

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION
ORDER NO. R5-2008-
WASTE DISCHARGE REQUIREMENTS
FOR
BP WEST COAST PRODUCTS
ARCO/BP STOCKTON FUEL TERMINAL #40T
ENHANCED BIOREMEDIATION PILOT STUDY
SAN JOAQUIN COUNTY

The California Regional Water Quality Control Board, Central Valley Region (hereafter Regional Water Board), finds that:

1. The BP West Coast Products (hereafter Discharger) submitted a Report of Waste Discharge on 30 November 2007 for a sulfate and nitrate injection pilot study for enhanced bioremediation. The Discharger owns the ARCO/BP fuel terminal #40T at 2700 Washington Street in Stockton, Assessor's Parcel Number 145-030-09, at township 1N, range 6E, section 8, Mount Diablo Base and Meridian. The general location of the facility is shown on Attachment A, which is attached hereto and made part of this Order by reference.
2. On 17 October 2003, the Regional Water Board adopted Waste Discharge Requirements (WDRs) Order No. R5-2003-0164 to regulate a previous sulfate and nitrate injection pilot study, which was completed in September 2004. The results of that pilot study showed that decreases in petroleum hydrocarbon concentrations were observed only near the injection points. Therefore, the Discharger proposed an expanded follow-up pilot study with additional injection points, increased mass of nitrate and sulfate injected, and a tracer to evaluate the rate of transport. On 2 May 2007, the Discharger submitted the *Work Plan For Enhanced Bioremediation Pilot Study* and on 31 July 2007, submitted supplemental information in the *Response to Enhanced Bioremediation Work Plan Comment*.
3. The Discharger, along with three other bulk fuel terminal companies on the same parcel, formed the Stockton Terminals Technical Committee (STTC) to address groundwater pollution across the entire parcel. Site groundwater monitoring is performed by the STTC as required by Monitoring and Reporting Program (MRP) No. 5-01-0819. The Discharger will continue to follow this MRP and will also implement the MRP that is part of this Order. The Discharger's site currently has 35 on-site monitoring wells, three on-site wells installed for an In-Situ Stable Oxygen Generation (ISO-GEN) pilot study, and six off-site monitoring wells.
4. There are four identified groundwater bearing zones. A majority of the mass of petroleum hydrocarbon pollution is in the A water bearing zone, which is from about 5 to 20 feet below ground surface. The results of second quarter monitoring conducted in May 2007 showed that groundwater contains total petroleum hydrocarbons (TPH) as gasoline up to 80,000 micrograms per liter ($\mu\text{g/l}$), TPH as diesel up to 160,000 $\mu\text{g/l}$, benzene up to 9,400 $\mu\text{g/l}$, toluene up to

13,000 µg/l, ethylbenzene up to 3,100 µg/l, xylenes up to 14,000 µg/l, methyl tertiary butyl ether (MTBE) up to 28,000 µg/l, and tertiary butyl alcohol up to 3,000 µg/l.

5. The plume at the site is anaerobic. The Discharger proposes an expanded pilot study to evaluate injection of potassium nitrate, potassium sulfate, and potassium phosphate dibasic to bioremediate the petroleum hydrocarbon pollution. The Discharger will do weekly slug injections of the potassium nitrate/sulfate/phosphate substrate (described further in Finding 8 below) for three months with groundwater monitoring until concentrations of nitrate, sulfate, and any byproducts therefrom return to baseline levels. Each slug injection will be about 18 hours. If analytical data show that the microorganisms have used up the injected nitrate and sulfate before the end of one year, the Discharger has proposed additional injections for up to three months. The pilot study will be concluded when the amendments and byproducts do not exceed baseline levels.
6. The Discharger proposes to inject substrates into a total of seven wells. The substrates will be injected into existing wells IS-1, IS-2, and IS-3, which were previously used for the ISO-GEN pilot study, and into four proposed new wells in the vicinities of existing monitoring wells AR/MW-3A, AR/MW-8A, AR/MW-13A, and AR/MW-24A. The Discharger proposes the injection of the potassium nitrate/sulfate/phosphate solution to stimulate anaerobic biodegradation of the petroleum hydrocarbon pollution. A potassium bromide tracer will be used to assess the rate of transport. The well locations were selected based on location and spacing within the plume, and the injections target the A zone pollution.
7. The remedial process for hydrocarbon plumes depends upon stimulating growth of indigenous microorganisms. The microorganisms obtain energy by oxidizing one compound and reducing another compound. Different amounts of energy can be obtained from different compounds. The first compounds to be utilized are those that provide the most energy. Microorganisms will consume carbon (i.e., petroleum hydrocarbons) first using oxygen as the electron acceptor until it is depleted, since oxygen provides the most energy. After oxygen depletion, a succession of anaerobic microorganisms becomes dominant, oxidizing (consuming) carbon and reducing the specific compounds, such as nitrate and sulfate, upon which their metabolism depends. In general, nitrate and sulfate are the next compounds to be reduced after oxygen. Iron also is reduced, but is not proposed for injection at the site based on potential for clogging the water bearing zone.
8. The Discharger proposes to inject the potassium nitrate, potassium sulfate, and potassium phosphate dibasic solution at concentrations of 140 milligrams per liter (mg/L) of nitrate as NO₃, 25 mg/L of phosphate, and 400 mg/L of sulfate. The injection solution will be prepared by mixing nitrate as NO₃, phosphate and sulfate

