave River	4/4/2001	450	99999	90	73
007N005W13H002	Mojave River	#######	393	99999	91	79
007N005W24R008	USGS	#######	561	0.04999	68	160
007N005W24R008	USGS	#######	564	0.04999	68	160
007N005W24R008	USGS	#######	631	0.04999	88	170
007N005W24R008	Mojave River	#######	610	99999	100	150
007N005W24R008	Mojave River	#######	690	99999	110	150
007N005W24R008	Mojave River	#######	650	99999	120	170
007N005W24R008	Mojave River	1/2/2001	660	0.38	120	160
007N005W24R008	Mojave River	4/4/2001	664	99999	130	150
007N005W24R008	Mojave River	#######	643	99999	110	170
008N004W20Q011	USGS	#######	662	0.04999	88	200
008N004W20Q011	Mojave River	#######	670	99999	82	190
008N004W20Q011	Mojave River	#######	490	99999	49	79
008N004W20Q011	Mojave River	5/3/2000	660	99999	93	210
008N004W20Q011	Mojave River	8/1/2000	680	99999	110	240
008N004W20Q011	Mojave River	#######	340	0.45	39	55
008N004W20Q011	Mojave River	#######	649	99999	110	220
008N004W20Q011	Mojave River	#######	711	99999	99	210
008N004W21M004	USGS	8/5/1993	722	0.48	91	290
008N004W21M004	USGS	#######	1250	0.27	140	590
008N004W21M004	Mojave River	#######	1040	99999	130	380
008N004W21M004	Mojave River	#######	390	99999	36	69
008N004W21M004	Mojave River	#######	330	0.11	27	94
008N004W21M004	Mojave River	8/1/2000	320	0.22	41	70
008N004W21M004	Mojave River	#######	690	99999	110	210
008N004W21M004	Mojave River	#######	296	0.13	27	58
008N004W21M004	Mojave River	#######	316	99999	34	
008N004W29E006	USGS	#######	632	0.06	77	220
008N004W29E006	USGS	#######	1550	0.09	130	800
008N004W29E006	Mojave River	#######	860	99999	76	380
008N004W29E006	Mojave River	#######	710	99999	65	290
008N004W29E006	Mojave River	5/3/2000	600	99999	71	200
008N004W29E006	Mojave River	8/1/2000	640	99999	85	260
008N004W29E006	Mojave River	#######	770	0.45	120	330
008N004W29E006	Mojave River	#######	597	99999	90	230
008N004W29E006	Mojave River	#######	682	99999	80	260

009N001E16F004	USGS	8/3/1993	441	1.40	62	93
009N001E16F004	Mojave River	#######	690	1.11	120	170
009N001E16F004	Mojave River	#######	650	1.30	130	160
009N001E16F004	Mojave River	#######	730	1.40	160	190
009N001E16F004	Mojave River	#######	680	1.10	150	210
009N001E16F004	Mojave River	#######	738	1.10	140	200
009N001E16F004	Mojave River	#######	740	1.10	130	200
009N001W04M007	USGS	#######	203	0.65	31	38
009N001W04M007	Mojave River	6/8/1999	280	11.56	26	65
009N001W04M007	Mojave River	4/2/2001	268	2.30	30	77
009N001W04M007	Mojave River	#######	249	2.50	31	67
009N001W04R004	USGS	#######	1400	5.80	180	490
009N001W04R004	Mojave River	2/5/1999	1570	12.66	240	280
009N001W04R004	Mojave River	6/8/1999	1540	11.33	220	560
009N001W04R004	Mojave River	#######	1500	16.00	270	560
009N001W04R004	Mojave River	#######	1500	24.00	370	690
009N001W04R004	Mojave River	#######	1600	19.00	330	570
009N001W04R004	Mojave River	#######	1610	23.00	290	540
009N001W04R004	Mojave River	#######	1600	21.00	290	580
009N001W09D008	Mojave River	#######	2310	14.20	460	780
009N001W09D008	Mojave River	#######	2000	12.00	420	860
009N001W09D008	Mojave River	#######	2100	12.00	440	960
009N001W09D008	Mojave River	#######	2200	15.00	430	990
009N001W09D008	Mojave River	#######	2110	15.00	390	910
009N001W09D008	Mojave River	#######	2110	12.00	340	1100
009N001W12N007	USGS	#######	829	3.10	150	200
009N001W12N007	USGS	3/3/1993	729	2.30	110	190
009N001W12N007	Mojave River	2/5/1999	1130	2.44	230	320
009N001W12N007	Mojave River	#######	1100	2.70	250	310
009N002E03K009	USGS	#######	564	4.50	34	210
009N002E03K009	Mojave River	#######	480	4.20	25	120
009N002E03K009	Mojave River	6/8/1999	560	4.67	28	140
009N002E03K009	Mojave River	5/9/2000	460	4.90	28	130
009N002E03K009	Mojave River	#######	330	2.80	35	150
009N002E03K009	Mojave River	#######	480	4.40	33	130
009N002E03K009	Mojave River	#######	431	4.80	33	130
009N002E03K009	Mojave River	#######	411	4.50	30	110
009N002W03E003	USGS	6/2/1993	245	0.85	43	46
009N002W03E003	USGS	#######	241	0.84	39	44
009N002W03E003	Mojave River	#######	250	1.33	24	32
009N002W03E003	Mojave River	#######	210	1.11	25	31
009N002W03E003	Mojave River	#######	240	1.30	30	34
009N002W03E003	Mojave River	#######		13.00	0.30	34
009N002W03E003	Mojave River	#######	210	1.60	35	45
009N002W03E003	Mojave River	#######	240	1.80	33	36
009N002W03E003	Mojave River	#######	228	1.70	34	35
009N002W03E003	Mojave River	#######	221	1.60	32	36
009N002W06P001	Mojave River	#######	240	1.11	25	33
009N002W06P001	Mojave River	#######	270	1.56	28	51
009N002W06P001	Mojave River	#######	450	1.80	30	38
009N002W06P001	Mojave River	8/1/2000	230	2.10	33	60
009N002W06P001	Mojave River	#######	200	1.50	27	36

009N002W06P001	Mojave River	4/2/2001	241	1.50	28	62
009N002W06P001	Mojave River	#######	220	1.70	29	41
009N003W23C001	USGS	#######	212	0.98	25	28
009N003W23C001	Mojave River	#######	310	2.00	39	56
009N003W23C001	Mojave River	#######	310	1.78	35	64
009N003W23C001	Mojave River	5/3/2000				
009N003W23C001	Mojave River	#######	290	1.10	71	39
009N003W23C001	Mojave River	#######	250	1.50	77	54
009N003W23C001	Mojave River	#######	230	1.10	57	39
009N003W23C001	Mojave River	4/2/2001	258	0.92	68	37
009N003W23C001	Mojave River	#######	254	0.94	78	37
010N003E26H001	Mojave River	#######	390	0.44	29	78
010N003E27J005	USGS	#######	1040	9.00	150	370
010N003E27J005	USGS	#######	1620	11.00	210	640
010N003E27J005	Mojave River	#######	3070	20.00	240	1280
010N003E27J005	Mojave River	6/8/1999	3300	24.44	290	1610
010N003E27J005	Mojave River	5/4/2000	3300	22.00	380	1900
010N003E27J005	Mojave River	#######	3400	3.00	430	2200
010N003E27J005	Mojave River	#######	2900	21.00	290	1500
010N003E27J005	Mojave River	#######	772	99999	180	190
010N003E27J005	Mojave River	#######	3030	20.00	330	1900
010N004E19M004	Mojave River	#######	470	0.44	93	69
010N004E19M004	Mojave River	5/4/2000	520	0.29	130	93
010N004E19M004	Mojave River	#######	610	0.27	160	120
010N004E19M004	Mojave River	#######	690	0.38	180	120
010N004E19M004	Mojave River	#######	2360	99999	250	1100
010N004E19M004	Mojave River	#######	634	99999	150	110
Afton Canyon	Mojave River	5/4/2000	920	99999	140	79
Afton Canyon	Mojave River	#######	920	99999	200	90
Afton Canyon	Mojave River	#######	920	99999	150	93
Afton Canyon	Mojave River	#######	883	17.00	160	100
Afton Canyon	Mojave River	#######	1040	99999	200	80
Dam Forks	Mojave River	#######	152	99999	15	16
Dam Forks	Mojave River	#######	190	99999	11	48
Dam Forks	Mojave River	1/3/2001	240	0.38	11	43
Dam Forks	Mojave River	#######	120	99999	17	12
Dam Forks	Mojave River	#######	271	99999	14	50
Lower Narrows	Mojave River	#######	319	0.11	15	22
Lower Narrows	Mojave River	#######	430	99999	65	62
Lower Narrows	Mojave River	1/3/2001	360	0.45	40	43
Lower Narrows	Mojave River	#######	327	99999	46	42
Lower Narrows	Mojave River	#######	406	99999	56	33
Upper Narrows	Mojave River	#######	897	1.60	240	47
Upper Narrows	Mojave River	#######	840	2.20	240	240
Upper Narrows	Mojave River	1/3/2001	1100	0.97	230	260
Upper Narrows	Mojave River	#######	1090	99999	290	220
Upper Narrows	Mojave River	#######	885	99999	190	190

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A Watershed Management Approach to Assessment Of Water Quality and Development of Revised Water Quality Standards for the Ground Waters of the Mojave River Floodplain

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Abstract

The Mojave River watershed is located in the arid high-desert region of Southern California in San Bernardino County. In the 1970s and 1980s the Lahontan Regional Water Quality Control Board (RWQCB) established numerical water quality objectives (WQOs) for several locations in the watershed. Because the Mojave River flows underground for much of its 120 miles, some of the numerical WQOs apply to both surface waters and ground waters.

In 1996 the RWQCB assembled a watershed management team of local stakeholders for the Mojave Watershed. A primary goal identified by the stakeholders was to assess the current state of water quality for the Mojave River system. A possible long-term goal is the development of total maximum daily loads as required by the Clean Water Act (CWA). The Mojave River is listed as a water quality limited segment in accordance with Section 303(d) of the CWA. Recent data indicate that numerical WQOs are being exceeded at several locations.

The watershed team has developed and implemented work plans to sample surface waters and ground waters within the watershed. The final work plans included sampling at approximately 20 ground water monitoring wells and 10 surface water locations. The plans also included a list of constituents of concern for laboratory analysis. The RWQCB and various other stakeholders funded the sampling effort. The preliminary findings of the study indicate water quality impacts are likely associated with septic leaching systems, dairies, industrial and municipal wastewater disposal practices, and irrigated agriculture. The stakeholder group is currently assessing these data and developing a plan of action that includes additional surface and ground water sampling.

Geography

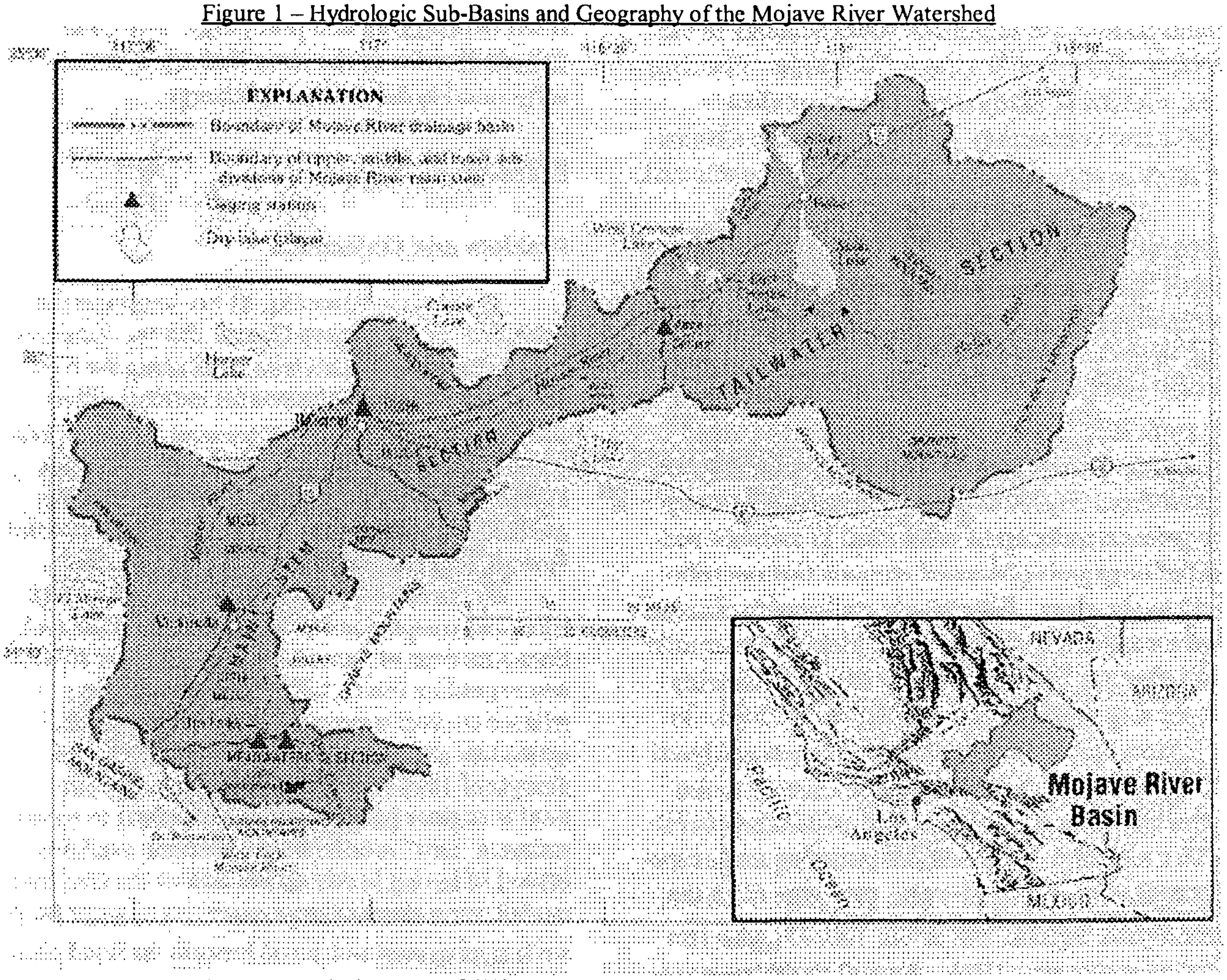
The Mojave River watershed is located entirely within San Bernardino County, and includes approximately 1,600 square miles of total drainage (Figure 1). Approximately 210 square miles of this drainage area is located in the San Bernardino Mountains, which are the headwaters for the Mojave River system. Elevations within the watershed range from approximately 8,500 feet above mean sea level (msl) at Butler Peak in the San Bernardino Mountains to 1,400 feet above msl at Afton Canyon near the terminus of the Mojave River.

Deep Creek and the West Fork of the Mojave River are located in the San Bernardino Mountains and are the two perennial tributaries to the Mojave River. Both tributaries have multiple branch tributaries within the San Bernardino Mountains. Deep Creek and the West Fork of the Mojave River converge immediately upstream of the Mojave Forks Dam, which was constructed for flood control to protect downstream land and property from damage during peak storm events. The Mojave River channel begins at the Mojave Forks Dam and extends for approximately 120 miles transecting the communities of Hesperia, Apple Valley, Victorville, Hinkley, and Barstow and finally terminating at Soda and Silver Dry Lakes near the community of Baker.

Climatology

Precipitation in the watershed includes both rain and snow. The majority of this snow falls in the upper elevations of the San Bernardino Mountains. Annual average precipitation in the San Bernardino Mountains is 42 inches, with most of the precipitation falling in the winter months. Annual average snowfall at Lake Arrowhead is approximately 80 inches. Annual average precipitation for the most arid portions of the watershed such as Afton Canyon is less than 4 inches. For the remaining portions of the watershed, annual precipitation rarely exceeds 6 inches. High intensity summer thunderstorms can produce several inches of rain over isolated areas.

Figure 1 – Hydrologic Sub-Basins and Geography of the Mojave River Watershed



Source: Modified from USGS Water-Investigations Report 95-4189

Daily temperatures in the watershed vary greatly from the higher to lower elevations. At the higher elevations, low daily temperatures in the winter are commonly below 32°F with mean daily temperatures of approximately 53°F. In contrast, peak daily temperatures in the summer at the lower elevations are typically above 100°F with mean daily temperatures of approximately 84°F. The elevated daily temperatures and low humidity in the lower elevations result in annual evaporation rates exceeding 90 inches per year.

Demographics

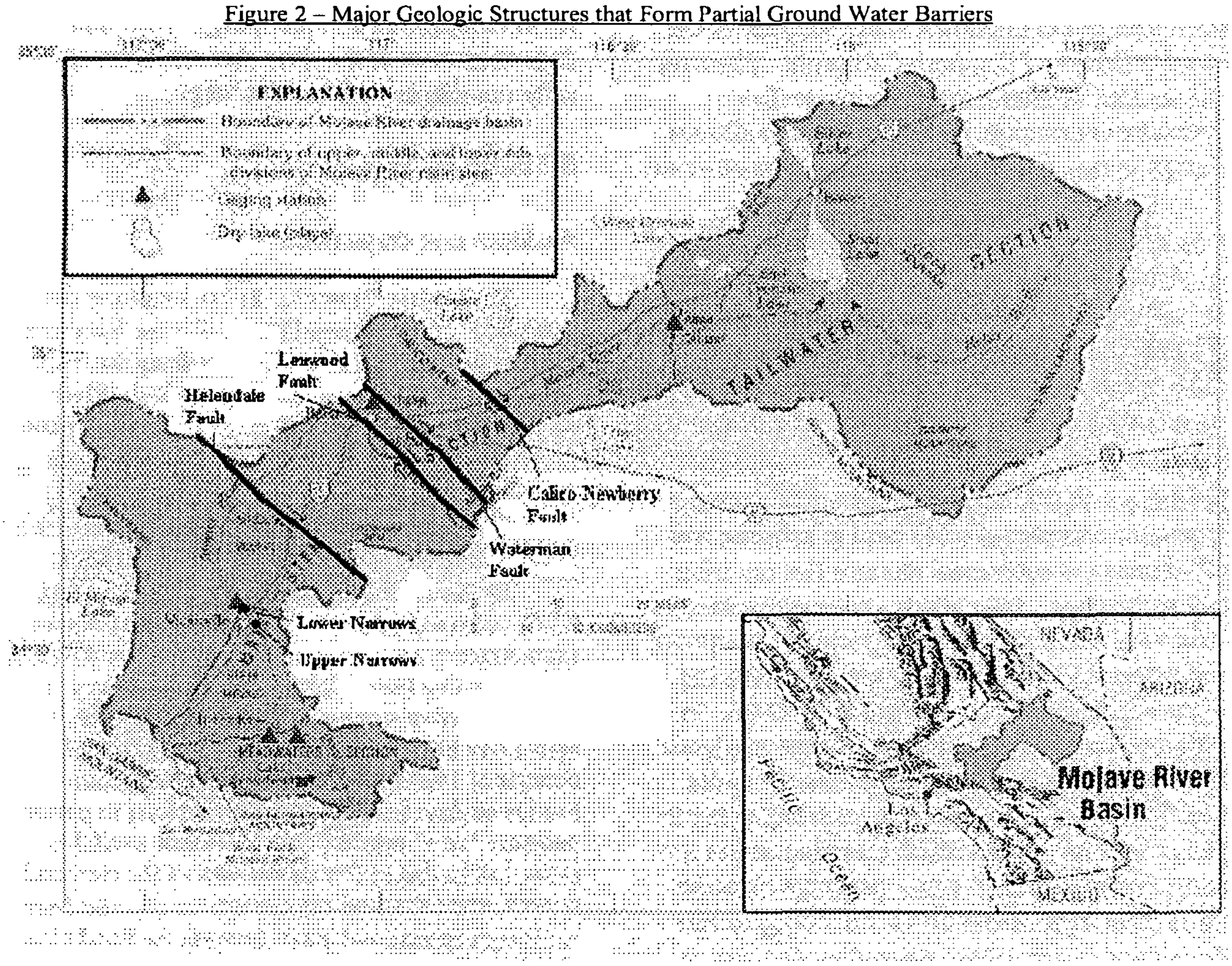
Population in the Mojave River watershed increased dramatically from approximately 6,000 people in 1930 to more than 295,000 people in 1997. Figure 1 illustrates the locations of various communities in the watershed. The majority of people live in the urbanized Upper Basin, where community populations in 1997 were (1) Apple Valley - 54,100; (2) Hesperia - 60,900; and, (3) Victorville -61,700. Significantly less people live in the primarily rural Middle and Lower Basins. The largest community in the Lower Basin is Barstow, which had a 1997 population of 22,650. Additional urban growth is expected throughout the watershed, and the projected population for the entire watershed by the year 2015 is nearly one-half million people.

Geology and Hydrology

The geology of the Mojave Watershed is a significant factor in understanding how numerical Water Quality Objectives (WQOs) can be appropriately established and implemented for the Mojave River system. The unconsolidated sediments of the Mojave Watershed generally consist of three units: (1) Tertiary and Quaternary older and younger alluvial fan deposits; (2) Quaternary older alluvium and playa deposits; and, (3) Quaternary younger alluvium and recent Mojave River alluvium. In general, the older fan and alluvial deposits are compositionally similar to the younger deposits, but are more consolidated and less transmissive.

The ground waters of the Mojave River floodplain aquifer are primarily within the younger and recent Mojave River alluvium, which consists of moderately to well-sorted course sands and gravels. Transmissivity values range from approximately 10,000 to 25,000 ft^2/day. The recent alluvium is typically less than 30 feet thick and follows the present day surface features of the Mojave River floodplain. The younger and recent alluvium form an alluvial plain that ranges from approximately 120 feet in width and 50 feet in thickness at the Upper Narrows near Victorville to several miles in width and about 250 feet in thickness immediately upstream of Barstow near the communities of Hodge and Lenwood (Figure 2). The Mojave River floodplain sediments are underlain and laterally bounded by the older and more consolidated alluvial fan and playa deposits. In some cases, the older sediments are absent and the floodplain sediments are in direct contact with bedrock.

Figure 2 – Major Geologic Structures that Form Partial Ground Water Barriers



Source: Modified from USGS Report 95-4189

Hydrologic Sub-basins

Previous hydrologic studies have separated the Mojave River watershed into sub-basins based on hydrologic features. This paper references the five hydrologic sub-basins discussed in USGS Report 95-4189. The five sub-basins are illustrated on Figures 1 and 2, and are described as: (1) Headwaters – tributaries above the Mojave Forks dam; (2) Upper Basin - Mojave Forks Dam to the Lower Narrows at Victorville; (3) Middle Basin - Lower Narrows to the Waterman Fault at Barstow; (4) Lower Basin - Waterman Fault to Afton Canyon; and (5) Tailwater - Afton Canyon to Silver Dry Lake. The five sub-basins include the both the floodplain aquifer and the regional aquifer systems. The floodplain aquifer generally follows the surface expression of Mojave River. The regional aquifer is located within alluvial and lakebed deposits that generally bound and underlie the floodplain.

The regional aquifer discharges ground water into the floodplain aquifer in some locations, but does not receive significant recharge. Ground water is pumped extensively from the regional aquifer for domestic, municipal, industrial, and agricultural use. The regional aquifer is in a condition of significant overdraft in some locations because of the imbalance between demand and natural recharge. Because the Regional Water Quality Control Board (RWQCB) has not established specific numerical WQOs for the ground water in the regional aquifer, this paper focuses primarily on the hydrology and quality of the Mojave River floodplain aquifer.

Hydrologic Effects of Geologic Structures

Bedrock within the watershed typically does not transmit large quantities of water, but plays an important role in the hydrogeology of the Mojave River system. Bedrock forms a topographic high along the Mojave River channel at the Upper and Lower Narrows near Victorville and at Afton Canyon, and is relatively impermeable at these locations. The bedrock acts as a ground water barrier, forcing ground water to the surface of the Mojave River channel. The Mojave River flows for several miles downstream of these locations before infiltrating back into the course sands of the river channel. Ground water in the floodplain aquifer is extremely shallow both upstream and immediately downstream of these bedrock structures, promoting vegetation and evapotranspiration.

Quaternary faults in the Mojave Watershed are: (1) sub parallel to the San Andreas and Garlock Fault systems; (2) trend in a northwest to southeast direction; and (3) are right-lateral strike-slip faults. These faults are the Helendale, Lenwood, Camp Rock/Harper Lake (e.g, Waterman), and Calico/Newberry Fault systems (Figure 2). Recent unpublished studies completed by the United States Geologic Survey (USGS) also suggest an unnamed fault exists on a similar northwest to southeast trend in the Victorville area that is near parallel to the Mojave River channel. Where these faults intersect the river channel, they typically act as partial barriers to ground water flow, forcing ground water to the land surface on the upgradient side of the fault. Ground water elevations are typically several feet lower on the downgradient side of these faults.

