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Mr. Paul Cho
California Regional Water Quality Control Board
Los Angeles Region
320 West 4th Street, Suite 200
Los Angeles, California 90013

October 30, 2017

Subject: Horizontal Biosparge System Construction Work Plan
SFPP Norwalk Pump Station, 15306 Norwalk Boulevard, Norwalk, California

Dear Mr. Cho:

This work plan was prepared by CH2M HILL Engineers, Inc. (CH2M), on behalf of Kinder Morgan Energy Partners, L.P. (Kinder Morgan), to install a horizontal biosparge well and additional compressed air system at the SFPP, L.P. (SFPP) Norwalk Pump Station site (Norwalk Station), located at 15306 Norwalk Boulevard, Norwalk, California (Figure 1). The purpose of the new system is to expand the footprint of the existing air sparge system into the southeastern area of the site.

Introduction

This work plan is based on information and recommendations provided in the following documents previously submitted to the Regional Water Quality Control Board (Water Board):

- CH2M. 2013a. Conceptual Site Model and Proposed Alternate Interim Remedy for Soil, Groundwater, and LNAPL, Defense Fuel Support Point Norwalk, California.
- CH2M. 2013b. Horizontal Biosparge System Construction and Pilot Test Work Plan, SFPP Norwalk Pump Station, 15306 Norwalk Boulevard, Norwalk, California.
- CH2M. 2014. Response to Comments – Horizontal Biosparge System Construction and Pilot Test Work Plan, SFPP Norwalk Pump Station, 15306 Norwalk Boulevard, Norwalk, California.
- CH2M. 2017a. Evaluation Report for the South-Central Area Horizontal Biosparge Pilot Test, SFPP Norwalk Pump Station, Norwalk, California.

The scope of work includes drilling and construction of one horizontal biosparge well in the southeastern area. The well will be constructed of 4-inch-diameter polyvinyl chloride (PVC), and the screen interval will be placed at a depth of approximately 45 feet below ground surface (bgs). New aboveground equipment will include a (second) containerized compressed air system, including a 175-horsepower (hp) rotary-screw air compressor.

For the purposes of evaluating system performance, seven nested soil vapor monitoring probes were installed to approximately 5 feet and 10 feet bgs in the southeastern area (SVM-17 through SVM-23) in May 2016 and February 2017. In addition, soil vapor monitoring probe SVM-9 and groundwater monitoring wells MW-8, GMW-36, GMW-O-15, GMW-O-16, GMW-O-18, and GMW-O-19 will be used to

evaluate the performance of the new system, and the potential for off-gassing beneath the residential area. These performance evaluation probes and wells are depicted on Figures 2 and 3. Table 1 summarizes the groundwater and soil vapor sampling and analysis plan.

The following sections summarize relevant background information, state the objectives of the planned work, describe the proposed scope of work and methods, and present a general schedule for implementation of this work plan. A Construction Completion Report will be prepared and submitted to the Water Board describing the results of this work.

Background Information

This section presents a summary of background information including site description, hydrogeologic conditions, existing remediation systems, effectiveness of the existing remediation systems, and selection of biosparge as an alternate interim remedy to the existing remediation systems. Additional details on site background are available in the Conceptual Site Model (CH2M, 2013a).

Site Description

The entire facility on which Kinder Morgan operates is owned by DLA Energy (formerly Defense Energy Support Center [DESC]) and was formerly occupied by 12 aboveground fuel storage tanks and associated piping and facilities. The tanks had a maximum capacity of 35 million gallons and were used to store and distribute refined petroleum products including jet propellant numbers 5 and 8 (JP-5 and JP-8), and reportedly also stored aviation gasoline and jet propellant number 4 (JP-4). DLA Energy also previously operated truck fill stands and various fuel transfer systems. The facility was decommissioned in 2001 and is no longer used to handle fuel. The aboveground tanks and the main infrastructure were demolished in 2011; demolition of the subsurface piping was completed in 2012.

Kinder Morgan has equipment within 2 acres at the site and easements for its pipelines along the southern and eastern boundaries of the facility. Previously, Kinder Morgan operated a pump station near the south-central area of the site. The pump station was used to transfer fuel to and from the site, and as an in-line pumping station for portions of the Kinder Morgan pipeline network. The pump station was decommissioned in 2001, but three pipelines remain in service and continue to convey refined petroleum fuels including gasoline, diesel, and jet fuel; the three pipelines include two 16-inch pipelines and one 24-inch pipeline heading eastward along the southern boundary of the site (one of the 16-inch pipeline bends at the southeastern corner of the facility and continues northward within the eastern easement). The pipelines were fitted with block valves and motor-operated valves within the site. The block valve located in the south-central area of the site was historically referred to as the “intermediate 24-inch block valve.” The “intermediate 24-inch block valve and other motor-operated valves were removed between the third quarter 2016 and second quarter 2017. There is a block valve located offsite near the southeastern area of the site, which is still in use, and is referred to as the “southeastern 24-inch block valve” or “offsite 24-inch block valve.”

Subsurface assessments have been performed at the site since 1986. Groundwater monitoring and remediation wells have been installed at the site for monitoring and as components of groundwater remediation systems (Figure 2). The investigations have evaluated and defined subsurface soil and groundwater within the uppermost groundwater zone that has been impacted by fuel-related hydrocarbons from historical releases from Kinder Morgan’s pipelines at the site. The primary impacts are to groundwater associated with fuel product that historically leaked from block valves and migrated vertically downward to the water table. Separate-phase floating product, or light non-aqueous phase liquid (LNAPL), as well as sorbed-phase and dissolved-phase fuel hydrocarbons, have been delineated in areas beneath the site and at offsite properties to the south, west, and east.

Site assessments indicate that the chemicals of potential concern are total petroleum hydrocarbons (TPH), including TPH quantified as gasoline (TPH-g), diesel (TPH-d), JP-4, JP-5, and JP-8; benzene, toluene, ethylbenzene, and total xylenes (BTEX); 1,2-dichloroethane (1,2-DCA); methyl tertiary butyl ether (MTBE); and tertiary butyl alcohol (TBA). A groundwater Monitoring and Reporting Program (MRP) has been in effect at the site since 1995. The current groundwater MRP is described in the *Revised Groundwater Sampling and Analysis Plan, SFPP Norwalk Pump Station, 15306 Norwalk Boulevard, Norwalk, California* (CH2M, 2013c).

