REMEDIAL ACTION PLAN

San Luis Obispo Tank Farm
276 Tank Farm Road
San Luis Obispo, California

December 18, 2007

PREPARED FOR

Chevron Environmental Management Company
276 Tank Farm Road
San Luis Obispo, California 93406

PREPARED BY

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Project No. 1212.001

AVOCET ENVIRONMENTAL, INC.

December 18, 2007 Project No. 1212.001

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Remedial Action Plan
San Luis Obispo Tank Farm
276 Tank Farm Road
San Luis Obispo, California

Dear Mr. Snelling:

Enclosed is the *Remedial Action Plan* for the San Luis Obispo Tank Farm. Attached are 12 hard copies for your use. Nine copies are loose, for inclusion in the *Project Execution Plan*, and three are in binders. We have also included two full-size drawing sets.

If you have any questions or require additional information, please do not hesitate to call.

Respectfully submitted,

AVOCET ENVIRONMENTAL, INC.

R. Van Hyning

Robert Van Hyning, P.E.
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RVH:sh
Enclosure

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LIST OF ABBREVIATIONS AND ACRONYMS

AASP	*San Luis Obispo Airport Area Specific Plan*
ACM	asbestos-containing material
amsl	above mean sea level
AOC	area of concern
APCD	San Luis Obispo County Air Pollution Control District
AST	aboveground storage tank
ASTM	ASTM International
bgs	below ground surface
BMP	Best Management Practice
BTEX	benzene, toluene, ethyl benzene, and total xylenes
Cal/OSHA	California Division of Occupational Safety and Health
CD	compact disc
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
cfs	cubic foot per second
DTSC	California Department of Toxic Substances Control
DWR	California Department of Water Resources
EPA	U.S. Environmental Protection Agency
ERWG	Ecological Risk Working Group
FML	flexible membrane liner
GIS	Geographic Information System
GPS	Global Positioning System
HDPE	high density polyethylene
LCM	lead-containing material
LNAPL	light nonaqueous-phase liquid
M&RP	Monitoring and Reporting Program
MCL	maximum contaminant level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NHIS	nonhazardous impacted soil
NOAA	National Oceanic & Atmospheric Administration
OSHA	U.S. Occupational Safety and Health Administration
OU	operable unit
PAH	polynuclear aromatic hydrocarbon
pcf	pound per cubic foot
PDF	portable document format
PG&E	Pacific Gas and Electric Company
psf	pound per square foot
psi	pound per square inch
PVC	polyvinyl chloride
RTP	Remediation Technology Panel

RWQCB	California Regional Water Quality Control Board
SERRT	Surface Evaluation, Remediation and Restoration Team
SLO	San Luis Obispo
TEPH	total extractable petroleum hydrocarbons
TIN	Triangular Irregular Network
TPH	total petroleum hydrocarbons
TPPH	total purgeable petroleum hydrocarbons
µg/L	microgram per liter
USDA	U.S. Department of Agriculture
USLE	Universal Soil Loss Equation
UST	underground storage tank

1.0 INTRODUCTION

Chevron[1] owns a 340-acre former tank farm property south of the city of San Luis Obispo (Figure 1), in San Luis Obispo County, that was constructed in 1910 to serve as the tidewater accumulation point for the petroleum pipeline from the San Joaquin Valley. This property, commonly referred to as the San Luis Obispo Tank Farm, SLO Tank Farm, or Tank Farm, was slowly withdrawn from operation during the later decades of the twentieth century, and by the late 1990s, was formally decommissioned. Chevron now desires to convert the property to alternative uses that are consistent with local planning, community needs, good environmental stewardship, regulatory requirements, and efficient asset management.

A long history of intensive industrial activity on the property, however, has affected its environmental condition. On March 15, 2007, Avocet Environmental, Inc. (Avocet) published the *Feasibility Study, Former San Luis Obispo Tank Farm* addressing the nature of the environmental impacts and recommending a set of preferred remedial alternatives. This *Remedial Action Plan* describes how the preferred remedial alternatives will be implemented.

1.1 REMEDIAL ACTION PLAN PURPOSE AND FRAMEWORK

This *Remedial Action Plan* is intended to provide regulatory agencies, the municipalities with jurisdiction over the site, and other stakeholders detailed information on how Chevron will implement the preferred remedial alternative from the *Feasibility Study*. It presents the detailed engineering, which is the basis for design of the preferred remedial alternative components. It also provides conceptual-level information on habitat restoration to support environmental analysis through the California Environmental Quality Act (CEQA) process, which will be necessary to permit this project.

This document is built upon a foundation of cooperative agreements with the regulatory community and local municipalities. As with the *Feasibility Study*, the *Remedial Action Plan* has followed the general framework for developing site remediation documents found in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). It has been adapted, however, to meet the needs of a non-CERCLA (Comprehensive Environmental Response, Compensation and Liability Act) site regulated by local agencies.

Working cooperatively with the various agencies to develop this plan has resulted in an approach with broad consensus and support. Nevertheless, it is understood that approvals and permits must be granted by these agencies independent of the cooperative process. Chevron will be working with the regulatory agencies and municipalities to clarify the permitting process, especially identifying the lead agency for environmental review under CEQA, which is

[1] This property was originally owned and operated by Unocal. Chevron purchased Unocal, including this property, in August 2005. Chevron is considered synonymous with Unocal for the purpose of this document.

anticipated to include cooperative agreements and memoranda of understanding between those bodies.

1.2 SCOPE OF THE REMEDIAL ACTION PLAN

For the purposes of this report, it is assumed that Chevron will pursue development of the site consistent with proposed land use plans. As such, where the *Feasibility Study* included discussions of open space alternatives for several of the Operable Units (OUs), those discussions are omitted from consideration in this report. However, ecological risks are the basis of remediation in the open space areas. Where remediation coincides with developable areas, the remedial approach ensures compatibility with allowable uses.

This report provides the reader with a brief background of the site, its current condition, an overview of the OUs and the associated preferred remedies developed in the *Feasibility Study*. Subsequent sections of the report describe implementation of those remedies and present the supporting engineering analyses. Detailed engineering drawings and specifications are included in the appendices. The drawings, which are presented as portable document format (PDF) files on the CD in Appendix A, are intended to be printed full-size (i.e., 24" x 36"). Line work quality and legibility will suffer if the full-size drawings are printed smaller (e.g., 11" x 17").

This report also describes important closure activities that were not relevant to the *Feasibility Study*, such as the approach for abandoning the pipelines or demolishing structures. These and some other minor cleanup issues were not identified as critical for evaluation in the *Feasibility Study* or previous risk management documents, since they do not pose a direct threat to human or ecological receptors. They do, however, affect implementation of the remedies and how they will be conducted and are, therefore, material to this document.

Since publication of the *Feasibility Study*, there have been further environmental studies as well as an extension of Runway 11-29 at the adjacent San Luis Obispo Regional Airport (Figure 1) that are relevant to future development of the site. Consequently, Chevron has evaluated potential changes to the existing *Airport Area Specific Plan* (*AASP*) prepared by the City of San Luis Obispo. The proposed land use plan incorporates the new ecological resource and land use feasibility studies. The *Feasibility Study* considered remedial activities that supported development consistent with the land use plans available at that time. Similarly, the *Remedial Action Plan* supports development consistent with the proposed land use plan, although it is recognized that this requires the approval of the City of San Luis Obispo.

This report provides a brief overview of the long-term maintenance items. It describes the general activities that will be performed to ensure continued achievement of the remedial objectives. This section also discusses the alternatives under consideration for future management of the open space.

If the primary objective of this process has been to protect human and ecological receptors from exposure to potentially harmful substances, a secondary objective has been to maintain and, if

possible, improve the ecological function associated with the various habitats across the site. Key among these are the wetlands, vernal pool fairy shrimp, and rare plant habitats. The *Remedial Action Plan* clearly identifies which habitats will be impacted and notes whether the impacts will be temporary, with the habitat being restored after remediation, or permanent, which requires mitigation (i.e., replacement) of the habitat elsewhere onsite. The specific requirements for habitat restoration and mitigation will be developed in concert with the regulatory agencies and will be distributed under separate cover as the *Habitat Mitigation Plan*.

1.3 OTHER PLANS

The *Remedial Action Plan* has been prepared to accompany the *Project Execution Plan*, which is an umbrella document for remediation, restoration, and permitting of this site. Other plans that support the *Remedial Action Plan* are either included as appendices to this report or are incorporated in the *Project Execution Plan*. One of these, the *Habitat Mitigation Plan*, has already been mentioned.

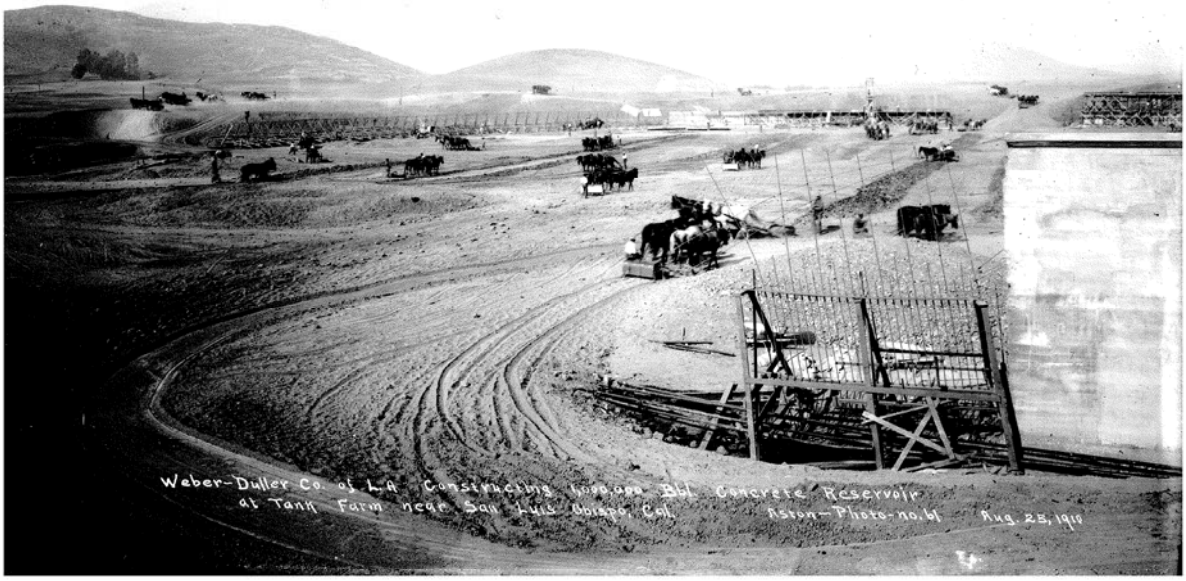
Other documents that are discussed in the text include the *Geotechnical Study*, the *Soil Management Plan*, and Land Use Covenants. The *Geotechnical Study* supports the engineering basis for the cap designs. The *Soil Management Plan* will address how contractors must handle impacted soil if its disturbance is unavoidable after remediation is complete. A draft of the plan is included in the appendices to this report. Land Use Covenants document restrictions on the property and record those with the deed, making its requirements binding upon future property owners. It will be developed by Chevron independently of this *Remedial Action Plan* through their legal department and with the California Regional Water Quality Control Board (RWQCB) and the municipalities.

Prior to construction, the contractor will also prepare a site-specific *Health and Safety Plan* that complies with the requirements of the supervisory jurisdiction as well as the stringent demands of Chevron's corporate health and safety program.

2.0 BACKGROUND INFORMATION

The following is intended to quickly acquaint the reader with the history, operations, and background of the Tank Farm. It is largely taken from the background discussion provided in the *Feasibility Study*, but has been edited and is a somewhat briefer summary. Readers desiring more detailed information are referred to the *Feasibility Study* and other background documents listed in the References of this report.

Chevron's 340-acre Tank Farm is located at 276 Tank Farm Road in western San Luis Obispo County, south of the city of San Luis Obispo and northwest of the municipal airport (Figure 1).



Construction of Reservoir 4 – August 25, 1910

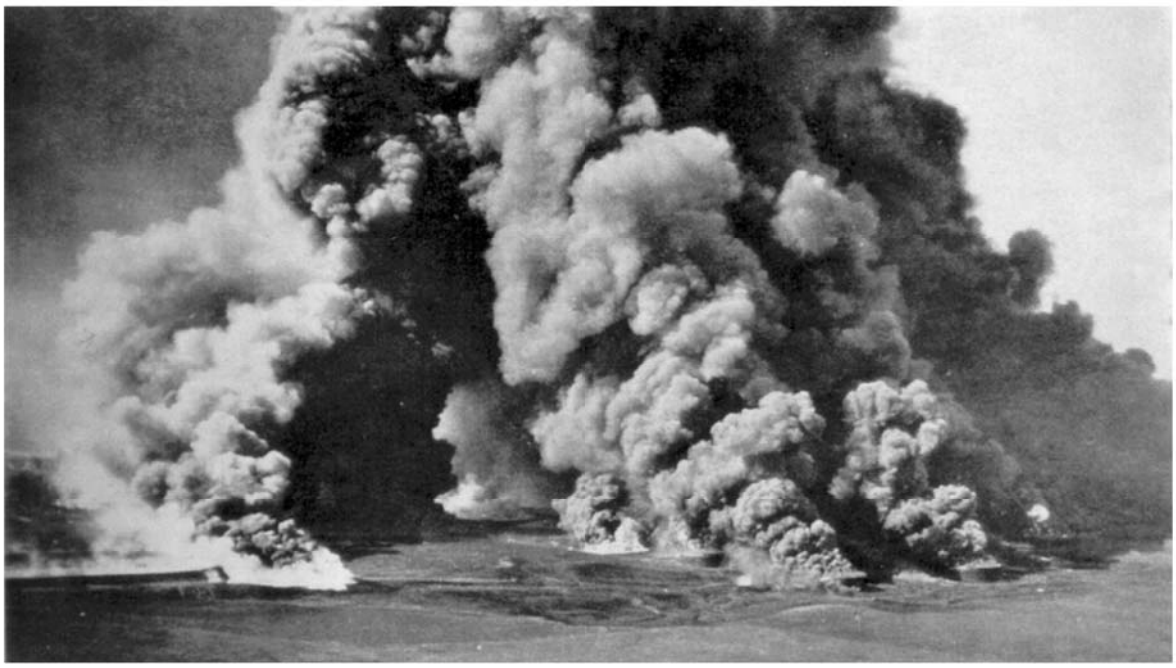
The site is divided into north and south sections by Tank Farm Road, and is bordered by light commercial and industrial development, the San Luis Obispo County airport, agricultural and pastoral lands, with scattered residences and a trailer park. The existing buildings in the northwest part of the site currently serve as Chevron's local headquarters for a variety of environmental and remediation operations (Figure 2).

From 1910 until the early 1980s, the SLO Tank Farm was used for storing crude oil transported via pipeline from the San Joaquin Valley. Storage facilities at the site included 6 large earthen reservoirs, ranging in capacity between 775,000 and 1,350,000 barrels[2], and 21 steel aboveground storage tanks (ASTs) capable of holding 55,000 barrels each. The reservoirs were constructed by excavating a circular or elliptical depression, which was then lined with wire-

[2] One barrel is equivalent to 42 gallons.

mesh-reinforced concrete. The walls were also reinforced concrete, but were constructed either vertically or integrated into the sloping sides of the depression. The walls and floors of the ASTs were constructed of heavy plate steel secured with rivets. The roofs of both the reservoirs and ASTs were of wood and composition. All told, the site had the capacity to store over 6 million barrels of petroleum.

On April 7, 1926, a lightning strike ignited a fire at the Tank Farm. At that time, there were 933,577 barrels of oil stored in the ASTs, and another 5,374,927 barrels of oil were stored in the reservoirs. The total inventory was 6,308,504 barrels of oil of various grades. Eyewitnesses claim that a lightning strike simultaneously ignited the vapors in Reservoirs 5, 6, and 7. The power of the resulting explosion registered on the Weather Bureau barograph in downtown San Luis Obispo, which recorded the time as 7:35 a.m. A second lightning strike ignited Reservoir 3 sometime between 7:50 and 7:55 a.m.



Morning of April 9, 1926. Reservoir 4 (left) has been extinguished. Reservoir 2 and ASTs (right) are still burning.

Despite suppression efforts by the facility staff, the fire spread to the other reservoirs and to 12 of the existing 15 steel ASTs over the course of the next four days by a combination of burning embers and boil-overs, where the heated oil flowed out of the reservoirs and onto the ground surrounding the tanks. By April 11, 1926, all but a few thousand of the six million barrels in inventory had been burned to coke and spread across the site. This release is considered responsible for most of the numerous surface occurrences (i.e., expressions) of highly weathered and burned petroleum that cover the ground in topographically low areas of the Tank Farm.

Subsequently, Unocal resumed operations at the Tank Farm, including reconstructing ten of the steel ASTs and four of the reservoirs (Reservoirs 3, 4, 5, and 6). Reservoirs 2 and 7 were never again used for petroleum storage. The reconstruction effort included expanding the fire breaks and enlarging the containment areas surrounding the reservoirs, which created numerous hydraulically closed depressions around the site; depressions that subsequently became wetlands.

In addition to the 6 reservoirs and 21 ASTs utilized for petroleum storage, the facility included a series of pipelines for oil movement to and from the site and for movement between the onsite tanks and facilities. Regional pipeline operations were also conducted at the site, primarily from the northwest area of the property (Northwest Operations Area; Figure 3). Facilities to support pipeline operations included a pumphouse, boilers (for heating crude oil to reduce viscosity) and an associated blow-down area, a petroleum physical properties testing laboratory, and an electrical equipment house (Figure 3). The Northwest Operations Area also included areas for general equipment storage and maintenance, as well as underground storage tanks (USTs) that contained diesel fuel and gasoline (England, Shahin & Associates, May 11, 1994). The USTs were removed in 1987.

Other historical activities at the site include the operation of a fire training school in the unpaved eastern portion of the Northwest Operations Area (Figure 3). The school consisted of several simulated sumps, flares, and tanks where students would practice techniques for extinguishing petroleum-fed fires. Off-specification gasoline and diesel fuel were fed to these fixtures from a set of three ASTs via a system of buried metal pipes.

The four reservoirs repaired after the 1926 fire continued in service for several more decades, but were progressively decommissioned beginning in the late 1950s and continuing into the mid-1970s, according to the following schedule:

Reservoir	Date Decommissioned
5	1959
3	1961
6	1961
4	1976

Field evidence suggests that decommissioning involved emptying the reservoirs of liquid petroleum and removing the roofs and, at Reservoirs 3 and 4, the vertical walls. The reinforced concrete covering the sloping slides and bottoms was left in place. In Reservoirs 2, 5, and 7, there is evidence that the concrete bottoms were ripped by the shank of a bulldozer in perpendicular directions. The bottoms of the remaining reservoirs have not been directly observed, so it is uncertain whether these have been similarly ripped. It is anecdotally reported that the ripping was done to prevent water from accumulating in the former reservoirs. Reservoirs 3 and 4 were largely backfilled by bulldozing the berms into the center of the reservoirs. Reservoir 4 generally contains 5 to 6 feet of non-engineered fill and construction debris above the concrete bottom, and Reservoir 3 is estimated to contain between 8 and 11 feet

of non-engineered fill. To provide access, a portion of the berms surrounding Reservoirs 5, 6, and 7 has been pushed into the reservoirs. Approximately 1.5 feet of non-engineered fill and construction debris cover the bottoms of Reservoirs 5 and 6, and in Reservoir 7 the berm debris was not distributed evenly across the reservoir bottom, but rather was left as an apron near the notch. Most of the bottom of Reservoir 7 is covered by several inches of interlayered tar and organic debris.

A review of historical aerial photographs shows that the ten steel ASTs remaining or rebuilt after the 1926 fire were decommissioned at various times. AST 522, located in the Northwest Operations Area, was removed sometime between 1959 and 1965. Eight of the nine remaining ASTs were removed in 1994, with the last AST being reserved for fire water storage. The final AST was removed in August 2000. Fire school exercises were suspended at the Tank Farm in the 1970s and transferred to the Richmond refinery. The pumphouse, pipelines, and boilers were taken out of service in the early 1990s and were demolished or decommissioned in the late 1990s. Of the original Tank Farm structures, only three buildings in the operation remain.

For several years, approximately 2 acres of land near the center of the property north of Tank Farm Road were leased to a recycling company. The site was used as a transfer station and accumulation point for recyclable materials such as paper, glass, and aluminum. The operation was shut down and removed in mid-2000, when the lease expired, and was not renewed (England Geosystem, April 17, 2001).

2.1 CURRENT CONDITION

Aside from the current Chevron office buildings situated in the northwestern portion of the property, the site presently consists of undeveloped land that contains native grasslands and both natural wetlands and wetlands resulting from water accumulating in depressions associated with the former oil storage facility (Figure 2). The site is best characterized as open space, with cattle grazing for the purpose of fire prevention and weed control. Adjacent land uses include light commercial and industrial development, the San Luis Obispo (SLO) County Regional Airport, agricultural and pastoral land with scattered residences, and a trailer park.

Some modifications and improvements have been made to the Northwest Operations Area since the last petroleum-dedicated ASTs were decommissioned in 1994. These include upgrades to the front gate, the addition of a modular office building adjacent to the northernmost original building, a new fire water tank to replace the water storage AST decommissioned in 2000, and various upgrades to the electrical and telecommunication systems (Figure 3).

2.1.1 Off-Site Utilities

Utility companies provide natural gas, electricity, and telecommunication service to the site or have lines that cross the site. The locations of these lines and easements are shown in Figure 4. The Gas Company owns a 4-inch-diameter gas line located just north of Tank Farm Road. The

line is buried in the shoulder of the road and terminates approximately 400 feet from the west boundary of the Northwest Operations Area. A 2-inch-diameter gas line tees off the main and runs underground along the western property line for approximately 500 feet. That branch line provides natural gas service to the Northwest Operations area. Aerial lines also run parallel to Tank Farm Road, offset to the north approximately 100 feet from the road centerline. The aerial lines include electrical power provided by Pacific Gas and Electric Company (PG&E), and telecommunications service provided by AT&T. Electricity and telecommunications services also branch off the main lines at the west boundary of the Northwest Operations area, run along the western property line, and serve the ongoing operations.

Also shown in Figure 4 is the proposed sewer that is scheduled to be installed by the City of San Luis Obispo in 2008. The City is in the process of obtaining easements and access agreements for construction and maintenance.

2.1.2 Operations Related Pipelines

Historical operations at the site were served by approximately 25,125 feet of crude oil pipeline, 47,340 feet of water supply line, and 1,172 feet of other pipeline. The approximate locations of these lines are shown in Figure 5. The analyses supporting the estimated lengths of pipeline are found in Appendix L. It is believed that most of the lines were abandoned in place, although it is reported anecdotally that much of the pipeline serving the ASTs was removed when the tanks were removed. Since there is no record of final cleaning or abandonment procedures, it is presumed that at least some of the lines still contain crude oil. Crude oil pipelines vary in diameter from 8 to 16 inches. It appears that the most common diameter is 8 inches, and using this as a nominal diameter for the entire network suggests that the crude oil pipeline volume is on the order of 16,750 cubic feet. It is unlikely, however, that this volume of oil remains in the lines. Many of the lines are demonstrably empty where they are exposed on the surface.

Much of the facility piping is found in the Northwest Operations Area, as shown in Figure 6. This includes nearly 20 percent of the total crude oil pipe network (approximately 4,300 lineal feet). This configuration allowed the operators to direct oil in and out of the facility and to transfer oil between the various storage locations as needed. There are also 4,900 feet of water line, 1,120 feet of dedicated Foamite fire-fighting lines, and leach and drain lines totaling slightly less than 1,200 feet. The estimated volume of the crude oil lines in the Northwest Operations Area is approximately 3,260 cubic feet.

2.1.3 Potential Land Use

It is expected that after closure, the site will be converted to new productive uses. These will be consistent with the evolving land use plans for the area, although the final land use configurations have not yet been determined. Chevron is working in concert with the City of San Luis Obispo, San Luis Obispo County, and other stakeholders to ensure that the final disposition of the site is in harmony with community at large.

A key decision will be which local government jurisdiction to place the Tank Farm under. At present, as noted previously in this report, the site is within unincorporated San Luis Obispo County. It has been proposed, however, to annex the Tank Farm into the City as part of the *AASP*. Chevron has proposed a new land use plan that incorporates new ecological and land use feasibility studies, and conforms to the revised runway protection zones resulting from extending Runway 11-29 at the SLO County Regional Airport. Chevron is evaluating the potential benefits and consequences of each alternative. Since a decision has not been made prior to publication of the *Remedial Action Plan*, the elements of each land use plan are briefly discussed below. However, remediation has been tailored in this plan to support the proposed land use concept.

The SLO County General Plan envisions future development on portions of the Tank Farm (Figure 7). Possible development areas under the County plan are situated on the east and west ends of the northern portion of the property (i.e., north of Tank Farm Road). Anticipated land uses in the eastern area include 17 acres zoned for industrial uses principally within the footprint of former Reservoir 4, and 19 acres zoned for commercial services immediately to the north. Land uses in the western area include 31 acres zoned for light industrial use. The sum of potentially developable land under the County plan is approximately 67 acres.

Although the site is presently within unincorporated SLO County, it also lies within the City of SLO's sphere of influence and the City desires to annex the site in accordance with the *Airport AASP,* dated January 2005. The central focus of the *AASP* is to convert the 340-acre site (approximately one-third of the Airport Area) and other surrounding areas to greater beneficial use, including limited commercial development (Business Park) and recreational open space, while enhancing the physical link between the Airport and City areas. The *AASP* compliments the adjacent *Margarita Area Specific Plan*, which addresses the area immediately north of the Tank Farm. The proposed land uses, as identified in the *AASP*, are shown in Figure 8 and include 2.3 acres of available Business Park development, 41.8 acres of Services/Light Manufacturing, and the balance (approximately 296 acres) as open space (43 potentially developable acres). The most obvious difference between the City and County plans is that the City plan includes potential development in the eastern end of the site, south of Tank Farm Road.

The site is located beneath the departure pattern for Runway 11-29 of SLO County Regional Airport, which has extended Runway 29 by approximately 500 feet. This had expanded the airport safety zones beyond those originally considered in the *AASP*. The airport safety zones are shown in Figure 9. These expanded zones render approximately 14.6 acres of the originally proposed building area less suitable for development. Further, environmental studies subsequent to the *AASP* have identified protected habitat for vernal pool fairy shrimp in several of the former tank rings north of the Northwest Operations Area (discussed further in Section 2.3). Consequently, Chevron has proposed revisions to the existing City land use plan that would be consistent with these post *AASP* developments.

The proposed land use plan is shown in Figure 10. It trades approximately 9 acres in the northwest portion of the site and on the west edge of the area south of Tank Farm Road for just under 16 acres in the northeast portion of the site. Overall, the developable area relative to the *AASP* land use plan increases by almost 7 acres but decreases by 16 acres relative to the existing SLO County General Plan. The proposed swap of land use designations also overlaps, to a large degree, with the SLO County General Plan. The proposed plan provides more developable frontage along Santa Fe Road, which is anticipated to see significant traffic when it eventually connects Tank Farm Road with Prado Road. It also avoids 3.28 acres of protected fairy shrimp habitat in the northwest corner of the site.

While it has not been decided whether "any or all" of the site will be annexed into the City, the design considered in this *Remedial Action Plan* envisions that the site is eventually developed as shown in the proposed land use plan (Figure 10). Chevron would perform the remediation necessary for regulatory compliance and potentially for development of those areas of the site identified for Service Commercial/Business Park land use. Chevron may elect to annex developable portions of the site into the City, while the remaining areas may be left as open space within the County for preservation as an ecological preserve. Future residential development of any area of the site is excluded by zoning, airport safety zone restrictions, and future institutional controls.

It is anticipated that cattle grazing may continue in selected areas of the site. Cattle are effective at controlling invasive weeds and limiting the fuel available to a potential fire. It is expected that cattle grazing would be limited to grassland areas, and would be excluded from upland and wetland restoration areas. The specific requirements for continued cattle grazing will be coordinated with the California Department of Fish and Game, the RWQCB, and the U.S. Fish and Wildlife Service.

2.2 SITE HYDROLOGY

Regionally, the Tank Farm is within the Central Coast Hydrologic Area, a 6,600-square-mile watershed that extends from Santa Barbara to the upper reaches of the Nacimiento River. More specifically, the site is within the San Luis Obispo Hydrologic Subunit, a 44,370-acre component of the larger San Luis Obispo Hydrologic Unit. The boundaries of these watersheds have been defined by the California Department of Water Resources and are illustrated in Appendix G.

