

STATE OF CALIFORNIA
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SANTA ANA REGION

ORDER NO. R8-2018-0092

GENERAL WASTE DISCHARGE REQUIREMENTS
FOR
IN-SITU GROUNDWATER REMEDIATION
AT SITES WITHIN THE SANTA ANA REGION

The California Regional Water Quality Control Board, Santa Ana Region (Regional Water Board), finds that:

1. Discharges of industrial chemicals, industrial waste, fuel and oil wastes, military facility waste, pesticides, heavy metals and other contaminants of concern (COCs) have degraded groundwater at various sites throughout the Santa Ana Region, and have impacted or are threatening to impact beneficial uses of groundwater. The COCs that have been discharged into the environment include, but are not limited to, the following general categories:
 - a. Hydrocarbons, typically those derived from petroleum.
 - b. Chemicals that are built on a hydrocarbon “skeleton,” which include –
 - i. Ethers, such as 1,4-dioxane and methyl tert-butyl ether (MTBE);
 - ii. halogenated hydrocarbons, including many classes of chlorinated hydrocarbons used as solvents and pesticides; and
 - iii. per- and polyfluorinated alkyl substances (PFAS).
 - c. Classes of biological control agents, beyond chlorinated pesticides, used in agriculture or for other purposes.
 - d. Classes of synthetic organic compounds, such as endocrine disruptors and industrial additives.
 - e. Metals, with an emphasis on the heavy metals because of their higher toxicity.
 - f. Oxyanions, such as nitrate and perchlorate.
 - g. Nitroaromatics such as TNT and nitramines such as RDX – essentially organo-nitrogen compounds.

The non-metal COCs, depending on their vapor pressure under a given set of conditions, may be volatile organic compounds (VOCs), semi volatile organic compounds (SVOCs), or non-volatile organic compounds (NVOCS).

2. Amendments are reactive materials, consisting of chemical and biological compounds that, when discharged to the subsurface in appropriate concentrations for the purpose of breakdown of COCs, do not result in significant long-term impairment of the environment (refer to Finding No. 5). Cleanup of groundwater at impacted sites may include the addition (discharge) of amendments as reactive materials into the subsurface (in-situ) to promote groundwater remediation. In-situ treatment may include the vadose zone soil and residual moisture, as well as the groundwater matrix which, involves both water and soil below the water table. This includes discharge of amendments directly to the groundwater, as well as

amendments added to extracted groundwater prior to its reinjection, in a closed loop system, for a “groundwater recirculation” system. Persons applying or proposing to discharge amendments to soil or groundwater to promote groundwater and soil remediation within a specified treatment zone are hereinafter referred to as Dischargers.

3. In-situ treatment includes processes such as oxygen enhancement, chemical oxidation, chemical reduction, biological oxidation or reduction, biostimulation (addition of nutrients to enhance biodegradation), bioaugmentation (introducing appropriate microbial consortium), and biogeochemical transformation. Also, for the purposes of this Order, groundwater extraction and amendment, with return of amended groundwater to the subsurface (groundwater recirculation) is also considered in-situ remediation. The application of amendments can be active, with hydraulic control of the treatment zone as the amendments are added to the extracted groundwater and recirculated through the subsurface, or passive, with the amendments injected into the treatment zone without hydraulic control.
4. The discharge of amendments to remediate groundwater may require bench-scale and/or small-scale pilot testing prior to design and implementation of full-scale remediation. The Executive Officer of the Regional Water Board (Executive Officer) will make the determination whether bench- or pilot-scale testing would be required. Discharges of amendments for both pilot studies and full-scale remediation are covered under this Order.
5. The discharge of amendments into soil or groundwater could affect the quality of waters of the State (i.e. groundwater). is therefore subject to waste discharge requirements (WDRs) in accordance with California Water Code (CWC) Section 13263. With proper management as required by this Order, however, the potential effects will be localized, of short duration, and are not expected to irreversibly violate water quality objectives. Groundwater monitoring is also required, including Compliance Points located outside of the treatment zone and boundaries of the plume, to verify that no irreversible violation occurs.
6. This Order sets forth general WDRs to regulate the discharge of amendments for the in-situ biological, chemical, and physical remediation of COCs in soil and groundwater. CWC Section 13263(i) establishes criteria that must be met by the Regional Water Board in order to prescribe general WDRs. The Regional Water Board finds that all of the following criteria, specified in CWC Section 13263(i), are applicable to the discharges authorized under this General Waste Discharge Requirements:
 - (a) The discharges are produced by the same or similar operations – the two methods for delivery of amendments are gravity (i.e., no pressure) injection and injection under pressure.
 - (b) The discharges involve the same or similar types of waste – all amendments are screened for their potential to degrade or destroy COCs.
 - (c) The discharges require the same or similar treatment standards – the effectiveness of all treatments is measured by the same chemical constituents and parameters that comprise our standards for site cleanup.
 - (d) The discharges are more appropriately regulated under general discharge requirements than individual discharge requirements—the general WDRs, as opposed to individual WDRs, for in-situ groundwater remediation will: (1) simplify the application process for Dischargers, (2) allow more efficient use of Regional Water Board resources, (3) provide for protection of groundwater, and (4) provide a level of protection comparable to individual WDRs. Therefore, it is more appropriate to regulate these discharges under general WDRs than individual WDRs.