Hydrogeologic Conditions

The site is underlain by the following hydrogeologic units (shallow to deep):

- **Semiperched groundwater zone between depths of approximately 25 and 50 feet bgs.** Groundwater flow within this uppermost zone is generally north to northwestward with a horizontal gradient of approximately 0.001 foot per foot (ft/ft).
- **Bellflower aquitard of the Lakewood Formation between depths of approximately 50 and 80 feet bgs beneath the site**. The Bellflower aquitard consists of predominantly clay, silty clay, and sandy clay with some interbedded sand with silt.
- **Exposition aquifer between depths of approximately 80 and 220 feet bgs.** The potentiometric surface in the Exposition aquifer is approximately 20 feet lower than that in the semiperched uppermost groundwater zone. This relatively consistent difference in hydraulic heads between the semiperched upper groundwater zone and the Exposition aquifer indicates that the Bellflower aquitard inhibits the vertical movement of groundwater in the site area. The horizontal hydraulic gradient in the Exposition aquifer beneath the site area has had a magnitude of approximately 0.001 ft/ft and a generally southeastward direction.

Overview of Existing Remediation Systems

Kinder Morgan operates remediation systems consisting of biosparging, soil vapor extraction (SVE), total fluids extraction (TFE; extraction of free product and/or groundwater using a top-loading pump), and groundwater extraction (GWE; extraction of groundwater using a bottom-loading pump) within the following areas:

- **South-Central Area** – LNAPL and dissolved-phase hydrocarbons occur in the south-central area beneath the site and offsite beneath the residential area to the south. These impacts occurred from a historical release from the intermediate 24-inch block valve and potentially other unidentified sources at the former pump station.
- **Southeastern Area** – LNAPL and dissolved-phase hydrocarbons occur in the southeast area beneath the facility and offsite in the Holifield Park area. These impacts occurred from a historical release from the southeastern 24-inch block valve in this area.

Figure 2 shows the existing remediation system layout in the south-central and southeastern areas, including SVE and TFE operations (GWE is also performed at one location in the southeastern area). At several locations, SVE is coupled with TFE (or GWE) in a process referred to as dual-phase extraction. The effectiveness of the current remediation system and a list of SVE, TFE, and GWE wells are included in the most recent quarterly remediation report (CH2M, 2017b).

In December 2015, Kinder Morgan completed installation of a horizontal biosparge well, BS-01, as shown on Figure 2. BS-01 is constructed of 4-inch-diameter Schedule (Sch) 80 PVC casing, with approximately 600 feet of screen installed 45 feet bgs. Additional details regarding the construction of the biosparge well are documented in the *Horizontal Biosparge Well and Soil Vapor Monitoring Probe*

Completion Report (CH2M, 2015). The containerized system suppling compressed air to BS-01 is rated for a maximum capacity of 500 standard cubic feet per minute (scfm). The system includes an interlock to ensure sparging cannot occur unless the SVE system is operating.

Pilot testing of BS-01 commenced in early January 2016 and continued through October 2016. Soil vapor data collected as part of the pilot testing have been submitted to the Water Board and Restoration Advisory Board under separate covers. A comprehensive evaluation report that incorporates soil vapor and groundwater data was submitted to the Water Board in August 2017 (CH2M, 2017a). Based on dissolved oxygen (DO) and sulfur hexafluoride (SF6) tracer data, the zone of influence (ZOI) of BS-01 at a flow rate of 480 scfm was approximately 50 feet on both sides of the well. Reductions in measured thickness of LNAPL in wells and dissolved hydrocarbon concentrations suggest a more expansive ZOI of up to 100 feet on both sides of the well in some areas.

As a result of biosparge operations, LNAPL thickness was significantly reduced in 21 monitoring and remediation wells. When comparing the effectiveness of the biosparge pilot program pre- and post-initiation, the average reduction in LNAPL thickness in all wells was 1.95 feet during the 10-month pilot study. In addition, dissolved-phase TPH-g, TPH-d, benzene, and MTBE concentrations also showed significant reductions during the test period. Based on these results, it was determined that operation of the south-central system would continue, with expansion of the system to the southeast area using a second horizontal well (CH2M, 2017a).

Objectives and Approach

This work plan describes activities for the installation and evaluation of a second horizontal biosparge well, BS-02, in the southeastern area of the site. Project objectives are as follows:

- Utilize the groundwater monitoring network in the southeastern area to evaluate BS-02 performance in terms of LNAPL removal and remediation of dissolved petroleum hydrocarbons.
- Evaluate the vacuum capture zone of the SVE network in the southeastern area and determine whether additional SVE wells are needed. This objective will be accomplished by performing subsurface vacuum monitoring prior to system startup, followed by routine sampling and monitoring of the soil vapor monitoring network.

Scope of Work

The proposed scope of work to accomplish the objectives of this work plan includes drilling, compressed air system installation, biosparge system startup, and monitoring. Primary activities associated with the scope of work are as follows:

- Pre-mobilization activities
- Field activities
  - Well mark-out and survey
  - Utility location
  - BS-02 drilling and installation
  - Equipment decontamination
  - Waste management
  - SVE vacuum capture zone assessment
  - Biosparge equipment installation
  - BS-02 startup
- System monitoring, data analysis, and reporting

Pre-Mobilization Activities

CH2M will perform the following permitting and field preparation tasks prior to commencement of field construction activities:

- Update the existing site-specific Health and Safety Plan to incorporate the planned fieldwork.
- Notify the Water Board, DLA Energy, and the City of Norwalk a minimum of 1 week in advance of the planned field activities.
- Notify Underground Service Alert (USA). As required by USA, the borings will be called-in and marked-out in white paint at least 2 business days prior to drilling.
- Obtain the required boring/well permits from the Los Angeles County Department of Public Health.
- Coordinate with Kinder Morgan personnel to arrange for a Kinder Morgan field inspector to be present during field activities near Kinder Morgan pipelines, if necessary.

Field Activities

Well Mark-out and Survey

Prior to construction activities, the borehole path will be marked on the ground surface with white spray paint and/or pin flags, and surveyed by a licensed surveyor for location and elevation every 50 feet along the borehole path. The survey report will be in the required format to upload to the Water Board's GeoTracker website.

Utility Location

Following well mark-out and surveying, an underground utility check will be performed using a private utility-locating subcontractor. CH2M and the subcontractor will coordinate with Kinder Morgan operations staff to clear the borehole path of potential underground utilities and other infrastructure.

Prior to drilling, a subcontractor will air knife to 10 feet bgs to check for the presence of underground utilities. Since the biosparge well pilot hole will be advanced initially at a 5 to 1 angle at the point of entry (that is, approximately 20 percent slope from horizontal), the drill bit will advance approximately 50 feet horizontally toward the southeast before reaching a depth of 10 feet bgs. Therefore, air knife potholing will be performed up to 10 feet deep every 3 feet from the entry point to 50 feet downrange, for a total of 17 potholing locations.

The proposed location of BS-02 will be finalized in the field based on the results of the surveys conducted by the private utility-locating subcontractor and USA mark-outs.