Base flow is ground water from the floodplain aquifer that is forced to the surface of the river channel at geologic structures such as bedrock or faults. Between 1931 and 1994, annual stream flow measurements at locations with geologic structures included: (1) the Lower Narrows at Victorville - 54,000 afy; (2) Barstow - 18,000 afy; and (3) Afton Canyon - 7.5 afy. Data collected since 1930 indicate that approximately 37 % of the annual surface water at the Lower Narrows is base flow. The remaining surface water at the Lower Narrows is storm water runoff from the headwaters and surrounding intermittent stream channels. Gauging station observations indicate that storm water rather than base flow constitutes the majority of gauged surface water at Barstow and Afton Canyon.

Overdraft of the Mojave River Floodplain Aquifer

Watering holes along the Mojave River were important water supply features for the pioneer settlers in the mid to late 19th century. The Mormon and Spanish trails followed sections of the Mojave River and relied upon these sources of water. Recorded locations include Lanes Crossing (river mile 20), Point of Rocks (river mile 34), Fish Pond (river mile 60), Forks of Road (river mile 70) and Camp Cady (river mile 82). The source of water at these locations was primarily the floodplain aquifer where geologic structures such as bedrock or faults forced ground water to the surface.

Early population development along the Mojave River floodplain was sparse and primarily agricultural. Between 1936 and 1960, human population increased in the watershed from 6,150 to 51,400. Table 1 illustrates the changes in water demand from the Mojave River floodplain aquifer between 1936 and 1960.

Table 1 – Historical Water Demand in Acre-Feet per Year

	1936			1960		
	Upper	*Middle*	*Lower*	*Upper*	*Middle*	*Lower*
Agricultural	11,250	5,950	1,200	21,700	17,150	8,150
Urban	200	100	250	2,950	900	2,050
Industrial	250	0	200	1,400	0	700
Totals	11,700	6,050	1,650	26,050	18,050	10,900
	1936 total - 19,400			*1960 total – 56,000*		

Beginning in about 1952, the watershed has changed from an agricultural to an urban setting. More than 339,000 people currently live in the Mojave Watershed and rely primarily upon ground water resources for municipal and domestic supply. Total ground water production from the floodplain aquifer has increased to an estimated 120,000 afy, which is significantly greater than natural and artificial recharge. Approximately 100,000 afy of ground water is extracted from the floodplain aquifer in the Upper and Middle Basins, and more than half of this use is for municipal and domestic supply.

Overdraft in the Upper and Middle basins has significantly lowered ground water levels in the floodplain aquifer. The lower ground water levels in the Upper Basin have resulted in decreased base flows measured at the Lower Narrows because less ground water is being forced to the surface at the Upper Narrows (Figure 2). Base flows at the Lower Narrows have steadily decreased from an annual average of 26,000 afy in the 1930s and 1940s to only 11,000 afy in 1993. The reduction in base flow at the Lower Narrows indicates that less water is being recharged from the Upper Basin to the Middle and Lower Basins.

In the 1990s, water users in the Lower Basin filed suit against upstream users. The suit was ultimately settled through a formal adjudication of the ground water basins. The adjudication includes requirements for reduced pumping throughout the watershed, and importation of water from California's aqueduct system. The adjudication is based in part on minimum base flow requirements at the Lower Narrows downstream of Victorville. If base flows are below the minimum annual value, then upstream users must purchase imported water to supply downstream users. Users that exceed their adjudicated pumping rights must also purchase imported water for recharge. The adjudication has been appealed to the State of California Supreme Court, and a final decision is pending. In the interim, most elements of the adjudication are being implemented though a stipulated agreement with users that are party to the judgment. Those parties that filed an appeal and did not sign the stipulated agreement are not currently bound by the judgment.

The Mojave Water Agency (Agency) has legal responsibility for implementing the requirements of the judgment. The Agency's strategy to abate the overdraft conditions is to reduce ground water extraction from the floodplain aquifer, and to recharge the floodplain aquifer with Bay/Delta water. The Agency currently has more than 20,000 acre-feet of water rights through California's Bay/Delta aqueduct system. Pipelines are being constructed to transport water from the aqueduct to recharge basins along the Mojave River floodplain. Bay/Delta water is currently being discharged to recharge areas along the Mojave River channel near Hesperia and Barstow. Additional recharge infiltration basins are planned downstream of Barstow as the pipeline is extended.

The quality of the Bay/Delta water plays an important role in the assessment of water quality in the flood plain aquifer and the potential development of revised WQOs. Depending on the location of the recharge basins and the seasonal/annual changes in water quality, the Bay/Delta water may be of higher or lower quality than the native ground waters of the floodplain aquifer. Regardless, eliminating overdraft conditions may improve water quality in some areas by reducing the recharge of naturally poor quality water from the older and deeper sediments. Reducing overdraft conditions will likely also improve and/or restore riparian vegetation along the Mojave River channel. Riparian vegetation provides valuable habitat for various species of birds and mammals.

Development of WQOs

WQOs for the surface and ground waters of the Mojave River watershed are established in the Water Quality Control Plan for the Lahontan Region (Basin Plan). WQOs are both numerical and narrative, and are established for the maintenance of high quality waters and the protection of beneficial uses. The beneficial uses of the ground waters of the Mojave River floodplain aquifer include municipal and domestic supply, industrial supply, agricultural supply, and freshwater replenishment.

Published water quality data for the Mojave Watershed dates back to 1908, when the USGS collected a surface water sample at the Lower Narrows near Victorville. Most of the water quality data for the watershed was collected by the USGS between 1944 and 1972; the USGS generally collected monthly surface water samples at three locations on the Mojave River upstream of Victorville, and at numerous locations in the headwaters tributaries. In 1975, the RWQCB used these data to establish numerical WQOs. Numerical WQOs were established at most locations for TDS, nitrate as NO_3 (e.g., nitrate), chloride, sulfate, boron, phosphate and fluoride. The WQOs were developed in terms of annual averages and 90th percentile values, and were intended to ensure maintenance of the existing quality of surface waters for the Mojave River and its headwaters tributaries. Table 2 below illustrates 14 of the 25 numerical WQOs contained in the Basin Plan for the Mojave River and its tributaries. The WQOs are generally listed in order of the headwaters area to the terminus of the Mojave River.

In 1981, the RWQCB revised numerical WQOs for TDS and nitrate in the Upper Basin in anticipation of dairies moving from the Santa Ana River Watershed to the headwaters along the West Fork of the Mojave River near the Mojave Forks Dam. The goal of the new and revised WQOs was to prohibit water quality degradation from waste discharges associated with the dairies. The TDS and nitrate WQOs were removed for the Mojave River at the Forks Dam, and a new standard for TDS and nitrate was added closer to the expected dairy locations at the West Fork of the Mojave River at the Highway 173 Crossing. TDS and nitrate WQOs were also added for the Mojave River at the Lower Narrows below Victorville.

There was also concern that dairies could relocate from the Santa Ana River Watershed to areas along the Mojave River downstream of the City of Victorville. Under contract with the RWQCB, the California Department of Water Resources (DWR) conducted a study and determined that the area most vulnerable to dairy waste discharges would be an approximate one-mile corridor along the Mojave River floodplain. In response to the findings of the study, the RWQCB established WQOs in 1983 at four new locations for sections of the Mojave River that *"flow underground in a confined channel."* The four numerical WQOs were established: (1) at the City of Barstow; (2) on the upstream side of the Waterman Fault; (3) on the upstream side of the Calico-Newberry Fault; and (4) immediately upstream of Camp Cady Ranch. Camp Cady Ranch is immediately upstream of Afton Canyon. The hypothesis was that surface water samples could be collected at these locations without constructing ground water monitoring wells because ground water is forced to the surface on the upstream side of geologic structures. These samples would then be considered as representative of the local ground water conditions. The numerical WQOs were established as instantaneous maximums for TDS and nitrate, and were based on historical ground water data collected primarily from domestic and municipal production wells within one mile of the Mojave River channel.

Table 2 - Numerical WQOs for the Mojave River and Tributaries (mg/L)

Location	TDS	Chloride	Sulfate	Boron	Nitrate (NO_3)
Lake Arrowhead	78/107	7.7/9.1	2.4/3	.04/.05	--
Lake Gregory	87/95	11/12	5.3/7.7	.30/.30	--
Deep Creek below Lake Arrowhead	83/127	9.1/16	1.3/4.9	.05/.07	.20/.60
Deep Creek above the Mojave Forks Dam	184/265	10.6/16	31.3/55	1.66/2.6	.60/2.0
East Fork of the West Fork of the Mojave River	140/200	12.7/22	10.7/17	.23/.40	--
West Fork of the Mojave River above Silverwood Lake	219/336	8.4/13	34/53	.26/.40	--
Silverwood Lake	220/440	55/110	20/110	--	--
West Fork of the Mojave River below Silverwood Lake @ Highway 173 Crossing	245	--	--	--	6
Mojave River at the Mojave Forks Dam	--	55/100	35/100	1.5/2.5	--

Mojave River at the Lower Narrows below Victorville	312	75/100	40/100	0.2/0.3	5
Mojave River at Barstow (*)	445	--	--	--	6
Mojave River at the Waterman Fault (*)	560	--	--	--	11
Mojave River at the Calico-Newberry Fault (*)	340	--	--	--	4
Mojave River at Camp Cady Ranch (*)	300	--	--	--	1

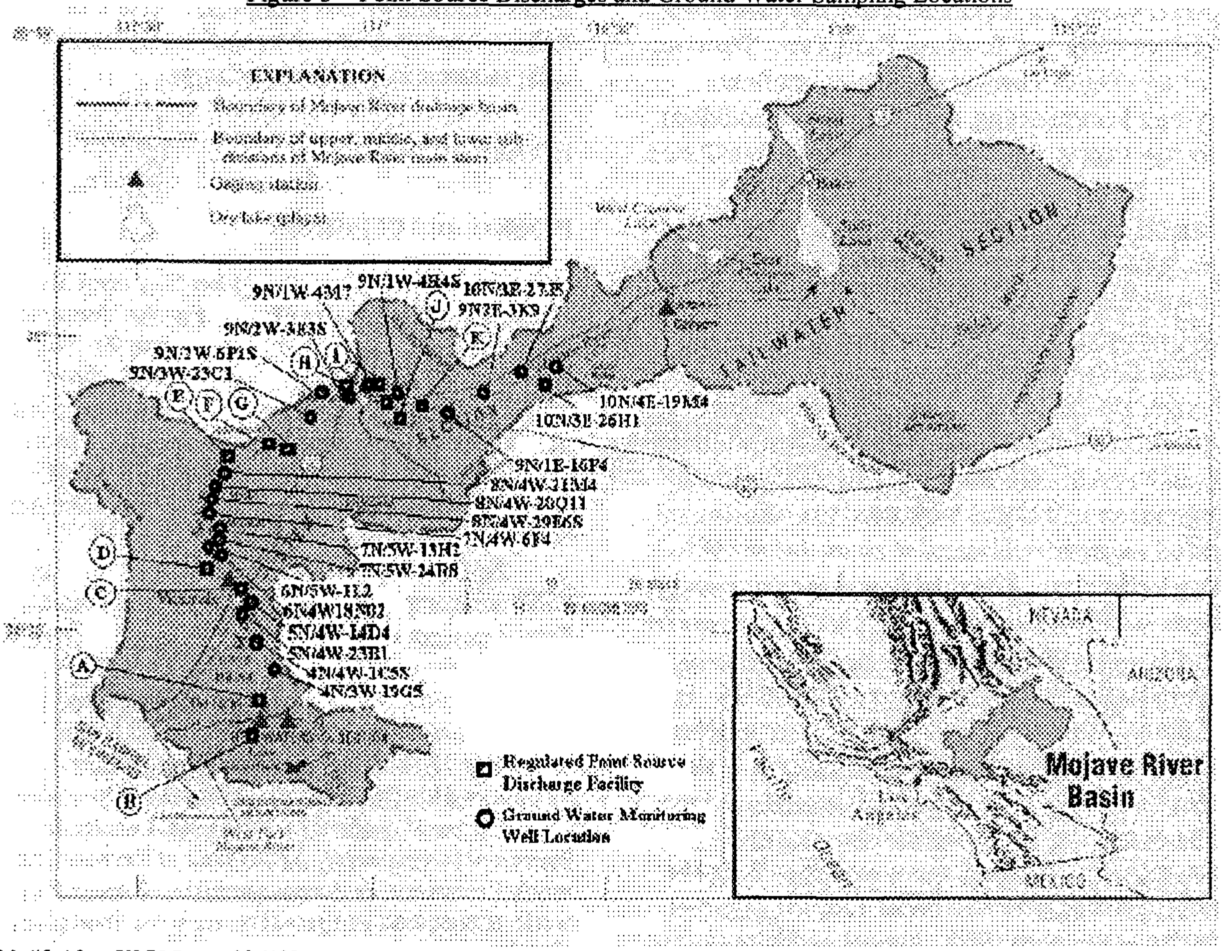
Single numbers represent instantaneous maximum
Double numbers represent annual average/90th percentile value
(*) - For ground waters that flow underground in a confined channel

The WQOs established at the Waterman Fault are unique in that they take into consideration water quality degradation associated with historic waste discharges near the Community of Barstow. The plume of contaminants was commonly referred to at the "Barstow Slug", and was reportedly caused by industrial discharges by the railroad industry and municipal discharges by the local community wastewater treatment plant. A plan was developed by the City of Barstow in the 1980s to pump the contaminated ground water from the floodplain aquifer and construct a pipeline to deliver the extracted water several miles downstream for industrial reuse. The WQOs at the Waterman Fault were developed in consideration of this plan, and were essentially cleanup levels for the remediation project. The project was never implemented, primarily because of water rights disagreements associated with the conveyance of ground water from the Middle to the Lower Basin.

A study completed in 1990 suggests that the plume of organic contaminants associated with the industrial discharges has naturally attenuated and no longer poses a threat to the beneficial uses of the river system. Subsequent studies completed by the USGS in 1996 strongly suggest that beneficial uses are severely impacted by historic discharges of inorganic contaminants associated with the former industrial and municipal discharges. The primary contaminants are TDS and nitrate. These studies suggest that on-going municipal discharges to a wastewater reclamation field and a golf course in the Barstow area continue to degrade of the ground water of the floodplain aquifer.

Limited trend monitoring has been completed in the Mojave River watershed since 1983 when WQOs were last established for the Mojave River watershed. Trend monitoring has been limited primarily because of the RWQCB's regulatory emphasis on permitting requirements for point source discharges. The general concept of this regulatory approach is that requirements for trend monitoring should be limited if the point source discharges are adequately regulated. Most surface and ground water monitoring completed since 1983 has been conducted by regulated facilities in accordance with permit monitoring requirements from the RWQCB. Samples collected by regulated facilities include waste effluent, and surface and ground water in the immediate vicinity of waste effluent discharges. The point source discharges along the floodplain aquifer are illustrated on Figure 3. Tables 3A and 3B list the permit monitoring requirements for these point sources.

Figure 3 – Point Source Discharges and Ground Water Sampling Locations



Modified from USGS Report 95-4189

Table 3A – Effluent Monitoring Requirements for Point Source Discharges to the Floodplain Aquifer

Facility	Fig. 3 ID. (#)	TDS	SO_4	Chloride	MBAS	Nitrate	Metals	VOCs (*)
Crestline CSD	A	X	X	X	X	X	X	X
Lake Arrowhead CSD	B				X			
Southdown Cement	C							X
Victor Valley WWTF	D	X	X	X	X	X	X	X
Silver Lakes WWTF	E	X	X	X	X	X		
Barstow WWTF	I	X	X	X	X	X	X	X
Yermo Annex WWTF	J	X	X	X	X	X	X	X
Nebo Annex WWTF	K	X	X	X	X	X	X	X

Table 3B – Ground Water Monitoring Requirements for Point Source Discharges to the Floodplain Aquifer

Facility	Fig. 3 ID. (#)	TDS	SO_4	Chloride	MBAS	Nitrate	Metals	VOCs (*)
Crestline CSD	A	X	X	X	X	X		X

Lake Arrowhead CSD	B	X	X	X	X	X		X
Southdown Cement	C							X
Victor Valley WWTF	D	X	X	X	X	X	X	X
Silver Lakes WWTF	E	X		X	X	X		X
Osterkamp Dairy	F	X				X		
N&M Dairy	G	X				X		
B&E Dairy	H	X				X		
Barstow WWTF	I	X			X	X		X
Yermo Annex WWTF	J	X		X	X	X		X
Nebo Annex WWTF	K	X		X	X	X		X

CSD – Community Services District
WWTF – Wastewater Treatment Facility
(*) – Analysis may include purgeable, base/neutral and/or acid extractable volatile organic compounds
(#) – See Figure 3 for Illustration of Point Source Discharge Facilities by Identification Letter

Water Quality Limited Segment

Section 303(d) of the federal Clean Water Act generally requires that a water body be listed as a water quality limited segment if one or more assigned beneficial uses are impaired. The Mojave River was previously listed because petroleum and solvent contaminants were present in ground water near Barstow. The 1996 water quality study documented in USGS Report No. 96-4301 supports the 303(d) listing for TDS and nitrate at Barstow. Data collected by the RWQCB and presented in this paper also supports the 303(d) listing for the Mojave River in the Barstow area.

Trend monitoring completed during the RWQCB's study also suggests that surface WQOs are being exceeded for TDS and nitrate at other locations along the Mojave River. These locations include (1) the Upper Narrows at Victorville; (2) the West Fork of the Mojave River at Highway 173; and (3) the Calico-Newberry Fault. In consideration of the recent data collected by the stakeholder group and the USGS data collected from the Barstow area, the 303(d) designation remains in place for the Mojave River.

The Clean Water Act requires that the RWQCB develop Total Maximum Daily Loads (TMDLs) for all water quality limited segments. The Mojave River is currently listed as a priority among numerous water bodies in the Lahontan Region for development of TMDLs. The data collected and presented in this paper are the initial steps toward the development of TMDLs for the Mojave River.

Development of the Watershed Management Initiative

In 1995 the State of California conducted a review of the regulatory programs implemented by the State Water Resources Control Board (State Board) and the nine RWQCBs. One of the recommendations of the review process was for the State Board and RWQCBs to focus regulatory activities using a "holistic" watershed approach rather than using the more traditional and fragmented regulatory programs. On this recommendation, the State Board and RWQCBs developed the Watershed Management Initiative. In 1996 the Lahontan RWQCB selected five watersheds as high priority, including the Mojave River.

One of the first tasks for the Mojave River watershed stakeholder group was to develop a watershed plan. A series of meetings were hosted by the RWQCB and attended by representatives of various stakeholders such as wastewater treatment plants, dairies, local and State government and municipal water purveyors. Through these meetings, the stakeholder group developed numerous goals and priorities to assess and potentially improve water quality. The first version of the plan was circulated for public comment in December 1996. Subsequent revisions to this plan have been developed and also circulated for public comment.

Several subgroups of stakeholders were assembled to address specific goals outlined in the watershed plan. Subgroups were developed on a volunteer basis from the various stakeholders. Two subgroups were developed to address water quality planning issues. The first subgroup (Headwaters Subgroup) focused on collecting and assessing surface water quality data for the headwaters of the watershed. The general goal for this Headwaters Subgroup was to determine if existing surface water quality was consistent with numerical WQOs established in the RWQCB's Basin Plan. In May 1997, the Headwaters Subgroup began collecting surface water data on a monthly basis at eight locations.

The second stakeholder subgroup (River Subgroup) was developed to focus on the surface waters and ground waters of the Mojave River system downstream of the headwaters. This area of the river system is complicated by the above-described geology and hydrology. Numerous meetings of the River Subgroup were held in 1998 to develop a sampling and analysis plan with a goal of assessing the overall condition of surface and ground water quality. As discussed below, the four existing WQOs were only one element of the planned assessment. Ultimately, a plan was finalized and implemented in February 1999. The initial plan included eight quarters (two years) of sampling at four surface water and 18 ground water monitoring locations. This plan was later modified in consideration of field conditions and data collected during the first sampling event, and the changes and associated rationale for the modifications are discussed below.

Development of Sampling Locations

The Headwaters Subgroup selected eight locations for surface water sampling based on locations where the RWQCB previously established numerical WQOs in the Basin Plan. The River Subgroup selected four additional surface water sampling locations based on the availability of perennial surface water and the availability of historical data. The four locations for the River Subgroup are along the Mojave River at: (1) the Mojave River Forks Dam; (2) the Upper Narrows; (3) the Lower Narrows; and (4) Afton Canyon. Surface water is typically available at these locations throughout the year, although the volume of flow is subject to the effects of seasonal variations and possible drought conditions. As noted in Table 2 above, numerical WQOs have only been established at the Lower Narrows among these four locations.

Ground water sampling locations for the River Subgroup were developed in consideration of several factors. The first factor was concern regarding the accuracy of the four existing numerical WQOs for ground waters that "*flow underground in a confined channel.*" These WQOs were established assuming that base flow surface water could be collected at these locations and would be representative of ground water conditions. Overdraft throughout the watershed has resulted in rare base flows at Barstow, the Waterman Fault, the Calico-Newberry Fault and upstream of Afton Canyon at Camp Cady. More recent ground water studies conducted by the USGS also indicate that a comparison of ground water and surface water quality is questionable because of the complicated hydrogeology throughout the watershed. Lastly, instantaneous maximum WQOs for TDS and nitrate may not take into account seasonal and annual variations in water quality caused by wet and dry conditions. Therefore, one of the identified goals of the sampling effort was to collect ground water data at these locations to compare against the existing numerical WQOs.

The second factor was the point source discharges of waste along the Mojave River as illustrated on Figure 3. The River Subgroup recognized that historical effluent and receiving water (surface water and ground water) data are available for these facilities, and continue to be collected in accordance with permit requirements. Accordingly, the River Subgroup opted to focus sampling efforts away from these facilities. Data collected by the River Subgroup would then be assessed in concert with the data from the permitted facilities.

The third factor was suspected non-point sources of pollution that could discharge waste to the Mojave River through surface flow or ground water pathways. Non-point sources identified by the River Subgroup included storm water discharges, agricultural return flow and septic leaching disposal systems. The River Subgroup selected areas for ground water sampling where non-point sources are known or suspected. A separate subgroup was developed to collect storm water samples at outfalls to the Mojave River, and to begin the assessment of potential impacts associated with storm water discharges. The storm water assessment has not been implemented.

The last factor in selecting ground water sampling locations was the availability of reliable ground water sampling points. The River Subgroup recognized the economic infeasibility of installing a large number of new monitoring wells throughout the Mojave River watershed for the purpose of water quality studies. Fortunately, the USGS has installed numerous ground water monitoring wells throughout the Mojave Watershed during the last decade to implement a series of hydrology studies for the Mojave Water Agency. The focus of the Agency's studies has been to develop a detailed mathematical hydrologic model for the watershed to facilitate the adjudication and long-term resource management. In several locations, the USGS installed clusters of two-inch diameter polyvinyl chloride wells screened at various intervals within the floodplain aquifer. Well borings were typically continuously cored and assessed using various geophysical techniques. Detailed borehole logs and well construction details are available for each well. Data collected by the USGS and the Agency included horizontal and vertical ground water gradients, stable ground water isotope chemistry, and a limited data set for inorganic and organic ground water chemistry. The isotope data is important because ground water of recent age suggests recent recharge, indicating that the water is from the floodplain aquifer rather than the regional aquifer.

The River Subgroup received permission to use the Agency's wells, and developed the following six general criteria for optimum well selection: (1) the well was installed by the USGS on behalf of the Agency for hydrologic studies during the last 10 years; (2) the well screen length would be no longer than 40 feet; (3) the well screen intersects the ground water table; (4) ground water chemistry data is already available for the well; (5) the well is within or immediately adjacent to the river floodplain; and, (6) geologic information and/or ground water stable isotope data is available and indicate that the well is screened in the floodplain aquifer.

Staff of the RWQCB reviewed the geologic and isotope data in coordination with staff of the USGS to ensure wells being sampled were within the floodplain aquifer. Wells with short screen lengths that are screened across the water table surface were chosen where possible because the effects of waste discharges are expected to be observed in the upper portions of the aquifer. Note that the six criteria were optimal for well selection, and not all wells chosen for the RWQCB's water quality study met all of the criteria.

Development of Constituents of Concern

Constituents of concern (COC) for the Headwaters Subgroup were chosen based on the existing numerical WQOs in the RWQCB's Basin Plan as illustrated above in Table 2. No additional COCs were selected because other contaminants are not known or suspected in the headwaters area. The River Subgroup developed a list of COC based on: (1) the existing WQOs contained in the Basin Plan; (2) the existing water quality database for surface and ground waters; (3) known and suspected point and non-point source waste discharges; and, (4) naturally occurring constituents that could be elevated in the environment because of geologic conditions. The list of COCs selected by the River Subgroup were VOCs, dissolved priority pollutant metals, radon, methylene blue additive substances (MBAS- i.e., detergents) and the inorganic monitoring parameters TDS, sulfate, chloride, boron, fluoride, and nitrate.