7. State Water Resources Control Board (State Water Board) Resolution No. 68-16 requires that in regulating the discharge of waste, the high-quality waters of the State shall be maintained unless it is demonstrated that any change in quality will be consistent with the maximum benefit to the people of the State, will not unreasonably affect beneficial uses, and will not result in water quality less than that described in water quality control policies. The Regional Water Board's Water Quality Control Plan (Basin Plan) specifies water quality objectives (WQOs) for groundwater within the Santa Ana Region (described further in Finding No. 11). The temporary degradation allowed by this Order, within the in-situ treatment zone, is consistent with Resolution No. 68-16 because (a) the purpose of discharging amendments to the groundwater is to accelerate and enhance remediation of groundwater pollution, and such remediation will benefit the people of the State; (b) the degradation is limited in scope and duration; (c) best practicable treatment and control of the discharge necessary to assure that a pollution or nuisance will not occur and the highest water quality consistent with maximum benefit to the people of the State will be maintained, including adequate monitoring and hydraulic control to assure protection of water quality, are required by this Order; and (d) the discharge will not cause WQOs to be exceeded beyond the Compliance Point(s), and potential increases in concentrations above WQOs within the zone of distribution are expected to be temporary, and will not result in long-term deleterious effects on water quality.
8. The amendments that can be used under this Order to remediate the target COCs in soil and groundwater are listed in Attachment A to this Order.
9. State Water Board Resolution No. 92-49 ("Policies and Procedures for Investigation and Cleanup and Abatement of Dischargers Under Water Code Section 13304")(Resolution No. 92-49) requires the Regional Board to require actions for cleanup and abatement of discharges that cause or threaten to cause pollution or nuisance to conform to the provisions of State Water Board Resolution No. 68-16 ("Statement of Policy with Respect to Maintaining High Quality of Waters in California")(Resolution No. 68-16) and the Basin Plan. Pursuant to Resolution No. 92-49, the Regional Board shall ensure that dischargers are required to clean up and abate the effects of discharges in a manner that promotes attainment of either background water quality, or if background levels of water quality cannot be restored, the best water quality which is reasonable, and which complies with the Basin Plan including applicable WQOs. This Order is consistent with State Water Board Resolution No. 92-49: "Policies and Procedures for Investigation and Cleanup and Abatement of Discharges under Section 13304 of the Water Code" by conforming with section III(F)(2)(b). This Order is also consistent with other applicable water quality policies and procedures, and regulations adopted by the State Water Board.
10. The Regional Water Board, acting in accordance with CWC section 13244, adopted a revised Basin Plan on March 11, 1994. The Basin Plan was subsequently approved by the State Water Board on July 21, 1994. Subsequent revisions to the Basin Plan have also been adopted by the Regional Water Board and approved by the State Water Board as recently as February 2016. The Basin Plan identifies beneficial uses and WQOs for waters within the Santa Ana Region, including Groundwater Management Zones (GMZs). The designated beneficial uses for the GMZs include Municipal and Domestic Supply, Agricultural Supply, Industrial Service Supply, and Industrial Process Supply. The requirements contained in this Order are consistent with the Basin Plan.
11. In accordance with Section 2200, Title 23 of the California Code of Regulations (CCR), each discharger for whom WDRs have been prescribed is required to submit an annual fee to the

State Water Board. The annual fee is based on (1) the threat to water quality and (2) the complexity of the discharge, in accordance with the ratings in the annual fee schedule contained in section 2200. It is expected that most, if not all, of the discharges covered by this Order will have a threat to water quality of Category 3 and a complexity rating of B, for a combined rating of 3-B. Category 3 is the lowest threat to water quality category, and Category B is the middle complexity rating, for dischargers that have a physical, chemical or biological treatment system, and do not meet the higher complexity rating definition for Category A. Discharges with a rating of 3-B contain pollutants that could degrade water quality or cause a minor impairment of designated beneficial uses within the treatment zone of the receiving groundwater.

12. Each discharge authorized under this Order will have a site-specific groundwater monitoring and reporting program that will comply with the requirements prescribed in this Order. The groundwater monitoring and reporting program will address changes in geochemistry that may alter the oxidation/reduction state of one or more constituents within the treatment zone, and consequently may result in the production of non-desirable compounds, such as hexavalent chromium, within the treatment zone.
13. The Regional Water Board is the lead agency pursuant to the California Environmental Quality Act (CEQA; Public Resources Code, section 21100 et seq.). The issuance of WDRs for the cleanup of defined groundwater contamination plume(s) is exempt from CEQA as a Class 30 exemption pursuant to California Code of Regulations, title 14, section 15330. Class 30 covers any minor cleanup actions taken to prevent, minimize, stabilize, mitigate, or eliminate the release or threat of release of a hazardous waste or substance which are small or medium removal actions costing \$1 million or less. Projects covered under this order may not exceed \$1 million in costs and may not include the onsite use of a hazardous waste incinerator or thermal treatment unit or the relocation of residences or businesses, or an action that involves the potential release into the air of VOCs.
14. These general WDRs are not intended to alter or supersede any existing requirements of local governmental agencies.
15. The Regional Water Board has notified interested agencies and persons of its intent to prescribe general WDRs for these discharges and has provided them with an opportunity to submit their written views and recommendations.
16. The Regional Water Board in a public meeting heard and considered all comments pertaining to the general WDRs.

IT IS HEREBY ORDERED that, pursuant to Section 13263 of the CWC, Dischargers authorized to discharge under this Order, in order to meet the provisions contained in Division 7 of the CWC, and regulations adopted thereunder, shall comply with the following:

A. CONDITIONS OF ELIGIBILITY

1. A Discharger may seek coverage under this Order to discharge amendments to groundwater for the purpose of promoting in-situ remediation of COCs, provided that the cost of the remediation does not exceed \$1 million in costs and will not involve the onsite use of a hazardous waste incinerator or thermal treatment unit or the relocation of residences or businesses, or an action that involves the potential release into the air of volatile organic compounds. The amendments that are authorized to be discharged in

accordance with this Order are listed in Attachment A.