Locally, the Tank Farm is situated north of the East Fork of San Luis Obispo Creek, which is tributary to San Luis Obispo Creek, and is illustrated in Figure 11. A small portion of the Tank Farm discharges to this creek directly, referred to as Design Point B on Figure 11. However, most of the Tank Farm consists of a closed catchment that retains storm water. This is a legacy of the historical containment structures and other topographic modifications that were made to facilitate operations.

Ditches along Tank Farm Road collect storm water from the frontage properties. A local high point is located approximately 1,000 feet east of Higuera Road. Storm water collected east of this point drains toward the Tank Farm and eventually discharges into the North Marsh wetland complex.

A small channel, referred to by the City of San Luis Obispo as Tank Farm Creek, is located on the western side of the property and collects storm water from a catchment approximately 485 acres in size, including about 150 acres that are on the Tank Farm proper. Tank Farm Creek discharges from the site at a concrete outlet works labeled Design Point A on Figure 11. Much of that catchment is located north of the Tank Farm and currently enters the site as sheet flow, or concentrated into natural channels, along the northern property line. Development plans for the Margarita Area will change the upgradient hydrology and will likely concentrate flow at one or possibly a few locations. Remediation and grading on the east side of the property will also affect this drainage. Anticipated changes to the onsite hydrologic system are discussed in subsequent chapters. Remediation and restoration of the North Marsh may require further changes to the site hydrology. The details of these changes will be developed as the *Habitat Mitigation Plan* is finalized in conjunction with the regulatory agencies. It is believed, however, that the natural retention capacity of the onsite wetland complexes will be more than adequate to address any foreseeable hydrologic changes. Improvements that may be necessary for conveyance of storm water to the wetlands will be made in conjunction with the upstream developers' habitat restoration activities, as necessary.

2.3 WETLANDS AND RARE PLANT HABITAT

The Tank Farm currently hosts wetland and rare plant habitats (Figure 12). Much of the wetland habitat has been established from the closed hydrologic conditions onsite that are artifacts of the containment and fire suppression controls constructed after the 1926 fire. Several delineations of the wetlands have been accompanied by supporting scientific studies. This report focuses on the most current delineation, which encompasses federal as well as state wetlands. This most recent delineation identified 75.95 acres of state wetlands (incorporating 55.8 acres of federal wetlands). This total also includes 32.1 acres of vernal pool fairy shrimp habitat. In addition, the site supports several other rare plant habitats that are identified in Figure 12.

It is likely that these current measurements will be revised to reflect recent legal developments relative to wetland delineation. There may also be modifications to the rare plant surveys, which will be conducted in the spring and summer of 2008. Modifications to these surveys and their effect on remediation or grading will be attached to this report as an addendum as the information becomes available.

2.4 ENVIRONMENTAL SITE CHARACTERIZATION SUMMARY

Considerable effort has been expended to characterize the site. The following is offered as a brief summary to orient the reader who is not otherwise familiar with that characterization work. It focuses on those portions of the characterization that are most relevant to the remedial action,

including the key soil and water impacts, wetland and rare plant habitats, and the environmental impacts considered pertinent to risk management. For those readers desiring more detailed information on the site characterization efforts, the documents listed in the reference section are useful, especially the following:

- *Feasibility Study, Risk Management Summary*
- *Seep Evaluation Trenching Report*
- *Supplemental Site Characterization*
- *Remediation Technology Panel (RTP) Assessment of Off-Site Migration and On-Site Surface Expressions of Hydrocarbons at the San Luis Obispo Tank Farm Site*
- *Surface Hydrocarbon Inspection and Mitigation Plan* (recently approved by the California Department of Fish and Game, Office of Spill Prevention)

Given that petroleum storage and handling facilities operated on the property for many decades, it is not surprising that environmental issues at the site are generally petroleum-related. Crude oil is found in soil as deep as 60 feet below the ground surface (bgs). It is also seen in surface expressions ranging from solid asphalt-like coke to viscous liquid. The locations and nature of these impacts are shown in Figure 13.

Characterization of these impacts has included, in addition to their careful identification and delineation, an evaluation of their importance relative to human and ecological health, and the need for their remediation. Key to this effort has been the cooperative process between Chevron and the regulatory community that has progressively reviewed existing data, evaluated assessments, identified data gaps, established the risk associated with a given impact, and determined which impacts require remediation. Following are the principal impacts identified in the various site studies, RTP report, or *Risk Management Plan,* that were further evaluated in the *Feasibility Study*:

- Liquid hydrocarbon surface expressions (red areas in Figure 13) impacting the seasonal wetlands in the bottoms of Reservoirs 5 and 7.

- Plastic surface hydrocarbon expressions (purple areas in Figure 13) found across the site, but predominantly in low lying areas (e.g., North Marsh, Reservoir 3) that pose an entrapment hazard to small animals.

- Groundwater affected by light nonaqueous-phase liquid (LNAPL) and benzene beneath the Northwest Operations area.

- Arsenic in the shallow soil of the Northwest Operations Area.

- Wetlands impaired by an asphaltic crust.

- The potential for methane to affect habitable structures

3.0 OPERABLE UNITS, AREAS OF CONCERN, AND THE INTEGRATED PREFERRED REMEDY

Once a consensus on the objectives of remediation had been reached, it was necessary to evaluate methods for achieving those goals. Chevron elected to generally follow the procedure outlined in the NCP, which establishes the framework for evaluation of remedial actions used by the U.S. Environmental Protection Agency (EPA). This provided a platform for selecting remedial alternatives that was familiar to the regulatory community and would provide a transparent and credible process for their evaluation.

Through that process, five operable units (OUs) were developed for the Tank Farm. The four terrestrial operable units are shown in Figure 14 (OU #5, site-wide groundwater, is not depicted). A brief description of each operable unit is provided in the sections below and is accompanied by a discussion of the associated preferred remedy. These descriptions are largely taken from the *Feasibility Study* but have been edited to reflect the current plan to pursue the development options where applicable, and to reflect refinement of the *AASP* land use zones. Detailed proposals for implementing the preferred remedies are provided in Sections 4 through 7. A summary list of the operable units, areas of concern, the relevant constituents of concern, and the preferred remedies is provided in Table 1.

3.1 OU #1- FORMER NW OPERATIONS AREA

OU #1 encompasses approximately 5 acres in the northwest area of the site. Historically, this area was used to support tank farm and pipeline operations and included equipment and processes not found across the remainder of the site. Consequently, this area is affected, at least in part, by a unique group of contaminants, namely arsenic in shallow soil and LNAPL with a significant lighter fraction, including benzene, toluene, ethyl benzene, and total xylenes (BTEX), in the saturated zone.

In addition, this area of the site is designated both by the City and San Luis Obispo County for potential commercial development (Figures 7, 8, and 10). Although the area zoned for commercial development in either land use plan includes all or portions of the northwest corner of the property, including the former AST containment berms, the area of OU #1 excludes the AST berms due to the identified value of the vernal pool fairy shrimp habitat that they support (Figure 12). An additional concern to this operable unit is that it lies within the 100-year floodplain (Figure 9), which affects how development can be implemented.

OU #1 includes two media-focused areas of concern (AOCs), groundwater (AOC #1) and soil (AOC #2). As stated previously, due to a set of conditions unique to the Northwest Operations Area, the LNAPL in the saturated zone also contains a light fraction (C_5-C_{20}), including benzene. This light fraction is responsible for the Northwest Operations Area being the only area of the site identified by the RTP where groundwater containing dissolved contaminants (total

petroleum hydrocarbons [TPH] and benzene) at concentrations greater than maximum contaminant levels (or frequently applied action levels) has migrated offsite. The LNAPL impact in the Northwest Operations Area covers an area approximately 600 feet long by 300 feet wide and ranges in depth from 4 to 28 feet bgs (Figure 14). The light fraction co-occurs with, and is dissolved in, the heavier oil. Light-end hydrocarbons, including BTEX, are hundreds of times more soluble in oil than in water. Therefore, this light fraction would be difficult to remove without also removing the heavier residual oil. In the Northwest Operations Area, groundwater typically occurs at depths ranging from 5 to 15 feet bgs.

Benzene is the most toxic constituent of BTEX and its presence in soil, groundwater, and soil gas has the potential to pose the greatest potential risk to future users of the site. The *Feasibility Study* describes the circumstances surrounding the presence and discovery of the BTEX in detail. In summary, it was determined that the BTEX does not pose a significant risk to building occupants, provided adequate institutional controls (e.g., vapor barriers) are in place.

AOC #2 includes shallow soil in OU #1, which is impacted by arsenic and, to a more limited extent, by TPH and polynuclear aromatic hydrocarbons (PAHs), and deeper (4 to 28 feet bgs) soil impacted by the above-described LNAPL. Within the operable unit, the arsenic is relatively widespread and limited to shallow ($\leq$2 feet) soil, which is consistent with its likely use as an herbicide. Although not relevant to the development plans considered in this report, the metals and PAHs have been identified as potential ecological risks and would be issues if the area were converted to open space[3]. The arsenic was identified as a potential human health risk for both open space and commercial development land uses. It is assumed that the entire operable unit is impacted with arsenic, subject to remediation given the available spatial distribution of data.

3.1.1 Preferred Remedy OU#1-AOC#1 Groundwater

It has been demonstrated that benzene dissolved in groundwater has historically migrated offsite in the vicinity of Well SLOW-12, but rapidly attenuates and does not appear to threaten downgradient water wells. The remedial action objectives for OU #1/AOC #1 established in the *Feasibility Study* are intended to prevent human contact with TPH- or benzene-impacted groundwater and ensure that groundwater resources downgradient of existing impacts are not affected. Given that the LNAPL is stable and unrecoverable, the dissolved phase is naturally contained, there is no evidence of hydrocarbon impacts to downgradient groundwater beneficial uses, and groundwater in the airport area is not used for drinking, it was concluded that monitored natural attenuation is sufficiently protective to be adopted as the long-term remedy for groundwater in OU #1/AOC #1.

Therefore, the preferred remedial alternative for AOC #1 is monitored natural attenuation with institutional controls and long-term monitoring. Monitored natural attenuation includes semiannual sampling of the existing groundwater monitoring network on and surrounding AOC #1; testing those samples for total extractable petroleum hydrocarbons (TEPH), total

[3] In its present condition, the Northwest Operations Area was not considered suitable habitat in the pERA.

purgeable petroleum hydrocarbons (TPPH), BTEX, and natural attenuation parameters; and reporting those findings to the RWQCB in accordance with an approved monitoring and reporting program.

Institutional controls will include deed restrictions limiting land use to commercial/industrial purposes, a soil management plan to be implemented in the event contaminated soils are disturbed, and groundwater use restrictions in impacted areas.

3.1.2 Preferred Remedy OU#1-AOC#2 Soil

AOC #2 includes shallow soil, which is impacted by arsenic and, to a more limited extent, by TPH and PAHs, and deeper (4 to 28 feet bgs) soil impacted by LNAPL containing a light fraction. The arsenic is relatively widespread and limited to shallow ($\leq$2 feet) soil, which is consistent with its probable former use at the site as a herbicide. The arsenic and PAHs have been identified as potential threats to human and ecological receptors (if the area were converted to open space). With regard to the deeper soil, the LNAPL is not considered a direct contact risk, but vapor intrusion by the volatile fraction may pose a risk to future onsite commercial workers. Remedial action objectives are primarily focused on preventing human and eco-receptor contact with arsenic, TPH, PAHs, and volatile hydrocarbons. Since the area is to be developed, it will not support suitable ecological habitat, thereby mitigating the potential for ecological risks.

The preferred remedy for OU #1/AOC #2 includes construction of a minimum 4-foot-thick soil cap. The cap will provide a barrier between the impacted soil and potential receptors and also provide a soil layer of sufficient thickness to facilitate foundation construction and utility installation with a low potential of disturbing contaminated soil. The Northwest Operations Area is within the 100-year flood plain associated with Tank Farm Creek. At its current grade, the southernmost structure within the Northwest Operations Area is subject to inundation during periods of moderate to heavy rain. Raising the ground elevation by 4 feet and regrading appropriately would also satisfy the requirements for construction in floodplains and help alleviate the current flooding problems. A geotextile would be placed between the cap and the existing ground surface. It would act as an identifying marker to reduce the likelihood of inadvertently excavating into the impacted soils. The cap will require long-term monitoring and maintenance. Institutional controls will include deed restrictions limiting land use to commercial/industrial purposes, excavation notification requirements, a soil management plan, groundwater use restrictions in impacted areas, and a vapor barrier requirement for any new buildings that are constructed in the OU; which will protect the building occupants from possible vapors from the underlying hydrocarbons.

3.2 OU #2- RESERVOIRS 5 AND 7

OU #2 includes the former Reservoirs 5 and 7 (Figure 14). Measured from the outside toe of the reservoir containment berms, the reservoirs cover a total area of 9.8 acres. The reservoirs contain about 8.5 acres of wetland, none of which are identified fairy shrimp habitat, although

Reservoir 5 contains local communities of Congdon's tarplant. Both reservoirs pond water during the winter, with the amount of water largely dependent on the amount of rainfall. In years of heavy rainfall, it is not unusual for 2 to 3 feet of water to accumulate in the reservoirs. The reinforced concrete bottoms, though ripped, are still present in both of the reservoirs but are covered by 1 to 2 feet of tar, non-engineered fill, and construction debris. In all land use plans, Reservoirs 5 and 7 are in areas designated as Open Space.

Reservoirs 5 and 7 are unique in that they are the only areas of the site impacted by liquid-type hydrocarbon surface expressions and these are the only surface expressions that are hydraulically connected to subsurface LNAPL sources. The implication of this is that simple removal of the shallow hydrocarbon-impacted soils will not effectively remediate the sheen that seasonally develops on surface water in the reservoirs. The source of the hydrocarbon sheen is mobile hydrocarbon extending to depths of up to 25 feet below the bottom of the reservoirs, which is displaced vertically upward during periods of a rising water table. Elimination of the sheen will require either removal of the mobile hydrocarbon at depth, making that hydrocarbon immobile, or raising the bottom of the reservoirs to elevations above the seasonal water table highs (RTP, 2006).

The preferred remedy caps Reservoirs 5 and 7, mitigates wetland impacts in other onsite areas, and provides institutional controls and long-term monitoring. Cap construction will involve removing existing non-engineered fill down to the existing concrete floor in each reservoir. Gravel will be placed directly on top of the existing concrete floor in each reservoir to a height of 1.5 feet above each reservoir's historical (1990 to 2005) high water table elevation. The gravel will be covered with a layer of geotextile and a combination of common earth fill and topsoil to create the finished surface. The cap will be graded to encourage runoff, thereby minimizing water infiltration into the gravel reservoir.

This approach requires removal of the existing wetlands. Mitigation for these impacts will occur in other suitable areas of the property. Specific institutional controls will depend partially on the degree of public access, but are expected to include fencing, signs, awareness programs, and similar active measures to ensure that access to the site is controlled. Other institutional controls will include deed restrictions and other covenants (as needed) to preserve the land as open space in perpetuity. Long-term monitoring will include periodic inspections and maintenance (as needed) to ensure that the institutional controls and cap remain effective.

3.3 OU #3- East Development Area (Reservoir 4)

OU #3 includes approximately 30 acres in the eastern part of the site (Figure 14) and is also zoned for possible future commercial development (Figures 7, 8, and 10). This operable unit includes Reservoir 4, several surface expressions of sticky ("purple-type") hydrocarbon that collectively cover an area of about 2.3 acres, and the former recycling center. The floor of former Reservoir 4 is covered with 5 to 6 feet of non-engineered, hydrocarbon-impacted soil and construction debris. The *Risk Management Summary* recommended that soil within Reservoir 4 be left in place with no further action, assuming that the area remains as open space. Due to the

entrapment hazard posed by the sticky hydrocarbon surface expressions, however, these areas, together with some proximal "blue"- and "green"-type expressions that are not physical hazards, were identified by the Ecological Risk Working Group (ERWG) for remediation. OU #3 contains several small areas of wetlands, none of which are fairy shrimp habitat, and at least two special status plants: Congdon's tarplant and SLO morning glory. Finally, three areas of relatively low, Level 2 ecological risk were identified in the former recycling center, but because the area is paved and does not provide suitable ecological habitat, the *Risk Management Summary* recommended no further action as long it does not revert to open space.

For purposes of the *Feasibility Study* evaluation, the development scenario was defined as including all of the activities necessary to leave the operable unit in a condition such that a developer could undertake construction. For OU #3, this is potentially significant since there are several feet of non-engineered fill within Reservoir 4 anticipated to be incapable of supporting a conventional spread footing building foundation without adverse differential settlement. Consequently, the *Feasibility Study* considered remedial alternatives that would support high foundation loads by removing and replacing the non-engineered, hydrocarbon-impacted fill within Reservoir 4, as well as development alternatives that would require minimal structural support, such as a parking lot.

Weathered, high-molecular weight TPH-impacted soil extends to depths of up to 50 feet below Reservoir 4 (Figure 12). As no significant risk has been attributed to the presence of this material, and considering the impracticability of contaminant removal, remedial measures targeting this material were not considered in the *Feasibility Study*.

Subsequent to the *Feasibility Study*, a refinement of the land uses shown in the *AASP* has been proposed. Consequently, the grading of the original preferred alternative was augmented to support this land use concept. The approach is at least equally effective, in that surficial hydrocarbon exposures are removed. In addition, the refined preferred alternative provides a soil cover over Reservoir 4 that is at least 4 feet thick, and as much as 11-feet thick .. The cover will provide a barrier between the impacted soil and potential receptors and also sufficient structural support for future onsite construction. A geotextile identifying layer, placed between the cap and the existing ground surface, would serve to reduce the likelihood of inadvertently excavating into the impacted soils. Landscaped areas of the cover would be planted with appropriate shallow-rooted vegetation to prevent erosion without penetrating the cover. Development will still require the installation of vapor barriers below any future foundations or slabs to protect against potential methane intrusion.

Construction will unavoidably impact wetlands, which will require mitigation, as well as some Congdon's tarplant and SLO morning glory communities. Since residual contamination will remain at depth, institutional controls (e.g., restrictions on excavation, development of a *Soil Management Plan*) will be used to minimize the potential for future onsite exposures. Long-term monitoring will be used to assess compliance and effectiveness.

3.4 OU #4- REMAINING SITE-WIDE TERRESTRIAL AND WETLAND AREAS

OU #4 includes all the remaining terrestrial and wetland areas of the Tank Farm not considered in the first three operable units. OU #4 covers an area of about 270 acres, all but 24 acres of which is planned open space. Three areas of concern were defined in the operable unit corresponding to "must-do" areas identified by the Surface Evaluation, Remediation and Restoration Team (SERRT) (Figure 14). These are:

- AOC#1 – the North Marsh
- AOC#2 – Reservoir 3
- AOC#3 – Other sticky hydrocarbon surface expressions.

All three of these areas were identified by the SERRT due to the presence of sticky hydrocarbon surface expressions. However, the conditions surrounding the occurrence of these surface expressions in each area of concern are subtly different, necessitating their separation. Over 70 acres of wetland occur in OU #4, including more than 30 acres identified as fairy shrimp habitat. The operable unit also includes substantial coverage by a variety of special status plants.

The *Risk Management Summary* report also recommended two areas of surface hydrocarbon expressions surrounding Reservoir 3, which were not identified as eco-risks, for ripping to facilitate re-vegetation. These areas, which are also identified in Figure 14, shall be scarified to depths of not less than 15 inches.

3.5 AOC#1 - NORTH MARSH

AOC# 1, the North Marsh, consists of approximately 11.9 acres of wetlands without vernal pool fairy shrimp habitat located east of the Northwest Operations Area. The wetlands include the most extensive coverage of pliable plastic (i.e., "blue" and "purple") hydrocarbon surface expressions at the Tank Farm. When grouped into areas based on proximity, these expressions cover about 7 acres. The extent in the shallow subsurface, however, may be significantly larger. Based on the 1926 topography of the North Marsh, these surface expressions may cover as many as 13 acres. The thickness of the expressions varies but has been estimated to be 2 to 3 feet on average. The North Marsh has not been identified as fairy shrimp habitat.

The preferred remedy is to excavate the plastic hydrocarbon surface expressions from the North Marsh, disposing of the impacted material offsite, and improving upon the original wetland function. The area of excavation is estimated to be between 7 and 13 acres, with an average assumed excavation depth of 3.5 feet. Given the areas and thickness, the excavation may generate anywhere from 40,000 to 73,000 cubic yards of material. Any material identified as unimpacted would be stockpiled separately and used later as backfill. It is anticipated that the soil would be disposed of as nonhazardous contaminated soil at an appropriate landfill. Depending on the landfill used, trucks may haul backfill material from the landfill on their return trip. It is assumed that the upper 1 foot of soil would be an appropriate organic-rich topsoil, to be specified in a future restoration plan, consisting either of clean soil from on site or imported to

the site. The actual amount of topsoil used would be based on the final soil balances, but it is assumed, for the purposes of this analysis, that 1 foot of topsoil will be imported for backfilling.

Once the excavation and backfill operations are complete, the marsh would be replanted to restore, and potentially improve, wetland function. Mitigation will likely require that additional wetlands be created elsewhere on the site. Institutional controls may include fencing, signs, awareness programs, and similar active measures to ensure that access to the area is controlled. Other institutional controls might include deed restrictions or other covenants that would maintain the wetlands in perpetuity. Long-term monitoring would include a monitoring and maintenance program to ensure that those controls remain effective.

3.6 AOC#2 - RESERVOIR 3

AOC #2 includes 8.4 acres within the footprint of former Reservoir 3. Much of the ground surface within the former reservoir area is covered by pliable hydrocarbon surface expressions with entrapment hazard potential. Studies have demonstrated that groundwater is not responsible for the hydrocarbon surface expressions in this former reservoir. These studies have determined that viscous oil is being slowly squeezed from the mixed reservoir fill as the soil slowly settles. The reservoir is filled with 8 to 11 feet of non-engineered fill, including berm soils, construction debris, and tar. Approximately 4 acres of precipitation/runoff-supported wetlands hosting fairy shrimp habitat form seasonally along the inside edges of the former reservoir.

The preferred remedy consists of constructing a geosynthetic and soil cap that will establish a permanent barrier between contaminated soil and potential human and eco-receptors. The cap will attempt to reestablish wetlands in the same area, thus minimizing the amount of habitat that must be created elsewhere on the site. Conceptually, the cap will be constructed by removing a minimum amount of hydrocarbon-impacted soil so that the cap can be installed without significantly changing the existing grades. Non-hazardous contaminated soil will be disposed of at an appropriate landfill. Since the remaining reservoir fill material is non-engineered and, at best, has poor bearing capacity, it will be necessary to support the cap with various soil and geosynthetic materials. A geotextile will be laid over the exposed work surface and anchored in a trench excavated around the perimeter of the work area. A tri-directional geogrid anchored in a 1-foot-thick gravel layer will be used to distribute loads as evenly as possible and to limit settlement to the cap center. A flexible membrane liner protected above and below by geotextiles will create the impermeable barrier. The primary function of the flexible membrane is to prevent downward migration of water, which may help to support wetland habitat in a manner similar to the current condition. The final component of the cap will be an overlying thickness of common fill and organic-rich topsoil, which will be contoured to mimic the existing topography and wetland hydrology.

Remediation may unavoidably impact up to 3.9 acres of wetlands, which has also been identified as habitat for a sensitive species. Even if the original wetland habitat is reestablished within Reservoir 3, additional mitigation may be required elsewhere on the site for the vernal pool fairy shrimp habitat. Institutional controls will include fencing, signs, awareness programs, and

similar active measures to ensure that access to the site is controlled. Other institutional controls might include deed restrictions or other covenants that would maintain the wetlands in perpetuity. Long-term monitoring will include periodic inspections and maintenance (as needed) to ensure that the institutional controls and cap remain effective.

3.7 AOC#3 - PLIABLE SURFACE EXPRESSIONS OF PETROLEUM

AOC #3 includes approximately 3 acres of sticky hydrocarbon surface expressions in six general areas of the south Tank Farm (Figure 14). These surface expressions occur in topographically low areas that accumulated petroleum during the 1926 fire. These expressions are limited in areal extent by surrounding berms and are 2 to 3 feet thick on average. Because these expressions are in topographically low spots, many occur within wetlands, some of which include protected fairy shrimp habitat.

The preferred remedy consists of excavating the plastic hydrocarbon surface expressions, disposing of the contaminated material offsite, and restoring the original grade. This alternative would also restore (at a minimum) the existing wetland function, create additional wetlands onsite to reach the expected mitigation requirements, establish institutional controls, and provide long-term monitoring. It is intended that the initial restoration of the impacted wetlands will occur at their current locations. Any further mitigation required in consultation with the regulatory agencies would occur elsewhere on the site.

Institutional controls may include fencing, signs, awareness programs, and similar active measures to ensure that access to the site is controlled. Other institutional controls might include deed restrictions or other covenants that would maintain the wetlands in perpetuity. Long-term monitoring will include periodic inspections to ensure that those controls remain effective.

3.8 OU #5- SITE-WIDE GROUNDWATER

OU#5 includes site-wide groundwater, exclusive of the Northwest Operations Area. Groundwater flows toward the southwest at an average rate of about 100 feet per year and primarily within sandy interbeds in the largely fine-grained valley fill. The major potential source areas for petroleum impacts to water quality in OU #5 are the LNAPL areas underlying the former reservoirs.

Groundwater monitoring of OU#5 has been conducted continuously since 1990, both on and off the property, through a network monitoring wells. The entire network is comprised of more than 80 monitoring wells. However, sufficient data has been collected during the 17-year program that the RWQCB has approved actively monitoring 29 wells. These are located in key positions around the site that ensure any changes in the groundwater conditions could be rapidly addressed.

Almost 1,000 groundwater samples have been collected from the entire monitoring network over the 17-year program. For the most part, these samples were tested for TEPH and BTEX,

although a significant number were also tested for PAHs. With respect to TPH, there is no maximum contaminant level (MCL); the RWQCB regulates this contaminant on a case-by-case basis but often ascribes 1,000 micrograms per liter (µg/L) as a reasonable action level. A study of the OU #5 monitoring record indicates that 43 percent (414) of the samples tested for TEPH contained detectable (>100 µg/L) concentrations. These concentrations range from 100 to 1,600 µg/L, with a median concentration of 220 µg/L. The vast majority of detected concentrations are in the 100 to 400 µg/L range, with many fewer in the 400 to 1,000 µg/L. Only 2 out of the 966 samples tested for TPH have contained concentrations greater than 1,000 µg/L, and neither of these was verified by resampling. Benzene has never been detected (<0.5 µg/L) in an OU #5 monitoring well.

Therefore, in OU #5 there is no direct evidence of offsite migration of dissolved contaminants in excess of MCLs or the frequently applied RWQCB TPH action level of 1,000 µg/L. These findings, together with those of the groundwater natural attenuation monitoring program, suggest that any dissolved hydrocarbons generated in OU #5 are being attenuated by natural processes within distances of a few hundred feet from the source.

As such, the preferred remedial alternative for OU #5 is monitored natural attenuation with institutional controls and long-term monitoring. Monitored natural attenuation includes semiannual sampling of the existing groundwater monitoring network on and surrounding OU #5, testing those samples for TEPH and natural attenuation parameters, and reporting these findings to the RWQCB in accordance with an approved monitoring and reporting program.

Institutional controls will include deed restrictions limiting land use to open space and/or commercial/industrial purposes and groundwater use restrictions in and adjacent to impacted areas. Land use restrictions may also be required on the Betita Property, situated south of the Tank Farm, due to the localized presence of petroleum in the subsurface (Figure 13).

4.0 GENERAL REMEDIAL ACTIONS

Sections 4 through 7 provide detailed descriptions of the proposed remedial design. This section focuses on the general remedial actions. That is, those actions applicable across the site, irrespective of the operable unit. This includes long-term monitoring, excavation, and the general approach used in capping.

4.1 LONG-TERM MONITORING

As described in the *Feasibility Study*, remedial action includes various long-term monitoring activities. The principal monitoring activity is groundwater sampling and reporting. The requirements of the current program are described in Monitoring and Reporting Program (M&RP) 93-120, which is provided in Appendix B along with supporting documentation describing its evolution over the last 15 years. The monitoring program currently requires sampling of onsite and offsite wells according to the list provided in Table 2.

Chevron currently samples all of the wells listed on a semiannual basis. Samples are tested for extractable range hydrocarbons, and samples from wells monitoring OU #1 are also tested for purgeable range hydrocarbons and BTEX. A few samples are analyzed for all three constituent types.

During remediation, 25 existing monitoring wells, including 4 that are currently monitored (Table 2), will be abandoned (Figure 20). Their abandonment is a direct result of the remedial activities. It is understood, however, that replacement of at least some of these wells will be required by the RWQCB. It is noted that only four of the affected wells are actively monitored under M&RP 93-120 at this time. Nevertheless, the number and location of replacement wells will be as directed by the RWQCB. The details of those requirements will be appended to the *Remedial Action Plan* once they have been finalized.