Because of sampling and funding limitations, only MBAS and the inorganic monitoring parameters were scheduled for ground water sampling during each quarterly event. These constituents are inexpensive for laboratory analysis, and sample collection does not require special techniques or equipment. VOCs, priority pollutant metals and radon were planned for one quarterly event each year during the two-year study. Ground water samples were analyzed for radon during the second quarter 1999 sampling event, and these data are discussed in this paper. Laboratory analysis of surface and ground waters for dissolved priority pollutant metals was planned for the third quarter 1999 event, but these data are not available for this paper. Laboratory analysis of ground water samples for VOCs was planned for a subsequent event provided that low flow well purging equipment could be obtained.

Data Collection

The Headwaters Subgroup initiated surface water sampling in May 1997. Monthly samples have been collected at the eight locations, with the exception of conditions where no water was available for sampling. The laboratory analytical data for these samples indicate that WQOs are not being exceeded in the tributaries to Deep Creek and the West Fork of the Mojave River. WQOs are being exceeded for TDS and nitrate at the West Fork of the Mojave River at Highway 173. The possible source(s) of these conditions are discussed below. The Headwaters Subgroup plans continued trend monitoring for sampling locations.

The River Subgroup initiated surface and ground water sampling in February 1999. During this first event, samples were collected at three surface water stations and 18 ground water monitoring wells. The three surface water locations were (1) the Mojave River at the Forks Dam; (2) the Mojave River at the Upper Narrows; and, (3) the Mojave River at the Lower Narrows. A second quarterly event was initiated in June 1999, and included four surface water stations and 22 ground water monitoring wells. The fourth surface water sampling location was the Mojave River at Afton Canyon.

Figure 3 illustrates the ground water monitoring well locations selected for the first and second sampling events. Table 4 lists these wells and describes well construction details, historical water levels and general location. Monitoring wells are listed in order from upstream to downstream locations. Minor modifications to the sampling program were made between the first and second events to address issues related to well access, well construction and ground water chemistry. A discussion below regarding the findings of the sampling effort provides a brief rationale for the minor changes in the sampling locations.

Table 4 - Construction Details for Ground Water Monitoring Wells

State ID #	Top of Perforation (ft.)	Bottom of Perforation (ft.)	Well Casing Diameter (in.)	Depth to Water (ft.)	Location
04N/03W-19G005S (*)	75	95	2	36-68	APPLE VALLEY
04N/04W-01C005S	60	80	2	19-38	HESPERIA
05N/04W-23B001 (*)	0	9.5	2	4	VICTORVILLE
05N/04W-14D004S	30	50	2	13-17	VICTORVILLE
06N/04W-18N02	10.2	14.8	2	3-7	ORO GRANDE
06N/05W-01L002S (*)	15	25	2	10	HELENDALE
07N/05W-24R008S	45	50	2	8-12	HELENDALE
07N/05W-13H002S	15	25	2	1-5	HELENDALE
07N/04W-06F004S (*)	15	20	4	3	HELENDALE
08N/04W-29E006S	45	50	2	8-13	HELENDALE
08N/04W-20Q011S	30	50	2	8-10	WILD CROSSING
08N/04W-21M004S	30	40	2	8-11	WILD CROSSING
09N/03W-23C001S	57	77	2	52-72	HODGE
09N/02W-06P001S	75.5	95.5	2	55-67	HINKLEY
09N/02W-03E003S	100	120	2	33-53	HINKLEY
09N/01W-09D008 (#)	60	80	2	51-54	BARSTOW
09N/1W-4M007S (*)	41.7	81.7	2	20-37	BARSTOW
09N/01W-04R004S	20	40	2	8-17	BARSTOW
09N/01E-16F004S (*)	130	150	2	101-143	NEBO
09N/01W-11K105 (#)	70	90	2	9	NEBO
09N/01W-12N007 (#)	60	80	2	7-25	NEBO
09N/02E-03K009S	45	65	2	41-58	YERMO
10N/03E-27J005S	35	45	2	24-38	HARVARD HILL
10N/03E-26H001 (*)	14.7	24.7	2	22	HARVARD HILL
10N/04E-19M004 (*)	9.5	19	2	12	MANIX

(*) – Well was not sampled during the first quarter 1999 event but was sampled during the second quarter 1999 event
(#) – Well was not sampled during the second quarter 1999 event but was sampled during the first quarter 1999 event

Sampling Procedures

Staff of the RWQCB completed all ground water sampling activities. Sampling was conducted in accordance with USGS Open Publication 95-399, Ground Water Data Collection Protocols and Procedures for the National Water Quality Assessment Program: Collection and Documentation of Water Quality Samples and Related Data. In general, wells were purged of a minimum of three well volumes and until field parameters of electrical conductivity, temperature and pH were stable. Purging and sampling were completed with either a two-inch submersible electric pump or by hand with a Teflon$_{TM}$ bailer. All ground water samples were transported to a California certified analytical laboratory for analysis. The sampling and chain of custody procedures are documented in the two quarterly monitoring reports published by the RWQCB, including requirements for well purging, data recording, sample collection and sample preservation.

Radon was added to the sampling program during the second quarter at the request of several municipal water supply stakeholders. Procedures for radon sample collection were conducted in accordance with methods prescribed by the contract laboratory. After complete well purging and field parameter stabilization, a plastic container was continuously filled with water from the well. Each amber glass sample bottle was submerged in the container while additional water was pumped (poured if hand bailing) into the container. Once the sample bottle was completely full, it was capped under water with zero headspace. The sample bottle cap was sealed with electrical tape to minimize the risk of air infiltration and/or radon decomposition.

First Quarter 1999 Data

Table 5 below illustrates the surface and ground water data collected during the first quarter of 1999. Monitoring points are listed in order from upstream to downstream locations. Data is denoted where concentrations exceed numerical WQOs contained in the Basin Plan and/or California Primary Drinking Water Standards.

Table 5 – First Quarter 1999 Ground Water and Surface Water Quality Data (mg/L)

Sample ID#	TDS	Nitrate as NO_3	Chloride	Sulfate	Fluoride	Boron	MBAS
West Fork of the Mojave River at Highway 173 (*)	170	**8.1**	22	16.5	0.38	ND	--
Mojave River at Forks Dam (*)	152	ND	8.3	19	1.3	0.15	--
4N/4W-1C5S	150	2.7	13	20	0.5	ND	ND
5N/4W14D4	600	37.4	62	97	0.5	0.4	ND
Mojave River at the Upper Narrows (*)	268	1.26	33	34	0.43	0.18	--
Mojave River at the Lower Narrows (*)	296	0.70	37	34	0.42	0.14	--
6N/4W-18N02	380	ND	39	58	0.3	0.1	ND
7N/5W-24R8S	610	ND	100	150	0.4	0.2	0.06
7N/5W-13H2S	380	ND	66	73	0.6	0.3	NA
8N/4W-29E6S	860	ND	76	380	0.5	0.3	NA
8N/4W-20Q11	670	ND	82	190	0.5	0.2	NA
8N/4W-21M4	**1040**	ND	130	380	0.5	0.3	NA
9N/3W-23C1	310	9	39	56	0.4	ND	NA
9N/2W-6P1S	240	5	25	33	0.7	0.2	NA
9N/2W-3E3S	250	6	24	32	0.4	0.1	NA
9N/1W-9D08	**2310**	**64**	460	**780**	1.4	5.7	ND
9N/1W-4R4S	**1570**	**57**	240	280	0.5	0.9	0.14
9N/1W11k15 (WF)	**730**	**10**	140	180	0.5	0.7	0.11
9N/1W12N7 (WF)	**1130**	**11**	230	320	0.5	1.0	0.14
9N/2E-3K9S (CN)	**480**	**19**	25	120	0.3	0.2	ND
10N/3E-27J5	**3070**	**90**	240	**1280**	0.3	0.8	0.1

(*) – surface water sampling location
bold denotes samples exceeding California Primary Drinking Water Standards
bold and underline denotes samples exceeding numerical WQOs established in the RWQCB's Basin Plan
(WF) – well data is compared against the WQOs established at the Waterman Fault
(CN) – well data is compared against the WQOs established at the Calico-Newberry Fault

Without additional data, the stakeholder group was reluctant to associate data from a specific well to one or more known or suspected point or non-point sources. The stakeholders made the following four modifications between the first and second quarter to refine the sampling program:

1. Well 05N/04W-23B001 was added to the sampling program to evaluate concentrations of nitrate (37.4 mg/L) and TDS (600 mg/L) detected at well 05N/04W-14D004S near the Upper Narrows. These values do not exceed established standards, but are significantly elevated in comparison to up-gradient and down-gradient samples.

2. Wells 09N/01W-09D008S, 09N/01W-11K015S, and 09N/01W-12N007S were removed from the sampling program. Data from the first quarter confirmed ground water degradation in the floodplain aquifer associated with historic and

current wastewater disposal practices in the Barstow area (see USGS Report 96-4301). Additional data will be necessary outside the scope of the stakeholder study to determine the nature and extent of the water quality degradation.

3. Wells 09N/01W-04M007S (4M7) and 09N/01E-16F004S (16F4) were added to the sampling program to evaluate water quality upstream (4M7) and downstream (16F4) of the Barstow area.

4. Wells 10N/03E-26H001 and 10N/04E-19M004 were added to the sampling program to evaluate the elevated concentrations of nitrate and TDS near the Calico-Newberry Fault at wells 09N/02E-3K009S and 10N/03E-27J005S.

Second Quarter 1999 Data

Table 6 below illustrates the surface and ground water data collected during the second quarter of 1999. Data is denoted where concentrations exceed numerical WQOs contained in the Basin Plan and/or California Primary Drinking Water Standards.

Data Observations

Staff of the RWQCB reviewed the data collected during the first and second quarters of 1999, and the recent and historical data collected from individual permitted waste discharge facilities. These data were compared to numerical WQOs, where established. Preliminary conclusions were developed regarding spatial and temporal trends in water quality, and the potential sources of observed ground water degradation. The following is a summary of eleven observations made by staff of the RWQCB, beginning with upstream sampling locations and working sequentially downstream. The data and several of the observations were published in two quarterly monitoring reports that were circulated among the stakeholders for review and comment. The data and observations were also presented and discussed with the stakeholders during a meeting hosted by staff of the RWQCB in August 1999.

1. ***West Fork of the Mojave River*** - A surface water sample collected from the West Fork of the Mojave River at Highway 173 exceeded the numerical WQO for nitrate during both the first and second quarter of 1999. Crestline CSD has been collecting a monthly surface water sample at this location since June 97 in accordance with permit monitoring requirements. These data indicate: (1) five instances where the WQO for nitrate was exceeded; and, (2) six instances where the WQO for TDS was exceeded, which occurred during low flow conditions in the summer and fall months.

   The WQOs for TDS and nitrate were established based on data collected prior to construction of Silverwood Lake, and may not take into account the effects of Bay/Delta water discharges that have replaced the natural flow of high quality surface water from the headwaters. The source(s) of nitrate in the surface water may include grazing activities along the Mojave River on Los Flores Ranch, and permitted discharges of treated domestic wastewater to reclamation fields and percolation ponds by Crestline CSD. The source(s) of TDS and nitrate in surface water requires further evaluation, including periodic sampling of potential sources of water quality degradation. This WQO may require modification to accommodate existing discharges of Bay/Delta water.

2. ***Mojave Forks Dam to Bear Valley Road Crossing*** - Ground water samples collected between the Mojave Forks Dam and the Bear Valley Road Crossing (Well 04N04W01C005S) indicate water quality similar to surface water samples from the headwaters areas along the West Fork of the Mojave River and Deep Creek. No WQOs are established over this section of the Mojave River. TDS concentrations in the two wells sampled in this area during the first and second quarter sampling events ranged from 150 to 180 mg/L. The concentration of nitrate in the two wells ranged from 2 to 2.7 mg/L. These data suggest that agricultural and urban activities in this area are having a limited measurable impact on water quality in the floodplain aquifer.

3. ***Bear Valley Road Crossing to the Upper Narrows*** - No WQOs are established over this section of the Mojave River. Groundwater samples collected during the first and second quarter of 1999 immediately upstream of the Upper Narrows at well 05N04W14D004S (14D4) contained elevated concentrations of TDS and nitrate. The maximum concentration of TDS and nitrate at this location was 600 and 39.6 mg/L, respectively. Well 14D4 is located on the east side of the Mojave River. A ground water sample collected during the second quarter 1999 at well 05N04W23B001 (23B1) contained TDS at a concentration of 360 mg/L, and nitrate was not detected in this sample. Well 23B1 is located on the west side of the Mojave River and immediately upstream of well 14D4. Water quality data

from well 23B1 is generally consistent with ground water conditions at upgradient sampling locations between the Mojave Forks Dam and the Bear Valley Road Crossing.

The source(s) of the elevated TDS and nitrate at well 14D4 requires future evaluation. One possible source is several hundred domestic septic leaching disposal systems located on the east side of the Mojave River at private residences. These septic systems are located on fractured bedrock. Septic leaching systems may be a dominant source of recharge to the floodplain aquifer in this area because base flow has decreased due to overdraft in the floodplain aquifer. Although the RWQCB prohibits the construction of additional septic leaching systems at this location, the existing systems may be one cause of the degradation.

Table 6 – Second Quarter 1999 Ground Water and Surface Water Quality Data (mg/L)

Sample ID#	TDS	Nitrate as NO_3	Chloride	Sulfate	Fluoride	Boron	MBAS	Radon pCi/L
West Fork of the Mojave River at Highway 173 (*)	230	**8.55**	29	21	0.44	0.11	--	--
Mojave River at the Forks Dam (*)	190	ND	45	63	1.8	ND	--	--
4N/3W-19G5	180	2.0	22	20	0.3	ND	--	370 ± 20
04N/04W-1C005S	150	2.0	13	17	0.3	ND	ND	390 ± 20
05N/04W-23B001	360	ND	24	3.9	0.5	ND	ND	100 ± 20
05N/04W-14D004S	600	39.6	71	120	0.4	0.4	ND	340 ± 20
Mojave River at the Upper Narrows (*)	790	ND	47	63	0.7	0.6	--	--
Mojave River at the Lower Narrows (*)	**390**	ND	46	61	0.4	0.1	--	--
06N/04W-18N02	350	ND	36	58	0.4	0.1	ND	130 ± 20
06N/05W-1L002S	410	ND	67	68	0.4	0.1	ND	173 ± 14
07N/05W-24R008S	690	ND	110	150	0.5	0.3	ND	240 ± 20
07N/05W-13H002S	410	ND	71	73	0.6	0.3	ND	240 ± 20
07N/04W-6F004S	420	2	58	71	0.4	0.3	--	508 ± 18
08N/04W-29E006S	710	ND	65	290	0.6	0.3	ND	330 ± 20
08N/04W-20Q011S	490	ND	49	79	0.6	0.2	--	450 ± 30
08N/04W-21M004S	390	ND	36	69	0.4	0.3	--	290 ± 20
09N/03W-23C001S	310	8	35	64	0.3	0.1	--	640 ± 30
09N/02W-6P001S	270	7	28	51	0.4	0.1	--	570 ± 30
09N/02W-3E003S	210	5	25	31	0.4	0.1	--	470 ± 30
09N/01W-4M007 (B)	280	**52**	26	65	0.6	0.2	ND	380 ± 20
09N/01W-4R004S	**1540**	**51**	220	**560**	0.4	0.8	ND	550 ± 30
09N/01E-16F004	690	5	120	170	0.5	0.3	ND	580 ± 30
9N/02E-3K009S (CN)	**560**	**21**	28	140	0.2	0.2	ND	240 ± 20
10N/03E-27J005	**3300**	**110**	290	**1610**	0.2	0.9	0.06	230 ± 20
10N/03E-26H001	390	2	29	78	0.4	0.1	--	160 ± 20
10N/04E-19M004	470	2	93	69	0.5	0.4	--	190 ± 20
Mojave River at Afton Canyon (*)	**1260**	ND	190	91	4.9	2.8	--	--

(*) – surface water sampling location
bold denotes samples exceeding California Primary Drinking Water Standards
bold and underline denotes samples exceeding numerical WQOs established in the RWQCB's Basin Plan
(B) – well data is compared against the WQOs established at Barstow
(CN) – well data is compared against the WQOs established at the Calico-Newberry Fault

4. ***Upper Narrows*** - A surface water sample collected from the Mojave River at the Upper Narrows above Victorville contained TDS at a concentration of 790 mg/L during the second quarter of 1999. While this location does not have an established numerical WQO in the Basin Plan, the observed water quality conditions could be associated with the elevated TDS noted downstream at the Lower Narrows. The elevated concentration of TDS at the Upper Narrows may also be linked to water quality degradation noted in well 14D4 as discussed above.

5. ***Lower Narrows*** - A surface water sample collected from the Mojave River at the Lower Narrows below Victorville during the second quarter of 1999 contained TDS at a concentration of 390 mg/L. This concentration exceeds the numerical WQO for TDS at this location of 312 mg/L as prescribed in the Basin Plan. Further evaluation is necessary to determine the possible source(s) of the elevated TDS, which may include the observed conditions at the Upper Narrows and well 14D4.

6. ***Lower Narrows to the Helendale Fault*** - No WQOs are established for this section of the Mojave River. Groundwater samples collected from eight wells between the Lower Narrows and the Helendale Fault generally exhibit similar water quality conditions. During the second quarter of 1999, TDS concentrations ranged from 270 to 710 mg/L with an average concentration of 536 mg/L. Nitrate concentrations were non-detectable with the exception of one well with a detection of 2 mg/L. Chloride concentrations ranged from 36 to 110 mg/L, with an average concentration of 62 mg/L. The spatial consistency of these data may be attributed to the treated effluent from the Victor Valley WWTF, which has quality similar to the observed ground water conditions. The treated effluent is consistent in quality and provides a significant portion of recharge to this section of the river system. Another factor may be the absence of concentrated urban and agricultural inorganic pollutant sources to the floodplain aquifer in this area. However, urban and potentially industrial growth in this area is expected in the future. Existing overdraft of the floodplain aquifer in this area is contributing to lower water levels and loss of riparian vegetation. The overdraft conditions could make this section of the river system highly susceptible to possible future waste domestic, commercial and industrial wastewater discharges because the depleted aquifer would provide limited dilution and attenuation capacity.

7. ***Helendale Fault to Barstow*** - Data collected from three wells between the Helendale Fault and Barstow contained low TDS but elevated concentrations of nitrate as compared to samples collected upstream of the Helendale Fault. WQOs are established at Barstow for TDS and nitrate at concentrations of 445 and 6 mg/L, respectively. TDS concentrations in the three wells during the second quarter of 1999 ranged from 210 to 280 mg/L, and nitrate ranged from 5 to 8 mg/L. These data indicate that the WQOs at Barstow are being achieved for TDS, but may be exceeded for nitrate. Likely sources of nitrate include waste discharges at three dairies located along this section of the Mojave River. Ground water monitoring conducted in accordance with permit monitoring requirements at two of these dairies indicates concentrations of nitrate in shallow ground water exceeding 200 mg/L. Additional regulatory activities at these dairies are necessary to evaluate possible sources for the observed conditions, and to ensure future compliance with permit requirements and the WQOs for TDS and nitrate at Barstow.

8. ***Barstow to the Waterman Fault*** - During the first quarter 1999, wells sampled in the Barstow area exhibited elevated concentrations of nitrate, TDS, chloride, sulfate and MBAS. WQOs for TDS and nitrate are established downstream of Barstow at the Waterman Fault at concentrations of 560 and 11 mg/L, respectively. Concentrations of nitrate in the four wells ranged from 11 to 64 mg/L, exceeding the WQO for nitrate in all four wells and the California Primary Drinking Water Standard of 45 mg/L for nitrate in two of the four wells. Concentrations of TDS in the four wells ranged from 730 to 2310 mg/L, exceeding the WQO for TDS in all four wells and the California Primary Drinking Water Standard for TDS of 1000 mg/L in three of the four wells. These data clearly indicate that the WQOs for TDS and nitrate at the Waterman Fault continue to be exceeded.

   The observed water quality degradation is likely attributed to historic and on-going discharges of domestic wastewater and agricultural return flow as discussed briefly in this paper above and as documented in USGS Report No. 96-4301. Four sampling locations were eliminated from the second quarter 1999 sampling event because no further data collection was necessary to document the water quality conditions. Further discussions are necessary with parties that formerly discharged and continue discharging waste in the area to evaluate necessary remedial actions to abate the affects of current and historic waste discharges and to attain compliance with the WQOs for TDS and nitrate.

9. ***Waterman Fault to Well No. 9N/1E-16F4*** - During the second quarter of 1999, well 09N01E16F004 (16F4) was added to the sampling program to evaluate the downgradient extent of water quality degradation observed in the Barstow area. No WQOs are established for this section of the Mojave River. In contrast to the shallow ground water in the Barstow

area (less than 20 feet below ground surface) depth to ground water downstream of the fault at well 16F4 exceeds 130 feet below ground surface. TDS and nitrate concentrations at well 16F4 were 690 and 5 mg/L, respectively. There are no identified sources of TDS and nitrate between the Waterman Fault and well 16F4. These data suggest that some degraded ground water may be migrating beyond the Waterman Fault and impacting the aquifer downstream of Barstow.

10. ***Calico-Newberry Fault to Afton Canyon*** - Groundwater samples collected during the first and second quarter of 1999 from two monitoring wells immediately upgradient and downgradient the Calico-Newberry Fault contained elevated concentrations of nitrate and TDS. The WQOs for TDS and nitrate at the Calico-Newberry Fault are 340 and 4 mg/L, respectively. During the first quarter of 1999, the concentration of nitrate in the two wells ranged from 19 to 90 mg/L. The concentration of TDS in the two wells ranged from 489 to 3,070 mg/L, respectively. These data indicate that the WQOs for TDS and nitrate at the Calico-Newberry Fault are being exceeded.

    Two wells were added further downgradient of the Calico-Newberry fault during the second quarter of 1999 to evaluate the spatial extent of TDS and nitrate in the ground water of the floodplain aquifer. The concentration of nitrate in both down gradient wells was 2 mg/L, and the concentration of TDS ranged from 390 to 470 mg/L. These data suggest that the WQO for nitrate may only be exceeded in a localized area near the Calico-Newberry Fault. However, the WQO for TDS may be exceeded over a larger downgradient area. Agricultural fields are located immediately adjacent to and within the Mojave River channel near the Calico-Newberry Fault. Regulatory activities are necessary in the area of these agricultural fields to evaluate the nature of the ground water degradation, and to work with stakeholders in the area to improve soil nutrient management practices.

11. ***Radon*** - Concentrations of radon ranged dramatically across the project area, and no concentration pattern was noted. Many of the wells exceeded a 1991 United States Environmental Protection Agency proposed drinking water concentration limit for radon of 300 pCi/L. No drinking water standard has been set for radon as of the date of this paper. Municipal and domestic water users should review these data in consideration of possible future regulatory standards for water public water supply.

Conclusions and Recommendations

Ground water degradation was noted in surface water and ground water throughout the Mojave River watershed, including violations of drinking water standards and numerical WQOs established in the RWQCB's Basin Plan. In a few instances, the degradation appears to be associated with known and regulated waste discharge activities such as dairies and domestic wastewater treatment plant discharges in the Barstow area. However, in most cases the water quality impacts are likely associated with non-point sources of pollution such as septic leaching disposal systems and agricultural activities. Some of the WQOs established in 1983 for sections of the Mojave River that flow underground may also have been set without full understanding of the complex hydrology and hydrochemistry of the area.

Overdraft of the floodplain aquifer also plays an important role in water quality planning. The loss of dilution capacity magnifies the impacts of both permitted and unauthorized waste discharges. Overdraft may also increase the potential for recharge of the floodplain aquifer with poor quality ground water from the older and deeper sediments.

As the watershed enters the 21st century, the area is struggling with its identity as a rapidly growing urban area with insufficient water supply to meet municipal needs. The Mojave Water Agency is implementing plans for artificial recharge of the floodplain aquifer using Bay/Delta water. Alternative water supplies such as reclaimed wastewater are being closely evaluated by the larger cities as a possible source of golf course and landscape irrigation water. Treated wastewater from various domestic, commercial and industrial sources has been and will continue to be discharged to the floodplain aquifer as permitted by the RWQCB. Each of these activities has the potential to increase the daily load of salts and other pollutants into the floodplain aquifer. Because ground water is also extracted from the floodplain aquifer for municipal and domestic uses, the local community water supply agencies may see an increase in the salinity of source water. Wastewater treatment plants would then also see an increase in the salinity of waste influent and effluent.

The author makes the following six recommendations for water quality planning and long-term management in the Mojave River watershed. These recommendations are being made by the author, and do not necessarily represent the opinions or proposed activities of the RWQCB.