2. In order for a Discharger to be covered under this Order, the Discharger must:
 - (a) Submit a Report of Waste Discharge (ROWD) using Standard Form 200, or any subsequent form approved by the State Water Board or the Executive Officer of the Regional Water Board. The ROWD shall contain the information specified in Attachment B (1) to this Order, and
 - (b) Have a Remedial Action Plan (RAP) approved by the Executive Officer. The RAP shall contain, at a minimum, the information specified in Attachment B (2) to this Order,
3. Upon receipt of the ROWD with necessary fees, and the RAP, the Executive Officer shall determine the applicability of this Order to such a discharge and the completeness of the application package.
4. If the discharge meets the requirements specified in this Order, the Executive Officer shall notify the Discharger that the discharge is authorized under the terms and conditions of this Order. However, if the Executive Officer finds that there may be impacts to water quality beyond that contemplated by this Order or that significant public controversy has emerged or will likely arise from enrolling the project under this Order, the Executive Officer shall develop individual WDRs to be considered at a regularly scheduled Regional Water Board meeting.

B. DISCHARGE PROHIBITIONS

1. The discharge of wastes in a manner other than as described in this Order is prohibited.
2. The discharge of treated or untreated solid or liquid waste to a navigable waters or tributaries of navigable waters is prohibited, unless that discharge is covered under separate National Pollutant Discharge Elimination System (NPDES) permits issued by the Regional Water Board.
3. The use of any amendment not included in Attachment A is prohibited.
4. The discharge of any radiological, chemical, or biological warfare agent or high level radiological waste is prohibited.
5. The discharge of wastes in geological formations in a manner that increases the mobility and/or extent of the contaminant plume through fracturing of the geologic formation is prohibited. Additionally, fracturing of aquitards that separate two distinct water-bearing zones is prohibited under any condition.

C. DISCHARGE LIMITATIONS AND SPECIFICATIONS

1. The injection and treatment processes shall be designed and implemented in such a way as to minimize or prevent the surfacing of wastes or an overflow of wastes or chemicals used in the treatment process. Any injection process that results in the excessive surfacing of waste shall be discontinued, and measures shall be taken to eliminate further surfacing.
2. The discharge of amendments shall not cause total dissolved solids (TDS) to exceed the

concentrations specified in Table 4-1 or the narrative WQOs specified in Chapter 4 of the Basin Plan for each groundwater management zone (GMZ), at the Compliance Points to be defined in the Monitoring and Reporting Program issued by the Executive Officer.

3. The discharge of amendments shall not cause nitrogen as nitrate-nitrogen (NO₃-N) to exceed the concentrations specified in Table 4-1 or the narrative WQOs specified in Chapter 4 of the Basin Plan for each GMZ, at the Compliance Points.
4. The discharge of amendments shall not cause the pH of the receiving groundwater at the Compliance Points to exceed or be below the range of 6 to 9.
5. The discharge of amendments shall not cause the remediation-target constituents, including their intermediate degradation products, to exceed background concentrations at the Compliance Points.
6. The discharge of amendments shall not cause any other applicable WQOs specified in the Basin Plan to be exceeded in the affected groundwater at the Compliance Points as defined in Attachment C.
7. The discharge of amendments shall not cause the groundwater at the Compliance Points to contain taste or odor producing substances at concentrations that cause a nuisance or adversely affect beneficial uses.
8. The discharge of amendments to property that is not owned or under the control of the Discharger is prohibited. The property under the control of the Discharger includes the horizontal borders of the treatment zone where the Discharger holds an agreement with the overlying property owner for purposes of investigation and remediation.
9. The discharge of amendments shall not cause the concentrations of chemical constituents of the receiving groundwater, which is designated in the Basin Plan as domestic and municipal supply, to exceed State or Federal Drinking Water Standards at the Compliance Point(s).
10. The Executive Officer is hereby authorized to approve modifications to Attachment A, based on technical information for the amendments such as manufacturer's safety data sheets and peer reviewed and published case studies. Updates to Attachment A will be posted on the Regional Water Board website within 30 days of receiving the Executive Officer's approvals:
https://www.waterboards.ca.gov/santaana/water_issues/programs/scp/index.html
11. The Executive Officer is hereby authorized to revise the information included in Attachments B and C as deemed appropriate on a case by case basis.

D. PROVISIONS

1. Neither the treatment nor the discharge of waste shall create a pollution, contamination or nuisance, as defined by Section 13050 of the CWC.
2. A copy of this Order shall be available at all times to operating personnel.
3. The Discharger shall allow Regional Water Board staff to:

- (a) Enter upon the Discharger's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this Order,
 - (b) Have access to and copy, at reasonable times, any records that must be kept under the conditions of this Order,
 - (c) Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this Order, and
 - (d) Sample or monitor, at reasonable times for the purposes of assuring compliance with this Order or as otherwise authorized by the CWC, any substances or parameters at any location.
4. Any Discharger who intentionally or negligently violates this Order shall be liable civilly in accordance with CWC Section 13350.
5. The CWC provides that any Discharger failing or refusing to furnish technical or monitoring program reports, as required by this Order, or falsifying any information provided in the monitoring reports, is guilty of a misdemeanor and is subject to a civil liability in accordance with CWC Section 13268.
6. The Discharger shall report any noncompliance that may endanger health or the environment. Any such information shall be provided orally or by e-mail to: info8@waterboards.ca.gov to the Regional Water Board within 24 hours from the time the Discharger becomes aware of the circumstances. A written submission shall also be provided within 5 days of the time the Discharger becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected; the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance. The Executive Officer, or an authorized representative, may waive the written report on a case-by-case basis if the oral or the e-mail report has been received within 24 hours.
7. The Discharger shall take all reasonable steps to minimize or correct any adverse impact on the environment resulting from noncompliance with this Order, including such accelerated or additional monitoring as may be necessary to determine the nature and impact of the noncompliance.
8. The Discharger shall furnish, under penalty of perjury, technical monitoring program reports; such reports shall be submitted in accordance with specifications prepared by the Executive Officer, which specifications are subject to periodic revisions as may be warranted (CWC Section 13267). This includes the Monitoring and Reporting Program that the Executive Officer issues to each Discharger, in accordance with this Order.
9. Where the Discharger becomes aware that it failed to submit any relevant facts in a ROWD or submitted incorrect information in a ROWD or in any report to the Regional Water Board, it shall promptly submit such facts or information.
10. (a) All reports of waste discharge submitted to the Regional Water Board pursuant to CWC Section 13260 shall be signed and certified as follows:
 - i. For a corporation – by a principal executive officer or at least the level of vice president,