BS-02 Drilling and Installation

A horizontal directional drilling (HDD) subcontractor will use a blind-end horizontal drilling technology to install one nominal 4-inch-diameter horizontal biosparge well to a depth of approximately 45 feet bgs. The target depth will be as close as practicable to the bottom of the uppermost groundwater zone to maximize the ZOI.

The borehole diameter for the biosparge well will be approximately 8 inches (at least 2 inches minimum annular space on either side of the 4-inch well casing) as required by the Los Angeles County Department of Public Health. Biodegradable guar-based drilling fluid will be used to facilitate advancement of the drill bit and circulation of the drill cuttings from the borehole.

The screened interval of the new southeastern horizontal biosparge well (BS-02) will be installed beneath the LNAPL smear zone, as shown on Figure 3. The entry point for BS-02 will be located along

the access road immediately south of the southeastern corner of the former truck fill stand. The estimated length of casing (riser pipe) is 475 feet, with 240 feet of slotted pipe ("screen"), for a total length of approximately 715 feet. A conceptual well completion diagram is presented on Figure 4.

BS-02 will be constructed of 4-inch-diameter, flush threaded, PVC Sch 80 casing and slotted pipe. The screen will have a maximum slot width of 0.012 inch or less, and will be naturally developed (that is, a filter pack will not be installed). The slotted section of the well will be installed as flat as practicably possible. The tolerance of the screen section will be ±1 foot vertically and ±3 feet horizontally, verified using a wireline navigation system. The well will be cement-grouted using 5 percent bentonite cement grout from the surface to a depth of approximately 20 feet bgs.

Immediately after the well casing, screen, and cement seal have been installed, the well will be flushed with a pH-adjusting and drilling-fluid-breaking solution via injection into the well to increase the effectiveness and reaction rate of the drilling-fluid-breaking enzyme. Most of the drilling fluid degradation occurs within the first 12 to 24 hours. The remaining well development steps, which include jetting and pumping, will be accomplished after a delay of hours up to a few days, as determined by the drilling subcontractor.

At the proximal end of the sparge well, a cleanout will be installed in a steel frame access manway, the dimensions of which will be approximately 24 inches by 60 inches, with a spring-assist H-20 rated cover. The termination of the well will include a 4-inch-diameter Sch 80 PVC "Y" pipe, connected to the end of the PVC well. The straight end of the "Y" will terminate inside the vault with a 4-inch national pipe thread (NPT) plug. The 45-degree elbow of the "Y" will connect to a 3-inch Sch 80 PVC ball valve and subsequently to a 3-inch Standard Dimension Ratio (SDR) 11 high-density polyethylene (HDPE) conveyance pipe (via transition fitting) that will stub outside of the vault at approximately 3 feet below grade, for connection by others. The stub should be covered with a slip cap (secured with duct tape), and its location indicated at the surface with a marking flag. The manways will be set in a concrete pad that measures at least 18 inches wide on all sides of the vault, and 6 inches thick.

Equipment Decontamination

Drilling equipment will be steam-cleaned using potable water prior to use. Sampling equipment will be cleaned before each use by washing with an Alconox-water solution and double-rinsing with potable water.

Waste Management

Waste generated during field activities will include the following:

- Equipment wash and rinse water
- Drilling fluid
- Soil cuttings
- Municipal waste (gloves, rags, paper towels)

Drilling fluid or soil cuttings generated from drilling and installation of the biosparge well will be contained in lined roll-off bins and temporarily staged onsite. Municipal waste that may include gloves, rags, and paper towels will be separately contained in Department of Transportation (DOT)-approved 55-gallon steel drums.

A composite sample of the soil cuttings will be collected and sent to a certified laboratory for waste disposal profiling purposes. The drummed solids (gloves, rags, paper towels) will be disposed of as municipal trash. CH2M will coordinate with Kinder Morgan personnel and the waste hauler to verify the laboratory parameters that need to be analyzed to meet waste profiling requirements.

CH2M will properly label each container as the waste is generated. The following label will be filled out and placed on the containers: "Non-Classified Waste Material, Laboratory Analyses in Progress."

SVE Vacuum Capture Zone Assessment

Prior to system startup, the existing SVE network in the southeast area, including wells and piping, will be evaluated to determine the radius of influence (ROI) of the SVE wells. The existing SVE wells in the southeastern area are GMW-36, GMW-O-15, and GMW-O-18. Testing will be performed by extracting vapor from these three wells over an 8-hour period to establish a relationship between flow rate and applied vacuum. Vacuum will be measured at nearby groundwater monitoring wells and soil vapor monitoring probes to determine the ROI. If ROI testing indicates the existing SVE system is not sufficient, existing groundwater monitoring wells MW-8, GMW-O-16, and GMW-O-19 will be converted to SVE wells to enhance the SVE network. A summary of the capture zone assessment and details about converting the monitoring wells to SVE wells, if necessary, will be provided in an addendum to this work plan, along with recommendations for additional SVE wells, as needed.

Additionally, at least two new soil vapor monitoring probes will be installed offsite in the residential area to the south of the BS-02 screen to serve as compliance monitoring points for the new biosparge system. The locations of these new probes and their construction specifications will be included in the work plan addendum.

Biosparge Equipment Installation

A second containerized air compressor will be required for the new horizontal well, with sufficient capacity to operate at least one additional (future) well.

The biosparge equipment will include the following:

- 175-hp rotary screw air compressor, supplying approximately 882 scfm and 125 pounds per square inch gauge (psig)
- 8-foot by 30-foot system enclosure with ventilation, noise suppression, ducting, and lights
- 240-gallon air receiver
- Electrical and controls using programmable logic controller(PLC)/operator interface terminal (OIT), and cellular network for alarm-dialer and remote monitoring

A conceptual process flow diagram of the equipment is provided on Figure 5.

The equipment will be placed along the access road just south of the southeastern corner of the former truck fill stand, near the existing air sparge system and the entry points.

BS-02 Startup

Biosparging at BS-02 will be initiated at a flow rate of approximately 0.1 cfm per foot of screen interval (cfm/ft), and increased gradually in steps over a period of 3 days to a target flow rate of 0.8 cfm/ft. The lateral extent of the ZOI in the saturated zone will be evaluated, and the SVE vacuum capture zone will also be re-assessed, based on field measurements at nearby groundwater monitoring wells and soil vapor monitoring probes.

System Monitoring, Data Analysis, and Reporting

Monitoring and evaluation of the new system will be conducted in three phases:

- Phase 1: Baseline Sampling
- Phase 2: Short-Term ZOI Evaluation and Soil Vapor Monitoring (Week 1)
- Phase 3: Long-Term Monitoring

Table 1 presents the proposed sampling and analysis program for the southeastern area. The soil vapor monitoring probes and groundwater monitoring wells listed in Table 1 were selected to meet the following objectives:

- **Soil Vapor Monitoring Probes –** Sufficient spatial coverage of probes to evaluate the ZOI of the biosparge well, potential migration of vapor hydrocarbons, and changes in vapor chemistry with depth above the smear zone and increasing distance from the biosparge well.
- **Groundwater Monitoring Wells –** Sufficient spatial coverage of wells to evaluate the ZOI of the biosparge well and changes in groundwater chemistry with increasing distance from the biosparge well.