1. Continue quarterly ground water monitoring in accordance with the sampling plans developed by the Headwaters and River Subgroups. Efforts should be made to modify the plans as necessary to add or delete monitoring points to fill data gaps. Frequent meetings should be held with the stakeholder groups to discuss the data and to coordinate the evaluation efforts.

2. Closely evaluate sources of observed water quality degradation at the West Fork of the Mojave River near Highway 173, at the Upper and Lower Narrows near Victorville and at the Calico-Newberry Fault. Regulatory activities should be taken as deemed necessary to ensure land use and waste disposal activities are consistent with regulations, plans and policies of the RWQCB.

3. Aggressively pursue regulatory actions as deemed necessary to investigate and remediate sources of observed water quality degradation in the Barstow area. A long-term goal should be to achieve compliance with the existing WQOs for the Waterman Fault, or to modify the WQOs in accordance with an approved implementation plan.

4. Aggressively implement a non-point source control program for the entire watershed to ensure agricultural and urban land users are utilizing appropriate best-management practices. This program should include dairies, irrigated agriculture, wastewater reclamation projects and municipal and industrial storm water discharges.

5. Develop a geographic information system (GIS) for water quality data and integrate this system with the GIS systems of other stakeholders such as land use agencies and the Mojave Water Agency. This effort should focus on effectively sharing and evaluating data with other stakeholders.

6. Begin the development of TMDLs for the watershed, taking into full account all point and non-point source discharges to the watershed. Considerations should include existing and future discharges of Bay/Delta water to the floodplain aquifer from Silverwood Lake and recharge basins.

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California Regional Water Quality Control Board

Lahontan Region

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Secretary for Environmental Protection

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Gray Davis
Governor

FAX TRANSMITTAL PAGE

DATE: 11/19/01

TO: Judy Unsicker

ORGANIZATION: C. Hunter 760-241-7393

PHONE NO:

FAX NO: 530 542-5470

FROM:

OF PAGES, INCLUDING COVER SHEET: Multiple – 2 parts

SUBJECT: Surface Water Analysis – Near Heaps Pk Landfill S.B. Mts.

✓ PER YOUR REQUEST
___ FILE
___ ORIGINAL TO FOLLOW
___ INFORMATION
___ RETURN COMMENTS
___ SIGNATURE

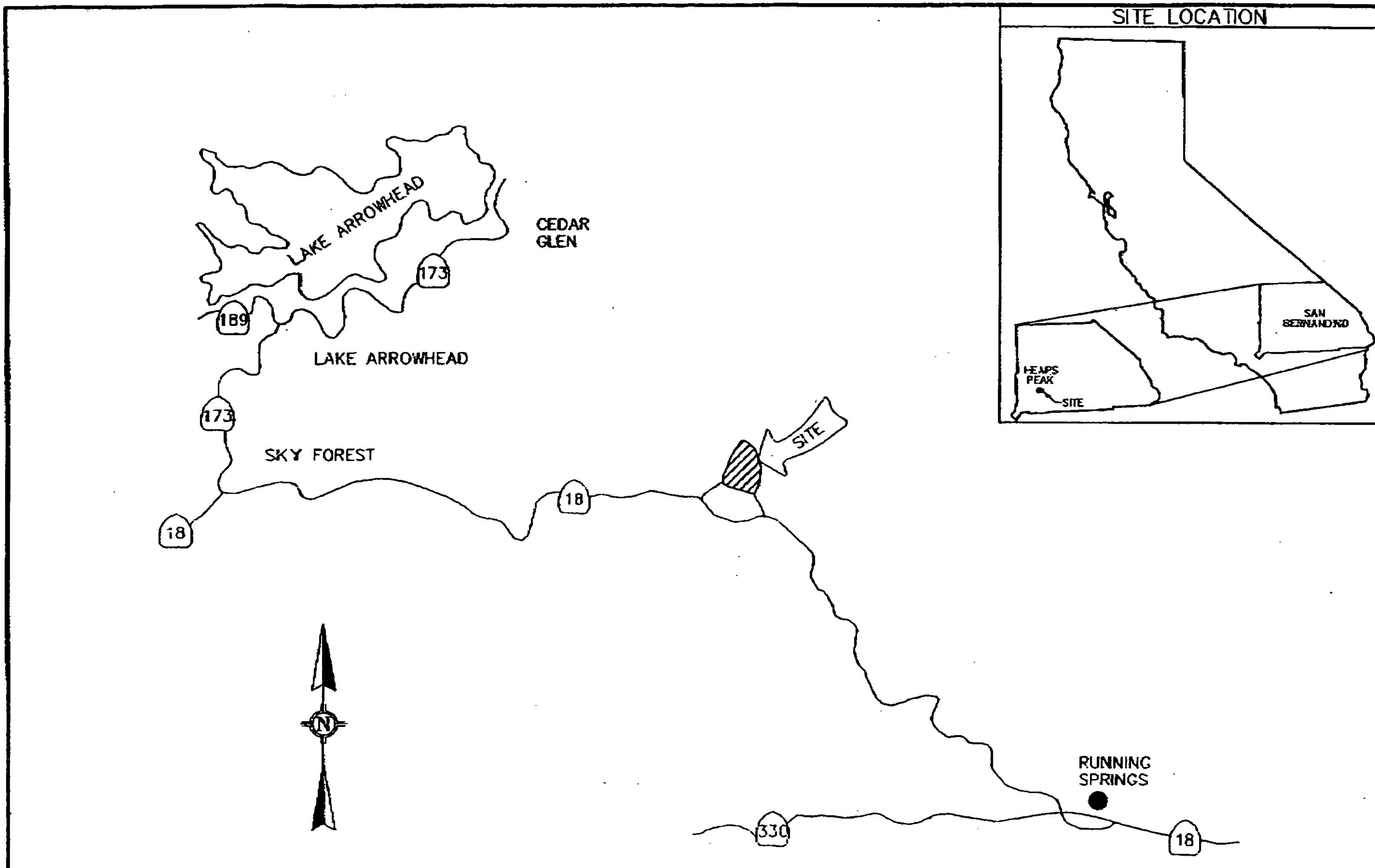
COMMENTS: Per your Request – Jay Cass' Instruction – Attach Tables of Analysis from 3 surface water location w/in Deep Creek Watershed. I have included 2 maps, 1 regional, 1 site map showing sample Loc. let me know if Tables don't turn out.

C. Hunter

x:Stationary/ CRWQCB fax form

California Environmental Protection Agency

NOV-19-2001 MON 02:08 PM CRWQCB/LAHONTAN-REGIONAL 17602411300



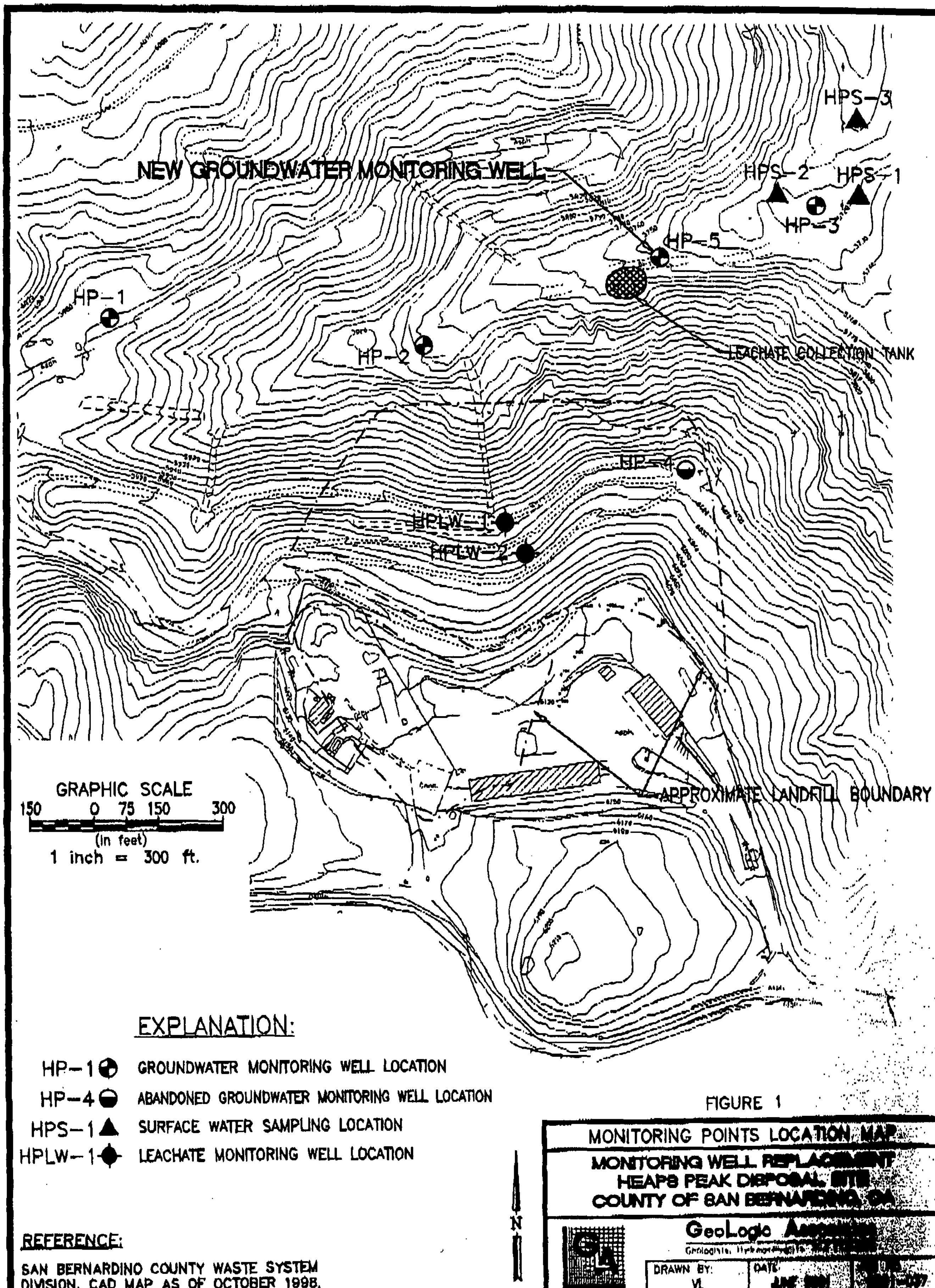
APPROXIMATE SCALE: 1" = 1.5 MILES

GEOSYNTEC CONSULTANTS

SITE LOCATION MAP
HEAPS PEAK SANITARY LANDFILL
SAN BERNARDINO COUNTY, CALIFORNIA

FIGURE NO.	1-1
PROJECT NO.	HR0227-B.4
DATE:	1 DECEMBER 1998

DWG: 0227FC08.DWG 19981123 IC



HPS-3
NEW GROUNDWATER MONITORING WELL
HPS-2
HPS-1
HP-3
HP-5
HP-1
HP-2
LEACHATE COLLECTION TANK
HP-4
HPLW-1
HPLW-2
APPROXIMATE LANDFILL BOUNDARY
GRAPHIC SCALE
150 0 75 150 300
(in feet)
1 inch = 300 ft.
EXPLANATION:
HP-1 GROUNDWATER MONITORING WELL LOCATION
HP-4 ABANDONED GROUNDWATER MONITORING WELL LOCATION
HPS-1 SURFACE WATER SAMPLING LOCATION
HPLW-1 LEACHATE MONITORING WELL LOCATION
REFERENCE:
SAN BERNARDINO COUNTY WASTE SYSTEM DIVISION, CAD MAP AS OF OCTOBER 1998.
N
FIGURE 1
MONITORING POINTS LOCATION MAP
MONITORING WELL
HEAPS PEAK DISPOSAL
COUNTY OF SAN
GeoLogic
DRAWN BY: VL
DATE:

TABLE 9-8
HEAPS PEAK DISPOSAL SITE
HISTORICAL SUMMARY DATA - SURFACE WATER SAMPLING STATION HPS-1

ANALYTE	UNITS	Apr 1990	Jun 1990	Sep 1990	Nov 1990	Jan 1991	Apr 1991	Jul 1991	Oct 1991
GENERAL CHEMISTRY									
Bicarbonate	mg/L	55	58	57	85	76	58	73	79
Carbonate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Chloride	mg/L	2.6	2.6	2.6	2	6	3	3	3
Cyanide, Total	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Fluoride, Total	mg/L	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1
Nitrate (as N)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate/Nitrite	mg/L	0.2	0.1	0.1	0.1	0.4	0.1	0.1	0.1
pH	units	NA	7.58	8.04	6.72	7.70	6.8	6.56	8.52
Specific Conductance	µmhos/cm	NA	127	151	129	130	90.5	135.8	136.5
Sulfate	mg/L	2	1.8	1.4	2	1	2	2	2
Sulfide	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Temperature	F	61.2	61.3	62.5	47.3	NA	49.5	63.32	NA
Total Dissolved Solids (TDS)	mg/L	100	86	96	100	55	105	95	90
Total Organic Carbon (TOC)	mg/L	1.0	[illegible]	[illegible]	1.4	1.6	2.4	3.6	1.7
Total Organic Halides (TOX)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Turbidity	NTU	NA	NA	NA	NA	NA	NA	NA	NA
METALS									
Antimony	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	mg/L	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Barium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Boron	mg/L	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Cadmium	mg/L	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Calcium	mg/L	12	15	15	15	16	11	15	16
Chromium, Total	mg/L	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Cobalt	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Copper	mg/L	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Iron	mg/L	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Lead	mg/L	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Magnesium	mg/L	5	5	5	5	5	5	5	5
Manganese	mg/L	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.03
Mercury	mg/L	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Molybdenum	mg/L	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Nickel	mg/L	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Potassium	mg/L	5	5	5	5	5	5	5	5
Selenium	mg/L	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Silver	mg/L	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Sodium	mg/L	6	7	8	7	7	5	7	7
Thallium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Tin	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	mg/L	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Zinc	mg/L	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
VOLATILE and SEMI-VOLATILE ORGANIC COMPOUNDS									
Bis(2-ethylhexyl)phthalate	µg/L	NR	NR	NR	NR	NR	NR	NR	NR
Chloroform	µg/L	0.08	0.2	0.02	0.02	0.02	0.02	[illegible]	[illegible]
Hexachloro-1,3-butadiene	µg/L	0.02	0.02	0.02	0.02	0.02	0.02	0.10	0.02
Methylene Chloride	µg/L	5	0.02	0.7	0.02	0.02	0.02	1	0.06
Toluene	µg/L	0.1	0.02	0.03	0.05	0.09	0.04	0.03	0.02
Trichlorofluoromethane	µg/L	0.01	0.02	0.86	0.02	0.02	0.02	0.02	0.02

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TABLE 9-8 (CONT'D)
HEAPS PEAK DISPOSAL SITE
HISTORICAL SUMMARY DATA - SURFACE WATER SAMPLING STATION HPS-1

ANALYTE	UNITS	Apr 1992	May 1992	Aug 1992	Nov 1992	Feb 1993	May 1993	Aug 1993	Nov 1993
GENERAL CHEMISTRY									
Bicarbonate	mg/L	24	29	61	73	37	38	55	68
Carbonate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Chloride	mg/L	2	4	3	3	3.0	3	3	6
Cyanide, Total	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Fluoride, Total	mg/L	0.12	0.1	0.1	0.1	0.1	0.1	0.1	[illegible]
Nitrate (as N)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate/Nitrite	mg/L	0.28	1.7	0.48	0.1	0.63	2.69	0.9	0.2
pH	units	7.26	NA	8.06	7.50	7.32	8.29	7.49	8.21
Specific Conductance	µmhos/cm	273	127.7	1440	96.1	92.6	62	126	147
Sulfate	mg/L	0.5	2	1	1	2.7	1	2	1
Sulfide	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Temperature	F	57.2	56.6	67.4	49.5	44.0	54.1	50.8	50.8
Total Dissolved Solids (TDS)	mg/L	78	77	93	72	54	24	78	105
Total Organic Carbon (TOC)	mg/L	0.5	1.0	2.8	5.1	4.0	4.4	2.6	[illegible]
Total Organic Halides (TOX)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Turbidity	NTU	NA	NA	NA	NA	NA	NA	NA	NA
METALS									
Antimony	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	mg/L	0.01	0.01	0.01	0.01	0.01	[illegible]	[illegible]	0.01
Barium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Boron	mg/L	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Cadmium	mg/L	0.001	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Calcium	mg/L	12	13	14	16	9	11	11.2	13
Chromium, Total	mg/L	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Cobalt	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Copper	mg/L	0.03	0.03	0.03	0.03	0.02	[illegible]	[illegible]	[illegible]
Iron	mg/L	0.1	0.1	0.1	0.1	0.1	[illegible]	[illegible]	[illegible]
Lead	mg/L	0.2	0.2	0.2	0.2	0.2	[illegible]	[illegible]	[illegible]
Magnesium	mg/L	5	5	5	5	5	5	[illegible]	[illegible]
Manganese	mg/L	0.02	0.02	0.02	0.02	0.02	[illegible]	[illegible]	[illegible]
Mercury	mg/L	0.0002	0.0002	0.0002	0.0002	0.0002	[illegible]	[illegible]	[illegible]
Molybdenum	mg/L	0.05	0.05	0.05	0.05	0.05	[illegible]	[illegible]	[illegible]
Nickel	mg/L	0.04	0.04	0.04	0.04	0.04	[illegible]	[illegible]	[illegible]
Potassium	mg/L	5	5	5	5	5	5	[illegible]	[illegible]
Selenium	mg/L	0.005	0.005	0.005	0.005	0.005	0.005	[illegible]	[illegible]
Silver	mg/L	0.01	0.01	0.01	0.01	0.01	0.01	[illegible]	[illegible]
Sodium	mg/L	6	6	7	7	[illegible]	[illegible]	6.5	7
Thallium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Tin	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	mg/L	0.05	0.05	0.05	0.05	0.05	0.05	[illegible]	[illegible]
Zinc	mg/L	0.02	0.02	0.04	0.04	0.09	[illegible]	[illegible]	[illegible]
VOLATILE and SEMI-VOLATILE ORGANIC COMPOUNDS									
Bis(2-ethylhexyl)phthalate	µg/L	NR	NR	NR	NR	NR	NR	NR	[illegible]
Chloroform	µg/L	0.5	0.5	0.8	0.5	0.5	[illegible]	[illegible]	[illegible]
Hexachloro-1,3-butadiene	µg/L	0.5	0.5	3	0.5	0.5	0.5	[illegible]	[illegible]
Methylene Chloride	µg/L	0.5	0.5	0.5	0.5	0.5	[illegible]	[illegible]	[illegible]
Toluene	µg/L	0.5	0.5	0.5	0.5	0.5	[illegible]	[illegible]	[illegible]
Trichlorofluoromethane	µg/L	0.5	0.5	0.5	0.5	0.5	[illegible]	[illegible]	[illegible]

TABLE 9-8 (CONT'D)
HEAPS PEAK DISPOSAL SITE
HISTORICAL SUMMARY DATA - SURFACE WATER SAMPLING STATION HPS-1

ANALYTE	UNITS	Mar 1994	Apr 1994	Aug 1994	Dec 1994	Mar 1995	May 1995	Jul 1995	Oct 1995
GENERAL CHEMISTRY									
Bicarbonate	mg/L	48.1	47.3	64	107	31	45	53	59
Carbonate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Chloride	mg/L	5.00	5.0	4	12	4	3	2	3
Cyanide, Total	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Fluoride, Total	mg/L	0.10	0.10	0.1	0.1	0.04	0.1	0.07	0.04
Nitrate (as N)	mg/L	0.865	0.518	3	0.8	0.8	0.6	0.5	0.7
Nitrate/Nitrite	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
pH	units	7.67	7.20	NA	NA	6.49	6.61	NA	7.42
Specific Conductance	µmhos/cm	111	106	NA	NA	149	78	NA	104
Sulfate	mg/L	19.2	20	3	1	1	1	1.6	1
Sulfide	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Temperature	F	44.1	57.1	NA	NA	42.3	52.7	NA	51.6
Total Dissolved Solids (TDS)	mg/L	70	70.8	97	187	86	76	94	94
Total Organic Carbon (TOC)	mg/L	0.6	3.07	2	7	1	1	2	0.6
Total Organic Halides (TOX)	mg/L	0.005	0.003	0.005	0.01	0.01	0.01	0.01	0.01
Turbidity	NTU	NA	NA	NA	NA	NA	NA	NA	0
METALS									
Antimony	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	mg/L	0.100	0.030	NA	0.0015	0.0015	0.0015	0.0015	0.0015
Barium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Boron	mg/L	0.100	0.075	0.1	0.4	0.4	0.09	0.04	0.09
Cadmium	mg/L	0.010	0.003	0.0008	0.002	0.002	0.002	0.002	0.002
Calcium	mg/L	11.7	11.1	14	34	10	9.2	10	12
Chromium, Total	mg/L	0.027	0.033	NA	0.003	0.003	0.003	0.04	0.003
Cobalt	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Copper	mg/L	0.004	0.011	0.01	0.003	0.008	0.003	0.003	0.002
Iron	mg/L	0.007	0.375	0.09	0.2	0.02	0.06	0.24	0.06
Lead	mg/L	0.030	0.010	0.05	0.028	NA	0.002	0.003	[illegible]
Magnesium	mg/L	2.38	2.53	3.4	4.2	2.0	2.1	2.4	2.7
Manganese	mg/L	0.005	0.009	0.058	0.08	0.006	0.002	0.003	0.006
Mercury	mg/L	0.0005	0.0002	0.0005	0.0002	0.0002	0.0002	0.0002	0.0002
Molybdenum	mg/L	0.008	0.003	0.02	0.008	0.008	0.008	0.008	0.008
Nickel	mg/L	0.005	0.002	0.025	0.012	0.012	0.012	0.012	0.012
Potassium	mg/L	1.38	1.23	1.6	3.1	1.3	1.2	1.2	1.3
Selenium	mg/L	0.010	0.030	0.004	0.002	0.002	0.002	0.002	0.002
Silver	mg/L	0.006	0.005	0.01	0.004	0.004	0.004	0.004	0.0045
Sodium	mg/L	5.46	5.79	7.8	14	5.9	5.3	5.2	6.4
Thallium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Tin	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	mg/L	0.005	0.002	0.01	0.004	0.004	0.004	0.004	0.004
Zinc	mg/L	0.004	0.012	0.008	0.010	0.012	0.002	0.010	0.011
VOLATILE and SEMI-VOLATILE ORGANIC COMPOUNDS									
Bis(2-ethylhexyl)phthalate	µg/L	NR	NR	NR	NR	NR	NR	NR	NR
Chloroform	µg/L	0.5	0.20	0.5	5	1	[illegible]	[illegible]	[illegible]
Hexachloro-1,3-butadiene	µg/L	0.5	0.07	0.5	5	2	2	2	2
Methylene Chloride	µg/L	2.0	0.70	1	5	1	1	1	1
Toluene	µg/L	0.2	0.07	1	5	2	2	2	2
Trichlorofluoromethane	µg/L	0.2	0.05	0.5	5	1	[illegible]	[illegible]	[illegible]