Another consideration to be discussed with the RWQCB will be future reductions in the monitoring frequency. It is proposed to reduce the overall frequency of monitoring within five years of approval of the *Remedial Action Plan.* The basis of this proposal is discussed more thoroughly in Sections 7.1.1 and 7.5. As with monitoring well replacement, however, the final requirements of the monitoring and reporting program will be prescribed by the RWQCB.

Long-term monitoring will also include periodic inspections of the caps and excavation areas. This will be done to ensure those remedies continue to function properly and are achieving the remedial action objectives. It is anticipated that inspections would occur on a semiannual basis. In particular, one event should occur just prior to the rainy season and the other during or just after the rainy season. Long-term monitoring will also be performed to evaluate habitat restoration and mitigation. This is covered in more detail in the *Habitat Mitigation Plan* (Padre, 2007b).

4.2 REMOVAL EXCAVATIONS

Some impacted near-surface soils, mostly those affected by petroleum with wildlife entrapment potential, will be excavated. These selective excavations have been chosen to either improve the function of a capping system or to mitigate an identified ecological risk. Where performed in conjunction with construction of a cap, the excavation will remove a limited amount of material defined by an excavation depth (e.g., 2 feet) or by exposure of some existing feature (e.g., a former reservoir bottom).

Clean-closure areas are described further in Sections 7.4.1 and 7.4.3, the North Marsh and Other Sticky Hydrocarbon Surface Expression areas of concern, respectively. The clean-closure approach will be limited to pliable hydrocarbon material as originally identified in the *Feasibility Study*. As a practical matter, it is understood that field determinations may occasionally be required to ascertain the need for removal. There may be field determinations as to the need for removal of some hydrocarbon materials, and that these determinations will be made with the concurrence of the appropriate regulatory agencies. A practical field methodology for making this determination is presented in the *Project Execution Plan* (Padre, 2007e).

Field investigations have shown that the isolated pockets of plastic hydrocarbon identified for removal are the byproducts of the fire or operational spills and appear to be localized to within 3 to 4 feet of the ground surface. In the event that these impacts are determined to extend locally to depths greater than 5 feet, it is proposed that removal excavations will be limited to a depth of 5 feet bgs. Four issues were evaluated in adapting this limitation: worker safety, the potential to encounter groundwater, mitigating risk to burrowing animals, and ensuring that plastic hydrocarbon does not resurface at some later date.

Excavations beyond 5 feet require special planning and support for worker safety, based on the requirements of the U.S. Occupational Safety and Health Administration (OSHA) and the California Division of Occupational Safety and Health (Cal/OSHA). In addition, excavations beyond 5 feet in the low-lying areas of the site are likely to encounter groundwater. The *Feasibility Study* demonstrated that the risks of further environmental impact and the expense associated with the handling and treatment of impacted groundwater did not warrant the effort.

One objective of the remedial design is to ensure that future open space uses of the site do not pose an unacceptable risk to potential ecological receptors, which includes burrowing animals. The proposed limit for excavation is below the burrowing depths of most animals that are likely to be encountered at the Tank Farm (DTSC, 1998). Further protection can be provided by using a 0.75-inch gravel for the first 6 inches of backfill to act as a barrier to burrowing animals, if that is deemed necessary.

It is also believed that 5 feet of compacted backfill will prevent resurfacing of the plastic materials. The materials are viscous and generally appear to mobilize only when exposed to the warming effects of direct sunlight (England Geosystem, Inc., 2000). By removing material from the near-surface and replacing it with a well-compacted backfill, the likelihood that the material

will resurface is very low. Soil used for backfill will be compacted to 90 percent of its relative maximum density as determined by ASTM International (ASTM) Method D1557. Remediation will include long-term monitoring and maintenance of the site. In the unlikely event that plastic hydrocarbon were to resurface, it will be detected by the long-term monitoring program and further remedial steps would be taken as part of site maintenance.

Clean materials, those not impacted by plastic hydrocarbon, will be segregated during excavation, stockpiled locally, and reused as common earth backfill. Common earth may include solid asphaltic (e.g., green-type) hydrocarbon. Materials that are impacted by plastic hydrocarbon will be disposed of offsite at an appropriate location.

It is uncertain, however, at what rate that disposal will be allowed to occur once traffic and air quality impacts are considered during the environmental analysis. Assuming that there are no constraints on truck trips, impacted soils will be loaded directly onto a truck and hauled offsite. An alternative will be to stockpile the impacted material onsite and remove it at a rate that does not unduly burden local streets or air quality.

The Northwest Operations Area will be used as a staging area, if needed, to stockpile contaminated soil prior to loading on trucks for offsite disposal (Figure 15). The Northwest Operations Area will be capped and later developed, so a small amount of hydrocarbon residue on the existing surface will not be problematic. It is estimated that remedial actions could generate up to 157,000 cubic yards of impacted soil (Appendix F).

If necessary, however, a secondary stockpile could be located on the south side of the Tank Farm, adjacent to the gate on the existing paved slab (Figure 15). It is likely that this area will be used to store equipment or materials. It is potentially available for impacted soil stockpiling if crossing Tank Farm Road to access the central staging area is seen as being problematic. The paved area is slightly more than an acre, and the stockpile would be limited in capacity to approximately 15,000 cubic yards.

Access routes to the proposed stockpile location are shown in Figure 17. The routes have been chosen to use existing roads and thereby avoid sensitive habitat. These routes may require widening and drainage improvement, as discussed in Section 6.1. A flagman or other means of traffic control will be provided, as necessary, at the Tank Farm Road crossing.

In operating a stockpile for impacted soil, it will be necessary to comply with local air quality and traffic regulations. This will likely require covering the stockpile and periodic monitoring to keep volatile organic compound emissions within regulatory limits. It will also be necessary to control dust and minimize stockpiling during the rainy season.

It is anticipated that most hydrocarbon-impacted soils will be disposed of at the nonhazardous impacted soil (NHIS) facility operated by the City of Santa Maria at their landfill. In order to ensure compliance with the appropriate disposal facility's acceptance criteria, representative samples will be collected of the materials designated for removal..

4.3 CAPS

Caps will be used to separate impacted materials from potential human and ecological receptors. They will be constructed from earthen materials, but may also include various geosynthetic materials for additional strength or material separation. In addition, caps will support either open space or development land uses.

A key distinction between the open space and development caps is that the former will include a topsoil layer that will be used to support revegatation. The development caps may be vegetated to minimize erosion, but that will be done directly on the structural fill. The revegetation will also be of a temporary nature, and will be maintained in place only long enough to minimize potential soil loss from the development areas. The development caps are constructed of structural fill with a minimum thickness of 4 feet. Conversely, the open space caps are more varied due to their differing design objectives and individual site constraints.

5.0 EARTH CONSTRUCTION MATERIALS

There are four principal types of earth materials used for this project: common fill, structural fill, gravel, and topsoil. Specifications regarding composition, grain size, and other relevant parameters are provided in Appendix E. The following sections provide more detailed information regarding each of these principal soil materials.

5.1 COMMON FILL

Common fill will be used for the majority of nonstructural and unspecialized fill needs for the project. It is readily generated from the available onsite soils. It may consist of silt, clay, silty sand, silty clay, clayey sand, or clayey silt. Common fill may have a wide gradation, as shown in Appendix E. One hundred percent of the material must pass a 1-inch screen, and up to 30 percent may pass the No. 200 sieve. The soil must not have any organic or otherwise decomposable or deleterious materials.

Common fill will generally be placed in lifts between 8 and 12 inches in thickness and compacted to within 90 percent of its relative maximum density as measured by ASTM D1557.

5.2 STRUCTURAL FILL

Structural fill is physically identical to common fill, but will be used in areas where greater soil strength is required, such as the caps that may support future development. The main difference between common fill and structural fill is that it must be placed in lifts with a maximum thickness of 8 inches and must be compacted to 95 percent of its relative maximum density per ASTM D1557.

5.3 GRAVEL

Gravel will be primarily used during this remediation project in the caps that will be constructed over Reservoirs 5 and 7. The gravel will provide a structural void space that will provide a low-resistance accumulation space for rising groundwater and LNAPL. Gravel may also be used as a bio-barrier (if needed) in excavations or shallow caps to prevent burrowing animals from exposing contaminated materials.

Soil used for this function must be hard, durable, and not susceptible to slaking when immersed in water. An acceptable gradation envelope is provided in Appendix E. One hundred percent of the material must pass a 0.75-inch sieve and no less than 75 percent must be retained on a No. 4 sieve. Further, no more than 5 percent of the soil may pass a No. 200 sieve.

The gravel may be placed in lifts of up to 12 inches in thickness and compacted with two passes of a 5,000-pound drum roller or similar piece of equipment.

5.4 TOPSOIL

Topsoil will be used to revegetate open space caps and backfilled excavations. Topsoil layers will typically be 1-foot-thick organic-rich soils harvested onsite, amended, or imported to meet the specifications.

Topsoil can be any combination of silt-based or clay-based soil found onsite or locally. Onsite topsoil sources will be expected to contain at least 10 percent organic material. Onsite soils not meeting this requirement can be amended by the addition of fertilizers and mulch. Amended soils, however, must contain at least 15 percent organic matter.

Topsoil will be placed in lifts no greater than 12 inches thick. It is anticipated that topsoil may be nominally compacted during placement, but will be scarified to a depth of at least 4 inches prior to seeding or planting.

Additional soil requirements will be specified in the *Habitat Mitigation Plan* to ensure that materials used for restoration or mitigation of habitats is compatible with both the flora and fauna served by that habitat.

5.5 EARTH MATERIAL SOURCES

It is anticipated that many of the soil materials needed for remediation may be obtained onsite. The following sections discuss the various proposed borrow sources, the types of materials available in each, and the estimated quantity of potential borrow material. Figure 16 shows the location of each of the borrow sources, and Table 3 summarizes the estimated material quantities available from each. A discussion of proposed access routes is provided in Section 6.1.

A quick comparison of Table 3 with the earth materials needs of Table 4 shows that there is ample soil for most of the project requirements. This abundance of borrow sources is presented to provide the greatest flexibility to Chevron in creating habitat to mitigate the unavoidable impacts caused by remediation. Borrows No. 1 and 2 are located adjacent to large existing wetland complexes. Borrowing from these areas provides the opportunity to expand those complexes. Further, it is uncertain what constraints may be imposed on construction activities. Redundant borrow sources reduces the likelihood of having to import significant quantities of material from offsite sources.

It is important to note, however, that some borrow materials, especially the tank berms, may contain asphaltic materials that are inseparably embedded into the soil matrix. Only the plastic hydrocarbon has been identified as posing a potential hazard or risk, and where these materials are expressed at the surface or exposed during other excavations, they will be removed. Conversely, the asphaltic material does not warrant remediation and its potential incorporation into the common or structural fills is consistent with the findings and recommendations of the *Feasibility Study*. Notwithstanding this, remediation efforts will attempt to favor borrow materials that are not impacted by asphaltic material.

Use of the borrow sites may result in habitat impacts. The maximum potential impact for each area is summarized in Table 5. It should be noted, however, that while all of the impacts attributed to remediation will occur, only some of the impacts associated with the borrow sources will be realized if a particular borrow source is used. This will be clarified as the project permitting progresses and the habitat mitigation requirements are finalized.

5.5.1 Flower Mound/OU #3

The Flower Mound is an approximately 17.3-acre site located in the northwest corner of the site (Figure 16). It is an outcrop of the basement bedrock complex known as the Franciscan Formation. Typically referred to as the "Franciscan mélange," the Franciscan Formation is comprised of a complex collection of various rock types. Although the Franciscan Formation found at the Tank Farm includes localized occurrences of coarse to fine-grained clastic sedimentary rocks, it more commonly consists of highly fractured and weathered metavolcanic rocks and serpentinite. It is these latter types of rock that comprise the Flower Mound.

Borrow activities at the Flower Mound/OU #3 Area will generate as much as 328,200 cubic yards of material, most of which must be blasted and processed to access. Approximately 73,700 cubic yards are located on adjacent properties. Chevron will negotiate access agreements with each property owner and determine the final disposition of offsite materials. It is expected, though, that at least 26,300 cubic yards, and potentially all, of the offsite material may be available for use by the project. Processing will at least include crushing, and may include sorting, depending upon what materials are required by the project.

Material produced from the Flower Mound will be crushed and screened to the material specifications included in Appendix E. It is anticipated that the Flower Mound material will be readily suitable for use as common, structural fill, or road base. However, preliminary testing (Padre, 2007a) suggests that the Flower Mound material may not be sufficiently durable for use as gravel in the caps that will be constructed over Reservoirs 5 and 7 (Section 7.2).

Use of the Flower Mound will require abandonment of two monitoring wells, MW-13 and TMW-4. Abandonment will be as described in Section 6.5. Replacement of monitoring wells, if necessary, will be as prescribed by the RWQCB.

The Flower Mound/OU #3 area is integral to future development plans for the site. The City of San Luis Obispo's proposed extension of Santa Fe Road crosses the middle of this work area and its rough grading is incorporated into the design. The final site grade, including the extension of Santa Fe Road, following the completion of borrow and remediation, affects 52.9 acres. As such, there will be permanent habitat impacts requiring mitigation elsewhere on the site. There are approximately 0.26 acre of wetland habitat in the Flower Mound/OU#3 work area and approximately 0.32 acre of rare plant habitat. There is no known vernal pool fairy shrimp habitat within the Flower Mound borrow area.

5.5.2 Berms

Numerous berms were erected around the site during its operational life. These were principally constructed to contain oil spills and to isolate the reservoirs in the event of fire. It is proposed to use the berms adjacent to Reservoirs 5 and 7 to supply the common fill required for cap construction. If borrow from the berms is maximized, approximately 71,600 cubic yards will be generated; 38,800 cubic yards at the Reservoir 5 site, and another 32,800 cubic yards at Reservoir 7. Construction of both caps requires 37,000 cubic yards, which will result in approximately 34,600 cubic yards of excess material that can be used for other common or structural fill needs. Excess material will be borrowed on an as-needed basis. This material may be locally contaminated and, therefore, unsuitable for structural fill. Borrow activities will be monitored and the materials segregated, as necessary. Habitat impacts related to borrowing of berm materials are discussed in the relevant remediation discussions later in this report.

5.5.3 Borrow No. 1

Borrow No. 1 is an approximately 8.6-acre site located adjacent to the North Wetland (Figure 16). It includes approximately 2.3 acres that may have been used as a disposal area for demolition debris from the 1926 fire. Anecdotal reports suggest that the disposed materials consist mostly of construction debris, such as concrete and wood. As described in Section 7.4.1, this material will be characterized, removed, and managed at an appropriately permitted facility. It is estimated that the disposal area contains approximately 10,325 cubic yards, assuming an average depth of approximately 4 feet.

Soil suitable for use as common and structural fill, and possibly as topsoil, could be removed from the borrow area after removal of the debris. The nominal grading contours for this area would begin at the existing floor of the wetland area and slope back to the east at approximately 0.5 percent. Side slopes would be no greater than 4:1 (horizontal:vertical). This grading approach would generate approximately 36,200 cubic yards of common or structural fill.

This borrow source may be used on an as-needed basis. Its main attraction is that after borrowing the available soil the area can be used to create additional wetland. Complete utilization of the borrow source and removal of the historical debris would potentially generate 7.84 acres of additional wetland habitat. This is in excess of the 0.77 acre of wetland that is currently present within the proposed borrow site. It is important to note, though, that the 0.67 acre is also vernal pool fairy shrimp habitat. Full development of the borrow site would also temporarily affect 0.37 acre of rare plant habitat.

5.5.4 Borrow No. 2

Borrow No. 2 is located on the east portion of the site, south of Tank Farm Road (Figure 16). It covers approximately 17.73 acres. This location is anticipated to provide topsoil for revegetation purposes. Most of this borrow site is within a future development area under the City's *AASP* and proposed land use plans. Further, its position within the airport safety zones (Figure 9) generally preclude it as a site for habitat mitigation.

It is estimated that at least 20,700 cubic yards of topsoil may be recovered from this location. It is assumed that the topsoil horizon is 2 feet thick, although the *Geotechnical Feasibility Study* (Padre, 2007a) suggests that as much as 4 feet of suitable material may be available. After borrow operations are completed, the site will be regraded as shown in Figure 39 to support future development.

It is estimated that 65,700 cubic yards of topsoil (Table 4) will be required for remedial construction. Any topsoil deficit will need to be closed by manufacturing topsoil from other borrow materials or importing topsoil from offsite sources.

Use of the entire Borrow No. 2 area will require abandonment of five monitoring wells, MW-17, MW-18, MW-21, MW-30, and MW-51. Abandonment will be as described in Section 6.5. Replacement of monitoring wells will be as prescribed by the RWQCB.

Excavation and restoration of Borrow No. 2 will permanently affect 1.38 acre of rare plant habitat and 0.98 acre of wetland. It will also temporarily affect 0.2 acre of rare plant habitat.

5.5.5 Borrow No. 3

Borrow No. 3 has a similar function to Borrow No. 1. It provides a useful source for common fill and structural fill, and possibly topsoil. It also provides a location that, if utilized, potentially creates additional wetland habitat that can be used to mitigate the habitat that is unavoidably impacted during remediation.

The proposed area is approximately 17.5 acres in extent, including approximately 6.59 acres of existing wetland (Figure 16). It is assumed that material will be borrowed from this source starting at the wetland along the south boundary. The existing grade would be lowered to the elevation in the southwest corner and then allowed to slope up at approximately 0.5 percent to the north. This approach will yield approximately 78,950 cubic yards of total borrow (19,700 cubic yards of top soil and 59,250 cubic yards of common earth), and could generate 10.92 acres of new wetland habitat if fully utilized. This is in excess of the 6.59 acres (3.12 acres of which are vernal pool fairy shrimp habitat) of wetland that is currently present within the proposed borrow site. Use of the borrow site may also permanently affect 0.92 acres of rare plant habitat.

Use of the entire area could impact several of the active wells in the groundwater monitoring network. Consequently, the use of this borrow area is anticipated to be minimal.

6.0 SITE-WIDE REMEDIAL ACTIONS

There are several construction-related remedial actions that are not considered specific to a particular operable unit. Those actions are discussed in this section and include mobilization and staging of equipment and materials, demolition of the existing buildings, miscellaneous cleanup activities, and abandonment of the remaining pipelines.

6.1 MOBILIZATION, STAGING AREAS, AND SITE ACCESS

Mobilization is when the contractor prepares the site to begin work. This includes a variety of tasks including moving equipment and support trailers onsite, improving site access, installing storm water and dust control Best Management Practices (BMPs), and habitat protection measures. To successfully accomplish this work, the contractor will require ready access to the work areas with logical and ample traffic routes. At the same time, the contractor must also minimize impacts to non-work areas and avoid sensitive habitat areas that must be preserved. Figure 17 shows the anticipated work areas and the proposed staging areas and access routes. Within the scope of the activities described in this *Remedial Action Plan*, the contractor shall limit his activities to the areas identified in Figure 17. In the event unforeseen site conditions require access to the off-limit areas, egress shall be coordinated on an as-needed basis with the appropriate regulatory authorities.

The work areas are the limits within which remediation activities will be conducted for a given operable unit or area of concern. The work area limit is generally defined by the extent to which a particular site must be cleared and grubbed to properly perform the work and provide the contractor with sufficient room to move equipment and materials. The limits shown in Figure 17 are, however, only approximate. Precise delineations of the work areas are provided in the drawings found in Appendix C.

The contractor will use the former recycling area as his primary staging area. It is paved, readily supplied with electrical power and telephone service, and is centrally located on the property with reasonably convenient access across Tank Farm Road. Major maintenance (e.g., engine rebuilds, fluid changes) will only be performed at the primary staging area in specially prepared areas with proper spill control measures in place.

Other local staging areas are also shown in Figure 17. These are located directly adjacent to the work areas and would be used to stage materials, park equipment, and other support activities. Vehicles and equipment can be fueled and minor maintenance (e.g., changing tires) can be performed at the local staging areas.

Water is available onsite for construction purposes. Water wells are located just north of the Northwest Operations Area, at the southwest corner of the site (south of Tank Farm Road), at the southernmost tip of the site (also south of Tank Farm Road), and on the eastern edge of the site south of Tank Farm Road (Figure 17). The contractor will supply pumps (as necessary), storage

tanks, and stands to fill water trucks. One storage tank and fill stand is expected be in the primary staging area (Figure 17), and another will likely be located south of Tank Farm Road, adjacent to the entrance. The final locations will be determined by the contractor to best facilitate his work, consistent with the work area constraints show in Figure 17. The contractor is responsible for determining the adequacy of water supply and for making any upgrades to the supply infrastructure. Prior to mobilization, the suitability of the existing water distribution network for conveying water for construction purposes will be evaluated. If feasible, fill stations would be located at readily accessible points such as the fire hydrants. Otherwise fill stations will be supplied by temporary overland pipelines.

Bottled water will be used for potable purposes and will be brought onsite and stationed at work and staging areas as needed. The contractor will also supply sanitary facilities at needed locations.

Chevron will have relocated its employees and operations prior to starting site remediation. The principal entrance to the site will, therefore, be relocated as shown in Figure 17. This location utilizes the existing entrance to the site south of Tank Farm Road, but is also reasonably close to the Primary Staging Area. It also consolidates access to the site at one point along Tank Farm Road. A traffic study (ATE, 2007) recommended a standard intersection with left-hand turn pockets and right-hand deceleration lanes at the site entrance. The intersection should also include signalization to control traffic during the construction period. A preliminary traffic control plan is shown in Figure 18. The plan will be finalized in concert with the SLO County Public Works Department. The conceptual plan moves the entrance gate back approximately 100 feet from the road. Berms will also be removed to provide deceleration lanes and to ensure adequate site distance. The greater distance from the road will allow trucks to park at the gate without blocking traffic along Tank Farm Road.

Other access points will be provided as needed but controlled by the contractor. Access to the site will also be maintained at the Northwest Operations Area, but will not be used as a primary access to the site.

The internal routes shown in Figure 17 are intended to provide the contractor with access to all potential work and borrow areas across the site with as little impact to sensitive habitat as possible. The access routes utilize existing dirt tracks. Those shown as solid lines in Figure 17 will be required, while those shown as dashes will only be used if the borrow sources shown at the end of those routes are developed. It is anticipated that most routes must be able to accommodate two-way traffic. Existing dirt tracks will be widened, as necessary, to at least 24 feet in the direction that is least likely to affect adjoining sensitive habitat. Management procedures will be used to minimize impacts from dust and erosion. Where necessary, the contractor will improve the roadway by grooming the subgrade to provide a reasonably smooth and regular surface. In areas potentially subject to inundation or rutting a geotextile will be placed over the subgrade and will be used to provide separation between the subgrade and a 6-inch-thick (minimum) course of compacted crushed miscellaneous base or gravel. As shown

in Table 5, the improved roadways are expected to temporarily impact 0.1 acre of wetland, 0.04 acre of vernal pool fairy shrimp, and 0.22 acre of rare plant habitat.

The contractor shall also provide traffic control to ensure the safe operation of vehicles and equipment. One key component will be controlling traffic crossing Tank Farm Road. It is anticipated that the contractor will at least provide a flagman and signs. It is possible, however, that in consultation with the appropriate municipal agency, a temporary stop sign or traffic light may need to be installed at this location.

The contractor may suggest alternative access points onto and across the Tank Farm. It is also possible that alternative routes may be required to mitigate impacts that may be later identified in the environmental analysis. Any alternative routes must be approved by the Construction Manager and the appropriate regulatory agencies prior to use.

Access to the borrow areas will be provided on an as-needed basis. As noted previously, some of the borrow sources may be used to facilitate other project needs such as mitigating habitat impacts. The use of these locations, and the associated access routes, will be determined at a later date.

6.2 BUILDING DEMOLITION

There are four buildings at the Tank Farm (Figure 3), located in the Northwest Operations Area, that will be demolished during remediation. Three of these buildings were constructed to support historical operations at the site but are now used primarily as office space. The fourth, a modular building installed adjacent to the northernmost original building, was constructed within the last five years to provide additional office space. Chevron personnel and operations will have been removed from the site prior to remediation, and it is possible that building demolition could precede implementation of the final *Remedial Action Plan*.

Given the age of the three older buildings, it must be assumed that lead-containing materials (LCM) and asbestos-containing materials (ACM) are present. Consequently, physical demolition of the buildings will be preceded by surveys and abatement. Asbestos and lead-based paint surveys will be conducted for each building by a California-licensed Asbestos Consultant and California-certified Lead Consultant, respectively. Positive surveys will require abatement.

Prior to abatement, a National Emissions Standard for Hazardous Air Pollutants demolition notification form, asbestos survey report, and an asbestos abatement workplan will be submitted to the San Luis Obispo County Air Pollution Control District (APCD). ACM will be abated in accordance with local, state, and federal regulations. Any suspect material not previously identified and found during abatement will be presumed to be ACM unless contradicted by specific laboratory data. Friable asbestos will be managed in air-tight roll-off bins and transported to a hazardous waste facility (e.g., Kettleman Hills) for disposal. Nonfriable asbestos will be managed as required for disposal at suitably permitted solid waste approved by Chevron.

Once abatement activities are completed, recyclable or potentially reusable materials will be removed. The building structure will be demolished using excavators. Some of the buildings have metal structural elements or siding. This will be segregated for recycling, if economic. Other materials will be loaded into haul trucks for disposal. Concrete foundations will be broken apart using a hydraulic hammer and removed. It is possible that concrete will be crushed and used as gravel elsewhere on the site.

Utility lines will be disconnected and abandoned. Where lines are aboveground, they will be removed. Where utility service is brought to a building underground, the line will be cut at a point at least 2 feet below grade and capped. Service lines that use pipes or conduits greater than 4I inches in diameter (e.g., water, sewer) will be filled with cement grout.

Voids created in the existing grade by demolition will be backfilled with structural fill or gravel.

6.3 MISCELLANEOUS CLEANUP

There are four locations onsite that have been identified as requiring cleanup or demolition that are not part of one of the operable units or areas of concern. They are not generally "contaminated" or impacted areas, although they may have some impacted soil associated with them. Rather, they are comprised of debris or abandoned structures that are unsightly or possible physical hazards. These are shown in Figure 19.

Three of the locations are found on the parcel north of Tank Farm Road. There are two debris piles along the north property line. They appear to contain mostly concrete debris. As with other concrete debris, the contractor may crush this material and reuse it for gravel elsewhere on the site. Otherwise, the concrete shall be hauled offsite for recycling or disposal.

The other area identified on the parcel north of Tank Farm Road is the historical debris disposal area adjacent to the North Wetland. As discussed in Section 5.5.3, the material in this area will be excavated and removed for disposal or recycling as appropriate. It is recommended that the limits and characteristics of the waste be defined prior to excavation and disposal. It is assumed that the debris extends to a depth of 5 feet and that the nominal excavation volume is 18,000 cubic yards. Material removed from the excavation will be segregated on the basis of how it will be managed. Concrete may be recycled, as described previously. Other construction debris will be sent to a solid waste landfill for disposal. Impacted soils will either be sent to the proposed stockpile area for later disposal or directly to the disposal facility as dictated by traffic and air quality requirements. The excavation will not be backfilled in order to accommodate habitat mitigation later in the project.

The fourth miscellaneous cleanup location is found south of Tank Farm Road, adjacent to Reservoir 6 (Figure 19). It is a concrete vault of uncertain purpose, approximately 5 feet wide, 12 feet long, and 8 feet deep. The crude oil supply line serving Reservoirs 6 and 7 connected to it, but it is not known if it was a separator, a valve box, or served some other purpose. The vault is, however, open and presents a physical hazard to people and animals and a possible

entrapment hazard to small animals. The steel hand rail will be removed and the upper 3 feet of the concrete wall will be broken and used to fill the bottom of the vault. A sand-cement slurry will be used to fill the void spaces. The remaining depth of the vault will be backfilled with common fill until the original grade is reestablished.

Abandoned concrete vault adjacent to Reservoir 6-to be abandoned

6.4 PIPELINE ABANDONMENT

When operational, the Tank Farm required numerous pipelines to move oil between the pump house, boilers, tanks, and reservoirs. The site was also served by water, natural gas, and septic lines. Figure 5 shows pipeline locations based on historical facility drawings. It is estimated that more than 25,000 feet of oil pipeline were installed onsite; approximately 4,500 feet are found in the Northwest Operations Area (Figure 6). Much of that pipeline remains in place, as indicated on Figure 5.