- ii. For a partnership or sole proprietorship – by a general partner or the proprietor, respectively
 - iii. For a municipality, state, federal, or other public agency – by either an executive officer or a ranking elected official.
- (b) All other reports required by this Order and other information required by the Regional Water Board shall be signed by a person designated in paragraph (a) of this provision, or by a duly authorized representative of that person. An individual is a duly authorized representative only if all of the following are true:
- i. The authorization is made in writing by a person described in paragraph (a) of this provision,
 - ii. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, and
 - iii. The written authorization is submitted to the Regional Water Board.
- (c) Any person signing a document under this section shall make the following certification:

"I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment."

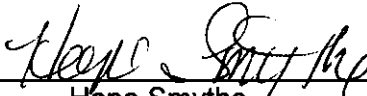
11. This Order does not convey any property rights of any sort or any exclusive privileges. The requirements prescribed herein do not authorize the commission of any act causing injury to persons or property, nor protect the Discharger from liability under federal, State or local laws, nor create a vested right for the Discharger to continue the waste discharge.
12. The provisions of this Order are severable, and if any provision of this Order, or the application of any provision of this Order to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this Order, shall not be affected thereby.
13. This Order becomes effective on the date of adoption by the Regional Water Board. This Order is in effect until rescinded by the Regional Water Board. Coverage under this Order may be terminated by the Executive Officer at any time upon giving reasonable notice to the Discharger.
14. The discharger shall take all reasonable steps to comply with the requirements of the United States Environmental Protection Agency Underground Injection Control program, specified in the Code of Federal Regulation, Title 40, Part 144.12(a).

E. MONITORING AND REPORTING REQUIREMENTS

1. The Executive Officer is hereby authorized to prescribe a Monitoring and Reporting Program for each authorized Discharger that includes essential elements from the Monitoring and Reporting Program template (Attachment C).
2. The Discharger shall file with the Regional Water Board technical monitoring reports in accordance with the Monitoring and Reporting Program specified by the Executive Officer and shall submit other reports as requested by the Executive Officer.

F. This order rescinds and replaces Order No. R8-2013-0029. This order does not affect previously authorized discharges under Order No. R8-2013-0029.

I, Hope Smythe, Executive Officer, do hereby certify that the forgoing is a full, true, and correct copy of an order adopted by the California Regional Water Quality Control Board, Santa Ana Region, on October 19, 2018.



Hope Smythe
Executive Officer

Attachment A List of Authorized Amendments

The following amendments are authorized to be used for in-situ remediation purposes in accordance with this Order. However, the presence of a material under one of the following categories does not necessarily guarantee the approval of the ROWD application by the Executive Officer. Other commercially available amendments that are not listed under a specific category may be applied upon approval by the Executive Officer.

1. Oxidation/Aerobic Degradation Enhancement Compounds:

This group encompasses chemicals that release oxidative free radicals interacting with and destroying COCs.

- Fenton's reagent (hydrogen peroxide, iron catalyst, and pH buffer)
- Hydrogen Peroxide
- Ozone
- Potassium or Sodium Permanganate
- Activated Sodium Persulfate
- Activated Sodium Percarbonate

2. Chemical Oxidant Activators:

In general, this group of compounds include activators required to essentially speed up the rates of oxidation reactions.

- Ferrous Iron
- Ferric Iron
- Chelating Agents (e.g., EDTA)
- Sodium Phytate
- Sodium Hydroxide
- Calcium Hydroxide
- Calcium Peroxide
- Calcium Carbonate
- Calcium Magnesium Carbonate
- Calcium Oxide
- Sulfuric Acid (catalyst only)
- Phosphoric Acid
- Silica and Silicates

3. Aerobic Bioremediation/Biological Oxidation:

In general, this group of chemicals include compounds releasing molecular oxygen or contain alternative electron receptors that serves as an electron acceptor for microorganisms to perform biological oxidation.

- Magnesium Oxide/Hydroxide/Peroxide
- Calcium Oxy-hydroxide
- Calcium Oxide/Hydroxide/Peroxide
- Oxygen/Peroxygens
- Nitrates

- Phosphates
- Ammonium Sulfate
- Ammonium Chloride
- Ammonium Carbonate
- Sodium Carbonate/Percarbonate

4. Aerobic Co-metabolic Bioremediation:

This group of compounds include chemicals that enhance co-metabolic bioremediation. During this process, microorganisms use the amendments to produce the non-specific enzymes and degrade COCs that do not support microbial growth.