TABLE 9-8 (CONT'D)
HEAPS PEAK DISPOSAL SITE
HISTORICAL SUMMARY DATA - SURFACE WATER SAMPLING STATION HPS-1

ANALYTE	UNITS	Mar 1996	May 1996	Aug 1996	Nov 1996	Feb 1997	May 1997	Aug 1997	Nov 1997
GENERAL CHEMISTRY									
Bicarbonate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Carbonate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Chloride	mg/L	3	4	5	14.9	6	6.0	6.0	6.0
Cyanide, Total	mg/L	0.007	NA	NA	NA	NA	NA	NA	NA
Fluoride, Total	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate (as N)	mg/L	0.7	0.6	0.14	0.14	0.158	0.06	0.13	0.18
Nitrate/Nitrite	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
pH	units	NA	7.45	6.78	NA	6.24	6.8	7.48	7.29
Specific Conductance	µmhos/cm	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate	mg/L	2	0.9	2	2	3.82	2.69	3.04	3.18
Sulfide	mg/L	0.03	NA	NA	NA	NA	NA	NA	NA
Temperature	F	NA	NA	NA	NA	NA	NA	NA	NA
Total Dissolved Solids (TDS)	mg/L	100	79	94	106	84	176	94	88
Total Organic Carbon (TOC)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Total Organic Halides (TOX)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Turbidity	NTU	NA	NA	NA	NA	NA	NA	NA	NA
METALS									
Antimony	mg/L	0.02	NA	NA	NA	NA	NA	NA	NA
Arsenic	mg/L	0.0026	NA	NA	NA	NA	NA	NA	NA
Barium	mg/L	0.01	NA	NA	NA	NA	NA	NA	NA
Beryllium	mg/L	0.0004	NA	NA	NA	NA	NA	NA	NA
Boron	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	mg/L	0.0008	NA	NA	NA	NA	NA	NA	NA
Calcium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Chromium, Total	mg/L	0.01	NA	NA	NA	NA	NA	NA	NA
Cobalt	mg/L	0.007	NA	NA	NA	NA	NA	NA	NA
Copper	mg/L	0.006	NA	NA	NA	NA	NA	NA	NA
Iron	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Lead	mg/L	0.005	NA	NA	NA	NA	NA	NA	NA
Magnesium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	mg/L	0.0002	NA	NA	NA	NA	NA	NA	NA
Molybdenum	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	mg/L	0.015	NA	NA	NA	NA	NA	NA	NA
Potassium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	mg/L	0.0042	NA	NA	NA	NA	NA	NA	NA
Silver	mg/L	0.005	NA	NA	NA	NA	NA	NA	NA
Sodium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	mg/L	0.003	NA	NA	NA	NA	NA	NA	NA
Tin	mg/L	0.042	NA	NA	NA	NA	NA	NA	NA
Vanadium	mg/L	0.005	NA	NA	NA	NA	NA	NA	NA
Zinc	mg/L	0.007	NA	NA	NA	NA	NA	NA	NA
VOLATILE and SEMI-VOLATILE ORGANIC COMPOUNDS									
Bis(2-ethylhexyl)phthalate	µg/L	ND	NA	NA	NA	NA	NA	NA	NA
Chloroform	µg/L	0.3	0.6	0.2	0.2	0.3	0.4	[illegible]	[illegible]
Hexachloro-1,3-butadiene	µg/L	0.6	0.6	NA	NA	0.2	0.1	0.17	0.17
Methylene Chloride	µg/L	1.2	1.2	0.2	0.2	0.2	0.2	0.21	0.21
Toluene	µg/L	0.7	0.7	0.3	0.3	0.3	0.3	0.12	0.12
Trichlorofluoromethane	µg/L	0.2	0.2	0.2	0.2	0.2	0.2	0.25	0.25

TABLE 9-8 (CONT'D)
HEAPS PEAK DISPOSAL SITE
HISTORICAL SUMMARY DATA - SURFACE WATER SAMPLING STATION HPS-1

ANALYTE	UNITS	Mar 1998	May 1998	Aug 1998	Nov 1998	Feb 1999	May 1999	Aug 1999	Nov 1999
GENERAL CHEMISTRY									
Bicarbonate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Carbonate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Chloride	mg/L	7.0	6	6	6	4.0	1	2	2
Cyanide, Total	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Fluoride, Total	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate (as N)	mg/L	0.14	0.06	0.14	0.077	0.28	0.03	0.13	0.12
Nitrate/Nitrite	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
pH	units	7.20	6.5	7.2	7.3	7.32	7.2	7.8	7.7
Specific Conductance	µmhos/cm	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate	mg/L	2	4.5	4.0	3.4	0.5	4.1	1.4	2.0
Sulfide	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Temperature	F	NA	NA	NA	44.6	41.0	50.0	51.8	NA
Total Dissolved Solids (TDS)	mg/L	76	64	88	88	102	164	84	93
Total Organic Carbon (TOC)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Total Organic Halides (TOX)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Turbidity	NTU	NA	NA	NA	NA	NA	NA	NA	NA
METALS									
Antimony	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Barium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Boron	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Calcium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Chromium, Total	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Copper	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Iron	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Lead	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Molybdenum	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Potassium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Silver	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Sodium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Tin	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
VOLATILE and SEMI-VOLATILE ORGANIC COMPOUNDS									
Bis(2-ethylhexyl)phthalate	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	µg/L	0.17	0.17	0.17	0.17	0.17	0.17	0.24	0.24
Hexachloro-1,3-butadiene	µg/L	0.17	0.17	0.17	0.17	0.17	0.17	0.47	0.47
Methylene Chloride	µg/L	0.21	0.21	0.21	0.21	0.21	0.21	0.37	0.37
Toluene	µg/L	0.16(a)	0.12	0.12	0.12	0.12	0.12	0.14	0.14
Trichlorofluoromethane	µg/L	0.25	0.25	0.25	0.25	0.25	0.25	0.48	0.48

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TABLE 9-8 (CONT'D)
HEAPS PEAK DISPOSAL SITE
HISTORICAL SUMMARY DATA - SURFACE WATER SAMPLING STATION HPS-1

ANALYTE	UNITS	Mar 2000	May 2000	Aug 2000	Nov 2000	Feb 2001	May 2001	MED.	AVG.	STD. DEV.	MIN.	MAX.
GENERAL CHEMISTRY												
Bicarbonate	mg/L	NA	NA	NA	NA	NA	NA	57.5	57.5	19.2	24.0	107
Carbonate	mg/L	NA	NA	NA	NA	NA	NA	NC	NC	NC	NC	NC
Chloride	mg/L	2	3	2	3	NA	3	3.00	3.91	2.64	2.0	14.9
Cyanide, Total	mg/L	NA	NA	NA	0.006	NA	NA	NC	NC	NC	NC	NC
Fluoride, Total	mg/L	NA	NA	NA	NA	NA	NA	0.10	0.10	0.01	0.07	0.12
Nitrate (as N)	mg/L	0.4	0.16	0.14	0.14	NA	0.19	0.185	0.452	0.582	0.077	3.00
Nitrate/Nitrite	mg/L	NA	NA	NA	NA	NA	NA	0.48	0.83	0.84	0.20	2.69
pH	units	7.5	NA	7.6	7.7	NA	7.4	7.40	7.35	0.53	6.24	8.52
Specific Conductance	µmhos/cm	NA	NA	100	900	NA	100	127.0	213.6	315.1	62.0	1440.0
Sulfate	mg/L	2.7	2.3	1.6	1.8	NA	2.6	2.00	3.17	4.16	0.50	20.00
Sulfide	mg/L	NA	NA	NA	0.2	NA	NA	NC	NC	NC	NC	NC
Temperature	F	NA	NA	57.2	42.8	NA	48.2	51.60	52.59	7.13	41.00	67.40
Total Dissolved Solids (TDS)	mg/L	98	90	88	70	NA	84	88.0	91.0	27.7	24	187
Total Organic Carbon (TOC)	mg/L	NA	NA	NA	NA	NA	NA	2.00	2.54	1.67	0.6	7
Total Organic Halides (TOX)	mg/L	NA	NA	NA	NA	NA	NA	NC	NC	NC	NC	NC
Turbidity	NTU	NA	NA	2	0	NA	0	0	0.5	1	0	2
METALS												
Antimony	mg/L	NA	NA	NA	0.00012	NA	NA	NC	NC	NC	NC	NC
Arsenic	mg/L	NA	NA	NA	0.00030	NA	NA	NC	NC	NC	NC	NC
Barium	mg/L	NA	NA	NA	0.0067	NA	NA	NC	NC	NC	NC	NC
Beryllium	mg/L	NA	NA	NA	0.00042	NA	NA	NC	NC	NC	NC	NC
Boron	mg/L	NA	NA	NA	NA	NA	NA	0.090	0.085	0.009	0.075	0.09
Cadmium	mg/L	NA	NA	NA	0.00012	NA	NA	NC	NC	NC	NC	NC
Calcium	mg/L	NA	NA	NA	NA	NA	NA	12.5	13.6	4.9	9	34
Chromium, Total	mg/L	NA	NA	NA	0.0021	NA	NA	0.030	0.026	0.016	0.0021	0.04
Cobalt	mg/L	NA	NA	NA	0.00010	NA	NA	NC	NC	NC	NC	NC
Copper	mg/L	NA	NA	NA	0.00027	NA	NA	NC	NC	NC	NC	NC
Iron	mg/L	NA	NA	NA	NA	NA	NA	0.090	0.128	0.121	0.007	0.375
Lead	mg/L	NA	NA	NA	0.000098	NA	NA	NC	NC	NC	NC	NC
Magnesium	mg/L	NA	NA	NA	NA	NA	NA	2.5	2.7	0.7	2	4.2
Manganese	mg/L	NA	NA	NA	NA	NA	NA	0.020	0.027	0.029	0.002	0.08
Mercury	mg/L	NA	NA	NA	0.00045	NA	NA	NC	NC	NC	NC	NC
Molybdenum	mg/L	NA	NA	NA	NA	NA	NA	NC	NC	NC	NC	NC
Nickel	mg/L	NA	NA	NA	0.00073	NA	NA	NC	NC	NC	NC	NC
Potassium	mg/L	NA	NA	NA	NA	NA	NA	1.3	1.5	0.6	1.2	3.1
Selenium	mg/L	NA	NA	NA	0.00093	NA	NA	NC	NC	NC	NC	NC
Silver	mg/L	NA	NA	NA	0.000098	NA	NA	NC	NC	NC	NC	NC
Sodium	mg/L	NA	NA	NA	NA	NA	NA	7	7	2	5	14
Thallium	mg/L	NA	NA	NA	0.000063	NA	NA	NC	NC	NC	NC	NC
Tin	mg/L	NA	NA	NA	0.000083	NA	NA	NC	NC	NC	NC	NC
Vanadium	mg/L	NA	NA	NA	0.0017	NA	NA	NC	NC	NC	NC	NC
Zinc	mg/L	NA	NA	NA	0.003	NA	NA	0.010	0.014	0.013	0.003	0.04
VOLATILE and SEMI-VOLATILE ORGANIC COMPOUNDS												
Bis(2-ethylhexyl)phthalate	µg/L	NA	NA	NA	[illegible]	NA	NA	NC	NC	NC	NC	NC
Chloroform	µg/L	0.24	0.17	0.28	0.28	NA	0.28	NC	NC	NC	NC	NC
Hexachloro-1,3-butadiene	µg/L	0.47	0.19	0.28	0.28	NA	0.28	NC	NC	NC	NC	NC
Methylene Chloride	µg/L	0.27	0.24	0.27	0.27	NA	0.27	NC	NC	NC	NC	NC
Toluene	µg/L	0.14	0.14	0.22	0.22	NA	0.22	NC	NC	NC	NC	NC
Trichlorofluoromethane	µg/L	0.40	0.099	0.23	0.23	NA	0.23	NC	NC	NC	NC	NC

TABLE 9-9
HEAPS PEAK DISPOSAL SITE
HISTORICAL SUMMARY DATA - SURFACE WATER SAMPLING STATION HPS-2

ANALYTE	UNITS	Apr 1990	Jun 1990	Nov 1990	Jan 1991	Apr 1991	Jul 1991	Oct 1991	Apr 1992
GENERAL CHEMISTRY									
Bicarbonate	mg/L	94	70	98	98	55	94	88	36
Carbonate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Chloride	mg/L	22	11	13	14	16	9	5	6
Cyanide, Total	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Fluoride, Total	mg/L	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.13
Nitrate (as N)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate/Nitrite	mg/L	0.2	0.5	0.1	0.2	0.1	0.2	0.1	0.28
pH	units	NA	7.50	7.75	8.00	7.25	7.13	7.84	7.13
Specific Conductance	µmhos/cm	NA	255	210	220	262	184.4	199	170.2
Sulfate	mg/L	10	5.6	10	11	6	2	3	2
Sulfide	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Temperature	F	60.5	66.6	52.9	NA	60.6	71.78	NA	56.3
Total Dissolved Solids (TDS)	mg/L	180	130	155	115	175	120	95	97
Total Organic Carbon (TOC)	mg/L	3.0	1.0	2.9	2.2	12.0	3.3	2.4	2.0
Total Organic Halides (TOX)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Turbidity	NTU	NA	NA	NA	NA	NA	NA	NA	NA
METALS									
Antimony	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	mg/L	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Barium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Boron	mg/L	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Cadmium	mg/L	0.001	0.001	0.001	0.001	0.001	0.001	0.003	0.001
Calcium	mg/L	19	23	23	28	29	22	19	18
Chromium, Total	mg/L	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Cobalt	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Copper	mg/L	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Iron	mg/L	0.2	0.1	0.1	0.1	0.3	0.1	0.1	0.2
Lead	mg/L	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Magnesium	mg/L	5	5	5	5	5	5	[illegible]	[illegible]
Manganese	mg/L	0.04	0.02	0.02	0.02	0.23	0.02	0.04	0.14
Mercury	mg/L	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Molybdenum	mg/L	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Nickel	mg/L	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Potassium	mg/L	5	5	5	5	7	5	5	5
Selenium	mg/L	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Silver	mg/L	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Sodium	mg/L	10	12	13	14	14	11	8	10
Thallium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Tin	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	mg/L	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Zinc	mg/L	0.02	0.41	0.02	0.02	0.02	0.02	0.02	0.02
VOLATILE and SEMI-VOLATILE ORGANIC COMPOUNDS									
1,1-Dichloroethene	µg/L	0.08	0.08	0.08	0.08	0.08	[illegible]	[illegible]	0.5
Methylene Chloride	µg/L	[illegible]	0.02	0.02	0.51	0.02	0.1	0.12	[illegible]
Toluene	µg/L	[illegible]	0.03	0.03	0.21	0.05	0.01	0.01	[illegible]
Xylenes, Total	µg/L	[illegible]	0.04	0.04	0.04	0.11	0.04	0.04	0.5

Ground-Water Pollution

In: Seminar publication; protection of public water supplies from ground-water contamination Environmental Protection Agency

Long-Term Effects

For millennia, man has disposed of his waste products in a variety of ways. The disposal method might reflect convenience, expedience, expense, or best available technology, but in many instances, leachate from these wastes have come back to haunt later generations. This is largely because we have not thought out the consequences of our actions. Ground-water pollution may lead to problems of inconvenience, such as taste, odor, color, hardness, or foaming; but the pollution problems are far more serious when pathogenic organisms, flammable or explosive substances, or toxic chemicals or their by-products are present, particularly when long-term health effects are unknown.

Individual polluted ground-water sites generally are not large, but once polluted, ground water may remain in an unusable or even hazardous condition for decades or even centuries. The typically low velocity of ground water prevents a great deal of mixing and dilution; consequently, a contaminant plume may maintain a high concentration as it slowly moves from points of recharge to zones of discharge.

An oil-field brine holding pond was constructed adjacent to a producing well in central Ohio in 1968. Two years later when the well was plugged, the holding pond was filled, graded, and seeded. The chloride concentration in the ground water in the vicinity of the former pond still exceeded 36,000 mg/1 some 10 years after the operation began and 8 years after reclamation.

Scores of brine holding ponds were constructed in central Ohio during an oil boom in 1964; many are still in use. In 1978 a number of test holes were constructed within 200 feet of one such pond. Within this area shallow ground water contained as much as 50,000 mg/1 of chloride. Moreover, brine-contaminated ground water provides part of the flow of many streams and this has caused degradation of surface-water quality.29, 30, 31

Documentation of the migration of leachate plumes originating at garbage dumps and landfills is becoming increasingly abundant. Data show that under certain hydrologic conditions leachate plumes can move considerable distances and degrade ground water throughout wide areas. Furthermore, the problem is worldwide. Exler3z described a situation in southern Bavaria, Germany, where a landfill has been in operation since 1954 The wastes are dumped into a dry gravel pit. As Figure 116 illustrates, data collected from 1967 to 1970 showed the narrow lense-shaped plume had migrated nearly 2 miles.

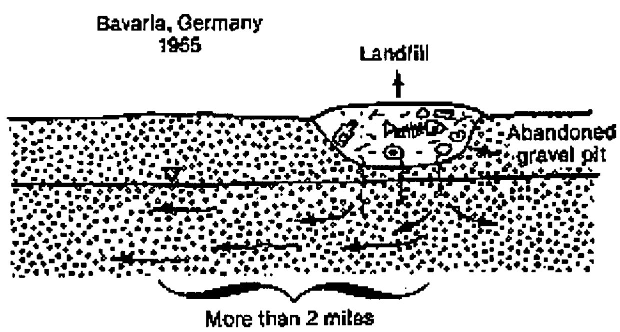


Figure 116. Leachate from a Landfill in Bavaria has migrated more than 2 Miles and the Ground Water has been degraded for narly 25 years

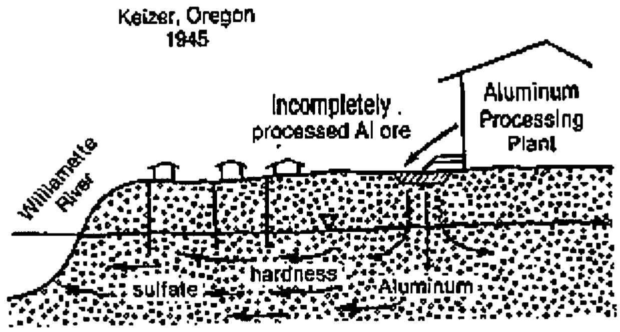


Figure 117. Thirty-Three Years after disposal began the leachate from Aluminum ore and mill tailings is still a problem in Keiser, Oregon

As Figure 117 illustrates, incompletely processed aluminum ore was dumped into a borrow pit in Keizer, Oregon from August 1945 to July 1946.33 The ore and mill tailings had been treated with sulfuric acid and ammonium hydroxide. When first recognized by local residents in 1946, the ground water was contaminated by more than 1,000 mg/1 of sulfate; many shallow domestic wells tapping the Recent alluvium were contaminated. In the Spring of 1948 the waste was removed from the borrow pit. Two wells, reportedly capable of producing more than 700 gpm (gallons per minute) were installed near the pit and the contaminated groundwater was pumped to waste for several months. By 1964 the contaminants had migrated more than a mile. No doubt some of the contaminants are still in the ground water at Keizer.

A well-documented study by Perlmutter and others 34 showed that disposal of chromium and cadmium-rich plating wastes from an aircraft plant on Long Island during a 20-year period contaminated a shallow aquifer. Figure 118 illustrates this study. The contamination was first discovered in 1942, and by 1972 the degraded ground water zone was about 4,200 feet long and 1,000 feet wide. The 1972 study demonstrated that the chromium-cadmium enriched cigar-shaped plume "had not only reached Massapequa Creek but was present in the stream as well as in the beds beneath it."35

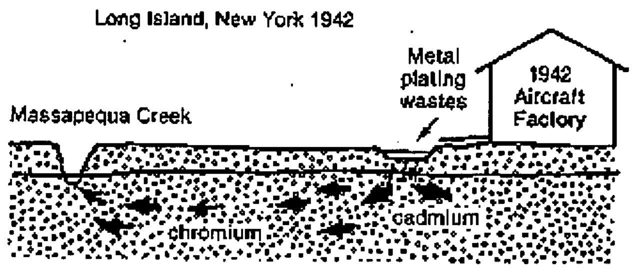


Figure 118. More Than 36 Years After Disposal of Plating Wastes Began, the Ground Water Remains Polluted in South Farmingdale.

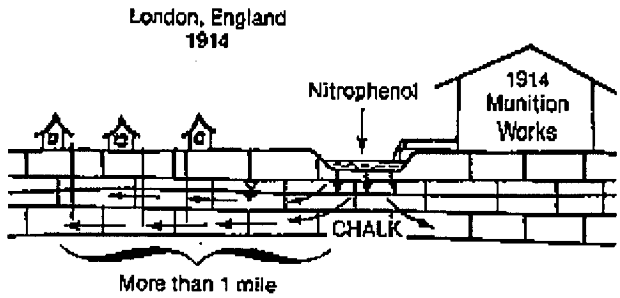


Figure 119. The Picric Acid, Which Has Been Found in the Ground Water Near London for Decades, Originated at a World War I Munitions Plant.

During the middle and late 1930's grasshopper infestations were stripping the vegetation throughout wide areas in the Northern Great Plains. In western Minnesota partial control was obtained by a grasshopper bait consisting of arsenic, bran, and sawdust. Eventually the leftover bait was buried. In May 1972, a contractor drilled a well near his office and warehouse on the outskirts of a small town. During the next two and a half months 11 of the 13 individuals employed at the site became ill; two were hospitalized. They were suffering from arsenic poisoning. One sample of water from the well contained 21 mg/1 of arsenic. Analyses of soil from the site revealed arsenic concentrations ranging from 3,000 to 12,000 mg/l. Apparently the well was drilled in the vicinity of the grasshopper bait disposal site, which had long been forgotten by the local residents.

Wastes from munitions works include picric acid, a toxic, intensely bitter, pale yellow substance. Picric acid is not readily removed by traditional water treatment methods and its migration through either the unsaturated zone or the saturated zone does not appear to neutralize it.

During the World War I years of 1914-1918, wastes from the manufacture of explosives at a plant near the Thames River just northeast of London, England, were placed in abandoned chalk pits. Figure 119 illustrates the migration of these wastes. In the early 1920's water from a nearby well was first reported to have a yellow tint.37 Additional water samples collected between 1939 liq and 1955 also contained a characteristic yellow picric acid tint. Sampling ceased in 1955 when the pump was removed. By 1942 the pollutants had migrated at least a mile as indicated by another contaminated well. There is no reason to believe that the picric acid has been flushed from the aquifer. The ground water has certainly been polluted for 40 years, quite probably for more than 70 years, and very likely will be polluted for many more years to come.

Because of high evaporation and low recharge, waste disposal in arid regions can lead to long-lived groundwater quality problems. In the first place, salts are concentrated by evaporation to form highly mineralized fluids. Secondly, water supplies may not be readily available and, therefore, every effort must be made to protect existing sources.

Ground-water contamination in the desert environment near Barstow, California, was described by Hughes.38 Beginning around 1910, waste fuel oil and solvents from a railroad system were discharged to the dry floor of the Mojave River near Barstow. The first municipal sewage treatment plant was constructed in 1938; the effluent was discharged to the riverbed. Sewage treatment facilities were enlarged in 1953 and 1968. Effluent disposal was dependent on evaporation and direct percolation into the alluvial deposits.

At the U.S. Marine Corps base near Barstow, industrial and domestic waste treatment facilities first became operational in 1942; effluent disposal relied on direct percolation and evaporation. Some of the effluent was used to irrigate a golf course. Other sources of groundwater contamination were two nearby mining and milling operations.

As Figure 120 shows, analysis of well waters collected during the Spring of 1972 indicated the existence of two zones of contaminated ground water in the alluvial deposits of the Mojave River. The deeper zone, originating from the 1910 disposal area, exceeded 1,800 feet in width and extended nearly 4'/z miles in a downgradient direction. Its upper surface lies 60 or more feet below land surface. The second or shallow zone originates at the sewage treatment lagoon installed in 1938 and at the Marine Corps golf course. This zone consists of two apparently separate plumes. The upgradient plume extends nearly 2 miles downstream, while the plume originating at the golf course is nearly a mile long; the plumes are about 700 feet wide. Hughes estimated that the pollution fronts are moving at a rate of I to 1.5 feet per day. The Marine Corps well field lies in the path of these plumes; several domestic wells have already been contaminated. In this instance poor waste disposal practices, beginning nearly 75 years ago may cause water-supply problems at the Marine Corps base unless expensive corrective measures are undertaken.

Figure 120. Waste Disposal Beginning Nearly 70 Years Ago at Barstow, California is Now Threatening an Important Well Field at the Nearby Marine Base.

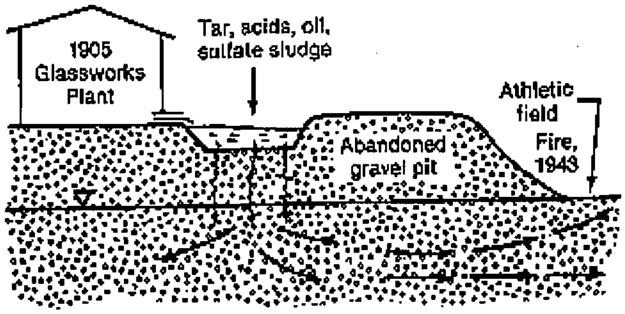


Figure 121. Ground-Water Pollution by Wastes from a Gasworks Plant Near London Has Even Created a Fire Hazard.

From 1905 to 1967 wastes from a gasworks plant were deposited in abandoned gravel pits along the Lee River near Waltham Cross, a few miles northwest of London, England.39 Figure 121 shows that the tar acids, oils, and sulfate sludge infiltrated to contaminate the ground water over a wide area. Apparently the pollution was first detected in 1935, some 30 years after disposal began. At that time oil, floating on the ground water, emerged at land surface. Continual but slow accumulation of oil on and near the land surface led to hazardous conditions and, in 1943, the oil was ignited. Contaminated ground water was also encountered in new excavations where it appeared as high concentrations of sulfate in 1958 and as oily waters im 1961. In 1965, oily liquids also seeped into Pymmes Brook and the Lee River Navigation Channel following a substantial rise in the water table after heavy rains. Additional surface-water degradation occured in 1966 because of the discharge of oil from streamside seepage zones.

Ground water in the surficial sand and gravel deposit was contaminated over a wide area. Fortunately, most water supplies in this region are pumped from an underlying chalk, which generally is separated from the gravel by the London Clay. It is evident from this example that waste disposal, which began 80 years ago, continues to be troublesome and that ground-water contamination can indeed become a fire hazard.