Chevron intends to abandon most of the pipeline in place. Portions of the line that are within work areas will be removed for disposal, except for the Northwest Operations Area, where the pipelines may be closed in place by pressure-grouting. If a pipeline crosses an environmentally sensitive area (e.g., wetland) and would not otherwise be disturbed by remediation activities, it will also be closed in place by pressure-grouting. All pipelines will be flushed and, if possible, pigged to remove residual hydrocarbon and vapors prior to abandonment. If a section of pipeline is in such poor condition that it cannot be adequately cleaned, it will be excavated and removed in its entirety.

6.4.1 Pipeline Inventory

The positions of the pipelines shown in Figure 5 and Figure 6 have not been field verified. While these figures (and the similar engineering drawings found in Appendix C) are reasonable approximations of their locations, final remediation will require more accurate information. It is, therefore, expected that prior to abandonment, a detailed field survey will be performed to locate the lines and characterize their contents. Potholes will be dug at key locations (e.g., ends, transitions, junctions, valves) to expose the pipe and determine its diameter and materials of construction. Line tracing will be performed using an appropriate geophysical instrument operated by a trained technician. The alignment of the pipeline will be flagged every 5 feet. Pothole and flag locations will be recorded using a high-precision Global Positioning System (GPS) unit and entered into a Geographic Information System (GIS) database. A detailed pipeline inventory, noting location, depth, size, materials of construction, and condition, will be created to guide abandonment activities.

Given the interconnected, and possibly deteriorated, web of pipelines within the Northwest Operations Area, Chevron may elect to cut the lines at the operable unit boundary and

completely remove them from its interior. In this case, the lines will be removed in accordance with Section 6.4.4 after their positions have been confirmed.

6.4.2 Pipeline Flushing and Pigging

Water trucks attached to portable pumps would be connected via hose to each petroleum pipeline segment within the facility. Additionally, several portable storage tanks or vacuum trucks would be stationed and attached to the pipelines to receive and collect the flush water. Each pipeline segment will be flushed with an adequate volume of water to remove residual oil from the pipelines. Pipeline flushing operations will continue until flush water containing total petroleum hydrocarbons of less than 100 parts per million is achieved.

The pipeline segments that may be suitable for pigging will be identified by Chevron during the initial potholing activities. The pigging operations will be basically the same for each pigging run segment. Each segment will have a beginning location where the pig is "launched," and an end section where the pig is "received." The pigging operation procedures are presented below.

First, the launching/receiving locations will be prepared for the procedure. Buried ends of the pipeline will be excavated. The excavations will vary depending on the depth of the pipe, but should not typically exceed an area larger than 7 feet wide by 12 feet long (84 square feet) and no more than 5 feet in depth. A trench box may be used to minimize the area affected by the excavation.

The pipeline fluids will be drained from the pipe and the pipe will then be cold-cut to gain access to the pipe. The pig launcher/receiver will then be attached to the exposed pipe end.

Once the pig launcher and receiver are attached to the pipeline, the subject pipe segment will be pigged. The pigging operation will involve the use of scraper-type or foam pigs. The scraper pig is constructed to help remove any remaining hydrocarbons from the inside walls of the pipeline as it moves down the pipe. The pigs will be pushed through the piping segment using liquefied nitrogen gas or compressed air.

At the receiving end, vacuum trucks will be used to remove any liquids from the pipe as the liquids are pushed ahead of the pigs. Carbon filtration canisters will treat any vapor emissions generated during pipeline purging operations, in accordance with APCD requirements. Chevron will obtain approval from APCD for the proposed activities. Recovered hydrocarbons and water from the pigging operation will be properly disposed of or recycled by Chevron.

There is the possibility that a pig may become lodged in the pipe by an obstruction. If the pig becomes obstructed along a pipe segment, these locations will be identified by the field crews. Excavation activities may be required to remove the pig and the damaged/obstructed section of pipe.

6.4.3 Pipeline Grouting

Pipelines that are scheduled for abandonment and have diameters greater than 4 inches will be grouted with a cement-slurry to prevent any future ground subsidence from pipe wall collapse. A portable grout pump will be used to pump grout into the pipeline segments. Grout will be pumped until grout exits the other end of the pipe segment. Following grouting, the pipeline segment ends will be backfilled with soil and the soil compacted.

6.4.4 Pipeline Segment Removal

Chevron proposes to remove intra-facility petroleum piping that may be affected by project remediation activities or is determined to be in poor condition. If practical, the pipeline segments will be flushed or pigged prior to removal. The pipeline segment endpoints will be isolated and cut. The pipeline segment will then be uncovered by excavating a trench to the existing pipeline depth. As the pipeline is removed from the trench, a spill containment device will be placed under the pipeline end to catch any residual fluids in the containment. All liquids drained from the piping into the containment device will be removed using a vacuum truck and hauled to an approved facility for disposal or recycling. The pipe segments will then be cut into manageable pieces, the pipe ends wrapped in plastic to prevent spillage, the segments removed from the trench, and the trench backfilled. Scrap pipe will be temporarily stored in bins and transported offsite for recycling.

6.5 MONITORING WELL DESTRUCTION

Remediation will require the destruction of 25 monitoring wells across the site. These wells are listed in Table 2 and shown in Figure 20. Each of the affected monitoring wells is in an area that will be excavated or over which a cap will be constructed. Even if retention of the monitoring wells was desired, it would be costly and difficult to protect the wells in place, and it is likely that several would be inadvertently lost. The number and location of replacement wells will be as directed by the RWQCB. The details of those requirements will be appended to the *Remedial Action Plan* once they have been finalized.

Well abandonment will be performed in accordance with California Department of Water Resources Bulletin No. 74-81 and the applicable requirements of the San Luis Obispo County Department of Environmental Health. Permits for this activity will be obtained from the San Luis Obispo County Department of Environmental Health. Monitoring well monuments will be removed and disposed of offsite. The wells will be drilled out using an auger slightly larger than the original boring. Most of the wells consist of 4-inch casing in an 8-inch boring. In this case, a 10-inch-diameter auger would be used to drill out the well. Cuttings will be stored in drums and disposed of offsite. The boring will be backfilled with hydrated bentonite. The boring will be checked 24 hours after the initial abandonment. Additional hydrated bentonite will be added if settlement of the initial fill is observed.

A completion report for the abandonment will be submitted to the San Luis Obispo County Department of Environmental Health and to the RWQCB within ten days of abandoning the final boring listed on Table 2.

6.6 HISTORICAL PRODUCTION WELLS

Review of historical operational records and facility drawings has identified the approximate locations of three water wells. These locations are shown in Figure 19. Inspection of these areas has not revealed any surface features associated with the wells. It is likely that the wells were abandoned many years ago and any other record of them has long since been lost.

It is desirable, however, to ensure that the wells were properly abandoned. It is, therefore, proposed to conduct a thorough field investigation to verify the location and condition of the wells. It is probable that the wells were constructed with steel casings, and if they are still present, they should be detected by a magnetometer. A licensed geophysical contractor will sweep the approximate well sites and will map and stake any magnetic detections. A backhoe will be used to expose the detections and identify them. If the wells are located, the method of abandonment will be ascertained, and if the method does not meet modern standards, the well will be abandoned according to the requirements of California Department of Water Resources (DWR) Bulletin 74-81.

6.7 LAND USE COVENANTS

Land use covenants will be prepared for the various parcels that the site may be subdivided into. This will include not only potentially developable parcels, but also the open space areas . A land use covenant is a legal document that will accompany a parcel's deed. It will be signed by representatives of Chevron and the lead agencies (e.g., RWQCB), and will be notarized and recorded with the County Clerk/Recorder. It is intended to ensure that future owners of the properties understand what mechanisms are in place at the site to protect human health and the environment, and to identify for future property owners their responsibilities in maintaining those protections.

The specifics of the land use covenants for the Tank Farm will vary depending on which parcel is under consideration. It will, however, identify the allowed land uses and will exclude uses that might be allowed under current or future land use planning but are inappropriate for the site. The land use covenants will list the various caps and other containment features that must be maintained. It will be accompanied by various documents, such as the guidelines for vapor barriers (Appendix M), *Habitat Mitigation Plan* (Padre, 2007b), and *Soil Management Plan* (Padre, 2007c). The land use covenant will also restrict the use of groundwater in areas of impacted soil on the Tank Farm property. Chevron will work with adjacent land owners to establish covenants regarding soil and groundwater on adjacent properties affected by historical site activities.

Draft land use covenants (as required) will be prepared by Chevron for review by the RWQCB and the lead municipality once the *Remedial Action Plan* has been approved.

6.8 VAPOR BARRIERS

The *Feasibility Study* identified the need for vapor barriers as an engineering control in habitable structures erected in the potential development areas. Decomposition of the underlying hydrocarbons generates methane. Accumulation of methane within buildings would be unacceptable. A series of conceptual engineering approaches to control methane migration are presented in Appendix M. These range from simple passive systems, where a liner is constructed directly beneath a slab constructed on grade, to active systems that can be used to vent a parking structure that is slightly below grade.

The examples provided in Appendix M are reasonable illustrations of the general approaches used to construct vapor barriers. These diagrams have been used on other projects subject to methane or volatile organic compound intrusion, and have been approved by other regulatory agencies and municipalities. These are not, however, construction documents. It is expected that a developer will use these as guides in preparing his plans and specifications.

The final version of these guidelines, which will accompany the land use covenant, will be approved by the RWQCB and the lead municipality. The land use covenant will also include provisions requiring approval by those agencies of the construction documents to ensure compliance with the final vapor barrier guidelines.

7.0 OPERABLE UNIT REMEDIAL ACTIONS

This section presents the remedial actions specific to each operable unit. It provides detailed descriptions of how the remedial actions will be implemented, as well as the engineering and regulatory bases behind their design. This section includes numerous figures meant to illustrate the remedial actions, and while they are based on the engineering drawings found in Appendix C, they should still be considered only diagrams.

7.1 OU #1-NW OPERATIONS AREA

As described in Section 3.0, OU#1 (the Northwest Operations Area) consists of two media-based areas of concern. The first, AOC #1, is groundwater, and the second, AOC #2, is soil. The preferred remedy for AOC #1 is monitored natural attenuation with long-term monitoring and institutional controls. The preferred remedy for AOC #2 is construction of a soil cap, with a minimum thickness of 4 feet, and institutional controls to manage soil that may be exposed during development or maintenance of the site.

7.1.1 AOC #1 Groundwater

Monitored natural attenuation will be implemented using the same parameters and methods as specified in Monitoring and Reporting Program 93-120 (Appendix B). However, remediation will require abandonment of several monitoring wells (Table 2). Replacement will be determined in concert with the RWQCB, which will also approve a revised M&RP.. At a minimum, monitoring groundwater for TPH and BTEX (consistent with M&RP 93-120) will be performed at the remaining perimeter monitoring wells MW-49, MW-50, MW-56, and SLOW-17, and the off-site production wells 11Ea and 11Eb. Currently, monitoring is performed on a semiannual basis. After three years, the RWQCB will evaluate the semiannual groundwater data to determine if a reduction in the monitoring frequency is warranted.

A land use covenant will be prepared for the operable unit that includes restrictions on the use of groundwater. Those restrictions will prohibit installation of groundwater wells within or immediately downgradient of petroleum-impacted soils.

7.1.2 AOC #2 Soil-Development Scenario

It has been presumed in this plan that AOC #2 will be developed at some point in the future and will not be considered suitable habitat for flora or fauna. As such, the remedial objectives are to prevent human contact with the arsenic, TPH, and PAHs that are found in the shallow soil in this area. Construction of a 4-foot-thick soil cap was selected as the preferred remedial alternative in that it not only satisfied the remedial objective, but also made future development feasible by raising the grade out of the 100-year flood plain.

Prior to building the cap, unnecessary existing features must be removed and the site must be prepared for construction. Figure 21 illustrates the demolition plan and subgrade preparation

proposed for AOC #2. It is assumed that prior to demolition, building surveys have been completed for LCM and ACM, the pipelines within AOC #2 have been either abandoned in place or have been removed as described in Sections 6.2 and 6.4, respectively, and the monitoring wells within the AOC will have been abandoned per Section 6.5.

The first component of remedial action for AOC #2 will be demolition of the four existing buildings. As more fully discussed in Section 6.2, three of these buildings supported the historical petroleum handling operations and are likely affected by LCM and ACM. After surveys and abatement have been completed, the buildings will be demolished and managed in an appropriate manner. Demolition will also include removal of the existing fences and gates along the south and west boundaries of AOC #2.

Future development of the region around the San Luis Obispo Airport envisions widening Tank Farm Road to a 100-foot-wide right-of-way (City of San Luis Obispo, 2005). This will necessitate moving the southern boundary of the Northwest Operations Area north approximately 30 feet (Figure 21). To ensure that the historical infrastructure does not interfere with future road widening, Chevron will remove any existing features from this area, including pipelines and concrete foundations.

Northwest Operations Area along Tank Farm Road - looking west

Prior to any significant demolition work, the site must be cleared and grubbed within the limits shown in Figure 21 and more thoroughly defined on the construction drawings provided in Appendix C. Clearing and grubbing will consist of removing all vegetation from the site. Brush and small trees are cleared by cutting them down and pulling up the roots. The site is then grubbed to a depth of at least 3 inches using a tractor or small dozer to remove grasses and other low-lying vegetation.

Northwest Operations Area along west property boundary – looking north.

There are two underground pipelines along the west boundary of the Northwest Operations Area. One is a 2-inch-diameter natural gas line and the other is a 4-inch-diameter water supply line. The gas line is fed by the 4-inch-diameter gas main located in Tank Farm Road and owned by Southern California Gas Company. The water line is fed by the existing water well located adjacent to the southwest-most former tank ring, but is also connected to other water lines across the property. A series of timber poles support both electrical and telecommunication lines. Along that western boundary are drops to electrical panels that feed service to the buildings. Chevron will

remove the utilities along this property line prior to constructing the cap. The gas line will be cut and capped at the 4-inch main under Tank Farm Road. It will be necessary to coordinate this work with The Gas Company. Similarly, the aerial utilities will be disconnected at Tank Farm Road in coordination with AT&T and PG&E. Underground electrical and telecommunication conduits supplying service to the demolished buildings will also be removed. Excavations to remove buried conduits and pipelines will be backfilled with structural fill.

Northwest Operations Area - fire water tank

Northwest Operations Area - existing water well

It is likely that Chevron will retain the existing water well located adjacent to the southwest-most former tank ring (Figure 21). The well is also shown in the digital image below. Electrical service will be provided to the well after construction of the cap via an underground conduit. The location and specifications for the conduit are provided in the design drawings found in Appendix C. The conduit will be made of 4-inch-diameter PVC and will be buried at a depth of 5 feet, in accordance with applicable local rules and regulations for providing electrical service.

Two septic tanks with leach fields manage wastewater at the Northwest Operations Area. One tank serves the southern building and the other serves the northern building, as shown in Figure 21. The tanks and leach lines will be abandoned in place in accordance with the standards of San Luis Obispo County (SLOCo, 2006). This will require emptying the tank contents with a vacuum truck, supplying a receipt of the work to the County Inspector, and then filling the tank with a cement slurry or concrete.

Northwest Operations Area - typical light standard

There are six overhead light standards located around the paved portion of AOC #2. These will be removed and recycled or disposed of as appropriate. Concrete foundations for the lights will be broken apart to a depth of at least 2 feet bgs. The resulting hole will be backfilled with structural fill. Conduits providing electrical power to the lights will be cut at least 2 feet below the existing grade and capped. Conductors will be pulled and recycled.

A 10,000-gallon polyethylene water tank stores water for firefighting at AOC #2. Once the buildings are

demolished, the tank will no longer be needed and will be removed from the site. Water is supplied to the tank by the 2-inch-diameter water line that enters near the top of the tank. The larger 4-inch-diameter line connects to a booster pump and then to the water distribution system that feeds various hydrants surrounding the site. Water level in the tank is maintained by electronic sensors that ensure that a minimum depth of water is present at all times. The tank sits on a 4-inch-thick cast-in-place concrete slab and is protected by four bollards. Once the tank has been removed, the bollards will be pulled and the holes backfilled with a cement slurry or concrete. The concrete slab will be broken apart and recycled onsite along with other concrete debris for use as gravel. Water lines and conduits will be cut 2 feet below the existing grade, capped, and any excavations backfilled with structural fill. Electrical conductors will be removed from the conduit and recycled.

As can be seen from the above images and as indicated on Figure 21, AOC #2 is partially paved. The pavement will be left in place. Any valve boxes or other similar types of subterranean vaults not otherwise removed during demolition activities will be filled with cement slurry. Detachable parking curbs will be removed for recycling, and asphalt edge curbs will removed.

The former fire school used a concrete-and-asphalt-lined pit for teaching and training techniques for extinguishing petroleum-fed fires (Figure 21). The remains of the pit are shown in the adjacent image. It may be difficult to place and compact structural fill within the pit, which might result in unwanted differential settlement. It is, therefore, proposed to remove the loose debris in the bottom of the trench until a firm surface has been exposed. The trench will then be backfilled with cement slurry to the existing grade. The loose material will be drummed, profiled, and managed at an appropriately permitted facility.

Northwest Operations Area - burn trench used by former fire school

It is readily apparent on viewing Figure 21 that AOC #2 is cluttered with the concrete vestiges of the historical petroleum operations. Some of these foundations are flush with the ground surface, or nearly so, and can be abandoned in place, such as the one shown in the top image on the next page. Other concrete structures that project more than 6 inches above the ground surface will protrude above the subgrade preparation layer described below and will interfere with construction of the cap. Consequently, the contractor may leave in place any concrete structure that projects above the existing ground surface less than 6 inches. Concrete structures that project more than that distance must be removed. The concrete may be broken up and recycled onsite for use as gravel. The contractor may elect to remove the

Northwest Operations Area - typical concrete slab requiring removal

low-lying concrete structures, as well, if that proves more economic for gravel production. Voids produced during removal of the concrete structures will be replaced by structural fill to the existing ground surface.

Once the work area has been cleared and grubbed and the demolition and abandonment activities have been completed, the subgrade will be prepared. This will include compacting the existing ground surface to the specifications of structural fill. In addition, a 6-inch-thick layer of common earth will be placed over the entire work area and compacted to the specifications of structural fill. The intent of this effort is to provide a uniform surface over which to place the geotextile fabric described later in this section.

A retaining wall will be constructed along the south boundary of AOC #2, as shown in Figure 22. The purpose of the retaining wall is to ensure the maximum amount of developable land along the south boundary. Illustrations of the typical cap profile are shown in Figures 23 and 24. Additional illustrations showing both the retaining wall and sloped edge detail are shown in Figure 25 and Figure 26, respectively.

The retaining wall will be constructed of reinforced cast-in-place concrete with a minimum compressive strength of 3,000 pounds per square inch. A footing for the retaining wall will be excavated along the alignments shown in the figures and design drawings. The excavation shall be inspected and approved by the Engineer prior to placing any steel reinforcement. Weak or otherwise unsuitable soil shall be removed to a depth of at least 24 inches below the footing. If the removed soil meets the requirements of common earth it may be used for backfill. Otherwise, the soil shall be properly disposed and replaced with suitable material. All backfill associated with the retaining wall shall be placed as structural fill.

The retaining wall design is a standard configuration taken from the *Standard Plans for Public Works Construction* (1997), and the basis for its configuration is provided in Appendix K. The wall along the south boundary will be approximately 495 feet long and will vary in height between 3 feet and 6 feet 5 inches.

A 12-ounce geotextile will be used to identify the contact between the cap and former ground surface. It is intended to warn future construction workers that the underlying soil layers are potentially contaminated. Specific warnings and instructions will be provided in the land use covenants and *Soil Management Plan*. Along the retaining wall, the geotextile will be placed on the concrete footing and anchored by the overlying soil layers. Along the sloped soil boundaries, an anchor trench will be cut beneath the location of the slope break, which is the point on the cap surface where the grade switches from a gentle slope to a steeper slope that eventually meets the existing grade. The anchor trench will be at least 1 foot wide and 3 feet deep, and will be backfilled with structural fill. These end details are illustrated in Figure 26.

The cap itself covers approximately 6.4 acres and will be constructed of structural fill. To promote proper drainage across the site, the cap thickness varies from a minimum of 4 feet to a maximum of approximately 7 feet towards the center. It is estimated that 53,400 cubic yards of

common earth will be necessary to achieve the lines and grades depicted in Figure 22. It is anticipated that this material will be obtained from the Flower Mound borrow source (Figure 16) by crushing run-of-pit material to meet the specifications for common earth provided in Appendix E. The cap will be thicker, on average, than the nominal thickness specified in the *Feasibility Study*. This is primarily to provide adequate flexibility for future development layouts. The proposed grading allows for surface runoff. A thinner cap could be constructed using dedicated subsurface storm drains, but would require substantial expense to modify in the future. A future developer can also modify the surface grade without importing materials and still be assured that the required minimum thickness of the cap is maintained.

The *Geotechnical Feasibility Study* identified potentially soft soils typically between 6 and 25 feet bgs, although the depth varies, beneath the Northwest Operations Area. The settlement analysis (Appendix H) estimates that settlement due to the load of the cap could be on the order of 4 to 6 inches. The *Geotechnical Feasibility Study* estimated that additional settlement due to foundation loads could be on the order of 1 to 2 inches.

In general, it is not considered practical to remove the soil for recompaction. Groundwater is relatively shallow (on the order of 10 to 15 feet bgs). As was discussed in Section 7.1.1, groundwater in this area is affected by LNAPL, benzene, as well as TPH in the soil. The site would require significant dewatering, with treatment of the resulting effluent, and disposal of contaminated soils.

Some recompaction of the soils beneath the pipelines will occur as they are removed. To the degree possible during remediation, soils will be stockpiled over the Northwest Operations Area to promote settlement. Prior to construction of the cap, it may be necessary to temporarily stockpile petroleum-impacted soils prior to disposal. After construction of the cap, it may be used as a location for temporary stockpiling of material from the Flower Mound or other borrow sites.

Construction of the cap will include installation of three survey monuments at the locations shown in Figure 22. An illustration of a typical survey monument is shown in Figure 27. Should low spots develop following construction, they would be repaired as part of the long-term maintenance program until the property is sold.

Future building foundations will require consideration of the soil conditions. Specific and detailed geotechnical studies must be prepared for any work subsequent to cap construction. It is anticipated that future foundation design over the site will require geogrid reinforcement or the use of piles. Any work below the bottom of the cap must be in accordance with the *Soil Management Plan*.

Storm water management features for this cap are designed to handle a 100-year recurrence storm. Runoff is handled as sheet flow off the cap surface. It is directed from a high point near the mid-point of the site to ditches along the perimeter. It is carried in ditches to hardened drop points at the locations shown in Figure 22. Drop structures have rip-rap reinforced energy

dissipaters to prevent erosion. The calculations used to size the storm water management features are found in Appendix G.

Run-on occurs at two locations and is diverted away from the cap at each. Currently, storm water drains from the north toward where the cap will be constructed. Although the amount of flow is relatively small, it is undesirable to allow this water to pond at the cap toe. Consequently, a flow line will be established along the toe of slope that drains toward the existing ditches and wetlands to the east. Ditches along the toe of slope are hardened with gravel and cobbles to minimize erosion at the transition between the slope and the existing wetlands.

The other principal source of run-on is from the west, along Tank Farm Road. A local high point is located on Tank Farm Road approximately 1,000 feet west of the Tank Farm. Surface runoff from the surrounding properties is directed toward the Tank Farm in the swale that runs on the north side of the road. At present, the runoff drains onto the agricultural property adjacent to the Tank Farm. During heavy precipitation, the attenuation capacity of that land is exhausted and water drains onto the Northwest Operations Area as sheet-flow. Run-on then flows across the property, collecting in numerous local low points (including the southernmost building) until reaching the wetland complex. The cap will cut off this route for storm water flow, and as such, a new drainage ditch is proposed at the toe of the southern retaining wall. The flow line of the new ditch will start at the existing grade at the western edge of the property and drop to the floor of the wetland complex to the east and will be sized to accommodate up to 17.2 cubic feet per second of flow (Appendix G). Rip-rap will provide erosion protection at the entrance to the wetland complex. The ditch will include a culvert to allow access from Tank Farm Road onto the site. The alignment and slope of the ditch are illustrated in Figure 22, and a typical cross-section is shown in Figure 23.

In addition to the erosion control measures previously described, additional BMPs will be provided to minimize the potential for erosion from the cap to the wetland. Unmitigated, soil erosion could be as much as 0.2 ton per year (Appendix J). It is anticipated that the recommended BMPs will substantially lower this total. The ditches along the top of slope of the cap will be provided with sandbag chevrons to slow water flow and allow sediment to drop out of suspension. Further, the surface and slopes of the cap will be covered with a spray-applied mulch/seed, which will be maintained until the property is developed.

As discussed in Section 2.2 this portion of the site is within the 100-year flood plain of Tank Farm Creek. Construction of the pad is anticipated to locally remove approximately 12.4 acre-feet of flood storage capacity. It is estimated, however, that further downstream (south of Tank Farm Road) there is an additional 27.9 acre-feet of available storage capacity. Further, it is unknown how restoration of the North Marsh will affect flood storage capacity. However, it will likely be augmented by expansion of the wetland complex.

As described in Sections 6.7 and 6.8, institutional controls will be adopted to protect the integrity of the cap. The land use covenant will strictly define appropriate uses for the property. Excavation depths will be controlled, and excavations deeper than the bottom of the cap will be

conducted under the requirements of the *Soil Mitigation Plan* (Padre, 2007c). Prior to development of the site, access will be controlled through fences and gates. Additional fences will be installed around the interior boundary of the operable unit with a locking gate, as shown in Figure 22, to control access between the development area and the adjacent open space. Prior to development, the cap will be periodically inspected and maintained, as necessary.

7.2 OU #2-RESERVOIRS 5 AND 7

The primary remedial action objective for Reservoirs 5 and 7 (i.e., OU #2) is to prevent the emergence of liquid hydrocarbon on the open water that accumulates at these locations. The sheen produced by the liquid hydrocarbon may adversely affect ecological receptors such as water fowl. The *Feasibility Study* determined that the most feasible way to prevent contact is to cap the reservoirs in a manner that allows groundwater (and the overlying hydrocarbon) to fluctuate naturally and not try to find alternative (i.e., lower resistance) flow paths. This will necessitate reconstruction of the existing wetlands at another location onsite.

Prior to constructing the cap, it will be necessary to clear the work area. The demolition plans for Reservoirs 5 and 7 are illustrated in Figure 28 and Figure 29, respectively. The detailed engineering drawings for demolition are included in Appendix C. A work area boundary has been established for each reservoir. This boundary establishes where the contractor may operate his equipment, disturb habitat, and where cleanup and construction will take place. The contractor will identify this line in the field and provide protective measures to prevent impacts outside of the boundary. These will include cones, caution tape, temporary fencing (if appropriate), silt fences, and other dust and erosion control BMPs.

Reservoir 5 - typical protective enclosures

One of the first demolition tasks will be the removal of the protective enclosures, an example of which is shown in the adjacent image. These were installed to ensure that small animals, such as birds, are not entrapped in sticky plastic hydrocarbon surface expressions. They occur both inside and outside of the tank rings. Every location with a protective enclosure is presumed to overlie a surface expression of plastic hydrocarbon that requires removal. Those within the limits of the former reservoir berm are addressed as part of the cap construction. Outside of the berm limits, however, soil beneath the protective enclosures will be removed as described in Section 4.2. Note that there are some plastic hydrocarbon surface expressions outside of the Reservoir 5 work area (Figure 28). Excavation and impacted soil removal at this location is addressed in Section 7.4.3. The enclosure materials will be removed from the site by the contractor and recycled (if feasible) or disposed of in a solid waste landfill.

Other site preparation activities will include the removal of any pipeline remnants in the work area. The old 8-inch-diameter crude oil distribution line is nearly tangent to the southwest edge of the Reservoir 5 berm. A lateral from this line appears to branch into Reservoir 5. The remains of the lateral can be seen ending within the reservoir in the above image. The remains of the 12-inch and 8-inch lines that served Reservoir 7 may also still be present underground. The concrete superstructure that supported those lines is still visible in the reservoir (see adjacent image). It is expected that the 4-inch-diameter fire water line shown surrounding Reservoir 5 is still present. Since Reservoir 7 was abandoned after the 1926 fire, an upgraded fire water line was never installed at that location.

Reservoir 5 – former oil pipeline

If a pipeline is exposed or is encountered in grubbing, scarifying, or obtaining borrow soil, it will be removed and disposed of as described in Section 6.4.4. Those portions of existing lines that lie outside of the work area will be cut, flushed, pigged (if possible), and capped as described in Section 6.4.2.