- Methane
- Ethane
- Propane
- Butane
- Oxygen
- Nitrous Oxide
- Triethylphosphate

5. Reducing/Reductive Degradation Enhancement Compounds:

In general, this group of compounds involve treatment of COCs by chemical reduction including hydrogen, various sizes of zero valent iron (ZVI), zinc, polysulfide salts. This group of compounds can also be used to promote biogeochemical transformation of COCs. Biogeochemical transformation is the abiotic transformation of COCs by highly reduced iron minerals that have been formed by microbial activity. The biogeochemical transformation may be applied in the subsurface through direct injection, permeable reactive barriers (PRB), and in-situ bioreactors.

- Ferrous Sulfate
- Magnesium sulfate
- Calcium sulfate (gypsum)
- Sodium sulfate
- Potassium sulfate
- Ferrous lactate
- Ferrous Chloride
- Ferrous Carbonate
- Ferrous Gluconate
- Sorbitol Cysteinate
- Sodium Sulfide
- Sodium Dithionite
- Calcium Polysulfide
- Molecular Hydrogen
- Zero-Valent Iron
 - Granular
 - Emulsified
 - Micro-scale
 - Nano-scale

6. Anaerobic Biological Reduction/Dechlorination Compounds:

This group of chemicals includes utilizing organic matters in remediation processes in which microbial fermentation results in release of hydrogen/electron and reduce the COCs (e.g. reductive dechlorination of chlorinated VOCs or reduction of metals).

- Molasses
- Cheese Whey
- Starch
- Emulsified Vegetable Oil
- Corn Syrup
- Lactose
- Glucose
- Ethanol
- Methanol
- Propanol
- Lecithin
- Glycerol, Xylitol, Sorbitol
- Polylactate esters of fatty acids (e.g., Glycerol tripolylactate)
- Acetic acid and its salts
- Lactic acid and its salts
- Propionic acid and its salts
- Citric acid and its salts
- Benzoic acid and its salts
- Oleic acid and its salts
- Various Bean Oils (soy, guar, etc.)
- Complex sugars
- Food process byproducts including milk whey or yeast extract
- Complex organic material such as wood chips

7. Surfactants/Co-solvents:

In general, this group of compounds include electrolytes and co-solvents which improve contaminant mass recovery and prevent formation of gels in the subsurface. Surfactant/co-solvents are classified by ionic charge of the hydrophilic group in aqueous solution. As such, they are divided into ionic (i.e. anionic [e.g. sodium lauryl sulfate] vs. cationic [e.g. pH-dependent amines]) and nonionic. Various biodegradable long-chain alcohols, alcohol-based solutions, and electrolytes with low toxicity qualify to be used under this group.

- Terpenes
- Citric Acid
- Sodium Citrate
- Methyl Soyate
- Dibutyl Itaconate
- Ethyl Lactate
- Natural Oil Derived surfactants
- Ethoxylated Coco Fatty Acid Surfactants
- Ethoxylated Castor Oils Surfactants
- Ethoxylated Cocamides Surfactants
- Decyl Glucoside Sorbitan Oleate Surfactants

- Linear Alkyl Ether Surfactants
- Glycerol Monooleate
- Sorbitan Monolaurete

8. Bioaugmentation Organisms:

Bioaugmentation is introduction of specific competent strains, microbial consortium, or enzyme for improvement of the degradative capacity of the subsurface. Other amendments typically used in moderate or trace amounts could play a role in supporting bioremediation (e.g. trace metals, nutrients including Nitrogen, Phosphate, Potassium, vitamins).

- Dehalococcoides sp.
- Dechloromonas
- Dehalobacter
- Dehalogenimonas
- Desulfuromonas
- Desulfitobacterium
- Desulfovibrio
- Alcaligenes
- Arthrobacter
- Geobacter
- Nitrosomonas
- Nitrobacter
- Rhodococcus
- Pseudomonas
- Sphingomonas
- Mycobacterium

9. Sorbents

This group of compounds are essentially inert and remove the COCs using physical processes (i.e. adsorption). The major classes of sorbents include (a) inorganic complexes designed to adsorb and sequester metals and (b) carbon compounds designed to adsorb organics.

10. Tracer Study Compounds:

The tracer compounds shall be highly contrasting and not reactive with COCs to be treated (e.g. family of halogen salts).

- sodium fluorescein
- calcium chloride
- sodium chloride
- calcium bromide
- sodium bromide
- potassium bromide
- potassium iodide
- Rhodamine dyes
- Eosin dyes

11. Buffer Solutions:

Buffer solutions may be used to create groundwater pH conditions favorable for bacterial degradation of COCs, adjust oxidation/reduction (redox) potential (e.g. amino acid cysteine), or to adjust pH for treatment of metals in groundwater.

- calcium carbonate
- magnesium oxide
- magnesium hydroxide
- potassium bicarbonate
- sodium bicarbonate

12. Antifouling Agents:

This group of compounds are added to the subsurface to prevent or reduce undesirable effects of fouling in which a surface becomes encrusted with material from the surrounding environment. In biofouling, the encrusted material consists of organisms and their by-products.