All ground-water pollution is not necessarily bad. Inhabitants of Crosby, a small village in northwestern North Dakota, believed they produced the best coffee in the State because the water from which it was made contained "body". The rather highly mineralized water (dissolved solids = 2,176 mg/1, sulfate = 846 mg/1, chloride = 164 mg/l, and nitrate = 150 mg/1) used for brewing the coffee was obtained exclusively from an old dug well. The well, however, was constructed, probably near the turn of the century, at the site of the local river livery stable. Livestock wastes provided the peculiar flavor so characteristic of the coffee made in Crosby.

The manufacture of soda ash, caustic soda, chlorine, and allied chemicals began at Barberton, Ohio, shortly before the turn of the century. The plant discharged a mixture of calcium and sodium chlorides directly to the Tuscarawas River and to retention ponds. The discharge of chloride in 1966 averaged 1,500 tons per day.4t These wastes have led to serious ground-water pollution problems in eastern Ohio and have necessitated abandonment of streamside well fields at Barberton in 1926 and at Massillon and Coshocton in 1953.

Municipal wells at Zanesville, more than 135 river miles downstream from Barberton, have also been adversely affected by the chloride induced into the watercourse aquifer from the contaminated Muskingum River. Due to high treatment costs Zanesville officials considered abandoning their welt field in 1963. At the confluence of the Muskingum and Ohio Rivers, about 220 river miles below Barberton, is the city of Marietta. Almost 30 years ago, Marietta officials were concerned over the marked increase in chloride in municipal wells during the preceding 10 years.42 The cause, of course, was induced infiltration of the chloride-rich Muskingum River water.

It is evident that decades of poor waste-disposal practices at Barberton seriously impaired streamside aquifers and well fields for a distance of over 200 river miles. The soda ash plant at Barberton was closed in 1973 and waste discharges substantially reduced. Presumably, these water-quality problems will decrease in severity over the next several years, after a history of 90 years or more.

According to Mink and others43 mining operations in the Coeur d'Alene district of northern Idaho have been continuous for more than 90 years. Unfortunately, leaching of the ancient mining and milling wastes is now affecting the chemical quality of ground water in several areas, including Canyon Creek basin near Wallace. Here high concentrations of zinc, lead, copper, and cadmium occur in both ground water and soil samples.

In 1884 striking miners set fire to several deep coal mines in the vicinity of New Straitsville, Ohio. Still burning uncontrollably, the fires were started by disgruntled workers who rolled burning wood-filled coal cars into the shafts that honeycomb the ground under the town. In the years since, many wells have become contaminated, dried up, or produce water hot enough to make instant coffee.

Disposal of domestic, industrial, and municipal wastes, which probably began around 1872 through wells and sinkholes tapping a permeable limestone aquifer, was the birth of a contaminated area that now encloses some 75 square miles. By 1919 the practice of disposing of sewage at the northern Ohio town of Bellevue was well established and many wells had been contaminated. In the early 1960's some wells were reported to yield easily recognizable raw sewage. This problem began more than a hundred years ago and remains to this day.

A gasworks plant was built at Norwich, England, in 1815 and abandoned in 1830. Phenolic compounds, originating from whale oil, infiltrated and remained in the underlying chalk for at least 135 years when it contaminated a newly drilled well in 1950. These organic compounds, no doubt, are still there 170 or so years later.

Sources of Ground-Water Contamination

As water moves through the hydrologic cycle, its quality changes in response to differences in the physical, chemical, and biological environments through which it passes. The changes may be either natural or man-influenced; in some cases they can be controlled, in other cases they cannot, but in most cases they can be managed in order to limit adverse water-quality changes.

The physical, chemical, and biological quality of water may range within wide limits even though there are no man-made influences. In fact, it is often impossible or at least difficult to distinguish the origin (manmade or natural) of many water-quality problems. The natural quality reflects the types and amounts of soluble and insoluble substances with which the water comes in contact. Surface water generally contains less dissolved solids than ground water, although at certain times (generally during low flow rates) in areas where groundwater runoff is the major source of streamflow, the quality of both surface water and ground water is similar. During periods of surface runoff, streams may contain large quantities of suspended materials and, under some circumstances, a large amount of dissolved solids. Most commonly, however, during high rates of flow the water has a lower dissolved-mineral concentration.

Although the chemical quality of water in surficial or shallow aquifers may range within fairly wide limits from one time to the next, deeper ground water is characterized by nearly constant chemical and physical properties, at least on a local scale where the aquifer is unstressed by pumping. As a general rule, the dissolvedsolids content increases with depth and with the time and distance the water has traveled in the ground. A few uncommon water-quality situations exist throughout the country, reflecting unusual geologic and hydrologic conditions. These include, among others, thermal areas and regions characterized by high concentrations of certain elements, some of which may be health hazards.

For centuries man has been disposing of his waste products by burning, placing them in streams, storing them on the ground, or putting them in the ground using various methods. Man-made influences on streamwater quality reflect not only waste discharge directly into the stream, but also include highly mineralized or polluted surface runoff, which can carry a wide variety of substances. Another major influence on surface-water quality is related to the discharge of ground water into the stream. If the adjacent ground water is polluted, stream quality tends to deteriorate. Fortunately in the latter case, the effect in the stream generally will not be as severe as it is in the ground, due to dilution of the pollutant. See Reference 31 for example.

The quality of ground water is most commonly affected by waste disposal. One major source of pollution is the storage of waste materials in excavations, such as pits or mines. Water-soluble substances that are dumped, spilled, spread, or stored on the land surface or in excavations may eventually infiltrate to pollute ground-water resources. Ground water is also polluted by the disposal of fluids through wells and, in limestone terrains, through sinkholes directly into aquifers. Likewise, inflitration of highly mineralized surface water has been a major cause of underground pollution in several places. Irrigation tends to increase the mineral content of both surface and ground water. The degree of severity of pollution in cases such as these is related to the hydrologic properties of the aquifers, the type and amount of waste, disposal techiniques, and climate.

A major and widespread cause of ground-water quality deterioration is pumping, which may cause the migration of more highly mineralized water from surrounding strata to the well. The migration is directly related to differences in hydrostatic head between adjacent water-bearing zones and to the hydraulic conductivity of the strata. In coastal areas pumping may cause sea water to invade a fresh water aquifer. In parts of coastal west Florida, wild-flowing, abandoned artesian wells have salted, and consequently ruined, large areas of formerly fresh or slightly brackish aquifers.

The list in Table 10 shows that man-influenced groundwater quality problems are most commonly related to: (1)

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

BOARD ORDER NO. 6-01-16
WDID NO. 6B368907001

REVISED WASTE DISCHARGE REQUIREMENTS
FOR

ACE COGENERATION COMPANY; IMC CHEMICAL, INC., ACE POWER PLANT INDUSTRIAL WASTEWATER DISCHARGE

San Bernardino County

The California Regional Water Quality Control Board, Lahontan Region (Regional Board) finds:

1. Discharger

On July 13, 2000, A/C Power, - ACE Operations (ACE), submitted the necessary information to constitute a complete updated Report of Waste Discharge (RWD) for the ACE Plant wastewater discharge. IMC Chemicals, Inc. (IMCC) owns the land on which the plant is located. For the purposes of this Regional Board Order (Order), ACE Cogeneration Company (ACE) and IMC Chemicals, Inc. (IMCC) are referred to as the "Dischargers."

Naming IMCC as a Discharger in this Order is consistent with past determinations by Regional Boards and the State Water Resources Control Board (SWRCB) in naming landowners as Dischargers. If ACE fails to meet the requirements of this Order or future enforcement Orders, the Regional Board will look to IMCC to meet and/or complete the requirements of this Order and/or future enforcement Orders. Before IMCC is required to meet and/or complete such requirements, IMCC will be so informed of such requirements in writing by the Regional Board Executive Officer, and a new time schedule for compliance with such requirements, will formally be established. Hereinafter, the term "Dischargers" will be used to signify the scheme of primary responsibility for ACE and secondary responsibility for IMCC for compliance actions specified in this Order as they affect surface or ground waters on IMCC managed lands.

2. Facility

The Discharger operates a solid fuel (coal and/or petroleum coke) atmospheric fluidized bed combuster boiler at an electrical power and process steam cogeneration plant in Trona, near the west side of Searles Lake as shown on Attachment "A," which is made a part of this Order. The Discharger currently discharges its wastewater into a manhole junction with the IMCC Argus Facility all-other-liquor (AOL) discharge pipeline.

3. Order History

The Regional Board previously established Waste Discharge Requirements (WDRs) for the Facility under Board Order No. 6-90-16, which was adopted on March 8, 1990. On October 23, 1991, the Regional Board's Executive Officer issued a revised Monitoring and Reporting Program. The IMCC Argus Plant effluent is regulated under a separate Order.

4. Reason for Action

The Regional Board is revising WDRs for the Facility as part of a statewide program to periodically review and update WDRs. The purpose of this Order is to incorporate changes in regulations and regulatory policies, which apply to the operation of the Facility.

5. Facility Location

The Facility is located west of the Community of Trona adjacent to the IMCC Argus and Trona Facilities within Sections 7 and 18, T25S, R43 E, MDB&M, as shown on Attachment "A," which is made a part of this Order.

6. Description of Facility and Discharge

The ACE wastewater is composed primarily of cooling tower blowdown water plus other industrial and domestic wastewaters. The industrial wastewater (non-cooling tower blowdown) consists of various supply water treatment wastewater, boiler blowdown water, and plant washdown water. The cooling tower blowdown wastewater will also contain minor concentrations of biocidal and scale or corrosion inhibitors. Boiler, and all other cleaning wastewater, will be discharged in accordance with this Order or disposed of at an approved off-site disposal facility. The domestic wastewater consists of septic tank effluent. Solid waste ash from the ACE Plant is regulated under a separate Order.

After receiving pretreatment by oil/water separation, and septic tank solids removal, the respective flows are combined and discharged via a manhole junction, to the existing IMCC Argus plant all-other-liquor (AOL) discharge pipeline for subsequent conveyance to final disposal as underground injection or surface recharge on Searles Lake.

Non-chemical drains in areas subject to plant washdown and/or incidental spillage of oils are plumbed to the oil/water separator. Intercepted waste oil will be pumped from the separator and disposed of off site by an approved method. The oil/water separator clarified flow is plumbed to a wastewater holding tank where other wastewater including one septic tank discharge, except the neutralization basin discharge, is commingled and pumped to the IMCC Argus brine processing plant AOL discharge line. The wastewater from the water supply treatment process that may include the addition of caustic soda and sulfuric acid is plumbed to a neutralization basin for pH adjustment by the addition of acid or caustic solutions. The neutralization basin discharges to the ACE effluent line at a point downgradient from the wastewater holding tank.

The annual average flows from the ACE Plant to the IMCC AOL discharge line are 0.53 million gallons per day (mgd) of industrial wastewater and 0.0058 mgd of domestic wastewater. The combined ACE Plant effluent contains an annual average of approximately 25,000 mg/l of total dissolved solids (TDS) and pH values between 8.5 and 9.3. The monitoring results are summarized in Table 1.

Table 1

Parameter	Unit[3]	DLR[2]	Sampling Location			
			AOL Manhole[1]	Cooling Tower[1]	Potable Influent[1]	Brackish Influent[1]
Semi-volatile Organic Compounds (SVOC)	µg/l	10	< 10	< 10	< 10	< 10
Volatile Organic Compounds (VOC)	µg/l	5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons (TPH)	mg/l	2.0	< 2.0	< 2.0	< 2.0	< 2.0
Total Dissolved Solids (TDS)	mg/l	10	11,000 – 23,000	12,000 – 25,000	400 - 510	2,900 – 7,350
Arsenic	mg/l	0.02	0.10 – 0.32	.017 – 0.47	0.016 – 0.06	0.06 – 0.26
Chromium	mg/l	0.05	< 0.05	< 0.05	< 5.0	< 5.0
Copper	mg/l	0.05	< 0.05	< 0.05	< 5.0	< 5.0
Nickel	mg/l	0.05	< 0.05	< 0.05	< 5.0	< 5.0
Selenium	mg/l	0.05	0.06 – < 0.05	< 0.05	< 5.0	< 5.0
Zinc	mg/l	0.05	< 0.05	< 0.05	0.053 – 0.08	0.068 – < 0.05
pH	Units	0.1	8.5 – 9.0	8.8 –9.0	8.7 – 9.1	8.9 – 9.3

Note: 1. Data cited from February 1997 to January 2000 ACE Self-Monitoring Report.
2. DLR: Detection Limit for Reporting Purposes.
3. µg/l: micrograms per liter (parts per billion).
mg/l: milligrams per liter (parts per million).

7. <u>Discharger's Water Supply</u>

Water supply to the plant is from the IMCC imported potable supply line and from the local brackish ground water aquifer. The total dissolved solids values for these supplies historically have been in the approximate range of 300-500 mg/l and 5,900-12,700 mg/l, respectively.

8. Authorized Disposal Sites

The authorized final disposal sites are located east of the Community of Trona on Searles Dry Lake within T25S, R43E; MDB&M. The disposal sites lie within the Searles Valley Hydrologic Area of the Trona Hydrologic Unit.

The authorized ACE Plant discharge point for the combined industrial and domestic wastewater is the manhole junction with the IMCC Argus brine processing plant AOL line located at the IMCC Argus brine processing plant as described in Finding No.6.

9. Site Geology

The Plant is located in a closed structural basin filled with alluvium and non-marine evaporites. The basin is in the southwestern part of the Basin and Range geologic province of Southern California. Geologic units in the basin consist of alluvial deposits, saline deposits, and the surrounding bedrock complex. Within the basin, evaporite deposits alternate with mud beds. The thickness of the alluvial deposits range from about twenty feet in the northern portion of the basin to several thousand feet in the center of the valley.

10. Site Hydrogeology

Brackish ground water within the alluvial deposits in the Searles Valley area occurs under both confined and unconfined conditions. Ground water level in the alluvial deposits occurs within a few feet of the surface of the lake bed (at times rising to the surface). Ground water level in the uppermost aquifer beneath the ACE facility occurs at a depth of 170 feet below ground surface (bgs). The average annual precipitation in the vicinity of the ACE Plant is reported to be four inches. The ground water in the vicinity of the ACE Plant has a reported average TDS concentration of 33,200 mg/l.

11. Receiving Waters

The receiving waters are the surface and ground waters of Searles Valley Hydrologic Area of the Trona Hydrologic Unit as set forth and defined in the Water Quality Control Plan (Basin Plan) for the South Lahontan Basin. The Department of Water Resources (DWR) designation for the Searles Valley Hydrologic Area is 621.10.

12. Lahontan Basin Plan

The Regional Board adopted an updated Basin Plan which became effective on March 11, 1995, and amended to the Basin Plan on July 12, 2000. This Order implements the Basin Plan, as amended.

13. Beneficial Uses - Ground Water

The beneficial use of the ground waters of Searles Valley (DWR 6.52, listed in the Basin Plan, Table 2-2 as amended) as set forth and defined in the Basin Plan is:

a. Industrial Service Supply (IND).

Included within industrial service supply, mineralized ground waters of this sub-unit may be processed to make chemicals that can be used as food additives and ingredients in soaps and pharmaceuticals for both internal and external human use.

14. Beneficial Uses - Surface Water

The beneficial uses of the surface waters of Searles Lake (listed in the Basin Plan, Table 2-1) as set forth and defined in the Basin Plan are:

a. industrial service supply (IND);
b. contact water recreation (REC-1);
c. noncontact water recreation (REC-2);
d. wildlife habitat (WILD); and
e. saline water habitat (SAL).

15. California Environmental Quality Act (CEQA)

These revised WDRs are exempt from the provisions of the CEQA (Public Resources Code Section 21000 et seq.) in accordance with Section 15301 (Title 14, California Code of Regulations) because these WDRs govern an existing facility which the Discharger is currently operating.

16. Financial Assurance

The Discharger has provided documentation that financial assurance has been developed for closure and subsequent maintenance of the project site. This Order requires that the Discharger demonstrate, in an annual report, that the amount of financial assurance is adequate, or increase the amount of financial assurance.

17. Notification of Interested Parties

The Regional Board has notified the Discharger and interested parties of its intent to revise WDRs for this discharge.

18. Consideration of Public Comments

The Regional Board, in a public meeting, heard and considered all comments pertaining to the discharge.

IT IS HEREBY ORDERED that the Discharger shall comply with the following:

I. DISCHARGE SPECIFICATIONS

A. Effluent Limitations

1. The discharge of cooling water shall not contain volatile and semi-volatile organics, heavy metals and inorganic salts in excess of the following concentration limits.

Parameter	Unit	Concentration Limit
Total Petroleum Hydrocarbons	mg/l	1
TDS	mg/l	30,000
Volatile Organic Compounds	µg/l	5
Semi-volatile Organic Compounds	µg/l	10
Arsenic	mg/l	0.5
Chromium	mg/l	0.1
Copper	mg/l	1.3
Nickel	mg/l	0.1
Selenium	mg/l	0.25
Zinc	mg/l	5

2. The discharge of demineralizer wastewater from the neutralization basin shall comply with the numerical standards prescribed in Disharge Specification I.A.1.

3. The discharge to the Argus AOL line shall at all times have a pH between 6.0 and 9.5 pH units.

4. The discharge of wastewater from boiler cleaning operations, excluding the one-time initial boiler and pre-boiler cleaning wastewater discharge, shall comply with the numerical standards prescribed in Disharge Specification I.A.1. above, except for hydrazine. The discharge is prohibited if the concentration of hydrazine is greater than 0.01 ug/l after 30-minute neutralization contact time while maintaining a chlorine residual of 3 mg/l or greater.

B. Receiving Water Limitations

This discharge shall not cause a violation of any applicable water quality standard for receiving water adopted by the Regional Board or the SWRCB.

The discharge shall not cause the presence of the following substances or conditions in ground or surface waters of the Trona Hydrologic Unit.

1. Non-native (not naturally occurring in Searles Lake) toxic substances in concentrations that individually, collectively, or cumulatively cause detrimental physiological responses in humans, plants, animals, or aquatic life.

2. Identifiable chlorinated hydrocarbons, organophosphates, carbamates, and other pesticide and herbicide groups, in summation, in excess of the lowest detectable level.

3. Chemical Constituents - Ground or surface waters shall not contain concentrations of chemical constituents that adversely affect the water for beneficial uses.

4. Radioactivity - Waters shall not contain concentrations of radionuclides in excess of limits specified in the CCR, Title 22, Chapter 15, Article 5, Section 64443.

C. General Requirements and Prohibitions

1. There shall be no discharge, bypass or diversion of industrial or domestic wastewater from the collection, transport or treatment facilities to adjacent land areas or surface waters.

2. The discharge of waste, which causes violation of any narrative Water Quality Objective (WQO) contained in the Basin Plan, including the Nondegradation Objective, is prohibited.

3. The discharge of waste, which causes violation of any numeric WQO contained in the Basin Plan, is prohibited.

4. Surface flow or visible discharge of industrial or domestic wastewater from the disposal sites to adjacent land areas or surface waters is prohibited.

5. The discharge of waste except to the authorized disposal sites is prohibited.

6. Neither the treatment nor the discahrge shall cause a nuisance, pollution or threatened pollution as defined by Section 13050 of the California Water Code.

7. The Discharger shall remove and relocate or otherwise mitigate any wastes, which are discharged not in accordance with these WDRs.

8. All spilled material shall be contained and promptly cleaned up. No spilled material shall be discharged from the wastewater system.

9. Precipitation and drainage control facilities installed for the protection of the ACE Plant shall be designed and constructed to accommodate the anticipated volume of precipitation and peak flows from surface runoff in the event of a 100 year, 24-hour precipitation event.

10. Collection and holding facilities associated with precipitation and drainage control systems shall be emptied immediately following each storm or otherwise managed to maintain the design capacity of the system.

11. Best Management Practices (BMPs) shall be used to contain, to the extent practicable, all drippings, leaks, seepages and similar flows from equipment in the Administration/Water Treatment, Turbine Generator and Steam Generator buildings and Transformer Containment facility from being discharged to the wastewater system. This material shall not be routinely discharged to the wastewater system.

12. All discharges from the Transformer Containment facility due to rainfall or fire fighting activities shall be sampled and analyzed prior to any discharge to the wastewater system. No discharge shall occur prior to approval. For any discharge to the wastewater system to be approved, the quality of the wastewater discharged must meet the numerical standards prescribed in Discharge Specification I.A.1. All other discharges from the Transformer Containment facility are prohibited.

13. The discharge of wastewater from cleaning operations shall not contain substances in concentrations that are toxic to, or produce detrimental physiological responses in human, plant, animal, or aquatic life.

14. The waste shall not exhibit hazardous waste characteristics.

II. PROVISIONS

A. Rescission of WDRs

Board Order No. 6-90-16 is hereby rescinded.

B. Standard Provisions

1. The Discharger shall comply with the "Standard Provisions for Waste Discharge Requirements," dated September 1, 1994 (Attachment "B") which is made part of this Order.

2. "Hazardous" waste as used in this Order, is defined by Section 66261.3 of Title 22, CCR.

C. Monitoring and Reporting

1. Pursuant to Section 13267(b) of the California Water Code, the Discharger shall comply with the Monitoring and Reporting Program No. 01-16 as specified by the Executive Officer.

2. The Discharger shall comply with the "General Provisions for Monitoring and Reporting," dated September 1, 1994, which is attached to and made part of the Monitoring and Reporting Program.

D. Review of Project

1. The Regional Board shall reconsider this Order to prescribe more stringent discharge specifications if sampling conducted in accordance with the Monitoring and Reporting Program, or other pertinent data, indicate that the discharge is adversely affecting water quality by discharging: (a) constituents not naturally found in the receiving water or (b) constituents at concentrations greater than naturally occurring receiving water concentrations.

2. The Discharger shall submit a revised Discharge Management Plan (Plan) by **October 1, 2001**. The Plan shall; (a) propose BMPs for source control, facility operations, boiler cleaning process and treatment of wastewater and (b) propose effluent limits which can be achieved which are as close to the natural quality of Searles Lake ground and surface waters as practicable while allowing for the concentration of influent supply water and the discharge of constituents not removed through treatment or the implementation of BMPs. The Regional Board may reconsider this Order to modify the Discharge Specifications upon review of the Plan.

E. Closure and Post-Closure

The Preliminary Closure and Post-Closure Maintenance Plan (CPCMP), shall be updated when there is a substantial change in operations, and a report shall be submitted annually indicating conformance with existing operations. A final CPCMP shall be submitted at least 180 days prior to beginning any partial or final closure activities or at least 120 days prior to discontinuing the use of the site for waste treatment, storage or disposal, whichever is greater. The final CPCMP shall be prepared by or under the supervision of either a Civil Engineer or a Certified Engineering Geologist registered in the State of California. The updating of the CPCMP may be prepared by or under the supervision of the owner or operator of the waste disposal site.