As noted in Table 1, if measurable LNAPL is encountered during gauging of selected wells, groundwater samples will not be collected and alternate sampling locations will be considered. Groundwater sampling included in this work plan will be conducted generally in accordance with Kinder Morgan's current Groundwater Sampling and Analysis Plan (CH2M, 2013c). The soil vapor samples will be collected in accordance with the recommended guidelines in the Department of Toxic Substances Control (DTSC) *Advisory for Active Soil Gas Investigations* (DTSC, 2015).

Phase 1: Baseline Sampling

Prior to biosparge system startup, a baseline set of groundwater and soil vapor samples will be collected from selected wells during the normal operation of the TFE and SVE. Groundwater samples will be analyzed for volatile organic compounds (VOCs) including fuel oxygenates using U.S. Environmental Protection Agency (EPA) Method 8260B, TPH-g and TPH-d using EPA Method 8015M, and field water quality parameters (pH, DO, oxidation-reduction potential, temperature, and conductivity). Soil vapor samples will be analyzed for VOCs using EPA Method TO-15, TPH-g using EPA Method TO-3, and fixed gases (oxygen, carbon dioxide, and methane) using ASTM International (ASTM) D1946.

Phase 2: Short-Term ZOI Evaluation and Soil Vapor Monitoring (Week 1)

Short-Term ZOI Evaluation

The ZOI evaluation will be conducted after the 3-day startup period, and will require approximately 2 days to complete. The lateral and vertical extent of the ZOI will be based on the following observations and/or field analytical data from nearby groundwater monitoring wells and/or soil vapor monitoring probes: (1) changes in DO concentrations; (2) vadose zone pressure; (3) changes in water level; and (4) changes in vadose zone VOCs, oxygen, and carbon dioxide vapor concentrations.

Specific aspects of the ZOI evaluation are as follows:

- Down-well probes with pressure transducers and DO sensors will be placed in the four groundwater monitoring/observation wells nearest the screened section of BS-02 (GMW-O-16, GMW-O-18, GMW-36, and MW-08) to continuously measure water levels and DO concentrations.
- VOCs, oxygen, and carbon dioxide field readings using a 5-gas meter will be collected at regular intervals from the list of soil vapor monitoring probes provided in Table 1.
- Vadose zone pressure in the soil vapor monitoring probes will be measured at regular intervals.

Short-Term Soil Vapor Monitoring

Soil vapor monitoring will be conducted during the first week of operation. Selected soil vapor monitoring probes closest to the biosparge well (Table 1) will be sampled once per day to monitor VOC concentrations at depths of 5 and 10 feet bgs; samples will be analyzed using EPA Method TO-15.

Phase 3: Long-Term Monitoring

Groundwater

After the first week of operation, the groundwater wells indicated in Table 1 will be monitored quarterly for a period of 1 year. After 1 year of quarterly sampling, these wells will be sampled on a semiannual basis under the routine groundwater MRP. Groundwater samples will be analyzed for VOCs including fuel oxygenates using EPA Method 8260B, and TPH-g and TPH-d using EPA Method 8015M. A summary of selected wells and laboratory analyses for long-term monitoring is included in Table 1.

Vapor

After the first week of operation, the nested soil vapor monitoring probes indicated in Table 1 will be monitored for VOCs, oxygen, and carbon dioxide with a 5-gas meter as follows: weekly during the first month, monthly for the next 6 months, and on a quarterly basis thereafter. Concurrently, vadose zone pressure will be measured using a digital manometer.

Soil vapor samples will be collected quarterly from the same set of soil vapor monitoring probes (Table 1) for a period of 1 year to evaluate subsurface soil vapor concentrations near the site boundary. After 1 year of quarterly sampling, these soil vapor monitoring probes will be sampled on a semiannual basis. Soil vapor samples will be analyzed for VOCs using EPA Method TO-15, TPH-g using EPA Method TO-3, and fixed gases (carbon dioxide, oxygen, and methane) using ASTM D1946.

Data Analysis and Reporting

CH2M will prepare a Construction Completion Report for submittal to the Water Board that provides a record of the field activities conducted under this work plan. The report will include the following:

- Background, purpose, scope of work, field and laboratory methods, and results
- Site location map, soil vapor probe and well location map, biosparge well as-built cross- sectional diagram
- Table summarizing well completion details and laboratory analytical results
- Appendices with the county and city permits, boring logs, and laboratory reports

After sufficient data have been collected, the data will be compiled into an evaluation report that will include tabulated summaries of groundwater and soil vapor analytical data, and evaluation of results; the report will be submitted to the Water Board for approval.

In addition, collected data will be included in quarterly remediation progress reports that are submitted to the Water Board on April 15, July 15, October 15, and January 15 of each year.

Schedule

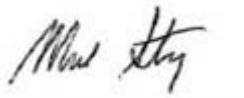
CH2M anticipates installation of the new biosparge well in November 2017, after this work plan is approved by the Water Board. Biosparge equipment installation and startup will occur in 2018, with system monitoring and data analysis commencing upon startup. The Construction Completion Report summarizing the results of the field activities will be prepared and submitted to the Water Board within 60 days of system installation. Evaluation reports will be prepared and submitted to the Water Board according to the schedule indicated above.

If you have any questions regarding this work plan, please contact Mr. Eric Davis/CH2M at (213) 228-8262, or Mr. Stephen Defibaugh, Kinder Morgan's Remediation Project Manager, at (714) 560-4802.

Regards,

CH2M HILL Engineers, Inc.

Eric Davis
Project Manager



Mark Strong
Senior Technical Consultant

c: Steve Defibaugh, Kinder Morgan
Norwalk Tank Farm Restoration Advisory Board

Attachments:

References

Table:

Table 1 – Groundwater and Vapor Sampling and Analysis Plan for the Southeastern Area

Figures:

Figure 1 – Site Location Map
Figure 2 – Remediation System Layout
Figure 3 – Southeastern Area Biosparge Well Location Map
Figure 4 – Conceptual Horizontal Biosparge Well Completion Diagram
Figure 5 – Process Flow Diagram

References

CH2M HILL (CH2M). 2013a. *Conceptual Site Model and Proposed Alternate Interim Remedy for Soil, Groundwater, and LNAPL, Defense Fuel Support Point Norwalk, California*. September 3.