- Chlorine dioxide
- Sodium hypochlorite
- Calcium hypochlorite
- Hydrogen peroxide
- Methylparaben
- Propylparaben

Attachment B
Requirements for Report of Waste Discharge (ROWD),
Minimum Requirements for the Remedial Action Plan (RAP)
&
Requirements for Electronic Submittal of Data

To be authorized to discharge under this Order, the Discharger must submit a ROWD in accordance with the following requirements. The discharge shall not commence until receipt of the Executive Officer's written authorization and a site-specific monitoring and reporting program. The Discharger shall comply with the following:

1. The Discharger shall submit a ROWD, as follows:
 - (a) Standard Form 200, or any subsequent form approved by the State Water Board or the Executive Officer of the Regional Water Board, shall be completed in full.
 - (b) The ROWD shall be accompanied by the first annual fee (if appropriate) in accordance with the current version of California Code of Regulation, Title 23, Division 7, Chapter 9, Waste Discharge Report and Requirements Article 1 fees for a discharge. The check or money order shall be made payable to the "*State Water Resources Control Board.*"
2. The ROWD shall be accompanied by a RAP, prepared and signed by a licensed civil engineer or licensed geologist as appropriate, which includes, at a minimum, the following information:
 - (a) A Conceptual Site Model for the site, including a characterization of the nature of petroleum hydrocarbon compounds, VOCs and other contaminants of concern in groundwater (and soil, if applicable), and a description of the treatment system.
 - (b) A description of site-specific hydrogeologic characteristics including significant water bearing zones, aquitards, and hydraulic conductivity.
 - (c) The GMZ, beneficial uses, and WQOs designated in the Basin Plan for the site.
 - (d) The background quality of groundwater not affected by the contaminants of concern.
 - (e) Safety Data Sheets and other product information for any materials (such as specific impurities) to be discharged in compliance with this order.
 - (f) A list of the amendments to be discharged in compliance with this Order, including the working/reacting mechanisms, breakdown reactions, reaction byproducts, and toxicity information of the byproducts.
 - (g) A detailed description of the amendment delivery system, including, material types(s), total application volumes, applied concentrations, and injection point(s) and/or well spacing, to assure adequate coverage of the contaminants in groundwater, and sufficient hydraulic control (in the case of groundwater recirculation systems).
 - (h) Evaluation of loading rates for nitrogen compounds, TDS, sulfate, bromate, and chloride compounds
 - (i) Information on the possibility of any adverse impact to current or potential designated beneficial uses of the groundwater, and whether the impacts will be localized and short-term.
 - (j) Location of nearby domestic, municipal, agricultural, and industrial supply wells, as

well as nearby surface water bodies and storm drains.

- (k) A Contingency Plan to be implemented to correct unexpected water quality effects that may cause or threaten to cause a condition of pollution or nuisance, or an adverse impact to beneficial uses of groundwater and/or surface water. The contingency plan shall also contain mitigation and control measures to ensure that in the event of surfacing of waste, all surfaced material is safely contained on-site and additional measures are taken to eliminate further surfacing.
- (l) The results of any bench scale and/or pilot testing performed for the treatment technology to be used;
- (m) Site-specific geology (lithology, fractional organic carbon, and physical parameters) and hydrogeologic parameters (calculated groundwater flow velocity and direction), hydrologic report;
- (n) Injection rate(s) and pressure(s);
- (o) Characterization and extent of contaminant(s) of concern;
- (p) Historical groundwater monitoring data;
- (q) Description of the aerial extent of the application area with a detailed site figure identifying the monitoring wells to be used to determine water quality upgradient, within the application area, downgradient from the application area and identify the compliance point;
- (r) A proposed schedule for the initiation and completion of the treatment process.
- (s) A proposed monitoring plan (see Attachment C for an M&RP template).
- (t) The background water quality of the aquifer of the groundwater remediation site(s) including contaminant types and concentrations for the following constituents:
 - o total dissolved solids (TDS),
 - o alkalinity
 - o bromates,
 - o sulfates,
 - o chlorides,
 - o nitrogen (NH_4 , NO_3 , NO_2),
 - o phosphorus,
 - o major cations (sodium, magnesium, potassium),
 - o chemical oxygen demand (for oxidative technologies only),
 - o biological oxygen demand (for oxidative technologies only),
 - o dissolved metals (arsenic, barium, cadmium, total and hexavalent chromium, copper, lead and selenium),
 - o total & dissolved iron,
 - o dissolved manganese,
 - o bacterial plate count (for aerobic bioremediation only),
 - o methane,
 - o conductivity,
 - o dissolved oxygen,
 - o dissolved carbon dioxide,
 - o oxidation-reduction potential
 - o turbidity
 - o temperature,
 - o pH.

This information will be used to establish baseline conditions. Additional monitoring during and after injection is also required as part of the monitoring and reporting program.

3. If the Executive Officer determines that pilot-scale testing is necessary to evaluate the impact of the amendment discharge into the groundwater at a specific site, a pilot test work plan shall be prepared and signed by a licensed civil engineer or licensed geologist as appropriate. The work plan shall include the same information that is listed under items 2(a) through 2(t).
4. Data generated after the start of the project shall be submitted in Electronic Data File (EDF) format.
 - (a) Results from chemical analysis of soil, vapor, and water samples shall be submitted in EDF format.
 - (b) The latitude and longitude of any permanent monitoring well or injection well, accurate to within 1 meter and referenced to a minimum of two reference points from the California Spatial Reference System (CSRS-H), shall be submitted in EDF format.
 - (c) The surveyed elevation relative to a geodetic datum of any permanent monitoring well or injection well shall be submitted in EDF format.
5. The Discharger, upon request, shall submit any additional information that the Executive Officer deems necessary to determine whether the discharge meets the criteria for coverage under this Order, and/or in prescribing an appropriate monitoring and reporting program.