with potable water. Two hundred and forty gallons of the potassium nitrate/sulfate/phosphate solution will be injected into each of the seven injection wells at a rate of about 0.074 gpm during each of the 14 weekly applications for a total dose of 23,520 gallons in the seven wells.

9. The Discharger anticipates nitrogen and phosphorous depletion within the plume because the microorganisms will take up these nutrients as the potassium nitrate/sulfate/phosphate solution is injected and used by the microorganisms. Potassium will replace sodium, which was used in the previous pilot study as the counter ion in the nitrate/sulfate/phosphate solution, in order to avoid an accumulation of residual sodium. No nutrients are expected to remain in the subsurface because the nutrient addition rate is designed to match the microorganism nutrient uptake rate.
10. Using a pneumatic pump system, the Discharger will inject the nitrate/sulfate/ammonium phosphate solution via above ground piping at a rate of 0.074 gpm per well. Natural groundwater flow velocity and direction will distribute the solution into the plume.
11. Bench-scale testing and baseline monitoring has not been performed because the effects of nitrate and sulfate application to groundwater, which occurred between May and September 2004, are well documented for this site. The Discharger conducted periodic sampling from 11 wells to monitor baseline concentrations for geochemical parameters during the pilot study and to determine whether baseline conditions were re-established after the test concluded. Monitoring during and after the test was conducted for dissolved oxygen (DO), ferrous iron, total alkalinity, nitrate, sulfate, sulfide, nitrogen, sodium, ammonium, total hardness, ortho-phosphate, total dissolved solids, and total phosphorous.
12. The results of monitoring, conducted until August 2005, showed brief exceedences of nitrate as NO_3 , sulfate as SO_3 , ortho-phosphate, and ammonium concentrations above their respective baseline concentration. All exceedences occurred in downgradient monitoring well AR/MW-1A, but returned to baseline conditions for the required constituents including nitrate, sulfate, sulfide, nitrogen, sodium, ammonium, phosphate, and total phosphorous by November 2004. The baseline concentrations for these eight constituents, as documented in the previous study, will serve as baseline conditions for this proposed study.
13. For this pilot study, the Discharger will monitor 17 downgradient monitoring wells (AR/MW-1A, AR/MW-3A, AR/MW-5A, AR/MW-5B, AR/MW-5C, AR/MW-5O, AR/MW-8A, AR/MW-8B, AR/MW-8C, AR/MW-10A, AR/MW-11A, AR/MW-12A, AR/MW-13A, AR/MW-13B, AR/MW-13C, AR/MW-23A, AR/MW-24A) and one upgradient well (PS-P29). Samples will be collected weekly during the first month,

monthly during the first six months, and quarterly thereafter during the pilot test for the parameters outlined in the attached MRP No. _____.