F. Financial Assurance

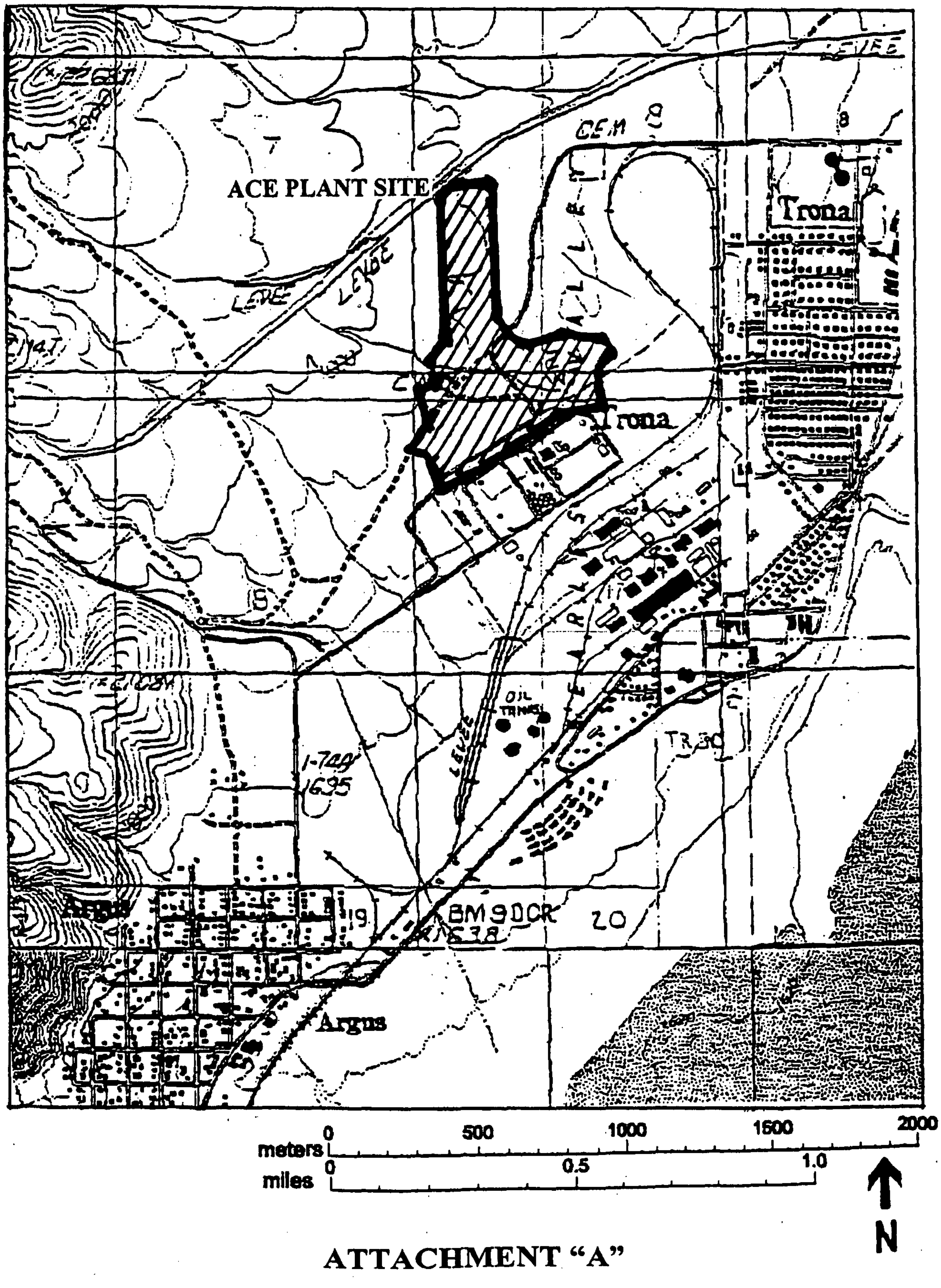
The Discharger shall submit a report annually providing evidence that adequate financial assurance pursuant to the requirements of the WDRs has been provided for closure, post-closure, and for potential releases. Evidence shall include the total amount of money available in the fund developed by the Discharger. In addition, the Discharger shall either provide evidence that the amount of financial assurance is still adequate or increase the amount of financial assurance by the appropriate amount. An increase may be necessary due to inflation, a change in regulatory requirements, a change in the approved closure plan, or other unforeseen events.

I, Harold J. Singer, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Lahontan Region, on April 11, 2001.

HAROLD J. SINGER
EXECUTIVE OFFICER

Attachments: A. Location Map
B. Standard Provisions for WDRs

4/2001 #3 KD/rp ACE WTP WDR



ATTACHMENT "A"

SITE LOCATION AND TOPOGRAPHY

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD

STANDARD PROVISIONS
FOR WASTE DISCHARGE REQUIREMENTS

ATTACHMENT B

1. Inspection and Entry

The Discharger shall permit Regional Board staff:

a. to enter upon premises in which an effluent source is located or in which any required records are kept;

b. to copy any records relating to the discharge or relating to compliance with the Waste Discharge Requirements;

c. to inspect monitoring equipment or records; and

d. to sample any discharge.

2. Reporting Requirements

a. Pursuant to California Water Code 13267(b), the Discharger shall immediately notify the Regional Board by telephone whenever an adverse condition occurred as a result of this discharge; written confirmation shall follow within two weeks. An adverse condition includes, but is not limited to, spills of petroleum products or toxic chemicals, or damage to control facilities that could affect compliance.

b. Pursuant to California Water Code Section 13260(c), any proposed material change in the character of the waste, manner or method of treatment or disposal, increase of discharge, or location of discharge, shall be reported to the Regional Board at least 120 days in advance of implementation of any such proposal. This shall include, but not limited to, all significant soil disturbances.

c. The Owners/Discharger of property subject to Waste Discharge Requirements shall be considered to have a continuing responsibility for ensuring compliance with applicable Waste Discharge Requirements in the operations or use of the owned property. Pursuant to California Water Code Section 13260(c), any change in the ownership and/or operation of property subject to the Waste Discharge Requirements shall be reported to the Regional Board. Notification of applicable Waste Discharge Requirements shall be furnished in writing to the new owners and/or operators and a copy of such notification shall be sent to the Regional Board.

d. If a Discharger becomes aware that any information submitted to the Regional Board is incorrect, the Discharger shall immediately notify the Regional Board, in writing and correct that information.

e. Reports required by the Waste Discharge Requirements, and other information requested by the Regional Board, must be signed by a duly authorized representative of the Discharger. Under Section 13268 of the California Water Code, any person failing or refusing to furnish technical or monitoring reports, or falsifying any information provided therein, is guilty of a misdemeanor and may be liable civilly in an amount of up to one thousand dollars ($1,000) for each day of violation.

f. If the Discharger becomes aware that their Waste Discharge Requirements (or permit) is no longer needed (because the project will not be built or the discharge will cease) the Discharger shall notify the Regional Board in writing and request that their Waste Discharge Requirements (or permit) be rescinded.

3. Right to Revise Waste Discharge Requirements

The Regional Board reserves the privilege of changing all or any portion of the Waste Discharge Requirements upon legal notice to and after opportunity to be heard is given to all concerned parties.

4. Duty to Comply

Failure to comply with the Waste Discharge Requirements may constitute a violation of the California Water Code and is grounds for enforcement action or for permit termination, revocation and reissuance, or modification.

5. Duty to Mitigate

The Discharger shall take all reasonable steps to minimize or prevent any discharge in violation of the Waste Discharge Requirements which has a reasonable likelihood of adversely affecting human health or the environment.

6. Proper Operation and Maintenance

The Discharger shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) that are installed or used by the Discharger to achieve compliance with the Waste Discharge Requirements. Proper operation and maintenance includes adequate laboratory control, where appropriate, and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems that are installed by the Discharger, when necessary to achieve compliance with the conditions of the Waste Discharge Requirements.

7. Waste Discharge Requirement Actions

The Waste Discharge Requirements may be modified, revoked and reissued, or terminated for cause. The filing of a request by the Discharger for waste discharge requirement modification, revocation and reissuance, termination, or a notification of planned changes or anticipated noncompliance, does not stay any of the Waste Discharge Requirements conditions.

8. Property Rights

The Waste Discharge Requirements do not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations.

9. Enforcement

The California Water Code provides for civil liability and criminal penalties for violations or threatened violations of the Waste Discharge Requirements including imposition of civil liability or referral to the Attorney General.

10. Availability

A copy of the Waste Discharge Requirements shall kept and maintained by the Discharger and be available at all times to operating personnel.

11. Severability

Provisions of the Waste Discharge Requirements are severable. If any provision of the requirements is found invalid, the remainder of the requirements shall not be affected.

12. Public Access

General public access shall be effectively excluded from disposal/treatment facilities.

13. Transfers

Providing there is no material change in the operation of the facility, this Order may be transferred to a new owner or operator. The owner/operator must request the transfer in writing and receive written approval from the Regional Board's Executive Officer.

14. Definitions

a. "Surface waters" as used in this Order, include, but are not limited to, live streams, either perennial or ephemeral, which flow in natural or artificial water courses and natural lakes and artificial impoundments of waters. "Surface waters" does not include artificial water courses or impoundments used exclusively for wastewater disposal.

b. "Ground waters" as used in this Order, include, but are not limited to, all subsurface waters being above atmospheric pressure and the capillary fringe of these waters.

15. Storm Protection

a. All facilities used for collection, transport, treatment, storage, or disposal of waste shall be adequately protected against overflow, washout, inundation, structural damage or a significant reduction in efficiency resulting from a storm or flood having a recurrence interval of once in 100 years.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

REVISED MONITORING AND REPORTING PROGRAM NO. 01-16
WDID NO. 6B368907001
FOR

ACE COGENERATION COMPANY; IMC CHEMICAL, INC., ACE POWER PLANT INDUSTRIAL WASTEWATER DISCHARGE

San Bernardino County

I. MONITORING

A. Flow Monitoring

The following shall be recorded in a permanent bound log book:

1. The quantity and identity of each separately identifiable wastewater stream discharged from the ACE Plant effluent discharge line to the manhole junction with IMC Chemicals, Inc. (IMCC) Argus brine processing plant all-other-liquor (AOL) discharge line.

2. The estimated quantity of domestic wastewater discharged from the ACE Plant effluent discharge line to the manhole junction with the IMCC AOL discharge line. Include rationale for estimated flow.

B. Plant Effluent Monitoring

1. A representative grab sample of the effluent discharged from the ACE Plant effluent discharge line to the manhole junction with the IMCC Argus AOL discharge line shall be collected semiannually (during first and third calendar quarters) and analyzed to determine the magnitude of the following parameters:

Parameter	Units	EPA Method
Total Petroleum Hydrocarbons[1]	mg/l	EPA 8015M
Volatile Organic Compounds [1]	µg/l	EPA 624/8260A
Semi-volatile Organic Compounds	µg/l	EPA 625/8270A
Total Dissolved Solids	mg/l	EPA 160.1
Arsenic	mg/L	EPA 6010
Chromium	mg/L	EPA 6010
Copper	mg/L	EPA 6010
Nickel	mg/L	EPA 6010
Selenium	mg/L	EPA 7740
Zinc	mg/L	EPA 6010
pH	pH units	EPA 9040

[1] For the time period between July 1, 2001 and June 30, 2003 these parameters shall be analyzed quarterly.

2. A representative grab sample of the effluent discharged from the cooling water system shall be collected annually (during the first calendar quarter) and analyzed to determine the magnitude of the parameters specified under item I.B.1, Plant Effluent Monitoring.

C. Oil/Water Separator Monitoring

The total volume of wastewater, including the approximate percent of petroleum products, pumped from the oil/water separator shall be recorded monthly for each pumping event. The date, name of authorized pumper/transporter, and final disposal location for each pumping event shall also be recorded in a permanent log.

D. Supply Water Monitoring

Representative 24-hour composite samples of both the influent brackish water and potable supply waters shall be collected annually (during the first calendar quarter) and analyzed for the parameters required under item I.B.1, Plant Effluent Monitoring.

E. Cleaning Wastewater Monitoring

Representative grab samples of each separate cleaning wastewater, including all boiler cleaning solutions and other cleaning wastewaters discharged to the wastewater system, shall be collected during each cleaning event and analyzed to determine the magnitude of the parameters specified under item I.B.1, Plant Effluent Monitoring.

F. Chemical Additive Monitoring

A list of the names and quantities of all chemical additives and their chemical constituents used in the ACE Plant processes, which could be present in the discharge to the Searles Dry Lake, must be prepared annually and submitted within thirty days of adoption of this Order and by January 31 of each subsequent year.

G. Offsite Disposal

The Discharger shall include, in each monitoring report, the volume and type of all waste, including oily wastewater removed from the oil/water separator, hauled off site for disposal. The person or company doing the hauling and the legal point of disposal shall also be recorded in a permanent log.

H. Financial Assurance

In the first quarter report of each year, the Discharger shall submit evidence that adequate financial assurance as described in Finding No. 16 has been obtained. Evidence may include a copy of the renewed financial instrument or a copy of the receipt for payment of the financial instrument. In addition, the Discharger shall either provide evidence that the amount of financial assurance is still adequate or increase the amount of financial assurance by the appropriate amount.

I. Operation and Maintenance

A brief summary of any operational problems and maintenance activities affecting effluent discharges shall be submitted to the Regional Board with each quarterly monitoring report.

This summary shall discuss:

1. Any significant modifications or additions to the wastewater conveyance system, treatment facilities, discharge point or disposal sites;

2. Any major maintenance conducted on the wastewater conveyance system, treatment facilities, discharge point or disposal sites;

3. Any major problems occurring in the wastewater conveyance system, treatment facilities, discharge point or disposal sites;

4. A summary of any spill events occurring during the monitoring period including date, materials and quantity spilled, date of telephone and written reports and disposition of cleanup activities; and

5. The calibration of any wastewater flow measuring devices.

II. REPORTING

A. Semi-annual monitoring reports shall be submitted to the Regional Board by the 30th day of the month following each semester. The reports will be due to the Regional Board on **January 30th** and **August 30th** each year. The report due on January 30th of each year shall contain results of the source water monitoring (Brackish supply water), and a tabulated summary of the previous year's data.

B. On or before **January 30, 2002** and before **January 30** every year thereafter, the Discharger shall submit an annual financial assurance report to the Regional Board. This report shall summarize the amount of money available to ensure the closure and subsequent maintenance of the project site in a manner that will not pose an adverse threat to the environment. This report should also provide a demonstration that the amount of financial assurance is adequate or the need to increase the amount of financial assurance based on inflation or other factors.

C. In accordance with General Provisions 3.a., the Discharger shall make a compliance statement in each submitted monitoring report, noting each violation that occurred during the reporting period and actions taken and/or proposed to return into compliance.

Ordered by: ______________________ Dated: **April 11, 2001**
HAROLD J. SINGER
EXECUTIVE OFFICER

Attachments: A. General Provisions for Monitoring and Reporting

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

GENERAL PROVISIONS **ATTACHMENT A**
FOR MONITORING AND REPORTING

1. SAMPLING AND ANALYSIS

a. All analyses shall be performed in accordance with the current edition(s) of the following documents:

i. Standard Methods for the Examination of Water and Wastewater
ii. Methods for Chemical Analysis of Water and Wastes, EPA

b. All analyses shall be performed in a laboratory certified to perform such analyses by the California State Department of Health Services or a laboratory approved by the Regional Board. Specific methods of analysis must be identified on each laboratory report.

c. Any modifications to the above methods to eliminate known interferences shall be reported with the sample results. The method used shall also be reported. If methods other than USEPA approved methods or Standard Methods are used, the exact methodology must be submitted for review and must be approved by the Regional Board prior to use.

d. The Discharger shall establish chain-of-custody procedures to ensure that specific individuals are responsible for sample integrity from commencement of sample collection through delivery to an approved laboratory. Sample collection, storage and analysis shall be conducted in accordance with an approved Sampling and Analysis Plan (SAP). The most recent version of the approved SAP shall be kept at the facility.

e. The Discharger shall calibrate and perform maintenance procedures on all monitoring instruments and equipment to ensure accuracy of measurements, or shall ensure that both activities will be conducted. The calibration of any wastewater flow measuring device shall be recorded and maintained in the permanent log book described in 2.b, below.

f. A grab sample is defined as an individual sample collected in fewer than 15 minutes.

g. A composite sample is defined as a combination of no fewer than eight individual samples obtained over the specified sampling period at equal intervals. The volume of each individual sample shall be proportional to the discharge flow rate at the time of sampling. The sampling period shall equal the discharge period, or 24 hours, whichever period is shorter.

2. OPERATIONAL REQUIREMENTS

a. Sample Results

Pursuant to California Water Code Section 13267(b), the Discharger shall maintain all sampling and analytical results including: strip charts; date, exact place, and time of sampling; date analyses were performed; sample collector's name; analyst's name; analytical techniques used; and results of all analyses. Such records shall be obtained for a minimum of three years. This period of retention shall be extended during the course of any unresolved litigation regarding this discharge, or when requested by the Regional Board.

b. Operational Log

Pursuant to California Water Code Section 13267(b), an operation and maintenance log shall be maintained at the facility. All monitoring and reporting data shall be recorded in a permanent log book.

3. REPORTING

a. For every item where the requirements are not met, the Discharger shall submit a statement of the actions undertaken or proposed which will bring the discharge into full compliance with requirements at the earliest time and submit a timetable for correction.

b. Pursuant to California Water Code Section 13267(b), all sampling shall be made available to the Regional Board upon request. Results shall be retained for a minimum of three years. This period of retention shall be extended during the course of any unresolved litigation regarding this discharge, or when requested by the Regional Board.

c. The Discharger shall provide a brief summary of any operational problems and maintenance activities to the Regional Board with each monitoring report. Any modifications or additions to, or any major maintenance conducted on, or any major problems occurring to the wastewater conveyance system, treatment facilities, or disposal facilities shall be included in this summary.

d. Monitoring reports shall be signed by:

i. In the case of a corporation, by a principal executive officer at least of the level of vice-president or his duly authorized representative, if such representative is responsible for the overall operation of the facility from which the discharge originates;

ii. In the case of a partnership, by a general partner;

iii. In the case of a sole proprietorship, by the proprietor;

iv. In the case of a municipal, state or other public facility, by either a principal executive officer, ranking elected official, or other duly authorized employee.

e. Monitoring reports are to include the following:

i. Name and telephone number of individual who can answer questions about the report.

ii. The Monitoring and Reporting Program Number.

iii. WDID Number.

f. Modifications

This Monitoring and Reporting Program may be modified at the discretion of the Regional Board Executive Officer.

4. NONCOMPLIANCE

Under Section 13268 of the Water Code, any person failing or refusing to furnish technical or monitoring reports or falsifying any information provided therein, is guilty of a misdemeanor and may be liable civilly in an amount of up to one thousand dollars ($1,000) for each day of violation under Section 13268 of the Water Code.

ANALYSIS OF THE BENEFICIAL USES REC-1, REC-2, SAL, AND WILD WITH RESPECT TO SEARLES DRY LAKE, IMC CHEMICALS, INC., TRONA, SAN BERNARDINO COUNTY AND RESPONSE TO IMCC COMMENTS MADE DURING THE JULY 2000 REGIONAL BOARD MEETING

California Regional Water Quality Control Board, Lahontan Region
15428 Civic Drive, Suite 100
Victorville, CA 92392

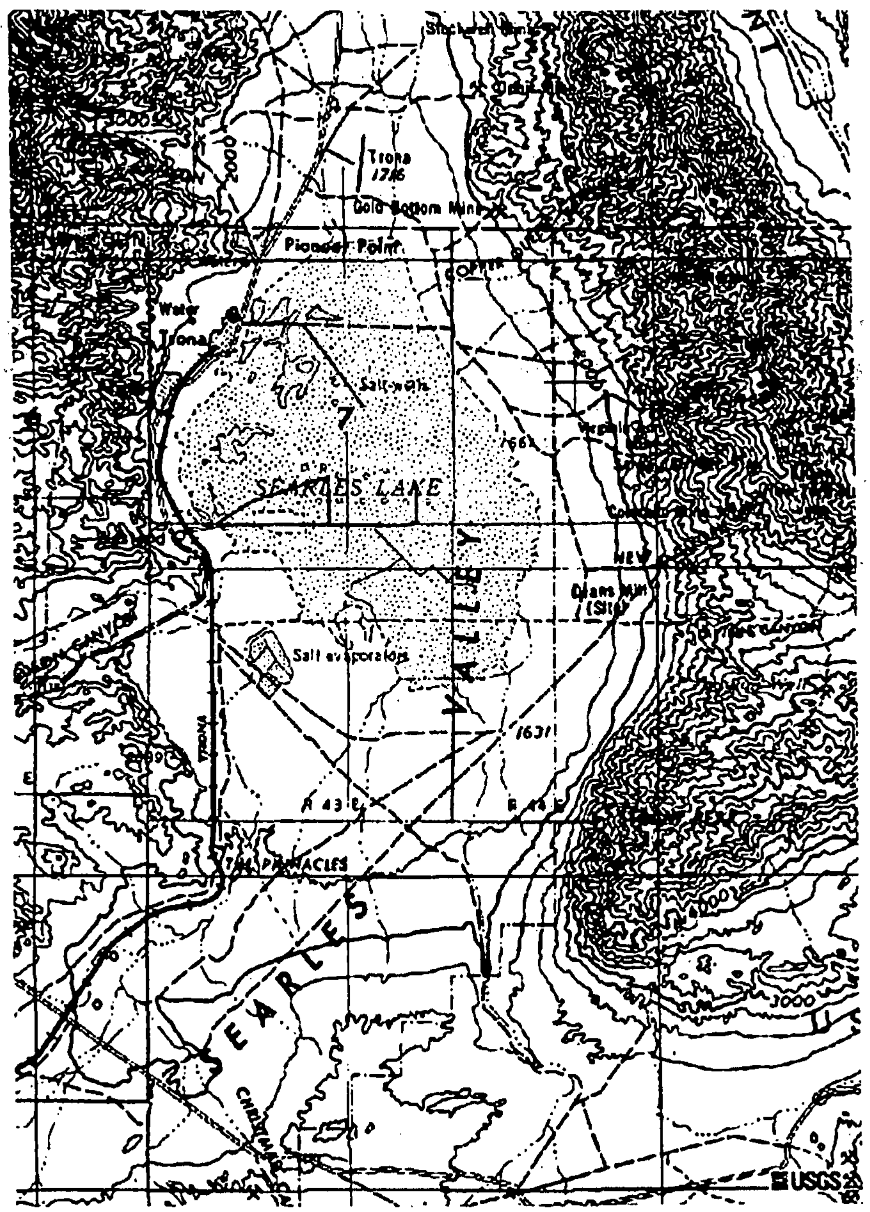
September 2000

Prepared by:

Elizabeth Lafferty, Associate Engineering Geologist
Greg Cash, Associate Engineering Geologist
Jehiel Cass, PE, Associate Water Quality Control Engineer
Judith Unsicker, Ph.D., Environmental Specialist IV (Specialist)

I. INTRODUCTION

At its July 12, 2000 Regional Board Meeting in Tahoe City, the Regional Board adopted amendments to the *Water Quality Control Plan for the Lahontan Region* (Basin Plan) including changes to designated beneficial uses of ground water associated with Searles Dry Lake. Photo #1 shows the location of Searles Dry Lake and Searles Valley, which are located about 20 miles east of Ridgecrest, California in San Bernardino County. The lake bed is located in (but is not the only surface water body within) the Searles Valley Hydrologic Area of the Trona Hydrologic Unit (HU No. 621.10).



(Photo #1)
Topographic Map of Searles Valley
(USGS-Web Page)

At the July 12, 2000 hearing, IMC Chemicals, Inc. (IMCC) and its consultant Tom Dodson presented testimony including written comments (dated June 12, 2000), maps and figures and requested the following modifications and beneficial use changes for "Searles Valley":

- Modification of the region-wide industrial waste discharge prohibition.
- Removal of the municipal and domestic supply (MUN) ground water beneficial use designation for portions of the Searles Valley aquifer.
- Removal of the following surface water beneficial use designations on all or most of the Searles Dry Lake bed: Agricultural Supply (AGR); Water Contact Recreation (REC-1): Non-Contact Water Recreation (REC-2); Inland Saline Water Habitat (SAL); and Wildlife Habitat (WILD)

The first two items above were included in the amendments approved by the Regional Board. The Agricultural Supply (AGR) use was never a formally designated use of Searles Lake. The July 2000 amendments moved a typographically inaccurate "x" in the Basin Plan's beneficial use table (Table 2-1, page 2-37, Trona Hydrologic Unit) to reflect the previously designated Industrial Process Supply or PRO use rather than the AGR use. Removal of the REC-1, REC-2, SAL and WILD uses was not part of the amendments circulated for public review and subsequently approved by the Regional Board.

This report responds to hearing testimony by IMCC representatives concerning the four beneficial uses which were not included in the July 2000 Basin Plan amendments. IMCC had requested removal of these uses earlier, but they were not included in the amendments because, after reviewing available information (including information submitted by IMCC), Board staff concluded that they are "existing" uses under the U.S. Environmental Protection Agency's (USEPA's) water quality standards regulation (40 CFR 131.3). This regulation provides that uses which were existing uses on or after its effective date (November 28, 1975) cannot be removed unless a use requiring more stringent criteria is added.

Staff also responded in writing to IMCC's June 12, 2000 written comments. That response document, which addresses many of the issues included in this report, was sent to Board members in the July agenda packet. Both the earlier response document and this report draw on a review of the scientific literature on the ecology and beneficial uses of saline lakes worldwide. A report summarizing information from this review (California Regional Water Quality Control Board, Lahontan Region, 2000) was sent to Board members in June.

Section II of this report describes each of the four contested beneficial uses, and its applicability to the surface waters of Searles Lake. Section II includes supporting information to show that these uses are "existing" uses under the USEPA regulation. Section III rebuts specific arguments and statements made during IMCC's presentation.

II. EVALUATION OF CONTESTED BENEFICIAL USES

A. Scope of IMCC's Request

The scope of IMCC's request for changes in beneficial use designations has changed over time. In earlier communications with staff, IMCC requested removal of uses from all surface waters in the Searles Valley HA. At the July Regional Board meeting, IMCC's testimony seemed to be focused on the brine ponds. During preparation of this report, staff contacted IMCC to clarify the scope of the request. IMCC is currently proposing removal of the REC-1 and REC-2 uses from the entire lakebed surface and removal of the SAL and WILD uses from the entire lakebed surface except for portions of four topographic sections in the northwest corner of the lakebed.