There is a lot of concrete and concrete debris within the work boundary of each reservoir. This includes old pump and lightning tower foundations, valve boxes, vaults, and other supports that were used during historical operations. There are also several small piles of broken concrete on the floor of Reservoir 5 (Figure 28). It also includes the concrete walls of the reservoirs that were cast on the berm slopes. The approximate extent of the walls for Reservoirs 5 and 7 is illustrated in Figure 28 and Figure 29, respectively. Although there appears to be little of the original walls left in Reservoir 5, much of the original walls remain in Reservoir 7 (see adjacent photograph). Concrete debris will be removed from the work area. If practical, it will be recycled to create crushed gravel for use on this project. Otherwise, it will be hauled offsite for recycling. Concrete that is too impacted by petroleum will be hauled away for disposal at an appropriate facility.

Reservoir 7 – overview of existing bottom and concrete-lined slopes

Five monitoring wells in OU #2 will be destroyed. Two of the monitoring wells are found in Reservoir 5 and three are found in Reservoir 7 (see Figure 28 and Figure 29, respectively). The monitoring wells are within the proposed cap boundaries. The procedures described in Section 6.5 will be used to abandon the monitoring wells.

It will also be necessary to remove the seepage study equipment that was installed to determine the process by which sheen formed on the open water of the reservoirs and which contributed to the design of the caps proposed in this *Remedial Action Plan*. The structures were constructed by excavating holes into the reservoir bottoms and installing large-diameter corrugated metal pipes on end. The annular space between the corrugated metal pipes and the soil was sealed with grout. The interiors were partially filled with clean sand and were instrumented to monitor water levels. Observations of water and LNAPL levels within the structures and the surrounding monitoring wells provided our current understanding on sheen formation.

Any remaining instrumentation will be removed from the structures and returned to Chevron for final disposition. Any remaining PVC sounding tubes will be pulled from the ground and disposed. The corrugated metal pipes will then be pulled from the ground using a backhoe or similar large piece of equipment. Any resulting void space will be filled during placement of the gravel layer, as described below.

Other debris, concrete, or metal that is discovered within the work area will also be removed. This will include the metal posts that are encountered at various locations, wire, fire hydrants, and other debris. Metal and concrete will be recycled where practical. Other materials will be disposed of as appropriate to their characteristics.

Reservoir 7 – accumulated debris in reservoir bottom

The last step prior to constructing the cap will be to expose the original concrete floor of the reservoirs. As can be seen in the adjacent image, there is a variable thickness of accumulated soil and organic matter. It is estimated that Reservoir 5 will generate 15,300 cubic yards and Reservoir 7 a further 11,000 cubic yards, for a total of 26,300 cubic yards. This will be stripped and disposed of at an appropriately permitted facility. Implementation of this part of the remediation will be most successful if accomplished in the summer, fall, and possibly early winter if there is little precipitation that year. Remediation may be postponed during periods of high groundwater levels and water in storage in the reservoirs. Once construction has begun, it should be finished as quickly as possible to prevent having to manage petroleum-impacted water.

The proposed grading plans for Reservoirs 5 and 7 are illustrated in Figure 30 and Figure 31, respectively. A diagram of the cap profile is shown in Figure 32. The engineering drawings (Appendix C) include the detailed designs for the caps.

Once the floor has been exposed, the reservoir bottom can be backfilled with gravel. As described in Section 5.3, this material will be selected and placed so that it provides a low-resistance pathway for groundwater and LNAPL to move into during their seasonal fluctuations. Consequently, it is desirable to have a relatively uniform material with little to no

fine material (i.e., particle size less than No. 200 sieve). This will create large void spaces with little resistance to flow and a low likelihood of future clogging. The gravel will be placed in lifts no greater than 12 inches thick and will be nominally compacted by one pass of a steel drum roller.

Placement of the gravel will be controlled by the nominal top-of-layer elevation. These elevations, 119.20 feet above mean sea level (amsl) for Reservoir 5 and 123.50 feet amsl for Reservoir 7, are based on the relative differences between the known concrete floor elevations and the highest observed local groundwater elevation plus a 1.5-foot factor-of-safety. The top of the gravel is above the downgradient ground surface of the reservoirs. Water cannot rise above this elevation within the reservoir without daylighting outside the reservoir, thereby controlling water levels within the reservoirs. The floor elevation of Reservoir 5 is 115.50 feet amsl, and the highest measured groundwater elevation between 1999 and 2002 was 117.70 feet amsl. Similarly, the floor elevation of Reservoir 7 is known to be 116.50 feet amsl, and the highest recorded groundwater elevation was 122.00 feet amsl.

The top of the gravel layer can be no less than the specified design elevations, and results in a minimum thickness of 3.7 and 7 feet for Reservoirs 5 and 7, respectively. It will be acceptable for the contractor to allow the gravel layer to be thicker, but the final surface cannot have depressions or low spots that dip below the nominal top-of-layer elevations. As shown in Table 4, it is estimated that 20,100 cubic yards of gravel will be needed to fill Reservoir 5, and another 39,000 cubic yards will be needed for Reservoir 7.

A 12-ounce[4] geotextile will be placed over the gravel to prevent migration of fine soil particles into the void spaces from the overlying soil layers. The geotextile will be anchored in a trench dug around the original concrete floor. The trench will be dug into a shelf cut into the existing berm. The shelf will be approximately 3 feet wide. It is anticipated that the trench will be dug by a small pocket-size excavator with an arm that can be offset from the machine's centerline. The trench will be centered in the shelf and will be approximately 1 foot wide and 3 feet deep. The configuration of the shelf and anchor trench is illustrated in Figure 33. The trench locations for Reservoirs 5 and 7 are shown in Figure 30 and Figure 31, respectively. The geotextile will be placed as required by the manufacturer. This will include trimming the edges that go into the anchor trench and sewing adjacent rolls together at their overlapped edges. Pro-forma calculations have been included in Appendix I that demonstrate the selected geotextile will prevent soil migration, has adequate tensile strength, and that the anchor trench is sized appropriately to prevent pull-out.

The final grades shown in Figure 30 and Figure 31 will be achieved by placing common fill with a 1-foot surface veneer of topsoil over the geotextile. The objective with these grading plans is to produce as natural-looking landform as possible. The final grade will be nominally controlled by grading from a control contour established near the top of the cap. The surface will slope at

[4] Geotextile is typically identified by its weight per square yard. Therefore, an 8-ounce fabric weighs 8 ounces per square yard.

no more than 4:1 (horizontal:vertical). Ditches will be established around the perimeter of the cap to ensure proper runoff of storm water. The final configuration of the slopes and ditches will be developed in the field to best integrate with the surrounding topography within the other parameters of the design. It is estimated that Reservoir 5 will require 12,500 cubic yards of common fill and 12,600 cubic yards of topsoil. As shown in Figure 30, the berm borrow around Reservoir 5 could generate another 26,300 cubic yards of common earth that could be used for fill around the site. This material will only be removed if needed elsewhere onsite. Reservoir 7 is expected to require 24,500 cubic yards of common earth and 11,000 cubic yards of topsoil for cap construction. An additional 8,300 cubic yards of soil are potentially available from the local berm borrow if needed elsewhere onsite.

The slopes and ditches are designed to minimize potential erosion. The ditch slopes will vary between 0.5 and 2 percent and are designed to accommodate the 100-year return period storm. The discharge points of each ditch are provided with some type of energy dissipation. Where velocities are less than 2 feet per second, a simple gravel mat is supplied. If the exit velocities are greater than 2 feet per second, a reinforced rip-rap energy dissipater will be installed. The hydrology and hydraulic calculations supporting the ditch dimensions and energy dissipaters are found in Appendix G.

The U.S. Soil Conservation Service recommends limiting soil erosion to less than 2 tons per acre per year. The calculations in Appendix J show that the estimated annual soil loss from the caps is 0.53 ton per acre and 0.77 ton per acre for Reservoirs 5 and 7, respectively.

The surfaces of the Reservoir 5 and 7 caps will be revegetated with an approved native plant seed mix. The specifications for this seed mix will be developed in conjunction with the forthcoming *Habitat Mitigation Plan*. The surface of the cap will be scarified to a depth of at least 3 inches. Prior to the onset of the rainy season, and preferably as close as possible to the season's first rain, the seed mix will be applied. The caps will be protected after application of the seed with jute net or spray-applied mulch that will minimize erosion until the vegetation can take root.

As noted previously, remediation of the Tank Farm results in unavoidable impacts to existing wetlands, some of which include desirable vernal pool fairy shrimp habitat. The demolition plans depict the wetlands on and around Reservoirs 5 and 7. Impacted wetlands are shown in blue, while wetlands not affected by construction are shown in green. Some of the wetland impacts will be temporary and the existing wetlands will be reestablished after remediation is complete. Those impacts that are permanent will be mitigated at another location onsite to be selected as the *Habitat Mitigation Plan* evolves in concert with the environmental analysis for the project. A summary of the estimated habitat impacts is provided in Table 5.

It is estimated that 4.83 acres of wetland habitat in and around Reservoir 5 will be affected by remediation. Of this total, 3.59 acres will be permanent impacts requiring mitigation at another location onsite. Approximately 1.21 acres of the affected wetlands are also vernal pool fairy shrimp habitat, although only 0.04 acre of that habitat is permanently removed from service.

Due to their similar size and configuration, the amount of habitat affected by remediation of Reservoir 7 is similar to that for Reservoir 5. The total wetland impact is estimated to be approximately 4.22 acres with a permanent impact of 3.65 acres. Of the total wetland impact, 0.90 acre has been identified as vernal pool fairy shrimp habitat, and 0.35 acre will require mitigation at another location onsite.

Both caps are expected to affect the habitat for rare plants onsite. The Reservoir 5 cap will affect 0.31 acre of habitat, but only 0.03 acre will be a permanent impact. Similarly, the Reservoir 7 cap will affect 0.28 acres of rare plant habitat, of which 0.15 acre will require mitigation at a different location.

Settlement is not anticipated to be a significant issue for the Reservoirs 5 and 7 caps. The caps will be constructed over the original concrete floors, which will tend to evenly distribute the overlying soil loads. The cap is further reinforced by the geotextile, which, within limits, will also distribute loads and provide a bridging support over localized weak spots. In addition, it is likely that the soils directly beneath the reservoir are overconsolidated; that is, they have experienced greater bearing stress than they currently experience. The reservoirs were loaded with a 20-foot or more thickness of oil for many decades. That historical load will have worked to compress the soils, and it is expected that additional settlement should be minimal.

To ensure proper performance of the caps, future settlement will be monitored. Three monuments will be placed on and around the cap, as shown on the grading plans for each of the caps. The monuments will be of a standard design acceptable to the City or County. Typically, a survey monument will consist of a 5/8"-diameter steel or aluminum rod between 3 and 5 feet in length. The rod is driven into the ground and then topped with a domed cap that threads onto the rod. One monument will be located on the top of the cap, another near the edge, and a third at a location adjacent to the cap on native ground. Monitoring of the cap will be as described in Section 9.0

7.3 OU #3/Flower Mound/Borrow Area No. 2 Regrading

OU #3 is located on the eastern side of the Tank Farm north of Tank Farm Road (Figure 14). As noted in the *Feasibility Study*, this area includes the remains of Reservoir 4, and has several plastic hydrocarbon surface expressions that pose potential entrapment hazards. Chevron has elected to implement a closure approach for this OU that supports future development in accordance with the proposed land use plan (Figure 10). This entails excavation of the surface expressions and construction of a cap over the former reservoir. It also includes grading of the Flower Mound and Borrow Area No. 2 to support future development.

The work area boundaries for OU #3 and the Flower Mound, and Borrow Area No. 2 are shown in Figure 34. Site disturbance associated with remediation of OU #3 grading of the east end of the property will be confined to this area. Preparation of the site for remediation will include clearing, grubbing, removal of the protective enclosures and monitoring wells, and demolition and removal of concrete debris and pipeline remnants. A demolition plan for the Reservoir 4

area is shown in Figure 35, and a demolition plan for the Flower Mound area is shown in Figure 36. Clearing and grubbing will remove vegetation from the work area. Grubbed vegetation will be managed as allowed by San Luis Obispo County, the RWQCB, and the APCD.

A chainlink fence secures the property along Tank Farm Road and along the eastern property line. A barbed-wire fence separates the Reservoir 4 area from other portions of the site. The barbed-wire fences are used by ranchers to create paddocks suitable for cattle grazing. The chainlink fence will be maintained, except that minor modifications will be made in its alignment to maximize the working area. The barbed-wire fence will be removed.

Five monitoring wells will be abandoned within OU #3. These are SP-6, SP-7, TMW-2, TMW-8, and TMW-9. These wells are included on the list in Table 2. The wells will be abandoned as described in Section 6.5. Replacement of the monitoring wells will be as prescribed by the RWQCB.

There are four protective enclosures clustered adjacent to the northwest boundary of Reservoir 4. These will be removed and recycled or disposed of as appropriate. It is presumed that plastic surface expressions are beneath each of these enclosures. The underlying soil will be excavated in accordance with Section 4.2 and the more specific descriptions found later in this section.

Abandoned concrete lightening stand foundation

Concrete foundations for the lightning towers and pumps are still found surrounding the reservoir (Figure 35). These will be removed from the work area and crushed for use as gravel elsewhere on the site, or will be sent offsite for recycling. In addition, frames constructed of wood and concrete (believed to be test plots from a previous study) are found on the west side of the reservoir. These will be removed for disposal at a permitted facility.

The remains of the foundations for the reservoir roof and interior wall can be seen in the field and are shown in Figure 35. The contractor can abandon these foundations in place as long as they do not interfere with achieving the lines and grades shown in Figure 38. The contractor will also have the option of recovering the foundations to create gravel for use elsewhere onsite if it can be shown that the cost would be less than importing material from offsite.

Reservoir 4 – abandoned oil pipeline

Crude oil and water lines historically served Reservoir 4 (Figure 5). It appears that most of the crude oil line has been removed (see adjacent image), or is possibly buried within the reservoir. There are exposed portions of the water line, but it is believed to be substantially intact due

to the hydrants that still surround the reservoir (Figure 34 Reservoir 4 (OU #3), Flower Mound and Borrow Area No. 2 Work Areas

Figure 35). The remains of the crude oil line will be exposed and removed to a point outside of the work area. Some of the water line is exposed at the surface; other portions are within the area that will be used as common earth borrow for the cap construction. As such, the water line will be cut at the three locations where it appears to enter the work area. Those portions within the work area will be removed, while those sections outside of the work area will be capped and managed as described in Section 6.4.

Figure 37 shows the areas where soil has been impacted by plastic hydrocarbon. This area is approximately 8.35 acres and is estimated to contain as much as 40,400 cubic yards of impacted soil. The contractor shall segregate asphaltic material and clean soil during the excavation. Those materials can be incorporated into the structural fill for the cap. Excavation shall be performed as described in Section 4.2. The remaining subgrade will be compacted to at least 95 percent of its relative maximum density per ASTM D1557.

Geotextile will be used to identify the cap bottom and to provide some structural support in the event of differential settlement. The potential for settlement is discussed later in this section. Approximately 342,900 square feet of geotextile will be anchored in a trench positioned around the former reservoir as shown in Figure 37. The trench will be 1 foot wide and 3 feet deep. Calculations estimating the resistance to pull-out for this trench (including potential strain induced by differential settlement) are provided in Appendix I.

The proposed grading plan for the Reservoir 4 cap and the Flower Mound is shown in Figure 38. The grading plan ensures a minimum of 4 feet of cover over the former reservoir bottom. The maximum thickness is approximately 11 feet, and the average thickness is just over 6 feet. The primary feature of the grading plan is the extension of Santa Fe Road. From Tank Farm Road, the rough climbs along gently sweeping curves for approximately 1,200 feet at slopes ranging between approximately 1 and 3 percent. It reaches a high point at approximately elevation 164, and then slopes downward approximately 400 feet to elevation 160, where it ties into the existing grade at the northern property boundary. The highest point of the grading area is at the northwest corner of the Flower Mound. From that point, most of the grade slopes between approximately 1 and 3 percent to the southwest. A portion of the northwest corner of the grading area slopes to the northwest, generally following the northern down slope of the Santa Fe Road extension. A small collector road connects with Tank Farm Road approximately 1,200 feet west of the future Santa Fe Road intersection. The collector road rough grade runs generally north approximately 900 feet at a slope of approximately 1 percent. At this point the collector road turns to the east and intersects the Santa Fe Road extension about 800 feet away. The slope of the eastern leg varies from approximately 3 to 10 percent. West and north of the collector road the grade slopes generally westward until it ties into the existing grade. On the east side of the grading area, approximately 900 feet north of Tank Farm Road is a small drainage basin that collects run-off from the entire grading area.

The layout of the cap and grading supports future development within the bounds of the proposed land use plan. It also includes the rough grading necessary to construct the extension of Santa Fe Road, and provides access to a land-locked parcel along the east property line. In addition, the grading improves the utility (and consequently the value) of the surrounding properties. It also provides a reasonably smooth transition to the former recycling area, which will be used as the contractor's primary staging area. It is estimated that this grading plan will require approximately 262,800 cubic yards of structural fill. However, the Flower Mound borrow area is expected to generate at least 328,200 cubic yards, and up to 402,000 cubic yards if Chevron has access to the off-site material

Some of the excess may be used to regrade Borrow Area No. 2. After topsoil removal, structural fill will be placed as shown in Figure 39. As noted previously, the limits shown in the figure are proposed for development in both the *AASP* and proposed land use plans. A portion of the grading establishes the rough grade for the Santa Fe Road extension south of Tank Farm Road. The remaining grading establishes contours that will support future development of the site.

Enhancement of existing drainages and the construction of new channels and detention features are required to adequately manage storm water. However, the features shown in this *Remedial Action Plan* are temporary, though they may be used for several years. Development of the area will include construction of a storm drain system, which will replace much of the overland system. Since even the first phase of development may follow remediation by several years, a properly designed and functioning overland system is necessary to prevent excess erosion and transporting unwanted sediment to the North Marsh wetland complex, to which this area is ultimately tributary. Supporting hydrology and hydraulics calculations for the overland system are provided in Appendix G.

The hydrologic design point for the area north of Tank Farm Road is identified on Figure 38. Overall, the peak flow to this point has been reduced, mostly due to the longer travel path that water must flow over, which results in a longer time of concentration. The existing peak flow at this point during the 100-year storm is estimated to be 67 cubic feet per second. The peak flow for the same storm after grading is estimated to be approximately 51 cubic feet per second.

Most of the graded areas will drain by sheet flow to the roads. The rough graded interior roads collect storm water and direct it to large, over-sized swales along Tank Farm Road and the north property boundary. The larger swale along Tank Farm Road discharges to an even larger swale along the toe of the collector road slope. That swale and the swale along the northern property line discharge to a small sediment removal basin just before the design point. The swales are broad and will be roughened and vegetated to reduce flow velocities, minimize erosion, and limit sediment transport.

Regrading of Borrow Area No. 2 will alter the hydrology. At present, precipitation is trapped in a closed catchment. Rough grading of the Santa Fe Road extension will permit 2.9 acres to discharge directly to the East Fork of San Luis Obispo Creek. The peak flow of this discharge during the 100-year storm is estimated to be 5.1 cubic feet per second. This is a relatively minor

contribution to the overall flow of the creek, and is unavoidable if Santa Fe Road is to be extended as described in the *Airport Area Specific Plan*.

In addition to the erosion control measures previously described, additional BMPs will be provided to minimize the potential for erosion from the cap to the wetlands. Unmitigated, soil erosion could be as much as 1.38 tons per acre per year (Appendix J). It is anticipated that the BMP regime will substantially lower this total. The ditches along the top of slope of the cap will be provided with sandbag chevrons to slow water flow and allow sediment to drop out of suspension. Further, the surface and slopes of the cap will be covered with spray-applied mulch, which will be maintained until the property is developed.

Remediation activities in OU #3 and the Flower Mound will affect wetland and rare plant habitat, which is summarized in Table 5. Two acres of wetland habitat will be impacted, although this is a permanent impact requiring mitigation elsewhere onsite. None of the impacted wetland is considered vernal pool fairy shrimp habitat. Remediation will also permanently affect 3.4 acres of rare plant habitat. Regrading of Borrow Area No. 2 will permanently affect 1 acre of wetland of which 0.67 acres is vernal pool fairy shrimp habitat. It will also permanently affect 1.4 acres and temporarily affect 0.2 acres of rare plant habitat.

It was noted previously in this section that there is a potential for settlement to occur. It is believed that decommissioning of Reservoir 4 included pushing berm material over the concrete floor. Field inspections of this material indicate that it has not been compacted. The *Geotechnical Feasibility Study* (Padre, 2007a) estimated that settlement may be on the order of 3 to 4 inches. During construction, the upper few feet of existing material will be compacted. It is not intended, however, to expose and recompact petroleum impacted soils. Since the planned grading is much thicker than the previously envisioned cap (11 feet versus 4 feet), it is expected to provide improved support. In addition, a 12-ounce geotextile will be used to provide additional tensile strength and load distribution capacity.

However, development will require lot- and building-specific geotechnical studies. Future foundations may require geogrid support or the use of piles if the thicker fill has not adequately compressed the underlying layers.. This latter approach would require handling spoils and other excavated materials in accordance with the *Soil Management Plan* and will be specified in any land use covenants attached to future parcels in this area.

Potential settlement of the cap will be monitored through the use of survey monuments. It is proposed that five monuments be installed in and around this operable unit. Their locations are shown in Figure 38. A typical survey monument detail is shown in Figure 27. The survey monument consists of a 5/8-inch-diameter steel or aluminum rod driven to a depth of between 4 to 6 feet bgs. The rod is topped with a threaded cap mounted flush with the ground that identifies the monument. The monuments will be periodically surveyed as part of the long-term maintenance requirements for the site.

In addition to possible high-load foundation requirements, the land use covenant will specify the various institutional controls that will accompany title to the property. These will include prohibitions on groundwater use in impacted areas, limitations on excavation, impacted soil management requirements, as well as general guidelines on the use of vapor barriers for habitable structures. An example of these guidelines is provided in Appendix M.

7.4 OU#4-Remaining Site-Wide Terrestrial and Wetland Areas

The remaining site-wide impacted terrestrial and wetland areas are addressed as OU #4. It includes three areas of concern. The first, AOC #1, is the North Marsh adjacent to the Northwest Operations Area. The second, AOC #2, is Reservoir 3, and AOC #3 is the remaining plastic ("sticky") hydrocarbon surface expressions.

7.4.1 AOC #1-North Marsh

The North Marsh is a large (approximately 11.9-acre) wetland complex adjacent to the Northwest Operations Area. The SERRT identified this area as requiring remediation as a result of the numerous surface expressions that posed potential entrapment hazards to small animals. After careful consideration, Chevron determined, and documented in the Feasibility Study, that the preferred approach to remediation would be to excavate the hydrocarbon material and restore the wetland in place with improved function and environmental utility.

The work area for OU #3/AOC #1 is defined by the clear and grub line shown in Figure 41. The contractor will, to the extent possible, stockpile and protect cleared wetland vegetation. Greater detail regarding selecting, segregating, stockpiling, and maintaining vegetation will be provided in the Habitat Mitigation Plan. One possible stockpile location is shown adjacent to the North Marsh in Figure 41. Other locations can be used, as necessary, as long as they minimize impacts to existing and otherwise unaffected habitat.

Every attempt will be made to minimize working outside of the excavation limits. However, it is also recognized that the excavation areas may expand in order to fully capture the hydrocarbon materials within the wetland.

There are three protective enclosures within the work area. These will be dismantled and removed for disposal or recycling, as appropriate. Since they are each within the wetland, the presumption that they enclose plastic hydrocarbons is addressed by the excavation described later in this section.

A small pile of concrete debris was identified on the east side of the wetland (Figure 41). This material will be removed for disposal. It may be recycled into gravel for use elsewhere on the site (if feasible), or it may be removed from the site for recycling, depending on the project economics.

As discussed in Section 5.5.4, the facility used a location adjacent to the wetland for debris disposal following the 1926 fire. Field observations indicate that inert materials, such as wood

posts, fencing, and concrete, were the principal materials discarded at this location. The area covers approximately 2.3 acres and is estimated to be on the order of about 5 feet deep. This suggests that there may be around 18,000 cubic yards of debris present. In the near term, Chevron will characterize the materials interred at this location so that they can be properly managed during remediation. At a minimum, the site will be cleared of debris when remedial activities for the North Marsh begin. It is also possible that Chevron might expedite the work if it would facilitate other remedial activities.

There are two monitoring wells in the work area that will be abandoned, B-36 and SP-4. They are more fully described in Table 2 and their locations are shown in Figure 41. The wells will be abandoned as described in Section 6.5. There are three other monitoring wells (B-33, B-35, and MW-16) that are immediately adjacent to the work area. These will be protected in place if possible.

PG&E and AT&T have utilities (power and telecommunications, respectively) that cross the work area adjacent to Tank Farm Road (Figure 41). The contractor will be responsible for protecting those utilities in place.

Several of the old facility pipelines intrude into the excavation area, as shown in Figure 41. The historical records indicate that there are a water line and two foamite lines in the north part of the excavation limits crossing in an east-west direction (approximately 400 lineal feet each in the work area, approximately 1,200 lineal feet total). These lines appear to have been used for fire suppression purposes at the 55,000-barrel ASTs. There are two former crude oil lines that cross the excavation area in an east-west direction almost at the midpoint (approximately 860 lineal feet each in the work area, 1,720 feet total). A water line and natural gas line (the latter is reported to have been abandoned) run parallel to Tank Farm Road in the unpaved shoulder area (approximately 270 lineal feet each in the work area). Another water line is found at the southwest end of the excavation area crossing in a north-south direction. A stub off that line protrudes into the excavation area approximately 60 feet in an easterly direction.

It is likely that pipeline abandonment will occur prior to remediation in the North Marsh. As such, the lines will have been flushed and the larger lines pigged. If the lines are not exposed during excavation, they will be abandoned in place as described in Section 6.4. If the lines are exposed during excavation of the North Marsh, they will be removed for disposal. The lines will be cut approximately 10 feet outside the work area. The exposed pipeline end will be capped and the local excavation will be backfilled with common fill.

A preliminary excavation boundary is shown in Figure 41. It is believed that this boundary includes all of the hydrocarbon expressions that affect the North Marsh. The boundary is delineated in this way mostly for permitting purposes so that the potential maximum impact is quantified in the environmental analysis. The entire excavation boundary, as shown in Figure 41, covers over 13 acres. The *Feasibility Study* estimated the average thickness of impacted soil to be 3.5 feet. Excavating to this depth within the boundary would generate 75,300 cubic yards of soil, most of which will require offsite management. The mapped hydrocarbon surface

expressions, in contrast, are only 7 acres (including the protective enclosures). Excavation limited to this area would result in a correspondingly lower volume (approximately 40,000 cubic yards). The actual volume is anticipated to be somewhere between these extremes, but the larger quantity will be used for planning purposes.

Excavation is expected to proceed from the north to the south. This allows haul trucks to most readily access either Tank Farm Road for offsite disposal or the temporary impacted soil stockpile in the Northwest Operations Area. The potential haul routes are shown in Figure 17. The access point from Tank Farm Road shown on the figure is preferred since the *Remedial Action Plan* envisions some form of active traffic control at this location while work is in progress.

Although remediation of the North Marsh will create the single largest wetland impact (11.9 acres) for the entire Tank Farm project, it does not affect any vernal pool fairy shrimp habitat, and the impacts are only temporary. In fact, remediation is expected to increase the size of the habitat by approximately 2.3 acres when the historical debris disposal area is cleaned up. Remediation may also temporarily impact up to 0.76 acre of rare plant habitat.

The specifics for restoration of the North Marsh and other protected onsite habitats are currently being developed. The forthcoming *Habitat Restoration Plan* will provide the conceptual approach to be used in restoration and mitigation. The final plan, however, will be developed in consultation with the City, County, and regulatory agencies such as U.S. Fish & Wildlife Service, U.S. Army Corp of Engineers, the RWQCB, and the California Department of Fish & Game as the project proceeds through permitting and environmental analysis.

7.4.2 AOC #2-Reservoir 3

Reservoir 3 was one of the largest reservoirs and one of the last to be decommissioned. Although it contains a large wetland complex, it is unlike Reservoirs 5 and 7 in that the wetland is not of the open water type. Rather, it is generally a wet-marsh-type, with substantial pockets of plastic hydrocarbon exposed at the surface where it poses a physical, and possibly chemical, hazard to ecological receptors. Further, the wetland does not appear to be fed by groundwater, again distinctly different from the wetlands in Reservoirs 5 and 7. The preferred remedial alternative for this area of concern is to remove a limited amount of impacted material and replace it with the cap components, which will include geosynthetics that will create an impermeable barrier and help to support the overlying cap materials. This is anticipated to allow replacement, and possibly expansion, of the existing wetlands.

The work area for Reservoir 3 is shown in Figure 42. This work boundary includes the adjacent wetland complex to the northwest that is impacted by plastic hydrocarbon surface expressions. Preparation of this work area will include clearing, grubbing, removal of concrete debris for recycling or disposal, dismantling and removal of the protective enclosures, and removal of exposed pipelines.