14. If the levels of nitrate and sulfate in AR/MW-23A drop below baseline levels and upon written approval of the Executive Officer, the Discharger may begin another three-month cycle of the injection with up to 280 mg/L of the potassium nitrate/sulfate/phosphate solution.
15. In the event that concentrations of nitrate, sulfate, nitrogen, sodium, ammonium, sulfide, phosphate, and/or phosphorous in downgradient well AR/MW-1A exceed the baseline concentrations listed in Item C.1 below by 20 percent or more, or if the injected material is observed leaving the well network above baseline concentrations, injections will cease and the Discharger will collect a confirmation sample. If the exceedance is confirmed, the Discharger will cease the injections and continue monthly monitoring of well AR/MW-1A for three months to generate enough data to establish a trend. If the levels, based on the concentration trend, are more than 20 percent above baseline levels, the Discharger will implement the contingency plan. The Discharger will install a groundwater extraction and treatment system and begin extraction of groundwater from extraction wells AR/MW-13A, AR/MW-3A, and AR/MW-8A, treat it, and then discharge it to the sanitary sewer or haul it off-site for disposal. The Discharger will also monitor well AR/MW-1A every other week until the levels decrease to baseline levels and then monthly for at least six months to confirm concentrations remain below baseline levels.
16. Groundwater consistently flows in an easterly direction at an average gradient of 0.0064 feet per foot. AR/MW-1A was selected as the well to evaluate for exceedences because it is about 280 feet east of the proposed injection wells.
17. The injection into waters of the State is subject to regulation under the California Water Code. This Order authorizes the Discharger to inject sodium sulfate, sodium nitrate, and ammonium phosphate into groundwater subject to specific discharge requirements.
18. The *Water Quality Control Plan for the Sacramento River and San Joaquin River Basins, Fourth Edition*, (hereafter Basin Plan) designates beneficial uses, establishes water quality objectives, contains implementation plans and policies for protecting waters of the basin, and incorporates by reference plans and policies adopted by the State Water Resources Control Board (State Board). Pursuant to Section 13263(a) of the California Water Code, waste discharge requirements must implement the Basin Plan.
19. Surface water drainage is to the San Joaquin River within the legal boundaries of the Sacramento - San Joaquin Delta. The beneficial uses of the Sacramento - San

Joaquin Delta are municipal and domestic supply; agricultural supply; process and service industrial supply; water contact recreation; noncontact water recreation; warm and cold freshwater habitat, warm and cold water migration, warm water spawning, wildlife habitat and navigation.

20. The beneficial uses of underlying groundwater are municipal and domestic, agricultural, and industrial service and process water supply.
21. Surrounding land uses are residential, commercial, and industrial.
22. State Board Resolution No. 68-16 (hereafter Resolution 68-16 or the "Antidegradation Policy") requires the Board in regulating discharges to maintain high quality waters of the state until it is demonstrated that any change in quality will be consistent with 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 plans and policies (e.g., quality that exceeds water quality objectives). Temporal degradation of groundwater at this site due to the nitrate, sulfate, and ammonium phosphate injection may occur. This temporary degradation allowed by this Order is consistent with Resolution 68-16 since (1) the purpose is to accelerate and enhance remediation of unacceptable concentrations of several waste constituents and such remediation will benefit the people of the state; (2) the discharge facilitates a pilot project to evaluate the effectiveness of cleanup technology in accord with State Water Board Resolution No. 92-49 and is limited in scope and duration; (3) best practicable treatment, including adequate monitoring and contingency plans to assure protection of water quality, are required; and (4) the injection will not cause water quality objectives to be exceeded beyond the project target area or the duration of the project as specified in Finding 5.

23. Section 13267(b) of California Water Code provides that:

In conducting an investigation specified in subdivision (a), the regional board may require that any person who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge within its region, or any citizen or domiciliary, or political agency or entity of this state who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge waste outside of its region that could affect the quality of the waters of the state within its region shall furnish, under penalty of perjury, technical or monitoring program reports which the board requires. The burden, including costs of these reports, shall bear a reasonable relationship to the need for the reports and the benefits to be obtained from the reports. In requiring those reports, the regional board shall provide the person with a written explanation with regard to the need for the reports, and shall identify the evidence that supports requiring that person to provide the reports.

The technical reports required by this Order and the attached MRP No. _____ are necessary to assure compliance with these waste discharge requirements. The Discharger owns and operates the facility that discharges the waste subject to this Order.