CH2M HILL (CH2M). 2013b. *Horizontal Biosparge System Construction and Pilot Test Work Plan SFPP Norwalk Pump Station*. November 18.

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CH2M. 2014. Response to Comments – Horizontal Biosparge System Construction and Pilot Test Work Plan, SFPP Norwalk Pump Station, 15306 Norwalk Boulevard, Norwalk, California. February 14.

CH2M HILL (CH2M). 2015. *Horizontal Biosparge Well and Soil Vapor Monitoring Probe Completion Report, SFPP Norwalk Pump Station, 15306 Norwalk Boulevard, Norwalk, California*. February 18.

CH2M HILL (CH2M). 2017a. *Evaluation Report for the South-Central Area Horizontal Biosparge Pilot Test SFPP Norwalk Pump Station, Norwalk, California*. August 3.

CH2M HILL (CH2M). 2017b. *Third Quarter 2017 Remediation Progress Report SFPP Norwalk Pump Station Norwalk, California*. October 13.

Department of Toxic Substances Control (DTSC). 2015. *Advisory for Active Soil Gas Investigations*. July.

Table

Table 1. Groundwater and Vapor Sampling and Analysis Plan for the Southeastern Area

SFPP Norwalk Pump Station, Norwalk, California

Parameter	Analytical Method	Sampling Method/Container	Southeastern Sample Locations
GROUNDWATER SAMPLING PLAN			
Baseline Groundwater Sampling [a, b]			
VOCs	EPA 8260B	3 x 40-ml VOA vials (preserved)	MW-8, GMW-36, GMW-O-15, GMW-O-16, GMW-O-18, and GMW-O-19
TPH-g and TPH-d	EPA 8015M	3 x 40-ml VOA vials (preserved), 1-L Amber	
Water Parameters (pH, DO, ORP, temperature, conductivity, and water level)	Field Measurement	Flow-through cell	
Short-Term Monitoring (during first week)			
Water level	Transducer	Down-well transducer	MW-8, GMW-36, GMW-O-16, and GMW-O-18
DO	DO Sensor	Down-well DO Sensor	
Long-Term Groundwater Monitoring (quarterly for 1 year and semiannual thereafter) [a, b]			
VOCs	EPA 8260B	3 x 40-ml VOA vials (preserved)	MW-8, GMW-36, GMW-O-15, GMW-O-16, GMW-O-18, and GMW-O-19
TPH-g and TPH-d	EPA 8015M	3 x 40-ml VOA vials (preserved), 1-L Amber	
Water Parameters (pH, DO, ORP, temperature, conductivity, and water level)	Field Measurement	Flow-through cell	
VAPOR SAMPLING PLAN			
Baseline Vapor Sampling			
VOCs	EPA TO-15	1-L Summa	SVM-9, SVM-17 through SVM-23, and additional offsite soil vapor monitoring probes. [d]
VOCs, O_2, CO_2	5 Gas Meter	Tedlar bag	
TPH-g	EPA TO-3	1-L Summa	
Fixed Gases (CO_2, O_2, and Methane)	ASTM-1946	1-L Summa	
Vadose zone pressure	Manometer	--	
Short-Term Monitoring (during first week)			
VOCs (once per day)	EPA TO-15	1-L Summa	SVM-9, SVM-18, SVM-20, SVM-22, and additional offsite vapor probes. [d]
VOCs, O_2, CO_2	5 Gas Meter	Tedlar bag	
Vadose zone pressure	Manometer	--	
Long-Term Vapor Monitoring (quarterly for 1 year and semiannual thereafter)			
VOCs	EPA TO-15	1-L Summa	SVM-9, SVM-17 through SVM-23, and additional offsite vapor probes. [d]
VOCs, O_2, CO_2 [c]	5 Gas Meter	Tedlar bag	
TPH-g	EPA TO-3	1-L Summa	
Fixed Gases (CO_2, Oxygen, and Methane)	ASTM-1946	1-L Summa	
Vadose zone pressure [c]	Manometer	--	

Notes:

[a] Groundwater samples and water level measurements will be collected per Kinder Morgan's Groundwater Sampling and Analysis Plan (CH2M, 2013c).

[b] Groundwater samples will not be collected at locations with measurable free product.

[c] Vadose zone pressure and VOC, O_2, and CO_2 will be collected weekly for the first month, monthly for the first 6 months, quarterly for 1 year, and semiannual thereafter

[d] Details of the additional soil vapor monitoring probes will be included in an addendum to this workplan.

CO_2 = carbon dioxide
DO = dissolved oxygen
EPA = U.S. Environmental Protection Agency
L = liter(s)
ml = milliliter(s)
O_2 = oxygen
ORP = oxidation-reduction potential
SF6 = sulfur hexafluoride
TBD = to be determined
TPH-d = total petroleum hydrocarbons as diesel
TPH-g = total petroleum hydrocarbons as gasoline
VOA = volatile organic analysis - glass vials with Teflon-lined septa
VOC = volatile organic compound