Reservoir 3 – former concrete wall foundation

There appears to be less concrete debris surrounding this reservoir than the others across the Tank Farm. There are a couple of lightning tower stands and some other loose concrete debris that will be removed for recycling. The remains of the original concrete that lined the reservoir berm slopes can also be observed at the ground surface (see image to left). Those portions that are within the excavation limits (Figure 42) will be removed for recycling as well, assuming that they are not heavily stained with hydrocarbon. Heavily stained concrete will be removed for disposal at an appropriately permitted facility.

Reservoir 3 also contains the single largest protective enclosure on the Tank Farm. This enclosure and the one just outside the berm to the north of the reservoir will be dismantled and removed from the work area. If practical, the materials will be salvaged or recycled. If this proves impractical, the contractor will dispose of the materials in an appropriately permitted facility.

Reservoir 3 – protective enclosure

A single abandoned pipeline approaches the reservoir from the north (Figure 42). It is uncertain if the line even continues into the reservoir. The line will be flushed, pigged (if practical), and abandoned in place (as described in Section 6.4), assuming that it does not interfere with excavation or construction of the cap. If this assumption proves incorrect, the pipeline will be cut outside the work area, capped, and the portion inside the work area will be removed for disposal.

The water supply line that served Reservoir 3 appears to be well out of the proposed work area and is not expected to affect the work in this area of concern. It does appear, however, that the water line crosses several of the other plastic hydrocarbon surface expressions adjacent to the reservoir. Managing the water line at these locations is described in Section 7.4.3, below.

Monitoring well MW-34, located on the southwest quadrant of the work area (Figure 42), will be abandoned. It will be abandoned as described in Section 6.5. Two other monitoring wells, MW-20 and MW-42, are adjacent to the work area and will be protected in place.

The preferred remedy developed in the *Feasibility Study* recommended removing approximately 2 feet of existing material and replacing it with the components of the cap. Nominally, this would be effective in that the work area is essentially flat, though slightly higher in the center and the east. The resulting depression supports the wetland habitat in this area. The refined approach in this *Remedial Action Plan* is to remove the minimum 2 feet of material at the outer edge of the excavation, but to deepen the excavation in the center of the reservoir so that the

excavated bottom has a 0.5 percent slope toward the interior. It is anticipated that this excavation will generate approximately 26,700 cubic yards of hydrocarbon-impacted soil that will require removal and disposal. The excavation will start at elevation 134, which is also the elevation that the top of the cap ties into the existing ground along the outer edge of the reservoir. The entire surface of the cap will then be approximately the same elevation as the existing wetland complex, which should allow restoration and expansion of the existing habitat.

The subgrade surface will be compacted to a depth of 6 inches to 90 percent of its relative maximum density per ASTM D1557. Construction equipment may require decontamination after compaction of the subgrade. Depressions in the subgrade resulting from compaction will be restored to the lines and grades of the design with common fill. A liner system will be installed over the subgrade to prevent the remaining hydrocarbon materials from migrating to the surface. The liner system will consist of (from bottom to top): 12-ounce geotextile; a 12-inch layer of gravel with a triaxial geogrid installed mid-thickness; 12-ounce geotextile; 40-mil high density polyethylene (HDPE) liner; 12-ounce geotextile; variable thickness (0-18 inch) common fill; and 1-foot thickness of topsoil. An illustration of the liner section and the anchor trench detail is shown in Figure 44.

The lower portion of the liner system is intended to bridge potentially soft portions of the remaining soils in the reservoir. A 12-ounce non-woven geotextile will be installed to ensure that fine soil particles do not migrate into the gravel layer. A 6-inch thickness of gravel will be placed over the geotextile. The initial 6-inch layer will be nominally compacted by at least one pass of a steel drum roller. A triaxial geogrid (Tensar TX-160, or equivalent) will be installed per manufacturer's specifications and secured in an anchor trench around the perimeter of the original reservoir bottom (Figure 43). The geogrid will be covered with an additional 6-inch layer of gravel.

As noted above, the purpose of this component of the liner system is support. For design purposes, it has been assumed that the center of the cap tries to settle by approximately 2 feet, equivalent to a 50 percent consolidation of the original impacted soil remaining between the excavation bottom and the original reservoir bottom. While each of the geosynthetic materials can readily accept the resulting strain, it is expected that the strain will be taken up first by the geogrid, which is designed for this type of application. Further, the geogrid will better distribute loads across the foundation, lessening the potential for differential settlement. This type of geogrid is a relatively new product, but is better at locking aggregate materials and provides superior load distribution than bi-axial geogrids. Supporting calculations for the geosynthetics are provided in Appendix I.

Three additional geosynthetic components will be placed on the compacted gravel. These will consist of a 40-mil HDPE flexible membrane liner (FML) over an 12-ounce non-woven geotextile and beneath an 12-ounce non-woven geotextile. The FML creates an impermeable barrier to future migration of hydrocarbon-impacted soils. It also will minimize infiltration losses from the overlying wetland. The primary purpose for the geotextiles is to protect the FML from punctures and abrasions due to angular particles in the common fill. A secondary purpose

for the geotextiles is to assist in distributing soil loads and bridging soft soils. Since the subgrade slope is so mild (0.5 percent), the use of smooth rather than a textured FML will be acceptable.

A variable thickness of common fill will be used to create a nominally level surface across the reservoir. It will be as much as 18 inches thick in the center of the reservoir and will taper out as it reaches the anchor trench bench (Figure 44). The common fill will be pushed onto the geosynthetics from a minimum 1-foot-thick layer. Equipment will not be allowed to operate directly on the geosynthetics. A 1-foot-thick layer of topsoil will be used to complete the cap. The topsoils will only be nominally compacted, and will be scarified prior to revegatation. Restoration of the wetland habitat will be performed in accordance with the *Habitat Mitigation Plan*.

A primary design objective of this remedial alternative has been to facilitate restoration and improvement of the existing wetlands while removing the potential for contact with the hydrocarbon-impacted soils. The liner system provides separation, and the design grades are intended to direct water within the catchment of the reservoir (approximately 11.5 acres) to accumulate in the wetland complex. Seasonally, approximately 12.5 acre-feet of water will accumulate within the new 6.5-acre wetland complex.

Remediation at Reservoir 3 will have a temporary impact to the entire existing 4.23-acre wetland complex, which is also vernal pool fairy shrimp habitat. Once remediation is complete, however, the entire habitat will be restored, and it is expected that an additional 2.27 acres of habitat will have been added (that is the entire area covered by the cap for Reservoir 3). Remediation will also affect 0.38 acre of existing rare plant habitat that will be mitigated elsewhere onsite.

Some settlement is anticipated (and considered desirable) after construction of the cap. The various geosynthetic elements of the cap are capable of withstanding the likely strains that may be imposed during settlement and are reinforced with a geogrid designed to limit excessive settlement. The excavation plan is designed to provide some additional weight over the center of the reservoir and encourage the greatest relative amount of settlement at that location. This is intended to encourage water to pool towards the center of the reservoir. Settlement will be monitored by three settlement monuments, as shown in Figure 43. One will be located as near to the center of the reservoir as practical, a second will be installed over the cap towards the perimeter, and a third will be installed locally on undisturbed ground. These monuments will consist of the typical cap section but will be cast into concrete blocks approximately 12 inches on a side.

7.4.3 AOC #3-Other Sticky Hydrocarbon Surface Expressions

There are an additional 12 areas affected by plastic hydrocarbon surface expressions. These are shown in Figure 45. It is proposed to excavate these areas as described in Section 4.2, and backfill them with common fill and 1 foot of topsoil at the surface. Several of these areas are adjacent to or within the work areas for other remedial activities, such as Reservoir 5 and

Reservoir 3. As a practical matter, those sites will be excavated in conjunction with preparing the work areas for the larger remedial activities.

The 12 locations comprise 5.90 acres and are estimated to generate approximately 28,700 cubic yards of potentially hydrocarbon-impacted soil requiring offsite disposal. Backfilling the excavations will require 19,200 cubic yards of common earth and 9,500 cubic yards of topsoil. Generally, the upper 3 inches of topsoil will be scarified after placement and seeded with a mix to be specified in the *Habitat Mitigation Plan*. Approximately 0.97 acre of wetland habitat, including 0.93 acre of vernal pool fairy shrimp habitat, will be temporarily impacted by the excavations. Wetland habitat will be restored as described in the *Habitat Mitigation Plan*. Remediation will also temporarily affect 0.19 acre of rare plant habitat.

In addition to the excavations, there are approximately 2.18 acres of wetland habitat that also supports vernal pool fairy shrimp that will be ripped to a depth of no less than 15 inches on at least a 24-inch grid. The upper 3 inches of soil will be scarified; that is, broken up into small pieces (Figure 43). This habitat is impacted by asphaltic hydrocarbon that, while not an ecological risk or physical hazard, still impairs the function of the wetland. It is believed that scarifying the surface will encourage improved plant growth.

7.5 OU#5-SITE-WIDE GROUNDWATER

Monitored natural attenuation will be implemented using the same parameters and methods as specified in Monitoring and Reporting Program 93-120 (Appendix B). However, remediation will require abandonment of several monitoring wells (Table 2). Replacement will be determined in concert with the RWQCB, which will also approve a revised Monitoring and Reporting Program. At a minimum, monitoring groundwater for TPH and BTEX (consistent with M&RP 93-120) will be performed at the remaining perimeter monitoring wells MW-49, MW-50, MW-56, and SLOW-17, and the off-site production wells 11Ea and 11Eb. Currently, monitoring is performed on a semiannual basis. After three years, the RWQCB will evaluate the semiannual groundwater data to determine if a reduction in the monitoring frequency is warranted.

8.0 HABITAT IMPACTS AND MITIGATION

The remedial actions described in this *Remedial Action Plan* will ultimately reduce potential human health and ecological risks. It will also improve the function and ecological value of various types of habitat found on the site. While these actions are being implemented, however, wetland and rare plant habitats will be impacted. Throughout the previous sections describing the remedial actions, collateral habit impacts have been identified. These are summarized in Table 5 and illustrated in Figure 46.

In total, it is anticipated that remediation will affect 29.0 acres of wetland, 9.5 acres of vernal pool fairy shrimp habitat, as well as 4.8 acres of rare plant habitat. Most of the habitat will only be temporarily affected and will be restored following remediation. However, 7.8 acres of wetland, 0.4 acre of vernal pool fairy shrimp, and 1.08 acres of rare plant habitat will be permanently removed from service and will require mitigation elsewhere onsite. It should be noted that remediation will expand existing wetland habitat areas by approximately 5 acres, irrespective of other mitigation efforts. Some of the potential mitigation areas are shown in Figure 46. In general, the locations are found in areas that can expand upon existing habitat such as the North Marsh or the wetland complex in the southwest portion of the site.

Restoration, improvement, and mitigation of impacted habitats will be described in the *Habitat Mitigation Plan*. A conceptual version of this plan is provided in . It provides additional detail on the delineation of wetland and rare plant habitats, opportunities and constraints related to mitigation, and proposed mitigation ratios for discussion. Habitat mitigation will be an ongoing point of discussion through the environmental analysis and permitting of this project. It is understood that the *Habitat Mitigation Plan*, as well as this *Remedial Action Plan*, will be revised as comments are received from external stakeholders such as the regulatory community. As the particulars of the mitigation ratios and acceptable mitigation areas are developed, the plans will be revised. It is expected that this will include detailed drawings showing the mitigation areas, specifications on planting and grading, and a habitat maintenance plan describing the frequency of watering, inspections, and procedures to follow to replace unsuccessful plantings.

9.0 LONG-TERM MAINTENANCE

Once the caps and other short-term remedial actions have been implemented, the long-term monitoring and maintenance phase of site closure will begin. Long-term monitoring is, in itself, considered a remedial action for various groundwater impacts. These have been previously discussed in Section 4.1. Long-term maintenance, however, is intended to ensure that those actions taken under this plan (e.g., excavations, cap construction) continue to achieve their remedial objectives. This is important, in that most of the impacted materials onsite will remain after remediation is complete, especially in the former reservoirs. Periodic inspection and, as necessary, maintenance are, therefore, necessary components of remediation.

Inspection will primarily cover excavations, habitat restoration and mitigation areas, and the open space caps and development caps. In general, it is anticipated that inspections will occur periodically after a given remedial action is completed. The frequency of inspections will be established in concert with the appropriate regulatory agencies. It is tentatively proposed to conduct inspections quarterly for the first five years after construction and semiannually after that.

Inspections will, at a minimum, look at the following:

- signs of erosion or burrowing by animals
- recurrence or new surface expressions of plastic hydrocarbon
- successful revegetation
- integrity of fencing and other onsite institutional controls
- settlement

Most of these activities will be visual inspections by trained technicians or subject experts (e.g., wetland habitat biologist). Settlement will be measured by properly trained technicians under the supervision of a surveyor or civil engineer licensed to practice in the state of California. Settlement measurements will monitor movement in the various caps.

Inspections will look for resurfacing of plastic hydrocarbon expressions at the excavation locations, especially if material at depths greater than 5 feet was left in place. Inspections will also include other areas of the site overlying impacted soils and will look for new surface expressions. In either case, resurfaced material will be removed using the standards and protocols described in this plan. Further recurrence of a surface expression will prompt evaluation and a focused remedial action.

The degree to which settlement is considered unacceptable will vary between caps. It is expected that significant settlement may occur at the Reservoir 3 cap. The geosynthetics are designed to accept strains of up to 2 feet. The caps to be built for Reservoirs 5 and 7 are somewhat more sensitive to settlement, in that it could compromise the void space available for

groundwater to occupy. These caps can accept settlements up to 1 foot, measured at the former reservoir centers before remedial activity would need to be considered.

The development area caps are not expected to experience significant settlement prior to subsequent construction activities. It is anticipated, however, that any structures built on these caps will include careful geotechnical engineering that incorporates the limits and constraints of the caps.

Over time, the caps may require maintenance. It is expected that this will be minor in nature and would include activities such as repairing drainages or discouraging bioturbation. It may also be necessary to replace topsoil if erosion is greater than expected or vegetation is slow to establish itself. Frequent maintenance, however, will be necessary for the storm water management features in the development areas. These include the surface mulching, cleaning of desilting basins, and periodic cleaning of the culverts located at the Northwest Operations Area.

More significant repairs would be made as needed, and would be based on observations made during the periodic inspections. This would include regrading if low spots were to develop in caps other than Reservoir 3.

While Chevron is committed to ensuring the long-term maintenance of this project, the mechanism for implementation has not yet been determined. Chevron may utilize its own forces or out-source the work to a third party with experience in habitat maintenance. The specifics of implementing long-term site maintenance will be developed in concert with the project stakeholders, including the lead municipalities, to ensure the long-term success of the project.

10.0 SCHEDULE

A preliminary project schedule is shown in Figure 47. It provides a high-level view of the anticipated timeline of the principal project components.

The schedule shows the *Remedial Action Plan* being submitted to SLO County as part of a grading permit application on December 20, 2007. As discussed in the introduction, it is understood that a CEQA-compliant environmental review will be necessary for this project and that the lead agency will be the County. The CEQA process will be triggered by a request for a discretionary approval from a governmental agency.

It is also understood that RWQCB approval of the *Remedial Action Plan* will be essential to any other project approval. The project schedule anticipates slightly more than one year for this process, but recognizes that time will also be necessary for the proposed land use changes and potentially annexation.

Once the project is approved, remediation will begin. At present, it is anticipated that two years will be necessary to complete all of the remedial actions. This nominally avoids work during the rainy seasons. It is also understood that this schedule may be lengthened due to mitigation measures stemming from the environmental analysis, or as a practical limitation of available manpower and equipment resources. Nominally, construction is seen being completed near the end of 2011.

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Tables

Table 1
Summary of Operable Units and Preferred Remedies
Chevron San Luis Obispo Tank Farm

Operable Unit	Area of Concern	Preferred Remedy
OU #1 Northwest Operations Area	AOC #1 - LNAPL/BTEX-Impacted Groundwater	Natural Attenuation + ICs + LTM
	AOC #2 - Surface Soils	Capping + ICs + LTM
OU #2 Reservoirs 5 & 7	-	Capping + ICs + LTM
OU #3 Reservoir 4	-	Capping/Excavation + ICs + LTM
OU #4 Remaining Site-Wide Surface and Subsurface Soils	AOC #1 - North Marsh Area	Excavation + ICs + LTM
	AOC #2 - Reservoir 3	Capping + ICs + LTM
	AOC #3 - PPSH Areas	Excavation + ICs + LTM
OU #5 Site-Wide Groundwater	-	Natural Attenuation + ICs + LTM

Table 2
List of Active Monitoring Wells and Wells Proposed for Abandonment
Chevron San Luis Obispo Tank Farm
San Luis Obispo, California

Active Monitoring Well ID	Northing (feet)	Easting (feet)	Ground Elevation (feet)	Total Depth (feet)	Proposed for Abandonment
11Ea	2,286,403.33	5,766,242.72	120.12		
11Eb	2,285,788.14	5,765,801.69	118.48		
11Ec	2,285,291.33	5,765,508.27	116.83		
11Ed	2,284,934.66	5,765,842.84	120.62		
11La	2,284,552.74	5,766,755.02	114.77		
MW-17	2,286,370.00	5,770,908.56	142.51	20.0	X
MW-18	2,286,168.77	5,770,163.88	142.48	21.5	X
MW-19	2,285,775.94	5,769,634.88	138.72	21.0	
MW-26	2,285,032.40	5,766,234.06	117.84	21.0	
MW-27	2,285,626.38	5,766,432.64	119.38	22.5	
MW-29	2,284,254.39	5,768,615.77	132.06	23.0	
MW-35	2,284,544.36	5,769,095.02	132.93	30.0	
MW-38	2,284,771.55	5,767,041.29	113.77	30.0	
MW-39	2,284,782.44	5,766,583.53	114.57	30.0	
MW-40	2,286,140.64	5,766,491.67	117.04	30.0	
MW-41	2,286,496.67	5,766,672.93	118.48	30.0	
MW-43	2,284,257.98	5,768,184.71	130.61	25.0	
MW-45	2,284,500.98	5,767,405.38	127.51	31.0	
MW-46	2,284,071.49	5,767,817.56	131.14	30.0	
MW-47	2,284,997.98	5,766,065.13	118.12	100.0	
MW-48D	2,285,438.75	5,766,297.58	119.40	40.0	
MW-48S	2,285,438.75	5,766,297.58	119.50	20.0	
MW-49	2,286,660.91	5,766,079.56	122.55	40.0	
MW-50	2,286,893.20	5,766,084.77	121.40	40.0	
MW-53D	2,285,863.52	5,766,440.08	118.00	40.0	
MW-53S	2,285,863.52	5,766,440.08	118.20	20.0	
MW-56	2,286,751.61	5,766,088.21	120.67	41.5	
SLOW-12	2,286,835.65	5,766,153.13	120.39	15.0	X
SLOW-17	2,286,602.27	5,766,284.93	120.46	28.0	
SLOW-18	2,286,728.07	5,766,212.88	120.21	26.0	X

Table 3
Estimated Borrow Source Quantities
Chevron San Luis Obispo Tank Farm
San Luis Obispo, California

Area	Topsoil (cy)	Common Earth (cy)	Gravel (cy)	Off-Site Cut (cy)
Borrow Area - 1	9,000	27,200	0	0
Borrow Area - 2	20,700	0	0	0
Borrow Area - 3	19,700	59,250	0	0
Borrow Area - Flower Mound	0	262,850	65,400	73,700
Reservoir 5 & 7 Berms	0	71,600	0	0
Total	49,400	420,900	65,400	73,700

Note: The Flower Mound borrow volume consists of on-site material only. The grading will generate approximately 73,700 cy of material outside of the property boundary.

Table 4
Estimated Remediation Construction Quantities
Chevron San Luis Obispo Tank Farm
San Luis Obispo, California

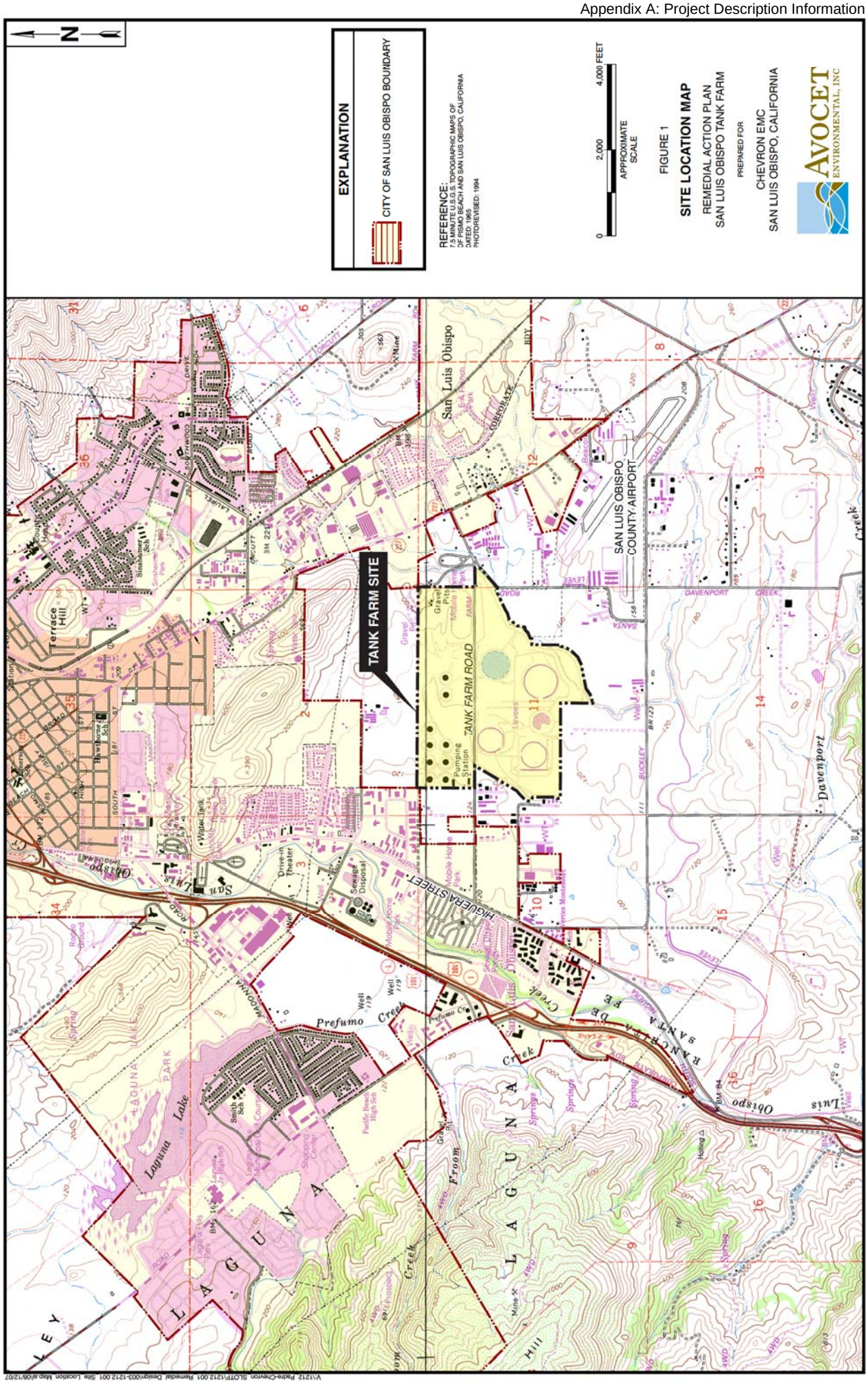
Area	Estimated Areas		Estimated Impacted Soil Volumes (cy)	Common Fill (cy)	Structural Fill (cy)	Gravel (cy)	Topsoil (cy)	Geosynthetics		
	Grading Area[1] (sf)	Work Area[2] (sf)						Geotextile 12oz. (sf)	Geomembrane (sf)	Geogrid (sf)
OU #1 - Northwest Operations Area	280,300	280,300	- -	- -	53,400	- -	- -	280,300	- -	- -
OU #2 - Reservoir 5	340,239	453,190	15,300	12,500	- -	20,100	12,600	340,239	- -	- -
OU #2 - Reservoir 7	295,939	349,815	11,000	24,500	- -	39,000	11,000	160,460	- -	- -
OU #3 and Flower Mound Borrow Area	2,290,570	2,290,570	- -	- -	262,800	- -	- -	342,886	- -	- -
OU #4 - North Marsh Area	580,800	678,988	75,300	53,800	- -	- -	21,500	-	- -	- -
OU #4 - Reservoir 3	300,161	581,436	26,700	5,100	- -	10,500	11,100	871,002	290,334	290,334
OU #4 - Remaining PPSH	256,873	155,860[3]	28,700	19,200	- -	-	9,500	-	-	-
Borrow Area 2	527,389	527,389	-	-	57,900	- -	-	- -	- -	- -
Total	4,872,271	5,317,548	157,000	115,100	374,100	69,600	65,700	1,994,887	290,334	290,334

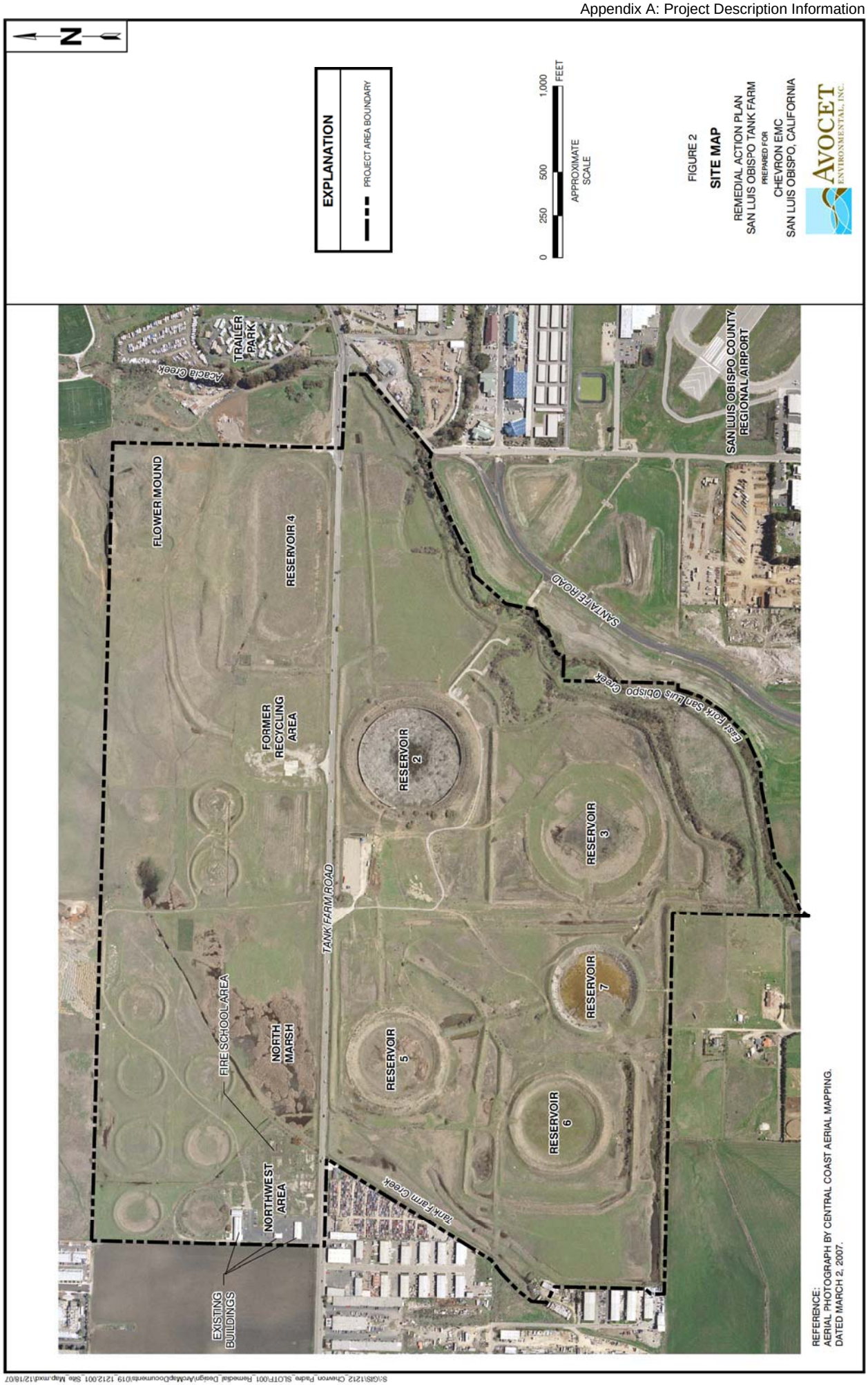
Notes: (1) The grading area is defined by the cut or fill boundary of any given excavation or cap.
(2) The work area, which is the entire area affected by remediation activities, includes all of the area within the identified clear and grub line.
(3) Some of the work area for Remaining PPSH has already been accounted for in the work areas corresponding to Reservoirs 5, 7, and 3.