Attachment C
Monitoring and Reporting Program (M&RP) Template for Order No. R8-2018-0092
For In-Situ Groundwater Remediation at Sites within the Santa Ana Region

A. Monitoring Provisions

1. All sampling, sample preservation, transport and analyses must be conducted in accordance with the current edition of "Standard Methods for the Examination of Water and Wastewater" (American Public Health Association) and/or with U.S. Environmental Protection Agency's guidelines for sampling, collection and preservation, unless other test procedures have been specified in this Order or by the Executive Officer.
2. Unless otherwise permitted by the Executive Officer, all analyses shall be conducted at a laboratory certified for such analyses by the State Water Resources Control Board – Division of Drinking Water (DDW). The Executive Officer may allow use of an uncertified laboratory under exceptional circumstances, such as when the closest laboratory to the monitoring location is outside the State boundaries and, therefore, not subject to certification. All analyses shall be required to be conducted in accordance with the latest edition of "Standard Methods for the Examination of Water and Wastewater" (American Public Health Association) and/or with U.S. Environmental Protection Agency's guidelines for sampling, collection and preservation.
3. All chemical, bacteriological, and bioassay analyses shall be conducted at a laboratory certified for such analyses by the DDW – Environmental Laboratory Accreditation Program (ELAP) or other State agency authorized to undertake such certification, or as approved by the Executive Officer. Additionally, all analytical methods applied for the abovementioned analyses shall be ELAP-approved at the time of analysis.
4. For every item where the requirements are not met, the Discharger shall submit a statement of the actions undertaken or proposed that will bring the discharge into full compliance with requirements at the earliest time and submit a timetable for correction.
5. The Discharger shall report all instances of noncompliance, submit a statement of actions undertaken or proposed that will bring the discharge into full compliance with requirements, and submit a timetable for corrective action.
6. The Discharger shall notify the Executive Officer within 24 hours by telephone of any adverse condition resulting from the discharge; such notification shall be affirmed in writing within five working days.
7. If the Discharger monitors any contaminants more frequently than required by this order, using applicable test procedures, or as specified in this Order, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the Discharger's monitoring report. The increased frequency of monitoring shall also be reported.
8. All monitoring instruments and devices which are used by the Discharger to fulfill the prescribed monitoring program shall be properly maintained and calibrated as necessary to ensure their continued accuracy.

9. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.
10. Daily samples shall be collected on each day of the week.
11. Monthly samples shall be collected on any representative day of each month.
12. Records of monitoring information shall include:
 - (a) The date, exact place, and time of sampling or measurements;
 - (b) The individual(s) who performed the sampling or measurements;
 - (c) The methods used for groundwater purging/sampling;
 - (d) The date(s) analyses were performed;
 - (e) The individual(s) who performed the analyses;
 - (f) The analytical techniques or method used; and
 - (g) All sampling and analytical results, including –
 - i. units of measurement used;
 - ii. minimum reporting limit for the analysis (minimum level);
 - iii. results less than the reporting limit but above the method detection limit (MDL);
 - iv. data qualifiers and a description of the qualifiers;
 - v. quality control test results (and a written copy of the laboratory quality assurance plan);
 - vi. dilution factors, if used; and
 - vii. sample matrix type.
13. The Discharger shall maintain all sampling, measurement and analytical results, including the date, exact place, and time of sampling or measurement; individual(s) who did the sampling or measurement; the method used for sampling or measurement; the date(s) and location(s) where analyses were conducted; analysts' name(s); and analytical techniques or methods used.
14. All reports and/or information submitted to the Executive Officer shall be signed by a responsible officer or duly authorized representative of the discharger and shall be submitted under penalty of perjury.
15. The Discharger shall file a report of any material change or proposed change in the character, location or volume of the discharge that is not mentioned in the RAP.

B. Monitoring Plan

The Discharger shall develop and implement a site-specific monitoring and reporting plan that will adequately assess the effectiveness of the project's management measures to prevent impacts to the quality and beneficial uses of the groundwater downgradient of the contaminant plume. Additionally, the plan shall include measures to assess the effectiveness of the project to remediate petroleum hydrocarbons, VOCs and other contaminants of concern at the subject site. The plan shall identify the following:

1. The treatment zone and zone of distribution to be used for in-situ remediation. Treatment zone is defined as the portion of a water-bearing zone where the injected amendment first comes into contact with the contaminant of concern. Zone of distribution is defined as the lateral and vertical spaces beyond the treatment zone in which the amendment and byproducts of its reaction(s) with the contaminant of concern and background groundwater chemistry could migrate, either through physical advection or chemical diffusion processes.
2. The Compliance Point(s) and monitoring points, including monitoring well and locations to be used to assess the impacts to water quality during the discharge of wastes. Compliance Point(s) are defined as those monitoring wells located downgradient, outside of the groundwater plume, and beyond the boundaries of a treatment zone, used for assessing the impacts to water quality and the effectiveness of the remediation.
3. A regional groundwater plume is the resultant of comingling of 3 or more contaminant plumes, with similar COCs, generated from different sources. Since, identifying Compliance Point(s) are not readily possible within a regional plume, exemptions are granted for requiring such wells under this Section, for the commonly known regional plumes such as Orange County Water District (OCWD) North Basin and South Basin plumes. If the COC(s) from one of the sources within the regional plumes is not detected from other sources, requirements of Compliance Points shall apply.
4. The following provides a template for the information to be included on the site's wells:

Well Type	Well ID	Latitude	Longitude	Elevation¹
Injection	INJ-01	XXXXXX	YYYYYY	ZZZZZZZ
Extraction	EX-01	XXXXXX	YYYYYY	ZZZZZZZ
Monitoring	MW-01	XXXXXX	YYYYYY	ZZZZZZZ
Compliance	CP-01	XXXXXX	YYYYYY	ZZZZZZZ

¹ Elevation shall be measured from top of the well casing.