Figures

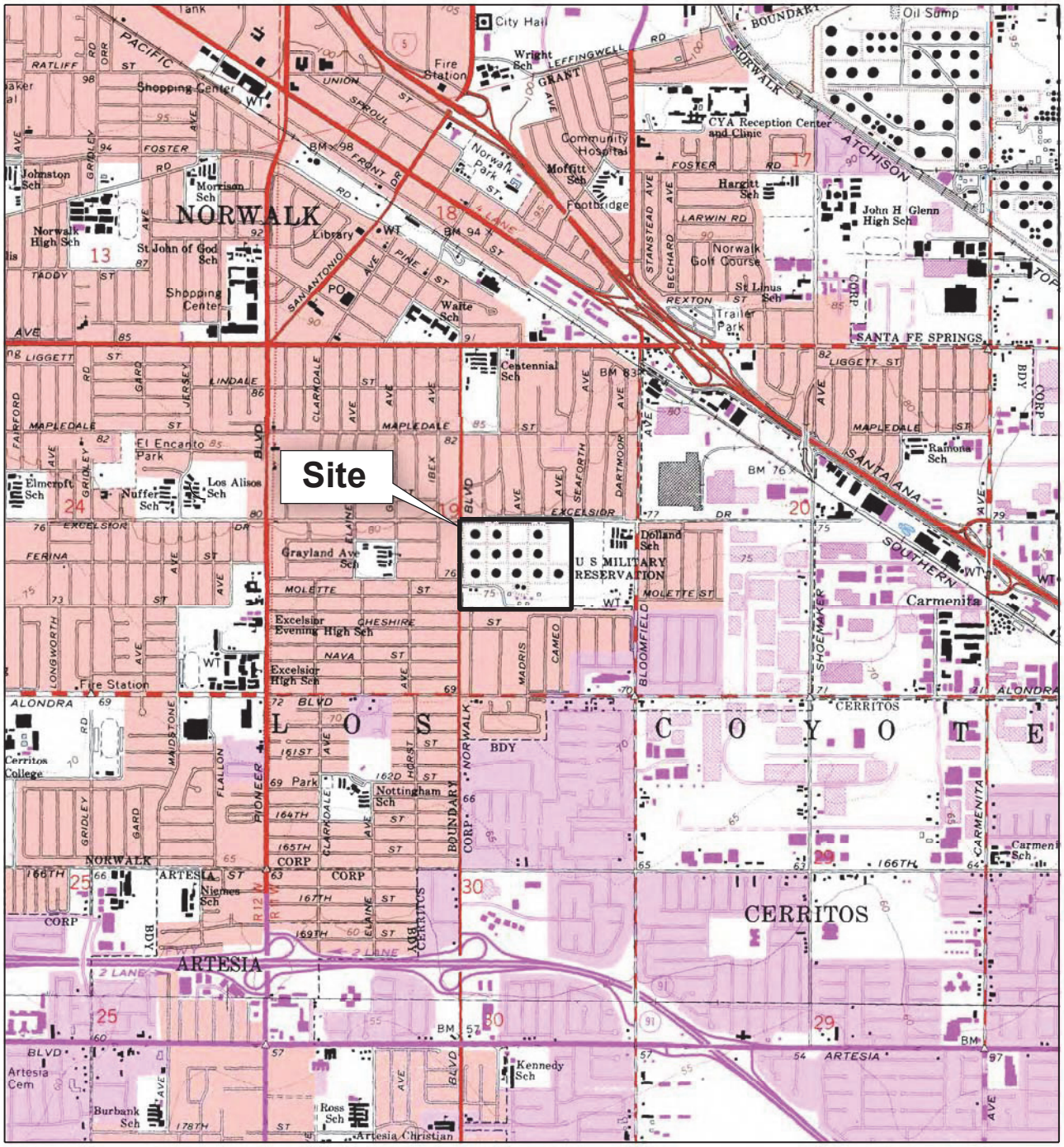
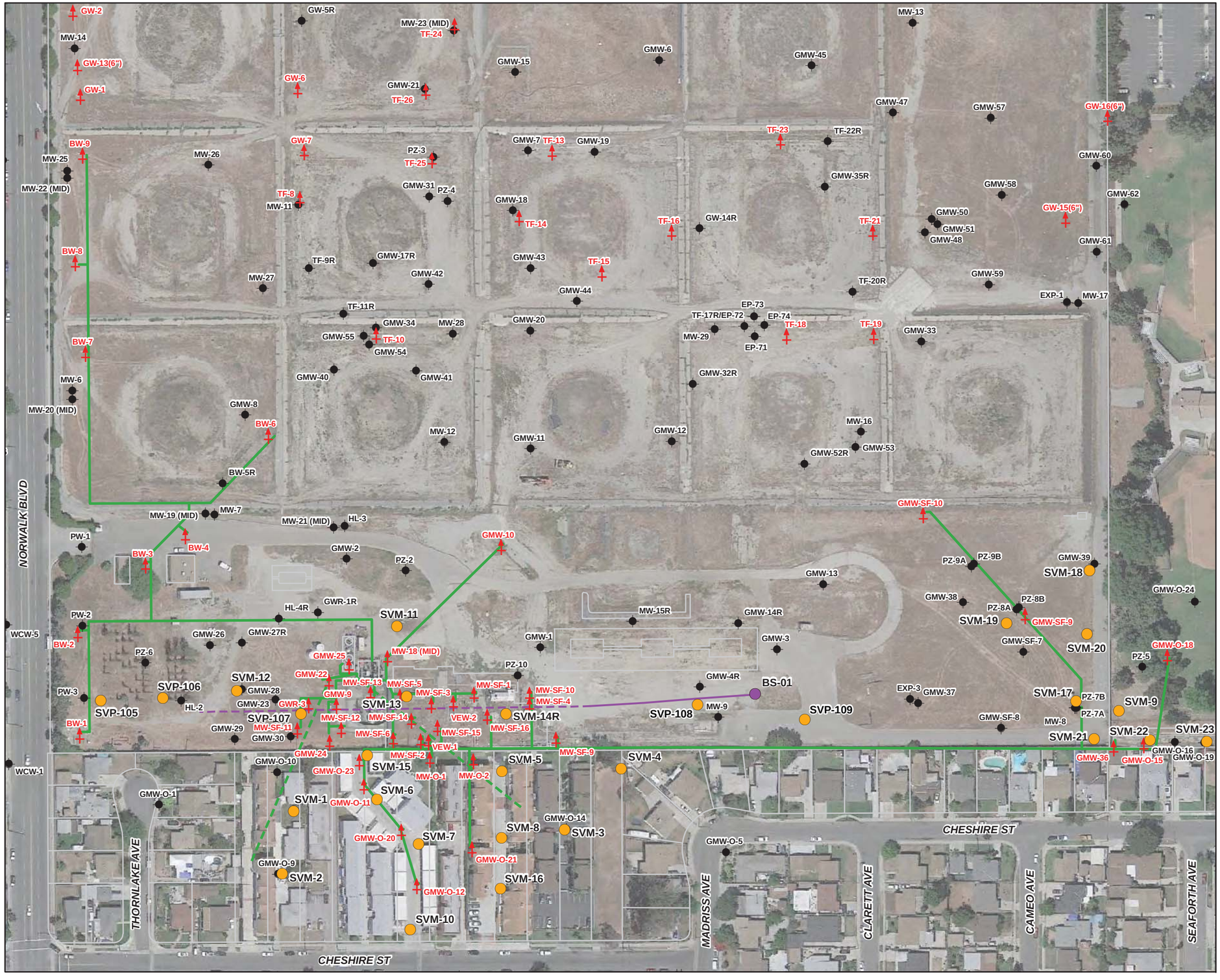


Figure 1
Site Location Map
SFPP Norwalk Pump Station
Norwalk, California

BASEMAP MODIFIED FROM U.S.G.S. 7.5 MINUTE QUADRANGLE MAP
LOS ALAMITOS 1964, CALIFORNIA. PHOTO-REVISED 1981.
WHITTIER 1965, CALIFORNIA. PHOTO-REVISED 1981.