24. The California Department of Water Resources sets standards for the construction and destruction of groundwater wells, as described in *California Well Standards Bulletin 74-90* (June 1991) and *Water Well Standards: State of California Bulletin 74-81* (December 1981). These standards, and any more stringent standards adopted by the State or County pursuant to California Water Code Section 13801, apply to all monitoring wells.
25. Issuance of this Order is an action to assure the restoration of the environment and is, therefore, exempt from the provisions of the California Environmental Quality Act (Public Resources Code, Section 21000, et seq.), in accordance with Section 15308 and 15330, Title 14, California Code of Regulations (CCR).
26. This discharge is exempt from the requirements of *Consolidated Regulations for Treatment, Storage, Processing, or Disposal of Solid Waste*, as set forth in Title 27, CCR, Section 20005, et seq., (hereafter Title 27). The exemption pursuant to Section 20090(d), is based on the following:
 - a. The Board is issuing waste discharge requirements,
 - b. The discharge complies with the Basin Plan, and
 - c. The wastewater does not need to be managed according to Title 22 CCR, Division 4.5, and Chapter 11, as a hazardous waste.
27. Pursuant to California Water Code Section 13263(g), discharge is a privilege, not a right, and adoption of this Order does not create a vested right to continue the discharge.
28. All the above and the supplemental data and information and details in the attached Information Sheet, which is incorporated by reference herein, were considered in establishing the following conditions of discharge. The Discharger and interested agencies and persons were notified of intent to prescribe waste discharge requirements for this discharge and provided with an opportunity for a public hearing and an opportunity to submit written views and recommendations. In a public meeting, all comments pertaining to the discharger were heard and considered.

IT IS HEREBY ORDERED that Order No. R5-2003-0164 is rescinded, and pursuant to Sections 13263 and 13267 of the California Water Code, BP West Coast Products, its agents, successors, and assigns, in order to meet the provisions contained in Division 7 of the California Water Code and regulations adopted thereunder, shall comply with the following while conducting the above-described pilot study:

[Note: Other prohibitions, conditions, definitions, and some methods of determining compliance are contained in the attached "Standard Provisions and Reporting Requirements for Waste Discharge Requirements" dated 1 March 1991, incorporated herein.]

A. Discharge Prohibitions

1. Discharge of wastes to surface waters or surface water drainage courses is prohibited.
2. The injection of other than potassium sulfate, potassium nitrate, and/or potassium phosphate into groundwater is prohibited.
3. Discharge of waste classified as 'hazardous' under Section 2521 of Title 23, CCR, or as 'designated' under Section 13173 of California Water Code is prohibited.
4. Discharge of groundwater, potassium sulfate, potassium nitrate, and/or potassium phosphate at a location or in a manner different from that described in Findings 5, 6, 8 and 10 is prohibited.

B. Discharge Specifications

1. No waste constituent shall be released or discharged, or placed where it will be released or discharged, in a concentration or in a mass that causes violation of the Groundwater Limitations.
2. This Order allows injection of potassium sulfate, potassium nitrate, and potassium phosphate for a three-month period under the conditions defined in Findings 5, 6, 8 and 10. No other products shall be discharged.
3. If the Discharger wishes to inject for a second three-month period, the Discharger shall submit the report described in Provision D.4.b. The Discharger shall not begin the second injection until the Executive Officer approves it in writing.

4. The sulfate/nitrate/phosphate solution shall only be injected through IS-1, IS-2, IS-3 and the four new injection wells, as described in Finding 6.

C. Groundwater Limitations

1. During the pilot study, the Discharger shall not cause an increase in amendments or byproducts including but not limited to nitrate, sulfate, nitrogen, sodium, ammonium, sulfide, phosphate, and/or phosphorous above 20 percent of the baseline concentration in downgradient well AR/MW-1A, which are as follows:

Nitrate as NO ₃	0.92 mg/L
Sulfate as SO ₃	4.8 mg/L
Nitrogen	2.8 mg/L
Sodium	67.3 mg/L
Ammonium as N	0.42 mg/L
Sulfide	0.29 mg/L
Phosphate as P	1.21 mg/L
Phosphorous	4.45 mg/L

2. When the pilot study is completed, the amendments and byproducts shall not exceed baseline levels.

D. Provisions

1. The Discharger shall notify Board staff a minimum of one week prior to the initial injection.
2. The Discharger shall comply with the attached MRP No. _____, which is part of this Order, and any revisions thereto as ordered by the Executive Officer.
3. The Discharger shall comply with the "Standard Provisions and Reporting Requirements for Waste Discharge Requirements," dated 1 March 1991, which are attached hereto and by reference a part of this Order. This attachment and its individual paragraphs are commonly referenced as "Standard Provision(s)."
4. All of the following reports shall be submitted pursuant to Section 13267 of the California Water Code. All technical reports required herein that involve planning, investigation, evaluation, or design, or other work requiring interpretation and proper application of engineering or geologic sciences, shall be prepared by or under the direction of persons registered to practice in California pursuant to California Business and Professions Code sections

6735, 7835, and 7835.1. As required by these laws, completed technical reports must bear the signature(s) and seal(s) of the registered professional(s) in a manner such that all work can be clearly attributed to the professional responsible for the work.