Table 5
Summary of Habitat Impacts
Chevron San Luis Obispo Tank Farm
San Luis Obispo, California

Area	Wetland Impacts		VPFS Impacts		Rare Plant Impacts	
	Temporary (acres)	Permanent (acres)	Temporary (acres)	Permanent (acres)	Temporary (acres)	Permanent (acres)
Remediation Areas						
Northwest Operations Area	- -	- -	- -	- -	- -	0.26
Reservoir 5	1.24	3.59	1.17	0.04	0.28	0.03
Reservoir 7	0.57	3.65	0.55	0.35	0.13	0.15
OU-3 and Flower Mound Borrow Area	- -	1.99	- -	- -	- -	3.35
North Marsh Area	11.92	- -	- -	- -	0.76	- -
Reservoir 3	4.23	- -	4.23	- -	0.38	0.40
Areas to be Ripped	2.18	- -	2.18	- -	1.78	- -
Sitewide PPSH Areas	0.97	- -	0.93	- -	0.19	- -
Access Roads	0.1	- -	0.04	- -	0.22	- -
Staging Areas	- -	- -	- -	- -	0.01	- -
Total	21.21	9.23	9.1	0.39	3.75	4.19
Borrow Areas						
Borrow Area No. 1	0.77	- -	0.67	- -	0.37	- -
Borrow Area No. 2	- -	0.98	- -	0.67	0.20	1.38
Borrow Area No. 3	6.59	- -	3.12	- -	0.92	- -

Figures


N
EXPLANATION
CITY OF SAN LUIS OBISPO BOUNDARY
REFERENCE:
7.5 MINUTE U.S.G.S. TOPOGRAPHIC MAPS OF
PISMO BEACH AND SAN LUIS OBISPO, CALIFORNIA
DATED: 1965
PHOTOREVISED: 1994
0
2,000
4,000 FEET
APPROXIMATE SCALE
FIGURE 1
SITE LOCATION MAP
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET
ENVIRONMENTAL, INC
TANK FARM SITE
TANK FARM ROAD
SAN LUIS OBISPO COUNTY AIRPORT
HIGUERA STREET
Prefumo Creek
Froom Creek
Laguna Lake
LAGUNA PARK
Terrace Hill
San Luis Obispo
Davenport Creek
Pumping Station
Sewage Disposal
Drive-in Theater
Water Tank
Gravel Pits
Mobile Home Park
Pacific Beach High Sch
Smith Sch
Shopping Center
Rodeo Ground
Levees
Springs
Wells
Mine
Hill
Creek
V:\1212 Padre-Chevron SLOTF\1212 001 Remedial Design\003-1212 001 Site Location Map a\08/12/07


N
EXPLANATION
PROJECT AREA BOUNDARY
0 250 500 1,000 FEET
APPROXIMATE SCALE
FIGURE 2
SITE MAP
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET ENVIRONMENTAL, INC.
EXISTING BUILDINGS
NORTHWEST AREA
FIRE SCHOOL AREA
NORTH MARSH
FLOWER MOUND
RESERVOIR 4
FORMER RECYCLING AREA
TANK FARM ROAD
RESERVOIR 5
RESERVOIR 6
RESERVOIR 7
RESERVOIR 2
RESERVOIR 3
Tank Farm Creek
East Fork San Luis Obispo Creek
SANTA FE ROAD
Acacia Creek
TRAILER PARK
SAN LUIS OBISPO COUNTY REGIONAL AIRPORT
REFERENCE:
AERIAL PHOTOGRAPH BY CENTRAL COAST AERIAL MAPPING.
DATED MARCH 2, 2007.
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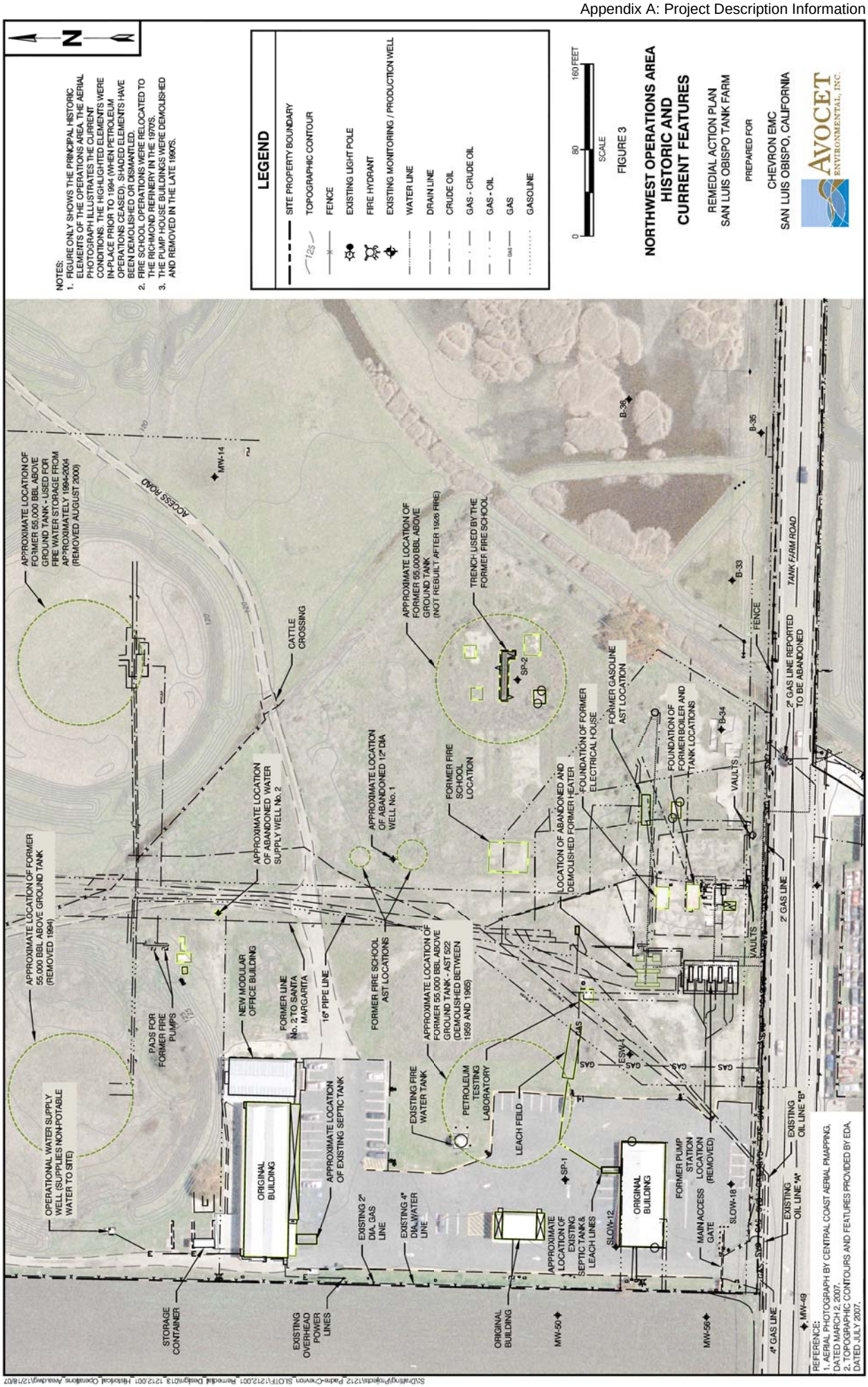
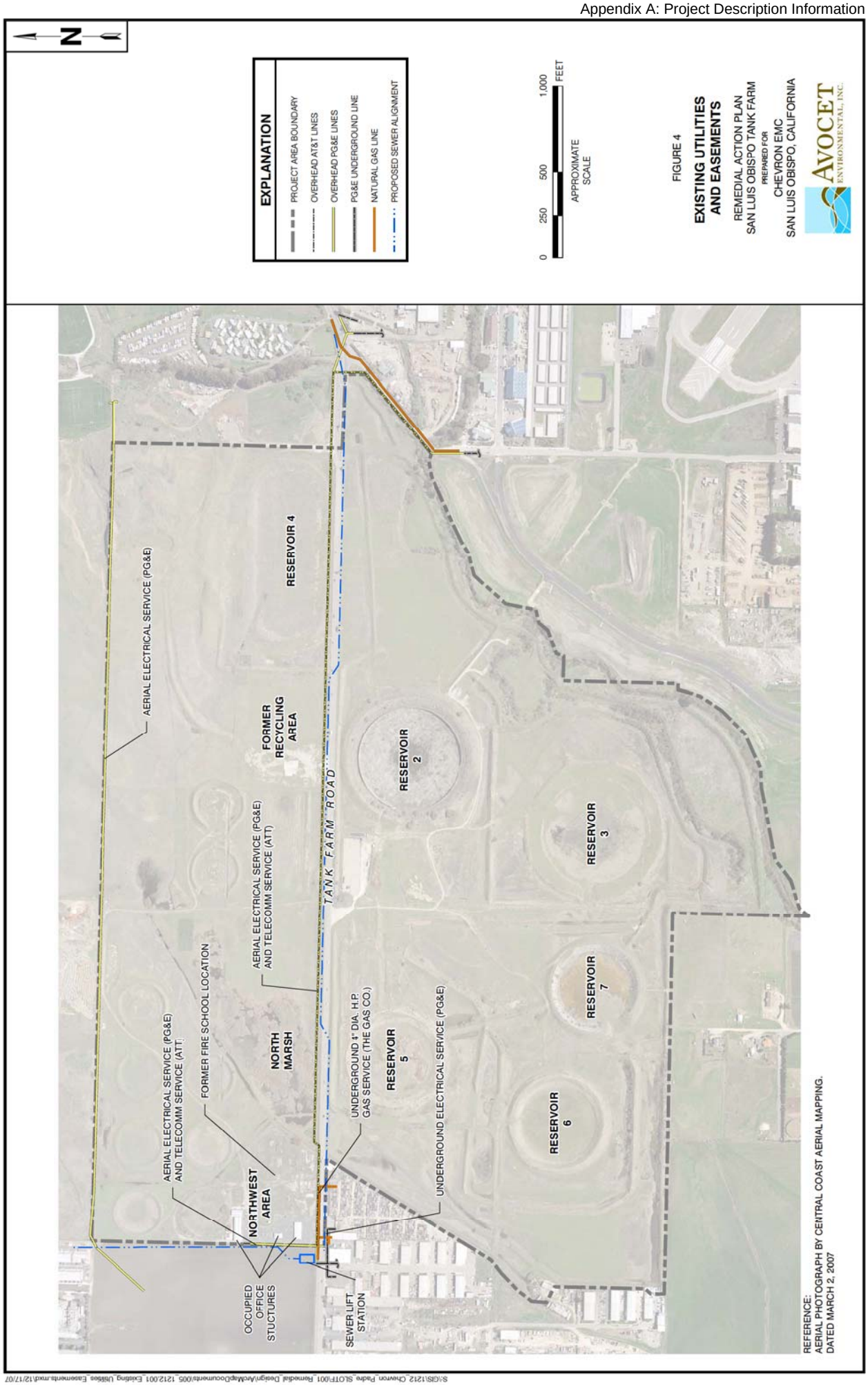

NOTES:
1. FIGURE ONLY SHOWS THE PRINCIPAL HISTORIC ELEMENTS OF THE OPERATIONS AREA. THE AERIAL PHOTOGRAPH ILLUSTRATES THE CURRENT CONDITIONS. THE HIGHLIGHTED ELEMENTS WERE IN-PLACE PRIOR TO 1994 (WHEN PETROLEUM OPERATIONS CEASED). SHADED ELEMENTS HAVE BEEN DEMOLISHED OR DISMANTLED.
2. FIRE SCHOOL OPERATIONS WERE RELOCATED TO THE RICHMOND REFINERY IN THE 1970'S.
3. THE PUMP HOUSE BUILDINGS WERE DEMOLISHED AND REMOVED IN THE LATE 1990'S.
LEGEND
SITE PROPERTY BOUNDARY
TOPOGRAPHIC CONTOUR
FENCE
EXISTING LIGHT POLE
FIRE HYDRANT
EXISTING MONITORING / PRODUCTION WELL
WATER LINE
DRAIN LINE
CRUDE OIL
GAS - CRUDE OIL
GAS - OIL
GAS
GASOLINE
0
80
160 FEET
SCALE
FIGURE 3
NORTHWEST OPERATIONS AREA
HISTORIC AND
CURRENT FEATURES
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET
ENVIRONMENTAL, INC.
APPROXIMATE LOCATION OF FORMER 55,000 BBL ABOVE GROUND TANK - USED FOR FIRE WATER STORAGE FROM APPROXIMATELY 1994-2004 (REMOVED AUGUST 2000)
ACCESS ROAD
MW-14
CATTLE CROSSING
APPROXIMATE LOCATION OF FORMER 55,000 BBL ABOVE GROUND TANK (NOT REBUILT AFTER 1926 FIRE)
TRENCH USED BY THE FORMER FIRE SCHOOL
SP-2
B-36
B-35
B-33
FENCE
TANK FARM ROAD
2" GAS LINE REPORTED TO BE ABANDONED
FORMER GASOLINE AST LOCATION
FOUNDATION OF FORMER BOILER AND TANK LOCATIONS
B-34
VAULTS
FOUNDATION OF FORMER ELECTRICAL HOUSE
LOCATION OF ABANDONED AND DEMOLISHED FORMER HEATER
FORMER FIRE SCHOOL LOCATION
APPROXIMATE LOCATION OF ABANDONED 12" DIA WELL No. 1
APPROXIMATE LOCATION OF ABANDONED WATER SUPPLY WELL No. 2
APPROXIMATE LOCATION OF FORMER 55,000 BBL ABOVE GROUND TANK (REMOVED 1994)
PADS FOR FORMER FIRE PUMPS
NEW MODULAR OFFICE BUILDING
FORMER LINE No. 2 TO SANTA MARGARITA
16" PIPE LINE
FORMER FIRE SCHOOL AST LOCATIONS
APPROXIMATE LOCATION OF FORMER 55,000 BBL ABOVE GROUND TANK - AST 522 (DEMOLISHED BETWEEN 1959 AND 1965)
2" GAS LINE
GAS
ESW-1
EXISTING FIRE WATER TANK
PETROLEUM TESTING LABORATORY
LEACH FEILD
SP-1
OPERATIONAL WATER SUPPLY WELL (SUPPLIES NON-POTABLE WATER TO SITE)
ORIGINAL BUILDING
APPROXIMATE LOCATION OF EXISTING SEPTIC TANK
EXISTING 2" DIA. GAS LINE
EXISTING 4" DIA. WATER LINE
SLOW-12
FORMER PUMP STATION LOCATION (REMOVED)
MAIN ACCESS GATE
SLOW-18
EXISTING OIL LINE "B"
EXISTING OIL LINE "A"
STORAGE CONTAINER
EXISTING OVERHEAD POWER LINES
APPROXIMATE LOCATION OF EXISTING SEPTIC TANK & LEACH LINES
MW-50
MW-56
4" GAS LINE
MW-49
REFERENCE:
1. AERIAL PHOTOGRAPH BY CENTRAL COAST AERIAL PMAPPING, DATED MARCH 2, 2007.
2. TOPOGRAPHIC CONTOURS AND FEATURES PROVIDED BY EDA, DATED JULY 2007.


N
EXPLANATION
PROJECT AREA BOUNDARY
OVERHEAD AT&T LINES
OVERHEAD PG&E LINES
PG&E UNDERGROUND LINE
NATURAL GAS LINE
PROPOSED SEWER ALIGNMENT
0 250 500 1,000 FEET
APPROXIMATE SCALE
FIGURE 4
EXISTING UTILITIES AND EASEMENTS
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET ENVIRONMENTAL, INC.
AERIAL ELECTRICAL SERVICE (PG&E)
RESERVOIR 4
FORMER RECYCLING AREA
RESERVOIR 2
TANK FARM ROAD
RESERVOIR 3
AERIAL ELECTRICAL SERVICE (PG&E) AND TELECOMM SERVICE (ATT)
FORMER FIRE SCHOOL LOCATION
NORTH MARSH
UNDERGROUND 4" DIA. H.P. GAS SERVICE (THE GAS CO.)
RESERVOIR 5
RESERVOIR 7
UNDERGROUND ELECTRICAL SERVICE (PG&E)
RESERVOIR 6
NORTHWEST AREA
OCCUPIED OFFICE STUCTURES
SEWER LIFT STATION
REFERENCE:
AERIAL PHOTOGRAPH BY CENTRAL COAST AERIAL MAPPING.
DATED MARCH 2, 2007
S:\GIS\1212 Chevron Parks SLOTF\001 Remedial Design\ArcMapDocuments\005 1212001 Existing Utilities Easements.mxd\12/17/07

N
NOTE:
LEACH LINES AND DRAIN LINES ARE SHOWN AS CRUDE OIL LINES ON THIS FIGURE FOR CLARITY. SIMILIARLY FOAMITE LINES ARE SHOWN AS WATER LINES DUE TO THEIR SIMILIAR FUNCTIONS DURING OPERATIONS.
EXPLANATION
PROJECT AREA BOUNDARY
CRUDE OIL PIPELINES
OTHER UNDERGROUND PIPELINES
SUMMARY OF PIPELINE LENGTHS
TYPES LENGTH (FEET)
CRUDE OIL 25,125
LEACH LINE (SANITATION) 258
DRAIN LINES 914
WATER LINE 38,263
FOAMITE 9,177
0 250 500 1,000 FEET
APPROXIMATE SCALE
FIGURE 5
CHEVRON PIPELINES
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET ENVIRONMENTAL, INC.
RESERVOIR 4
FORMER RECYCLING AREA
RESERVOIR 2
TANK FARM ROAD
RESERVOIR 3
RESERVOIR 7
RESERVOIR 5
RESERVOIR 6
NORTH MARSH
FORMER FIRE SCHOOL LOCATION
NORTHWEST AREA
SEE FIGURE 6 FOR DETAIL
OCCUPIED OFFICE STUCTURES
REFERENCES:
1. AERIAL PHOTOGRAPH BY CENTRAL COAST AERIAL MAPPING, DATED MARCH 2, 2007
2. GENERAL ARRANGEMENT SAN LUIS OBISPO TANK FARM, PRODUCERS PIPELINE, UNION OIL COMPANY OF CALIFORNIA, DRAWING No. UNKNOWN, DATED APRIL 3, 1950.
GENERAL ARRANGEMENT SAN LUIS OBISPO TANK FARM, NORTHERN DIVISION PIPELINE, UNION OIL COMPANY OF CALIFORNIA, DRAWING No. D2A180, DATED JULY 30, 1981.
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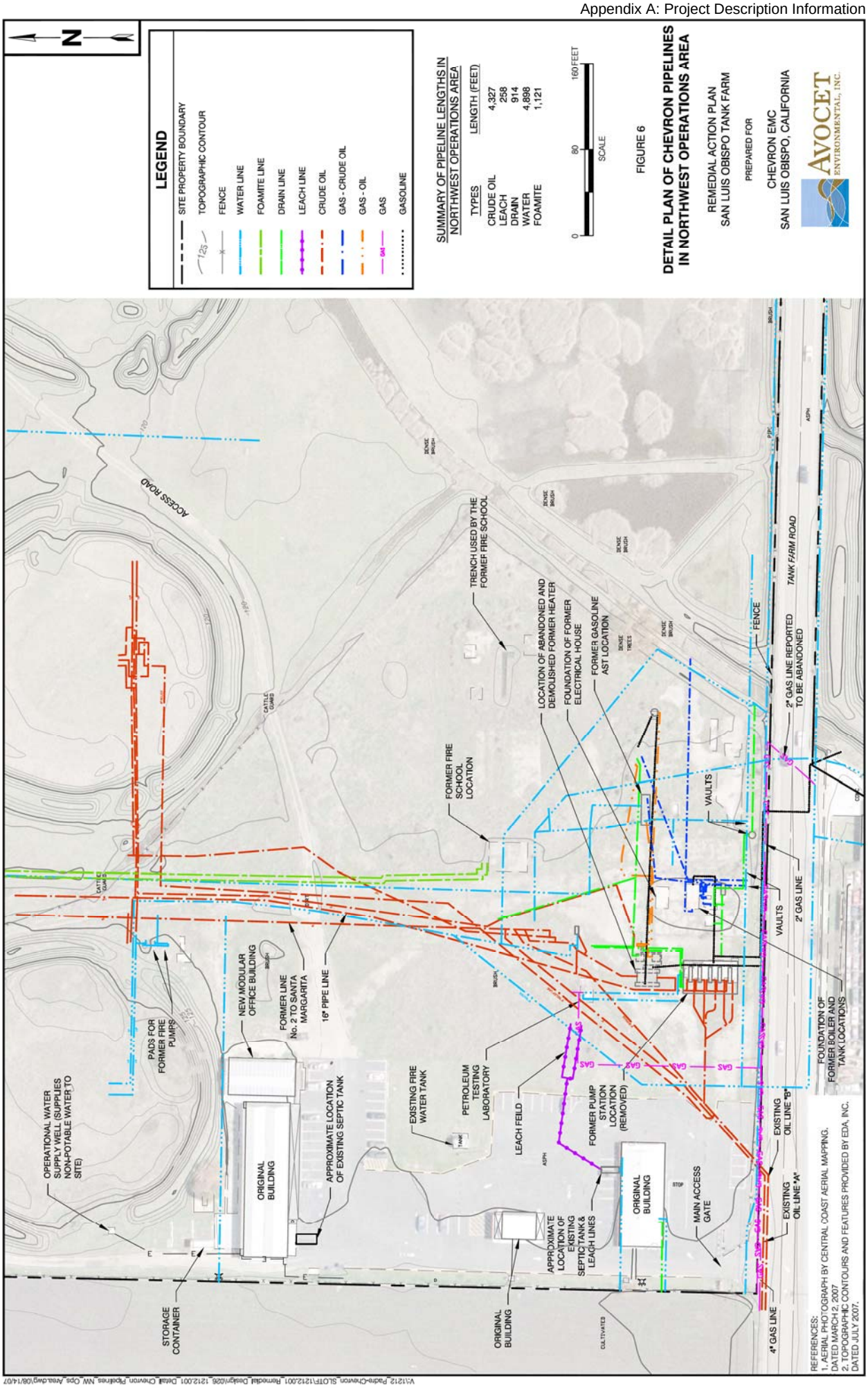
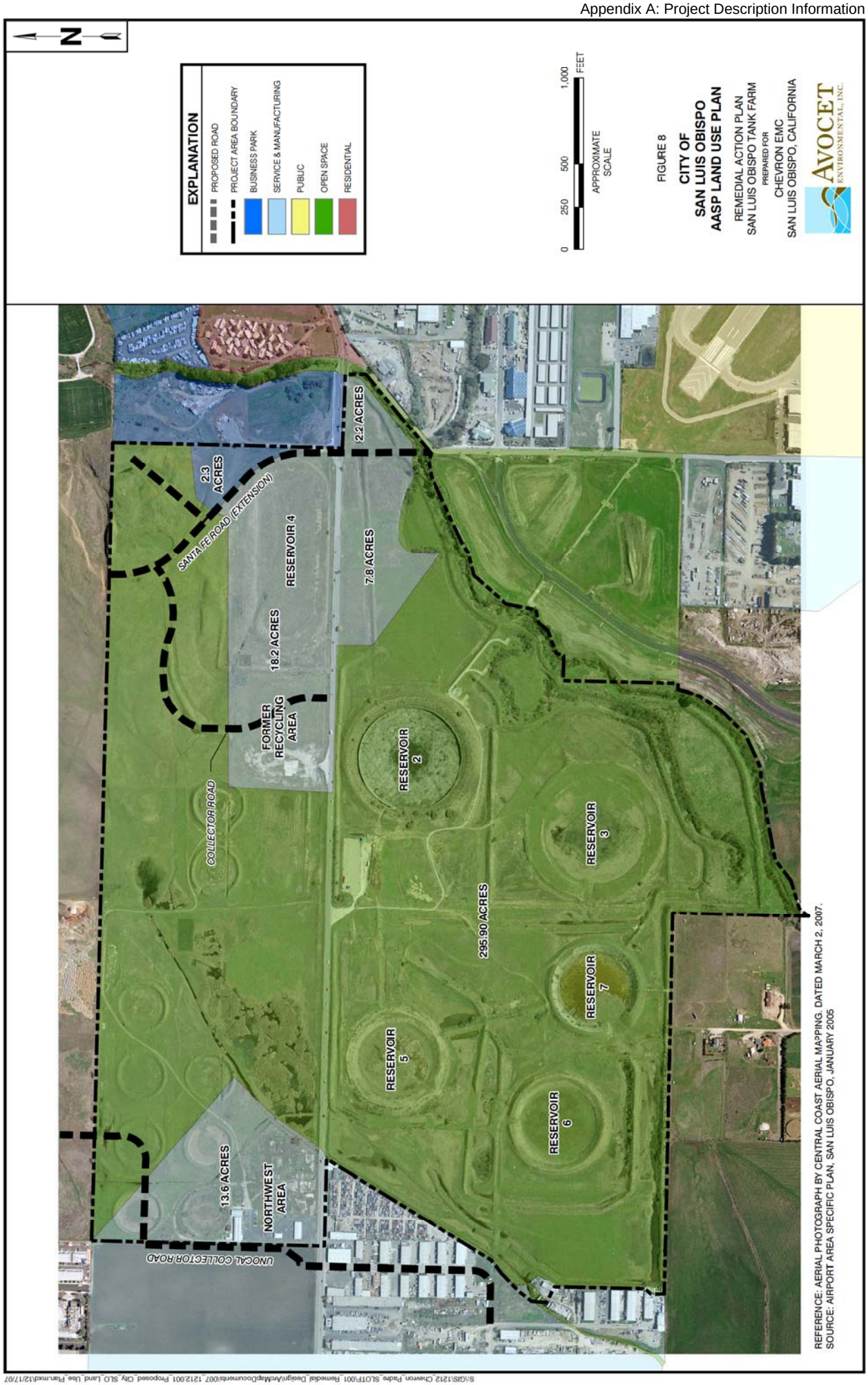

N
LEGEND
SITE PROPERTY BOUNDARY
TOPOGRAPHIC CONTOUR
FENCE
WATER LINE
FOAMITE LINE
DRAIN LINE
LEACH LINE
CRUDE OIL
GAS - CRUDE OIL
GAS - OIL
GAS
GASOLINE
SUMMARY OF PIPELINE LENGTHS IN NORTHWEST OPERATIONS AREA
TYPES LENGTH (FEET)
CRUDE OIL 4,327
LEACH 258
DRAIN 914
WATER 4,898
FOAMITE 1,121
0 80 160 FEET
SCALE
FIGURE 6
DETAIL PLAN OF CHEVRON PIPELINES IN NORTHWEST OPERATIONS AREA
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET ENVIRONMENTAL, INC.
ACCESS ROAD
TANK FARM ROAD
TRENCH USED BY THE FORMER FIRE SCHOOL
LOCATION OF ABANDONED AND DEMOLISHED FORMER HEATER
FOUNDATION OF FORMER ELECTRICAL HOUSE
FORMER GASOLINE AST LOCATION
FORMER FIRE SCHOOL LOCATION
FENCE
2" GAS LINE REPORTED TO BE ABANDONED
VAULTS
2" GAS LINE
FOUNDATION OF FORMER BOILER AND TANK LOCATIONS
NEW MODULAR OFFICE BUILDING
FORMER LINE No. 2 TO SANTA MARGARITA
16" PIPE LINE
PADS FOR FORMER FIRE PUMPS
OPERATIONAL WATER SUPPLY WELL (SUPPLIES NON-POTABLE WATER TO SITE)
ORIGINAL BUILDING
APPROXIMATE LOCATION OF EXISTING SEPTIC TANK
EXISTING FIRE WATER TANK
PETROLEUM TESTING LABORATORY
LEACH FEILD
FORMER PUMP STATION LOCATION (REMOVED)
APPROXIMATE LOCATION OF EXISTING SEPTIC TANK & LEACH LINES
MAIN ACCESS GATE
EXISTING OIL LINE "B"
EXISTING OIL LINE "A"
4" GAS LINE
STORAGE CONTAINER
CULTIVATED
REFERENCES:
1. AERIAL PHOTOGRAPH BY CENTRAL COAST AERIAL MAPPING, DATED MARCH 2, 2007
2. TOPOGRAPHIC CONTOURS AND FEATURES PROVIDED BY EDA, INC. DATED JULY 2007.