Legend

- Soil Vapor Monitoring Probe
- Horizontal Biosparge Well Entry Point
- Existing Groundwater Monitoring Well
- Existing Remediation Well
- Horizontal Biosparge Well (dashed line depicts approximate lateral extent of well screen)
- KMEP Remediation Piping Layout (above ground and below ground)
- Horizontal Vapor Extraction Well Piping

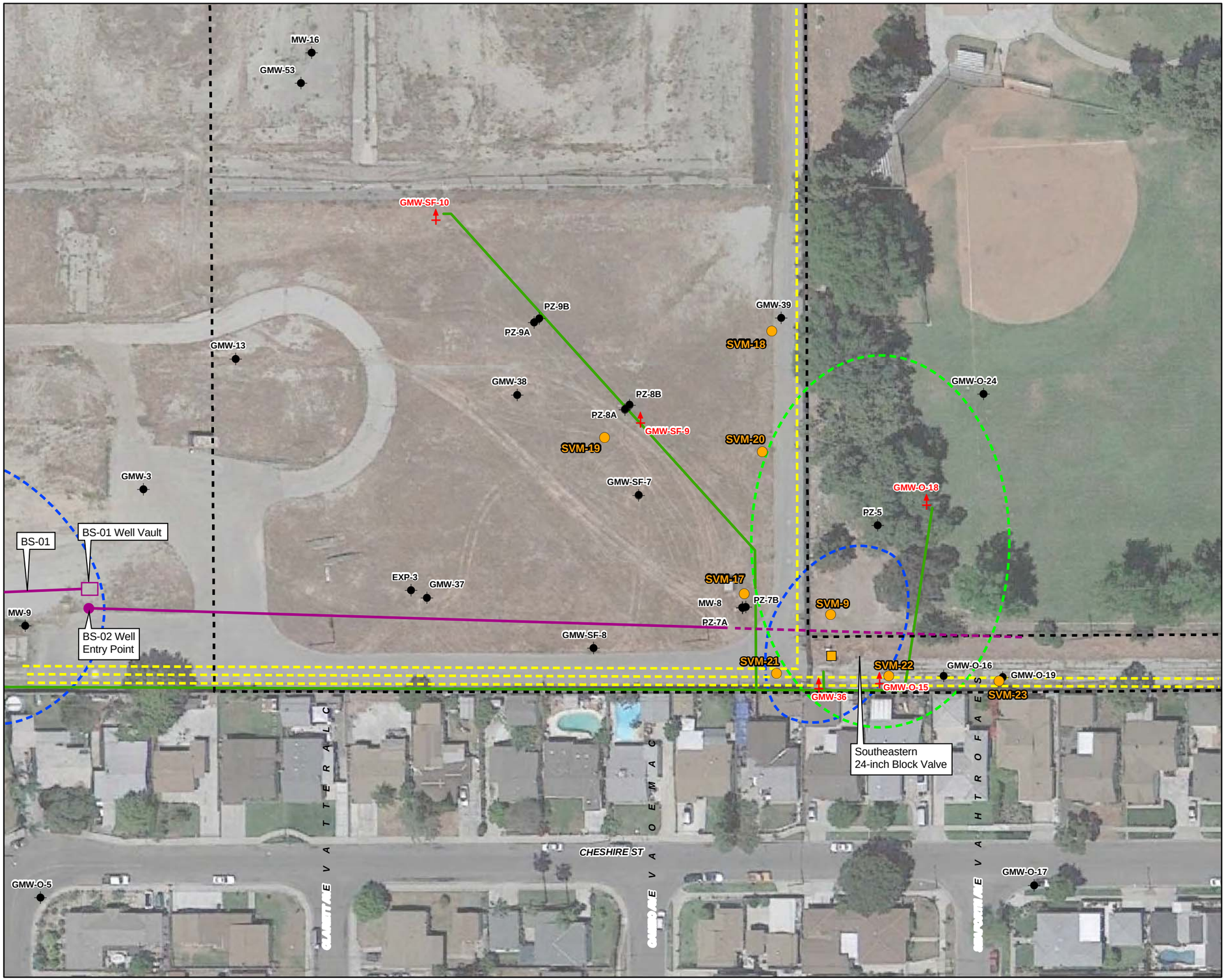
Imagery Source:
Google Earth April 17, 2013.

N

0 75 150 300
Feet

1 inch = 150 feet

Figure 2
Remediation System Layout
SFPP Norwalk Pump Station
Norwalk, California



Legend

- Eastern Soil Vapor Monitoring Probe Location
- Existing Groundwater Monitoring Well
- Existing Remediation Well
- KMEP Remediation Piping Layout (above ground and below ground)
- Proposed Eastern 15-Acre Property Boundary
- Approximate extent of dissolved phase in groundwater
- Inferred Historical Extent of LNAPL Zone (Smear Zone) from LNAPL Characterization Work Plan (AMEC Geomatrix, 2010)
- Estimated locations of Kinder Morgan Active Fuel Lines
- Existing and Proposed Horizontal Biosparge Well (dashed line depicts approximate lateral extent of well screen)
- Estimated Location of Cathodic Protection Well

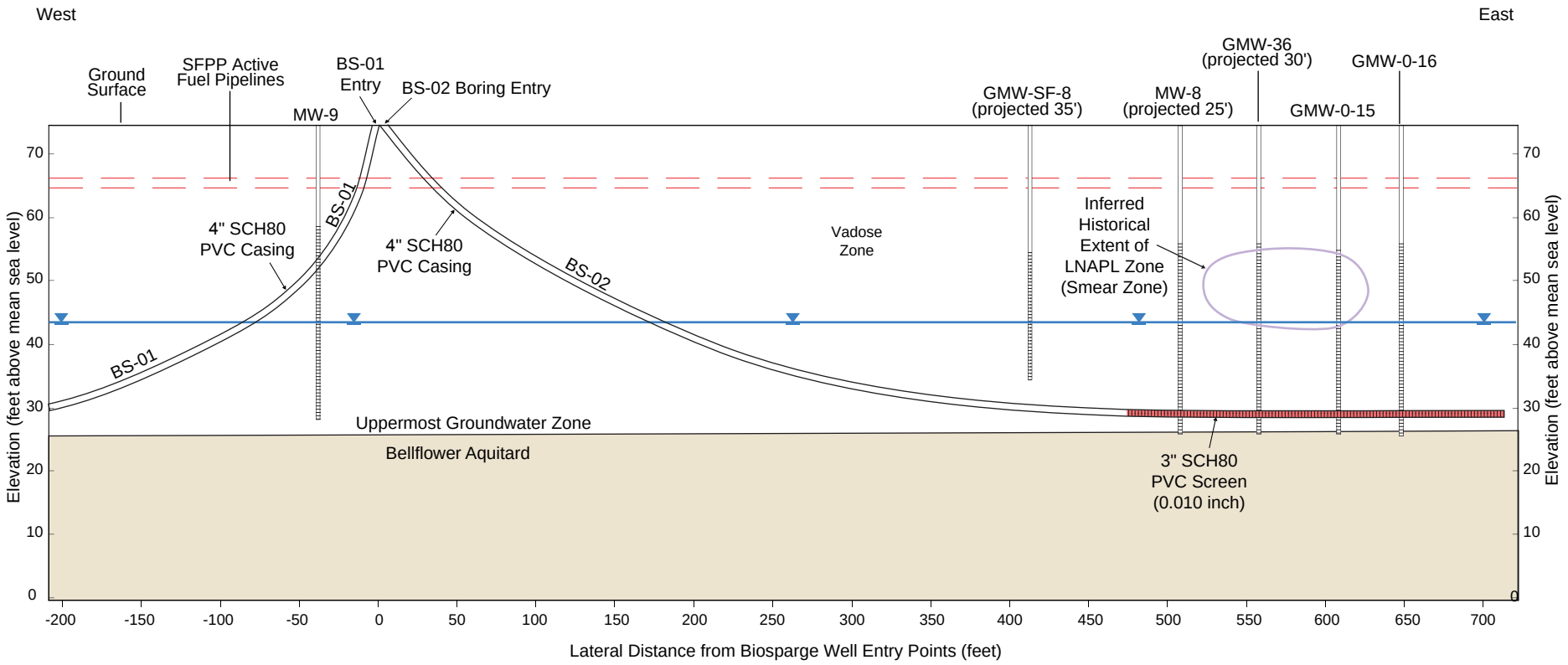
Imagery Source:
Google Earth April 17, 2013.