- a. The Discharger shall submit a Pilot Study Implementation Report due no later than **60 days** after startup of the enhanced bioremediation pilot study. The Pilot Study Implementation Report shall include a description of the injection system and results of the first month of operation including analytical results.
 - b. If the Discharger proposes a second three-month injection period, the Discharger shall submit an Evaluation Report at least **30 days** before the proposed injection. The Evaluation Report shall include analytical results to show the fate and transport of the initial sulfate/nitrate/phosphate injection and proposed injection details including volume, rate, and concentration for the second injection.
 - c. The Discharger shall submit a Pilot Study Evaluation Report no later than **one year** after the final injection ends, which shall include a summary of analytical results, an evaluation of injection effectiveness, and discussion of feasibility for full-scale remediation.
5. If groundwater samples from monitoring well AR/MW-1A are 20 percent or more above baseline concentrations of nitrate, sulfate, nitrogen, sodium, ammonium, sulfide, phosphate, and/or phosphorous, the Discharger shall immediately notify Regional Water Board staff of the exceedance(s) and obtain a confirmation sample within **7 days** of receiving the results. Within **48 hours** of receiving the confirmation sample results, the Discharger shall notify Regional Water Board staff of the results followed by written notification within **7 days**.
 6. Within **30 days** of confirming that baseline concentrations have been exceeded by 20 percent or more in monitoring well AR/MW-1A, the Discharger shall cease the injections and continue monthly monitoring of well AR/MW-1A for three months to generate enough data to establish a trend. If the levels, based on the concentration trend, are 20 percent or more above baseline levels, the Discharger will install a groundwater extraction and treatment system and begin extraction of groundwater from extraction wells AR/MW-13A, AR/MW-3A, and AR/MW-8A, treat the extracted groundwater, and discharge the treated water to the sanitary sewer or haul it off-site for disposal. The Discharger will also monitor well AR/MW-1A every other week until the levels decrease to baseline levels and then monthly for at least six months to confirm concentrations remain below baseline levels. Within

90 days of implementing the contingency plan, the Discharger shall submit a Contingency Plan Implementation Report.

7. The Discharger shall comply with all conditions of this Order, including timely submittal of technical and monitoring reports as directed by the Executive Officer. Violations may result in enforcement action, including Regional Water Board or court order requiring corrective action or imposing civil monetary liability, or in revision or rescission of this Order.
8. The Discharger shall maintain records of all monitoring information including all calibration and maintenance records, copies of all reports required by this Order, and records of all data used to complete the application for this Order. Records shall be maintained for a minimum of three years from the date of the sample, measurement, or report. This period may be extended during the course of any unresolved litigation regarding this discharge or when requested by the Executive Officer.
9. The Discharger shall at all times properly operate and maintain all facilities and systems of treatment and control that are installed or used by the Discharger to achieve compliance with this Order. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems, which are to be installed by the Discharger only when necessary to achieve compliance with the conditions of this Order.
10. A copy of this Order shall be kept at the discharge facility for reference by operating personnel. Key operating personnel shall be familiar with its contents.
11. As described in the Standard Provisions, the Discharger shall report promptly to the Regional Water Board any material change or proposed change in the character, location, or volume of the discharge.
12. While this Order is in effect, and prior to any change in ownership of the site or management of this operation, the Discharger shall transmit a copy of this Order to the succeeding Owner/Operator, and forward a copy of the transmittal letter and proof of transmittal to the Board.
13. The Discharger shall allow the Regional Water Board, or an authorized representative, upon presentation of credentials and other documents as may be required by law, to:
 - a. Enter upon the premises regulated by the Regional Water Board, or the place where records must be kept under the conditions of this Order;

- b. Have access to and copy, at reasonable times, any records that shall 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 purpose of assuring compliance with this Order or as otherwise authorized by the California Water Code, any substances or parameters at this Site.
14. The Regional Water Board will review this Order periodically and will revise requirements when necessary.

I, PAMELA C. CREEDON, Executive Officer, do hereby certify the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Central Valley Region, on _____.

PAMELA C. CREEDON, Executive Officer

Attachments