5. The following provides a template for the constituents that may be included in the monitoring program:

Constituent	Units	Frequency¹
Total Petroleum Hydrocarbons ²	µg/L	Monthly
Volatile Organic Compounds ³	µg/L	Monthly
Pesticides	µg/L	Monthly
Polychlorinated Biphenyls	µg/L	Monthly
Perchlorate	µg/L	Monthly
1,4-Dioxane	µg/L	Monthly
Perfluorinated Alkyl-Substances (PFAS)	ng/L	Monthly
Total dissolved solids	mg/L	Monthly
Alkalinity	mg/L	Monthly
Bromates	mg/L	Monthly
Sulfates	mg/L	Monthly
Chlorides	mg/L	Monthly
Nitrogen (NH ₄ , NO ₃ , NO ₂)	mg/L	Monthly

Phosphorus	mg/L	Monthly
Major cations (sodium, magnesium, potassium)	mg/L	Monthly
Chemical oxygen demand	mg/L	Monthly
Biological oxygen demand	mg/L	Monthly
Dissolved metals (arsenic, barium, cadmium, total & hexavalent chromium, copper, lead and selenium)	µg/L	Monthly
Total & dissolved iron	µg/L	Monthly
Dissolved manganese	µg/L	Monthly
Bacterial Plate Count	CFU/mL	Monthly
Dehalococcoides (DHC)	CFU/mL	Monthly
Volatile Fatty Acids (VFA)	µg/L	Weekly
Dissolved Gases (methane, ethane, ethene)	µg/L	Weekly
Dissolved oxygen	mg/L	Weekly
Dissolved carbon dioxide	µg/L	Weekly
Dissolved hydrogen sulfide	µg/L	Weekly
Oxidation reduction potential	mV	Weekly
Conductivity	µS/cm	Weekly
Turbidity	NTU	Weekly
Temperature	°C	Weekly
pH	Standard unit	Weekly

- ¹ Monitoring of groundwater (and soil vapor if applicable) at a minimum, should be on a monthly basis in the first quarter after the injection of chemicals into soil and/or groundwater. Depending on site conditions, specific monitoring parameters may be eliminated, and more frequent monitoring may be proposed as necessary. Monitoring frequencies after the first quarter of injection should be proposed as appropriate in the monitoring plan based on site conditions.
- ² Total petroleum hydrocarbons by EPA Method 8015 modified for gasoline and/or diesel fuel, if present.
- ³ For testing volatile organic compounds use EPA Method 8260B and report entire suite of constituents.

C. Reporting Requirements

1. All analytical data shall be reported with method detection limit¹ (MDLs) and with identification of either reporting level or limits of quantitation (LOQs).
2. Laboratory data for effluent samples must quantify each constituent down to the approved reporting levels for specific constituents. Any internal quality control data associated with the sample must be reported when requested by the Executive Officer. The Regional Water Board will reject the quantified laboratory data if quality control data are unavailable or unacceptable.
3. Discharge monitoring data shall be submitted in a format that is acceptable to the Executive Officer and must be arranged in a manner that clearly demonstrates compliance and/or noncompliance with this Order. Monitoring results shall be reported in a tabulated format which identifies all applicable chemical constituents required to be analyzed under the monitoring program and presents the associated sample collection dates and analytical detections for each compound in relation to waste discharge limitations and requirements established by this Order.

¹ The standardized test procedure to be used to determine the method detection limit (MDL) is given at Appendix B, "Definition and Procedure for the Determination of the Method Detection Limit" of 40 CFR 136.

4. For every item of monitoring data where the requirements are not met, the monitoring report shall include a statement discussing the reasons for noncompliance, and of the actions undertaken or proposed which will bring the discharge into full compliance with requirements at the earliest time, and an estimate of the date when the Discharger will be in compliance. The Discharger shall notify the Executive Officer by letter when compliance with the time schedule has been achieved.
5. Conclusions and recommendations regarding continuation of the existing process or any proposed modifications thereto shall be clearly presented for agency consideration, along with appropriate supporting justification or rationale.
6. All reports, plans and documents required under this Order shall be prepared under the direction of appropriately qualified professionals. The lead professional performing engineering and geologic evaluations and judgments shall sign and affix their professional geologist or civil engineering license stamp to all technical reports, plans or documents submitted to the Regional Water Board.
7. All monitoring reports submitted to the Executive Officer in compliance with this Order in paper copy format is also required to be submitted electronically via the Internet into the SWRCB's GeoTracker database. To comply with state regulations, the update to the GeoTracker database must include the following minimum information:
 - (a) The elevation of groundwater in any permanent monitoring well relative to the surveyed elevation.
 - (b) A site map or maps showing the location of all sampling points referred to in the report.
 - (c) The depth to the screened interval and the length of screened interval of any permanent monitoring well.
 - (d) Boring logs, in PDF format.
 - (e) Laboratory analytical data from any soil testing and/or groundwater monitoring shall be reported in Electronic Deliverable Format (EDF) in accordance with CWC Section 13195 et. seq. requirements, if applicable
 - (f) A complete copy of the report, in PDF format, which includes the signed transmittal letter and professional certification.

The GeoTracker website address is: <https://geotracker.waterboards.ca.gov>
Deadlines for electronic submittals coincide with deadlines for paper copy submittals.

D. Report Schedule

Monitoring reports shall include all data collected during the monitoring period, and shall be submitted on a quarterly basis to Regional Water Board staff in accordance with the following schedule:

<i>Monitoring Period</i>	<i>Report Due</i>
January – March	May 1 st
April – June	August 1 st
July – September	November 1 st
October - December	February 1 st

The Executive Officer has the authority to change the report submittal schedule, if deemed necessary, based on changes to the Site conditions.

Monitoring reports shall be submitted to:

Executive Officer
California Regional Water Quality Control Board
Santa Ana Region
3737 Main Street, Suite 500
Riverside, CA 92501

Ordered by:



Hope A. Smythe
Executive Officer

Date:

10/19/18