N

0 37.5 75 150
Feet

1 inch = 75 feet

Figure 3
Southeastern Area Biosparge Well Location Map
SFPP Norwalk Pump Station
Norwalk, California

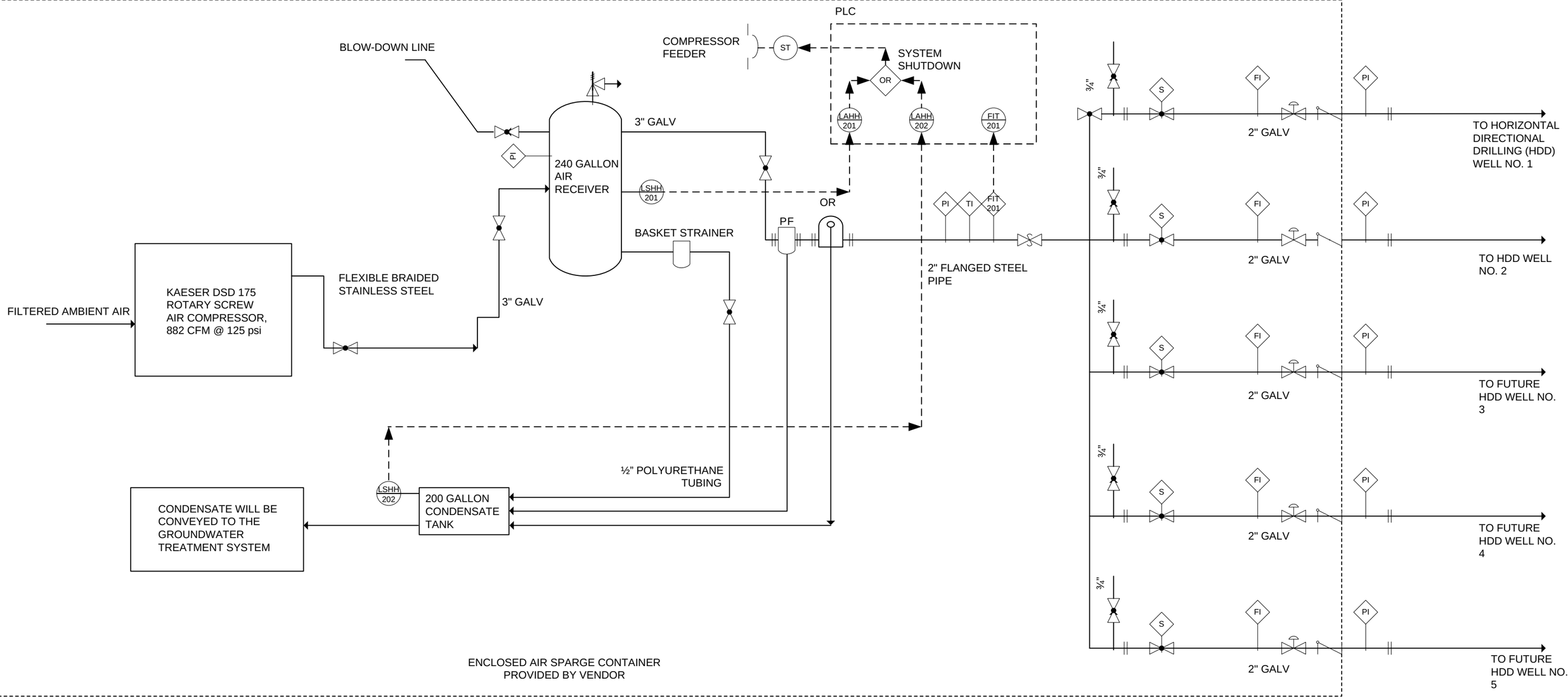


LEGEND

- Monitoring or TFE/SVE Well Screen
- Horizontal Biosparge Well Screen
- Approximate Groundwater Elevation in Uppermost Groundwater Zone (October 2017)

Note:
Top of the Bellfower Aquitard was interpreted based on (1) review of the lithological descriptions provided on the select well and boring logs (Preliminary Conceptual Site Model, AMEC Geomatrix, Inc., February 13, 2009) and (2) Conceptual Site Model and Proposed Alternate Interim Remedy for Soil, Groundwater, and LNAPL (CH2M HILL, September 3, 2013)

Figure 4
Conceptual Horizontal Biosparge Well Completion Diagram
SFPP Norwalk Pump Station
Norwalk, California



LEGEND

- S — SOLENOID
- BALL VALVE
- PRESSURE REGULATOR
- DIAPHRAGM VALVE
- CHECK VALVE
- OIL REMOVAL (OR) FILTER W/FILTER MONITORING & ECO-DRAIN
- BASKET STRAINER OR PARTICULATE FILTER (PF)
- PT — PRESSURE TRANSMITTER
- TI — TEMPERATURE INDICATOR
- PI — PRESSURE INDICATOR
- UNION
- PRESSURE RELIEVE
- KAESER AUTOMATIC MAGNETIC DRAINS (AMD) 6550
- FI — FLOW INDICATOR
- ST — CIRCUIT BREAKER WITH SHUNT TRIP DEVICE

LSHH= LEVEL SWITCH HIGH-HIGH

FIT= FLOW INDICATOR TRANSMITTER

ch2m.

TREATMENT CONCEPT
NOT FOR CONSTRUCTION

10/24/2017	FIGURE 5	Scale: N/A

Biosparge System
Process Flow Diagram
SFPP Norwalk Pump Station
Norwalk, California