Regional Board staff disagree that it is appropriate to confine recreational or biological use designations to portions of the lakebed, whether to the ponds or to a topographically designated area. Due to the large size of the lakebed (40 square miles), and the fluctuation of naturally ponded surface runoff (and associated biological communities) over time, it is unlikely that the saline and wildlife habitat potential of the entire lakebed has been adequately characterized by sampling to date. Wildlife, and the dispersal stages of many aquatic organisms, are mobile and do not recognize topographic section boundaries. Much of the lakebed is public land where human access for recreation is not, and probably cannot be restricted.

The brine ponds, which fluctuate in area between about two square miles (summer) and five square miles (winter), are physically connected to both the ground water beneath the lake bed, and to natural ephemeral surface waters which may pond on adjacent lakebed areas. Because they were constructed on, and are tributary to, waters of the State and of the United States, they are waters of the State and of the U.S. The ponds' percolation functions, and their connection with ground water, are recognized in the Regional Board's permits for IMCC (Board Order Nos. 6-91-908, 6-91-909, 6-91-910). Historically, the locations of the brine ponds have moved and the current locations do not include all previous locations. Because of their large size and their percolation function, it would be difficult if not impossible to isolate the ponds physically from adjacent surface and ground waters and to assert that they are separate water bodies which should have different aquatic habitat and wildlife habitat uses, or that they should not be considered waters of the State and of the U.S.

B. General Considerations Regarding Beneficial Uses

- Under the Clean Water Act (Section 131.10(j), states are expected to designate "fishable/swimmable" uses (i.e., aquatic life, wildlife, and recreational) uses, where attainable, for all surface waters.

- The currently designated beneficial uses apply to ephemeral surface waters when water is present. The USEPA does not consider "physical factors" such as low flows to be grounds for not designating recreational uses.

- The beneficial use definitions in the Basin Plan are broad, and include the phrase "including but not limited to".

- The uses in question for Searles Lake are designated uses of <u>all</u> desert playa lakes in the Lahontan Region, and Regional Board staff's literature review on saline lakes indicates that they are existing or reasonably attainable uses of all of these lakes.

C. Recreational Uses

The **Water Contact Recreation (REC-1)** use is defined as *"Beneficial uses of water used 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, and use of natural hot springs"* (Basin Plan, Page 2-2).

The definition of REC-1 includes wading, which occurs in the IMCC brine ponds as shown in photographs #3, 4 and 6. Water contact during mineral collecting has also occurred in the shallow brine on the eastern side of the lakebed (Photo #2). The eastern side of the lakebed is public land under U.S. Bureau of Land Management ownership. It is not an area approved for effluent discharge and is not covered by the IMCC wastewater brine ponds. During mineral collection, an access boring is drilled, the brine is pumped to the surface, and begins to crystallize into recognizable minerals. Mineral collectors and geologists plunge their hands into the brine to find the most favorable specimens. This water contact use is similar to recreational gold mining commonly conducted by prospecting while immersed in a stream. Mineral collecting events may be overseen and controlled by IMCC staff on the lands IMCC controls; however, the activity may still include water contact. See Section III of this report for further discussion of the attainability of the REC-1 use at Searles Lake.

Staff's literature review shows that water contact recreation does occur in saline lakes elsewhere in the world in spite of the poor water quality. In particular, in permanent saline lakes such as Great Salt Lake, the additional bouyancy provided by the high salinity is a recreational attraction in itself.

(Photo #2)-Digging Crystals in Searles Lake
(Trona Gem Club)

(Photo #3)-Collecting Crystals in Searles Dry Lake
(Eclectic Lapidary)
http://www.bovagems.com/eclectical, copyright C. Bova)

(Photo #4)-Collecting Crystals from the Surface water in Searles Dry lake
(Trona Gem Club)

(Photo #5)- A view across brine pond. (Photo #6)-Collecting Crystal Specimen.
(Eclectic Lapidary, http://www.bovagems.com/eclectical, copyright C. Bova)

(Photo #7)-Digging Crystals in Searles Dry Lake
(Trona Gem Club)

Non-contact Water Recreation is defined in the Basin Plan as: *"Beneficial uses of waters used for recreational activities involving proximity to water, but not normally involving body contact with water where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, and aesthetic enjoyment in conjunction with the above activities"* (Basin Plan, Page 2-2).

Board staff have observed that hiking, camping, boating, hunting, sightseeing and aesthetic enjoyment occur in the Searles Dry Lake area. Hiking and hunting occur on the eastern side of the lakebed. Hiking, camping and picnicking occur on the southern edge of the lakebed in the Tufa Towers area. Some uses such as boating are unusual, but Board staff have personally interviewed individuals who have used shallow draft kayaks on the liquid surface to participate in bird watching. Board staff have also personally observed international tourists resting and picnicking at the Rest Stop in Trona, enjoying and commenting on the beauty of the reflected images of the mountains (picnicking, sightseeing and aesthetic enjoyment). As noted in staff's earlier response to IMCC's written comments, the "Searles Lake Borax Discovery" site in Trona is a California State Historical Landmark, the Trona Pinnacles (tufa towers) are a National Natural Landmark, and sightseeing in the Searles Valley is promoted through sources such as the Maturango Museum in Ridgecrest. The REC-2 use is clearly an existing use of Searles Lake.

D. Habitat Uses

Biological integrity. The Clean Water Act requires protection of the "biological integrity" of the nation's waters. Appendix C to the USEPA (1994) *Water Quality Standards Handbook* provides definitions and guidance for the interpretation of "biological integrity". This term is defined as "the condition of the aquatic community inhabiting unimpaired water bodies of a specified habitat as measured by community structure and function". An impairment is "a detrimental effect on the biological integrity of a waterbody caused by an impact that prevents attainment of the designated use". An impact "is a change in the chemical, physical or biological quality or condition of a water body caused by external sources". Using these definitions, the biological communities associated with the ephemeral surface waters of Searles Lake and other desert playa lakes in the Lahontan Region can be seen to have their own unique levels of biological integrity. These waters are not "impaired" for habitat uses under natural conditions, even though chemical and physical water quality may be poor when compared with that of fresh waters, biodiversity may be relatively low, and some mortality of aquatic organisms and wildlife may occur as a result of harsh environmental conditions.

The SAL beneficial use was created with recognition of the unusual nature of inland saline water ecosystems. The original South Lahontan Basin Plan (California Regional Water Quality Control Board, Lahontan Region, 1975, page 1-4-5), states: *"Saline water habitats are relatively limited in number and offer a unique biological setting. Generally, animals and plants associated with salt marshes or saline habitats are somewhat tolerant to extremes of temperature and salinity and this is due to the wide ranges which occur naturally. These habitats provide a valuable source of food for migratory waterfowl and provide resting areas for waterfowl as well. Plants and animals in close association with saline habitats are not common elsewhere in the region and there are also fewer species thus offering less contrast "*

When states adopt "biocriteria" to protect aquatic uses, they generally do so in relation to reference conditions in undisturbed, unimpaired habitats. The reference conditions for Searles Dry Lake include the natural range of salinity, dissolved oxygen and temperature conditions, and the naturally high levels of trace elements such as arsenic. USEPA guidance on the development of site specific criteria based on natural background conditions (USEPA, 1997) states: *"For aquatic life uses, where the natural background concentration for a specific parameter is documented, by definition that concentration is sufficient to support the level of aquatic life expected to occur naturally at the site absent any interference by humans."*

Protection of the biological integrity of Searles Lake, including the brine ponds, would not require IMCC to treat the chemicals naturally present in the brine to levels better than reference conditions. When staff resources and additional biological information on Searles Lake and other desert playa lakes of the Lahontan Region are available, the Regional Board may wish to consider adopting site specific water quality objectives which reflect the unique reference conditions of saline lake ecosystems.

The **Inland Saline Water Habitat (SAL) use** is currently defined as *"Beneficial uses of waters that support inland saline water ecosystems including, but not limited to, preservation and enhancement of aquatic saline habitats, vegetation, fish, and wildlife, including invertebrates"* (Basin Plan, Page 2-2). Biological data for Searles Lake, and staff's review of scientific literature on other saline lakes in California and throughout the world, shows that a variety of plants, animals, and microorganisms are tolerant of the environmental conditions present in the Searles Lake brine ponds and the ephemeral waters which may pond naturally on the lakebed, and that some of these organisms have unique physiological adaptations to extreme environmental conditions including high temperature, low dissolved oxygen, and high salinity. Halobacteria, which are found in the Searles Dry Lake brine pools and waters of saline lakes generally, are salt tolerant, and some grow in conditions at or near salt saturation (about 300,000 mg/L TDS). The unique biochemistry which enables halobacteria to tolerate high salinity has current and potential applications in biotechnology. For example, suspensions of halobacterial membranes are used in the manufacture of recording films for dynamic holograms.

The staff literature review report summarizes the results of a scientific study of 24 California desert playa lakes and associated marsh pools, including field collections and laboratory cultures of sediment samples. The study identified 84 kinds of aquatic or semi-aquatic invertebrates, including rotifers, crustaceans (e.g., fairy shrimp, brine shrimp) and insects, and 46 different kinds of algae. Although they have been little studied, at least 30 species of protozoa are found in saline lakes worldwide. Some of these organisms can survive periods between significant runoff events as drought tolerant resting stages; others are able to survive by active migration to more permanent habitats. Aside from the difficulty of dispersal and potential toxicity from man-made chemicals, there is no reason why the saline aquatic organisms which occur at other hypersaline lakes in California when surface water is present and natural environmental conditions are favorable should not be found at Searles Lake. The SAL use is clearly an existing use of Searles Lake, and an attainable use in the future.

The **Wildlife Habitat (WILD) use is defined as:**. *"Beneficial uses of waters that support wildlife habitats including, but not limited to, the preservation and enhancement of vegetation and prey species used by wildlife, such as waterfowl"* (Basin Plan, Page 2-2). This definition is broad, and does <u>not</u> require that wildlife species be able to complete their entire life cycles using the resources provided by the designated water body. Searles Lake is probably most important as resting habitat for migratory birds. These birds may in turn become a food source to predators or scavengers which live along the perimeter of the lakebed or in the alluvial fan habitats at higher elevations. The saline wetland areas along the edge of the Searles Dry Lakebed provide wildlife habitat.

The California Department of Fish and Game (DFG) has documented several bird species at Searles Dry Lake using the perimeter or the surface of the lakebed as a resting site. Species of birds observed using the lake as a stopover on the Pacific Flyway (see Photos # 8 and 11-15) are Brown Pelicans (*Pelicanus occidentalis*), Common Snipe (Gallinago gallinago), White Faced Ibis (Plegadis chihi), Mallards (*Anas platyrhynchos*) and American Coots (*Fulica americana gmelin*) also known as mud hens. The Brown Pelican, the Mallard and the American Coot have been observed dead or dying at the site (Donna Davis, California DFG, 1997, personal communication). Predator or scavenger species observed at the lakebed include mammals such as the Kit Fox (*Vulpes macrotis*) and the Coyote (*Canis latrans*). These animals have been observed picking up dead birds as food at Searles Dry Lake in addition to other food sources. In addition to providing food for wildlife, migratory birds which visit desert playa lakes serve an important ecological function by carrying aquatic organisms (algae, invertebrates, etc.) from playa to playa.

The concept of biological integrity discussed above recognizes that the natural conditions of a particular ecoregion define acceptable levels of biological use attainment, including acceptable levels of mortality related to natural environmental factors. The death of some birds due to ingestion of or contact with brine is a natural ecosystem process. Mortality due to human alteration of water quality (e.g. discharge of petroleum products) is a "controllable factor" which should be controlled to protect the natural level of biological integrity. Searles Lake clearly supports a wildlife habitat use within the limits of its unique environmental conditions. It is important to note that many flocks of migratory birds come to rest at Searles Lake and safely leave the lake to continue migration.

III. RESPONSE TO SPECIFIC COMMENTS MADE BY IMCC REPRESENTATIVES AT THE JULY 2000 REGIONAL BOARD HEARING

This section includes Board staff's response to issues, questions or statements raised by IMCC staff or IMCC's consultant, Tom Dodson. The comments are summarized or paraphrased below.

A. Contact with the brine occurs only under controlled conditions

Tom Dodson: *You can only become involved with the brines under the most controlled conditions.*

This statement applies to the brine ponds rather than the lakebed as a whole. As noted in the discussion of recreational uses above, the public can access the lakebed from unfenced public lands on the east side of the lake. When the public is allowed on the dry lakebed within areas controlled by IMCC, even under careful supervision, contact with the brine has been documented. The brine is present in some areas of the lakebed under only a 2-inch thick crust, and Board staff have observed people falling through the crust.

B. REC-1 is not and has never been an existing use

Tom Dodson: What are the uses?...REC-1 is... (States from the Basin Plan) These uses include a whole group of uses. It is not an existing use, and never has been. There is nobody who conducts any single one of these uses on the lakebed and never has...EPA has stated that occasional use does not establish a Beneficial Use of a particular water body if it does not have the quality of physical characteristics to support this use.

The discussion and photographs on earlier pages show that recreational contact with Searles Lake brine during mineral collection does occur, and water contact recreation is therefore an existing beneficial use under the EPA water quality standards regulation. IMCC's comments center on whether the use should apply since the brine does not meet criteria for ingestion; see Items 3 and 6 below.

C. Searles Dry Lakebed is a harmful environment

Tom Dodson – *The lake is a harmful environment to humans*

It is important to understand that the natural lakebed surface has been altered by mineral processing activities over the past century. The natural lakebed surface may be present only in selected areas along the east, north and southeast portions of Searles Dry Lake. The brine ponds created by IMCC and its predecessors contain concentrated native and non-native chemicals (from effluent). It is these areas which may contain concentrations of chemicals which exhibit the primary hazardous environment to humans and other wildlife.

Humans are capable of taking precautions to limit their exposure to natural brine chemicals through potential routes of exposure such as ingestion, inhalation and dermal absorption. The risk to adults for most routes of exposure to the brines is very low. The route of highest concern is ingestion, which can be controlled. Dermal absorption is very low. Inhalation is also very low because the brines are saturated and not dry.

D. Does the Lakebed support an ecosystem?

Tom Dodson: *The lakebed ponds are always devoid of oxygen (03. to 0.4% milligrams per liter.) It does not support an ecosystem,...we would typically think of, that would be...supportive of wildlife. There is limited use by terrestrial animals. Birds do use it occasionally and animals have been found on the lakebed, most don't make it across.*

The National Research Council (1992) defines "ecosystem" as "A biological community together with the physical and chemical environment with which it interacts". Even if the biological community consists only of algae and bacteria, it and its environment still constitute an ecosystem. Migratory organisms (including birds and insects) are part of the ecosystem even if they interact with the physical/chemical environment and other plant and animal communities only part of the year. (For example, migratory salmon are important parts of coastal stream ecosystems, even if they spend only part of their life cycles there.) As indicated earlier in the discussions of biological integrity and habitat uses, the saline lakes of the Lahontan Region do support aquatic communities and wildlife habitat uses, and should be considered ecosystems with their own unique biological integrity. The aquatic organisms of saline lakes are adapted to tolerate their harsh environmental conditions, including low dissolved oxygen, or to escape them through resting stages or migration. Biological integrity for the ephemeral waters of desert playa lakes of the Lahontan Region, including Searles Lake, must be measured in comparison to undisturbed reference conditions for other desert playa lakes, not in comparison to other kinds of ecosystems.

E. ERA Report Recommendations

Tom Dodson: *The ERA Report recommended that the Regional Board consider all WILD and SAL dedesignations because of high salinity. This report was proposed six years ago, even before this, the scientists were saying that this is not an environment that will support wildlife. This is not an environment that will support the SAL uses.*

The ERA Report (Ecological Research Associates, 1994) was prepared in response to a requirement in previous Regional Board Orders No. 6-91-908, 909, and 910. The report is a summary of biodiversity and seasonal patterns of aquatic and terrestrial biota which use the brine ponds and their immediate environs. Four on-site surveys were conducted in December 1992, April 1993, August 1993 and February 1994. The report did not assess the entire Searles lakebed, but concentrated only on the area of the brine ponds.

The ERA report recommends that beneficial uses be separately listed for the brine ponds and the rest of Searles Dry Lake. The ERA report does not provide a detailed evaluation to support removal beneficial uses from the entire Searles Dry Lake bed. The report recommends that the only surface water beneficial uses that should apply for the brine ponds are Industrial Service Supply (IND) and Non-Contact Water Recreation (REC-2).

During the four ERA surveys, birds were observed to land on the ponds and after resting for about 30 minutes, they flew away. The ERA report mentions the presence of petroleum hydrocarbon compounds along the edge of the brine ponds, but concludes "inputs of compounds during beneficiation (i.e. petroleum by-products) which are not contained in the natural in-flow brines did not appear to have any harmful consequence." [More recent surveys have document dead waterfowl along the edge of the brine ponds; see Photo #14.]

Section II of this staff report summarizes evidence that the WILD use is an existing use of the brine ponds and other portions of the lakebed. Section II also explains that the SAL beneficial use was created to recognize the existence of uniquely adapted aquatic communities which are tolerant of the high salinity, high temperature, low dissolved oxygen levels, fluctuating water levels, and other extreme environmental conditions associated with natural saline lakes in the Lahontan Region. The Searles Lake brine ponds are comparable in many ways to natural inland saline water habitat, and, in the absence of man-made chemicals such as petroleum products, there is not reason why the SAL use should not be attainable in the ponds.

F. Attainable Beneficial Uses

Tom Dodson: *Federal threshold levels state that an attainable use may be reached by imposition of effluent limits required under sections 301 (b) and 306 of the [Clean Water Act]. These state that ... cost effective and reasonable Best Management Practices for non-point source control may be proposed. No "reasonable" methodologies exist to make the hypersaline brines on Searles Dry Lake suitable for any of the Beneficial Uses for which IMCC has requested de-designation. Inherent chemical qualities of the Searles Dry Lake brine eliminates REC-1, SAL and WILD from beneficial uses.*

The information summarized above demonstrates that the REC-1, SAL and WILD uses occur at Searles Lake, are existing uses within the meaning of the USEPA Water Quality Standards Regulation, and therefore are uses which cannot be removed. Regarding habitat uses, the concept of biological integrity recognizes that each kind of physical/chemical environment supports plant and animal communities adapted to its unique conditions. IMCC is required only to protect the level of biological integrity associated with the range of natural environmental conditions (salinity, etc.) prevalent at Searles Lake. No extraordinary treatment of or application of Best Management Practices to *natural* chemicals is required for use attainment.

The presence of a REC-1 use designation does not require IMCC (or by implication, the U.S. Bureau of Land Management, which owns most of the desert playa lakes in the Lahontan Region) to treat naturally present chemicals to levels which meet drinking water criteria. IMCC has the legal ability to restrict public recreational access to the lands that it controls whether or not the waters within these lands are designated for recreational uses. IMCC cannot restrict public access for recreational use on the lakebed lands it does not control.

IV. CONCLUSIONS AND RECOMMENDATIONS

- The evidence summarized above, including a scientific literature review and Regional Board staff's personal observations, shows that the REC-1, REC-2, SAL, and WILD uses are existing and attainable uses of the surface waters of Searles Lake, including the IMCC brine ponds and ephemeral waters elsewhere on the lakebed. Under federal water quality standards regulations, uses which have existed at any time since November 28, 1975 cannot be removed.

- When sufficient biological information becomes available, the Regional Board may wish to develop and adopt "biocriteria" for desert playa lakes of the Lahontan Region to define reference conditions for evaluation of beneficial use attainment.

- Federal regulations allow states to define subcategories of beneficial uses. The Regional Board might consider adopting a subcategory of the REC-1 use, applicable to all saline and geothermal waters of the Lahontan Region, defined to include body contact with but not ingestion of these waters.

- Regional Board staff believe that IMCC is capable of complying with permit and enforcement order conditions without any further changes in beneficial use designations.

V. BIBLIOGRAPHY

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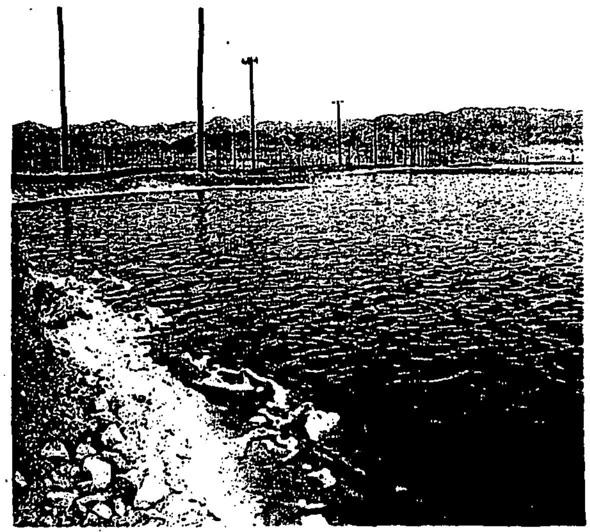
VI. ADDITIONAL PHOTOGRAPHS

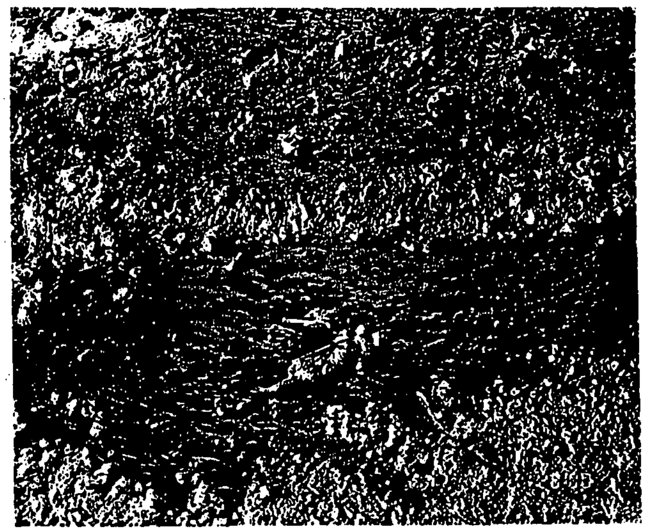
(Photo #8) - Pelicans on Searles Dry Lake (April 2000)
(Department of Fish and Game video)



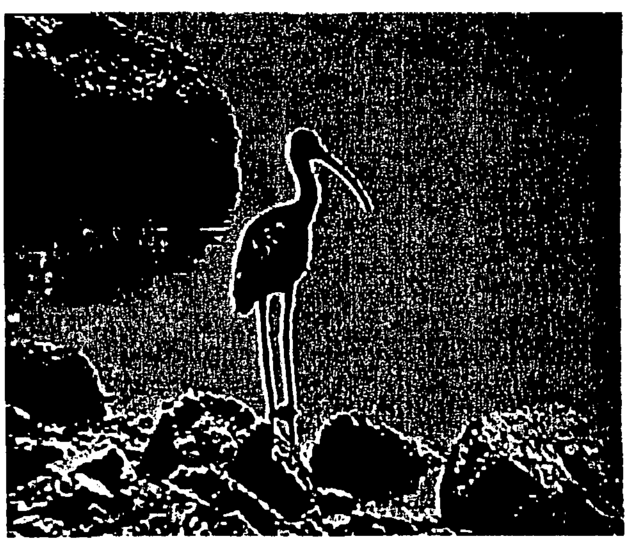
(Photo #9)-Shoreline of Searles Dry Lake
(Trona Gem Club)

(Photo #10) - Aerial Photo of Searles Dry Lake (looking northeast, 2-26-00)
(Department of Fish and Game)

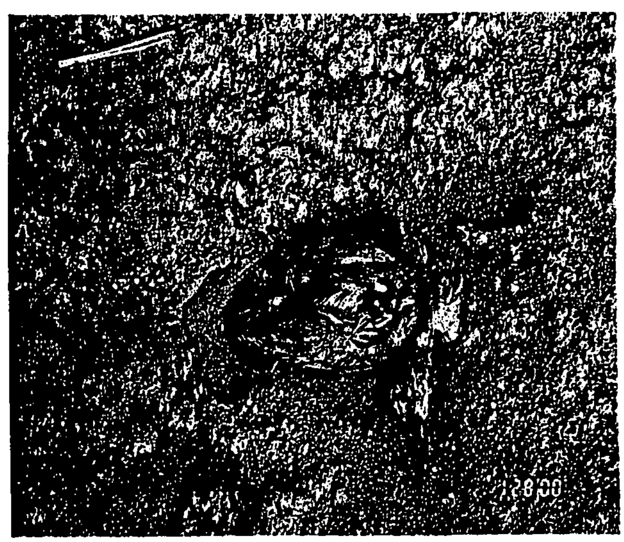
(Photo #11)– Common Snipe on Searles Dry Lake Lake (April 2000-Department of Fish and Game – video)



(Photo #12)-Dead Waterfowl in oil on Searles Dry (1-28-00-Department of Fish and Game)



(Photo #13)-White Faced Ibis on Searles Dry Lake (April 2000) (Department of Fish and Game- video)



(Photo #14) Dead duck, Searles Dry Lake (1-28-00) (Department of Fish and Game)

(Photo #15)-Pacific Flyway Migration Path
(Bureau of Sport Fisheries and Wildlife)