S:\GIS\1212 Chevron Plate SLOTF001 Remedial Design\Arcmap\Documents\006 1212 001 Existing SLO County Land Use Plan.mxd\12/17/07



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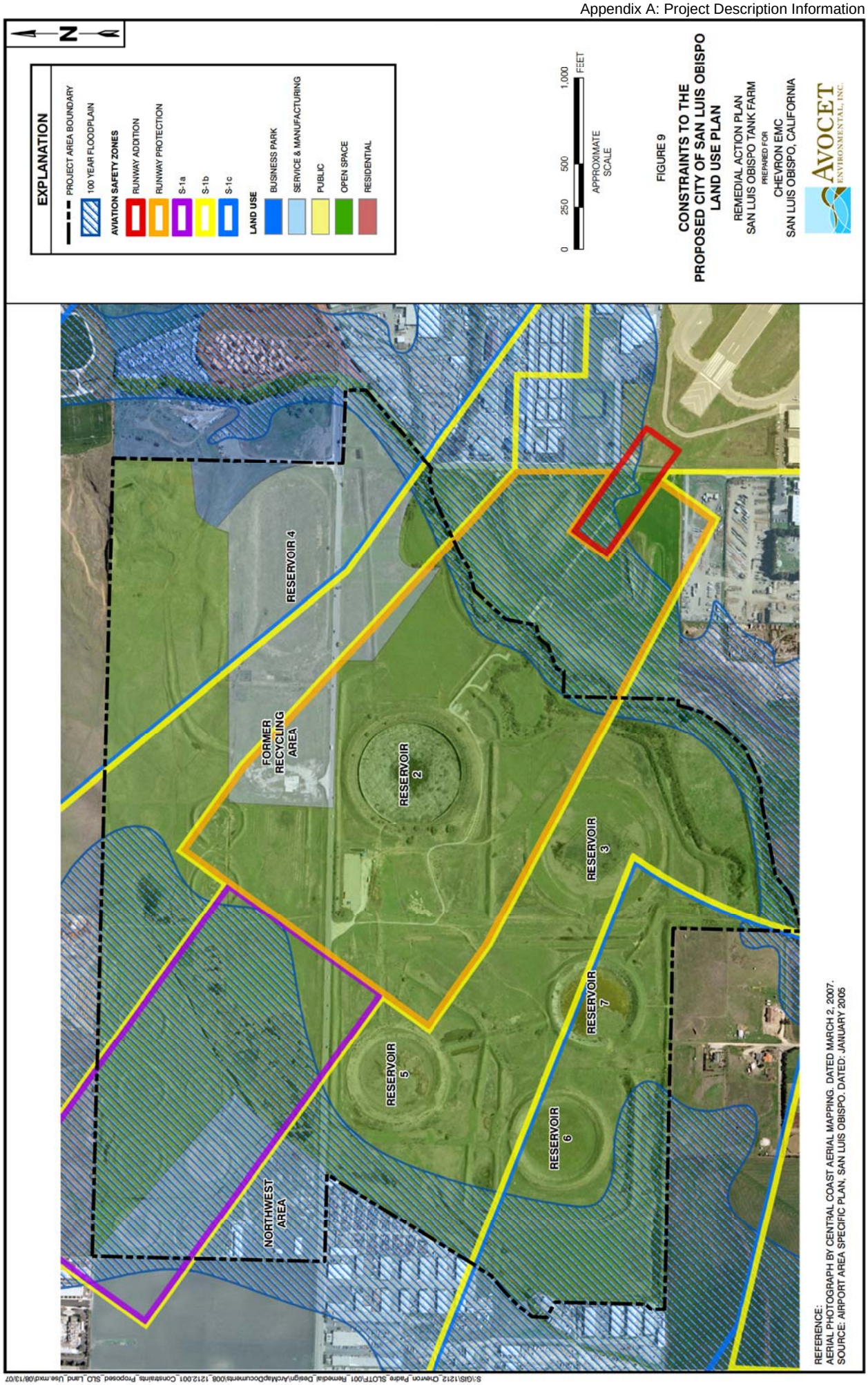
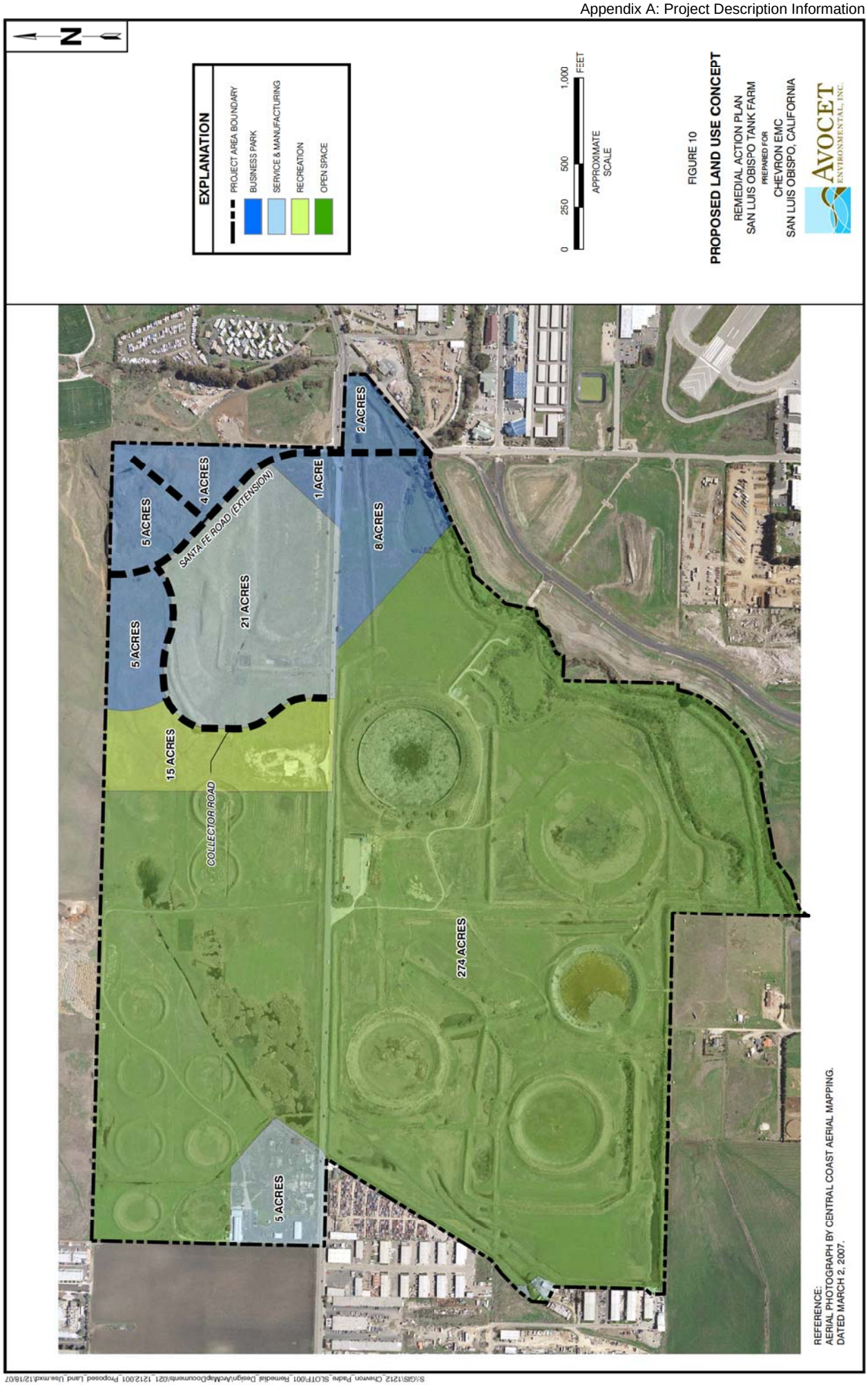

N
EXPLANATION
PROJECT AREA BOUNDARY
100 YEAR FLOODPLAIN
AVIATION SAFETY ZONES
RUNWAY ADDITION
RUNWAY PROTECTION
S-1a
S-1b
S-1c
LAND USE
BUSINESS PARK
SERVICE & MANUFACTURING
PUBLIC
OPEN SPACE
RESIDENTIAL
0 250 500 1,000 FEET
APPROXIMATE SCALE
FIGURE 9
CONSTRAINTS TO THE PROPOSED CITY OF SAN LUIS OBISPO LAND USE PLAN
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET ENVIRONMENTAL, INC.
RESERVOIR 4
FORMER RECYCLING AREA
RESERVOIR 2
RESERVOIR 3
RESERVOIR 7
RESERVOIR 6
RESERVOIR 5
NORTHWEST AREA
REFERENCE:
AERIAL PHOTOGRAPH BY CENTRAL COAST AERIAL MAPPING. DATED MARCH 2, 2007.
SOURCE: AIRPORT AREA SPECIFIC PLAN, SAN LUIS OBISPO. DATED: JANUARY 2005
S:\GIS\1212_Chevron_Padre_SLOTF\001_Remedial_Design\ArcMapDocuments\008_1212.001_Constraints_Proposed_SLO_Land_Use.mxd\08/13/07



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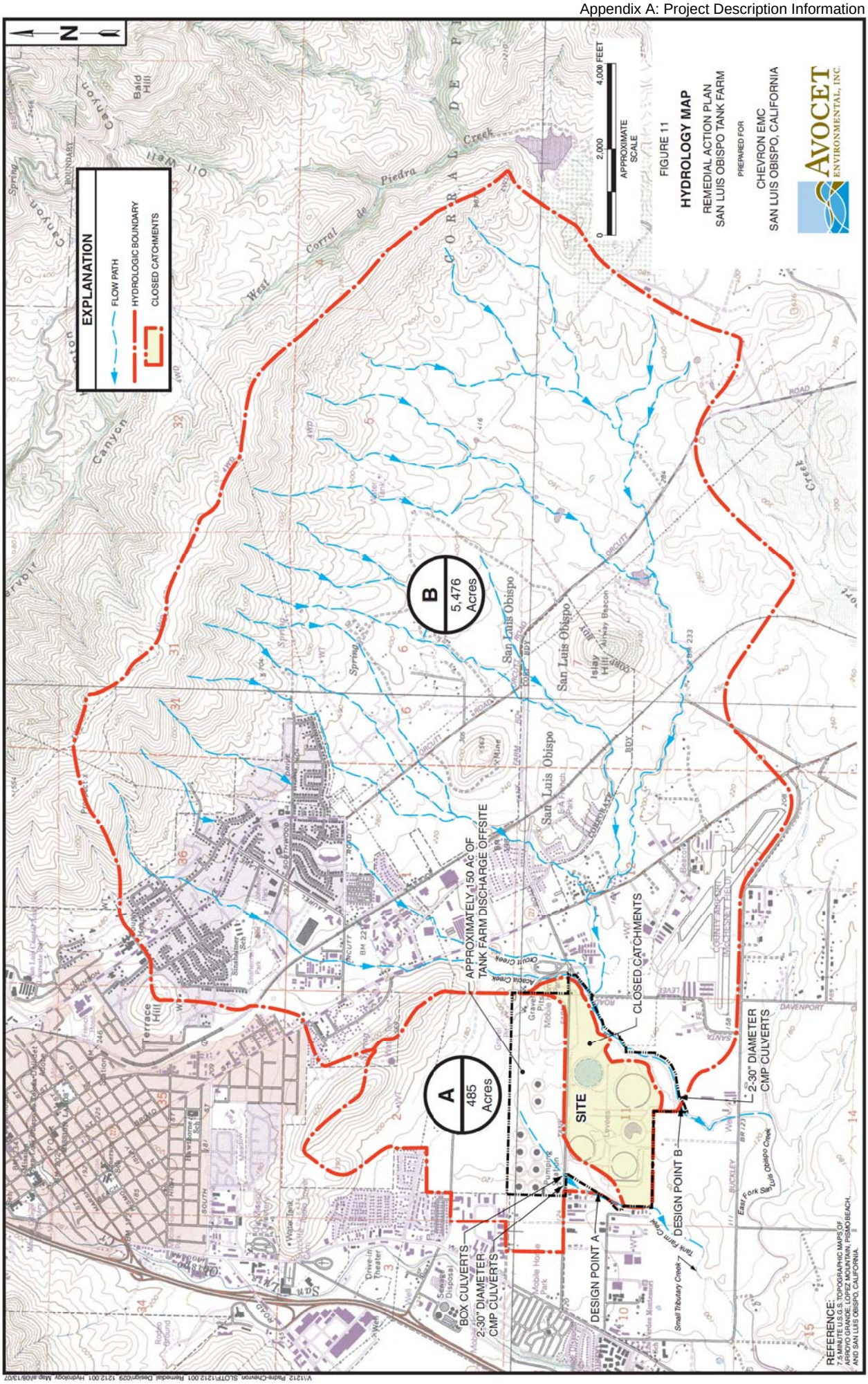
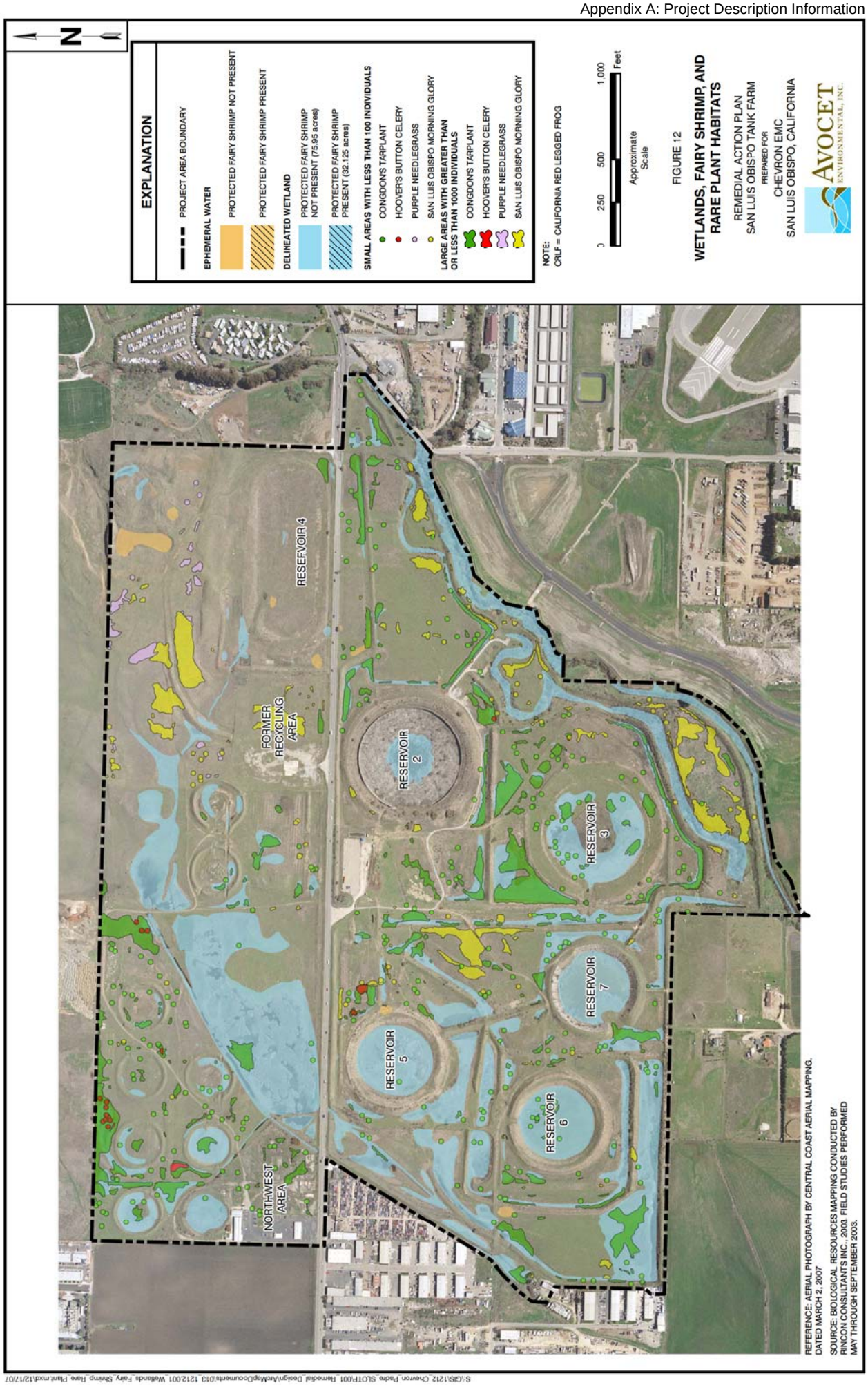
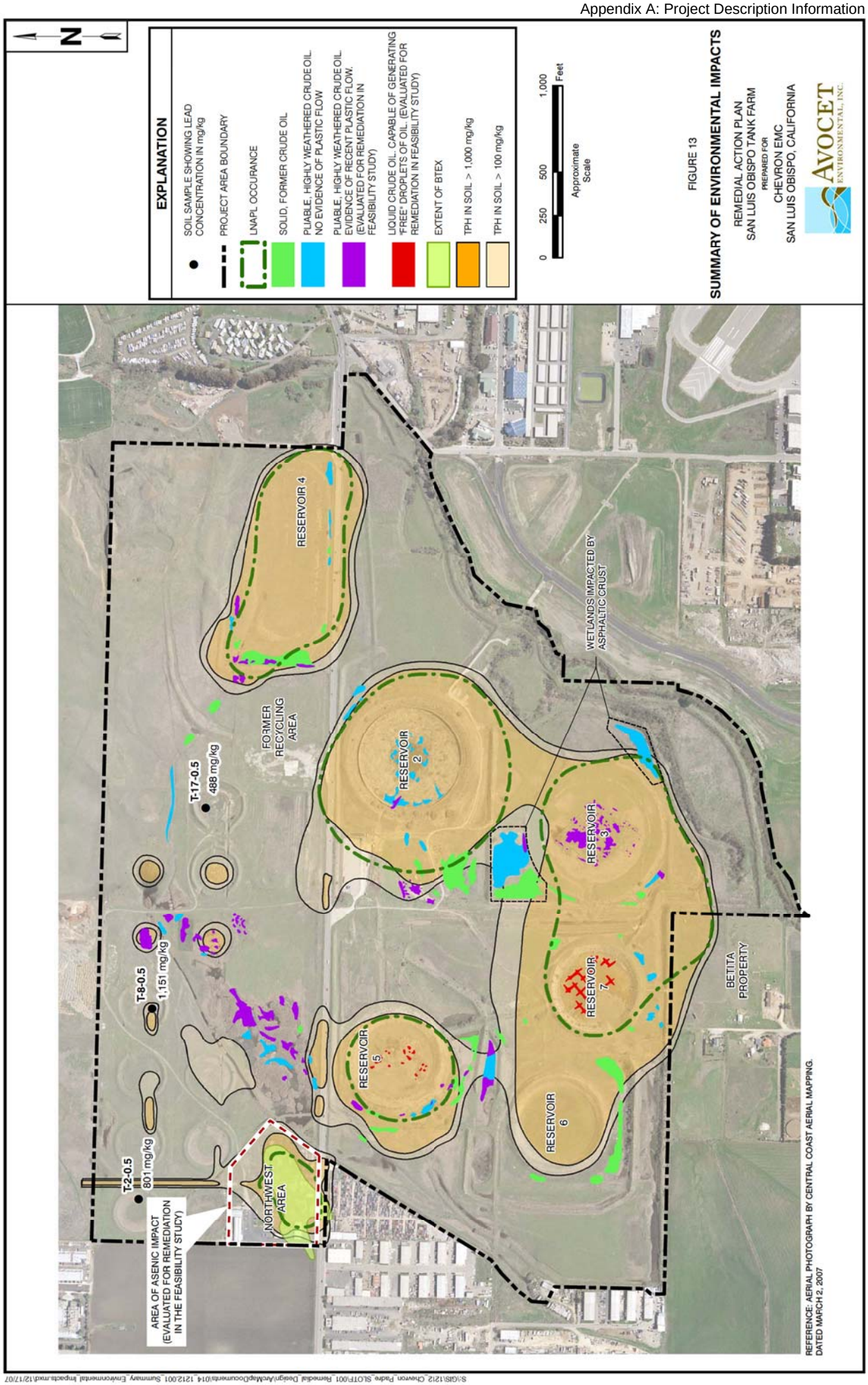
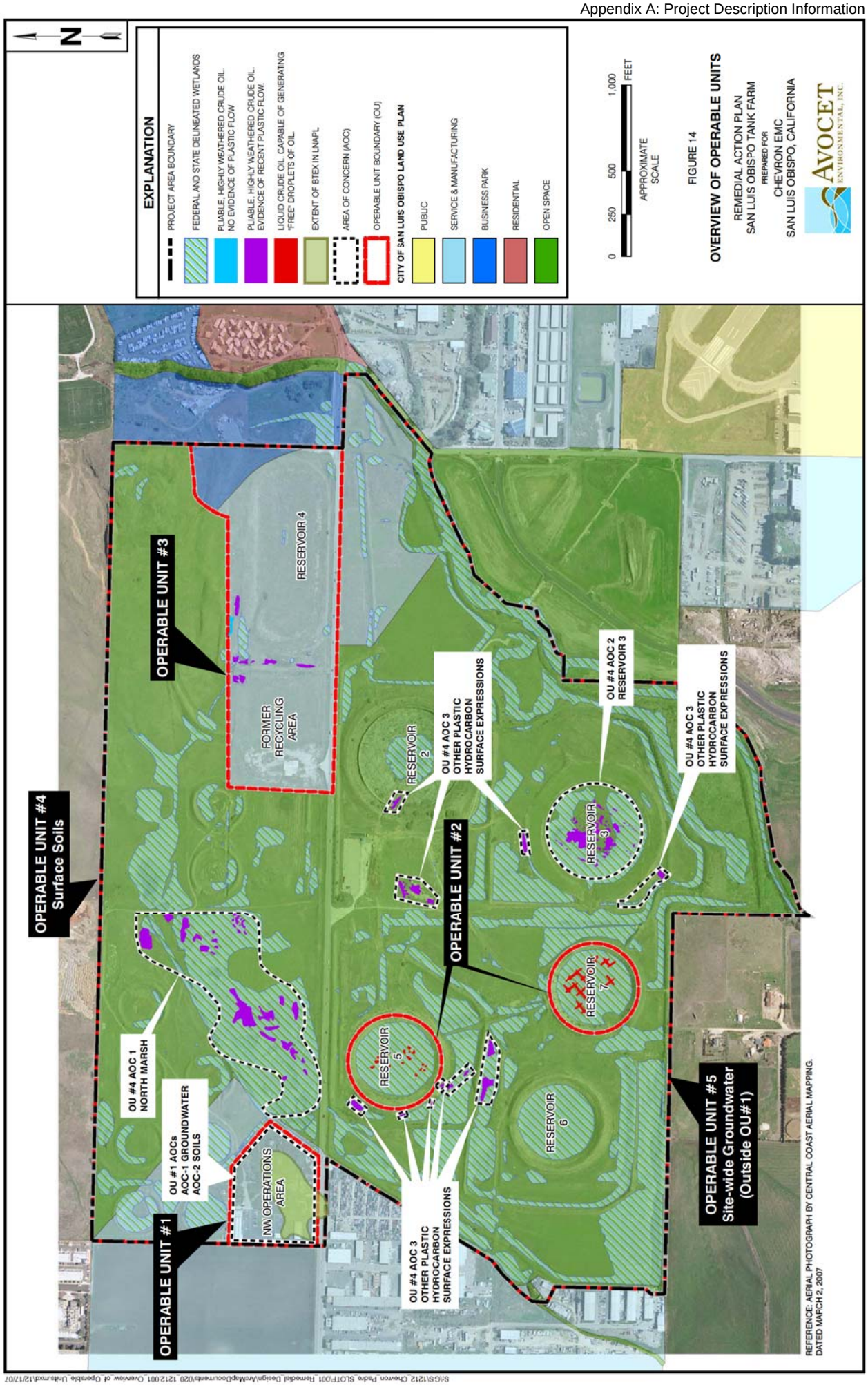
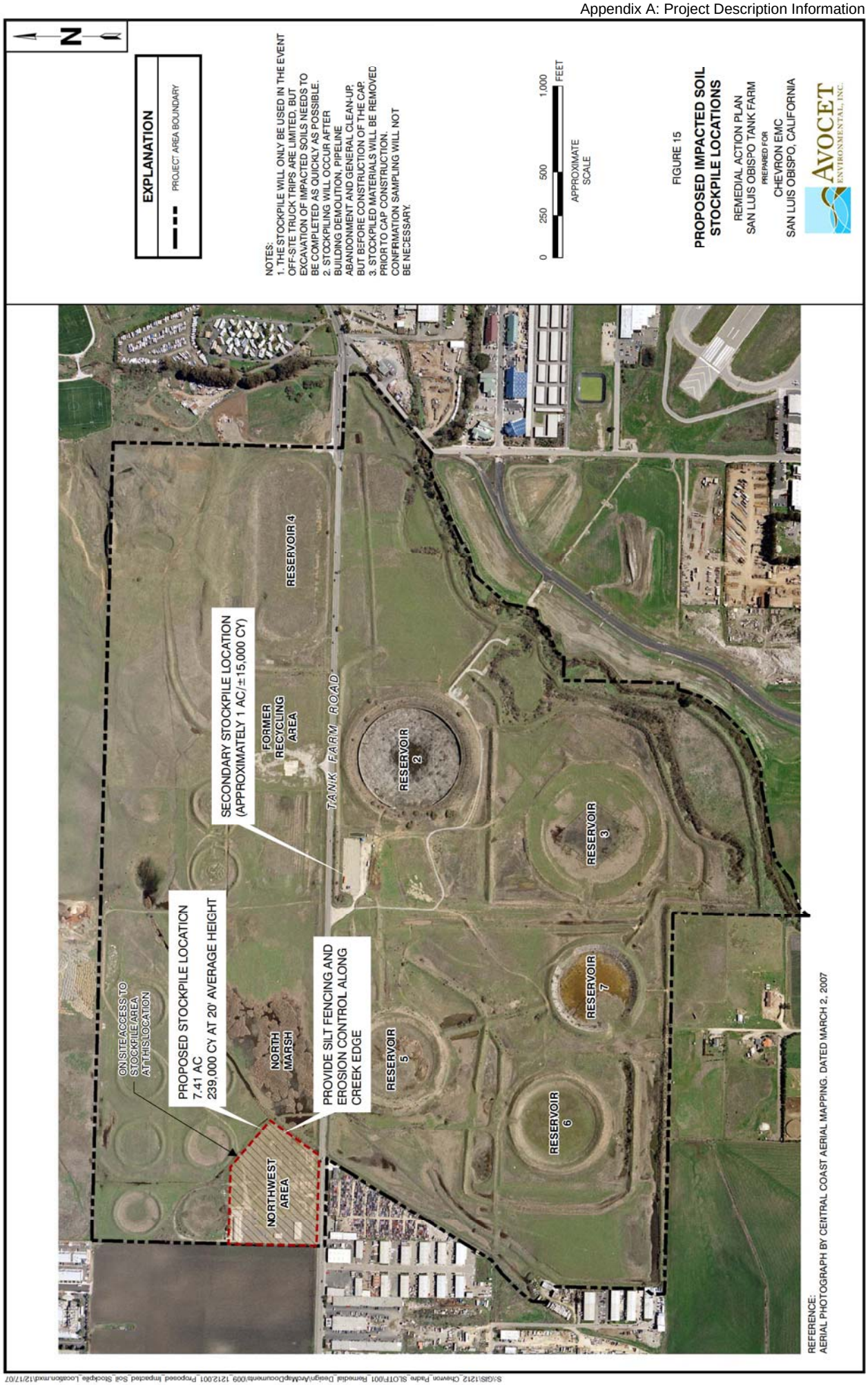

N
EXPLANATION
FLOW PATH
HYDROLOGIC BOUNDARY
CLOSED CATCHMENTS
0
2,000
4,000 FEET
APPROXIMATE SCALE
FIGURE 11
HYDROLOGY MAP
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET
ENVIRONMENTAL, INC.
A
485 Acres
B
5,476 Acres
APPROXIMATELY 150 Ac OF TANK FARM DISCHARGE OFFSITE
CLOSED CATCHMENTS
SITE
2-30" DIAMETER CMP CULVERTS
DESIGN POINT B
DESIGN POINT A
BOX CULVERTS
2-30" DIAMETER CMP CULVERTS
REFERENCE:
7.5 MINUTE U.S.G.S. TOPOGRAPHIC MAPS OF
EDNA, SAN LUIS OBISPO, CORRALDE MOUNTAIN, PISMO BEACH,
AND SAN LUIS OBISPO, CALIFORNIA.

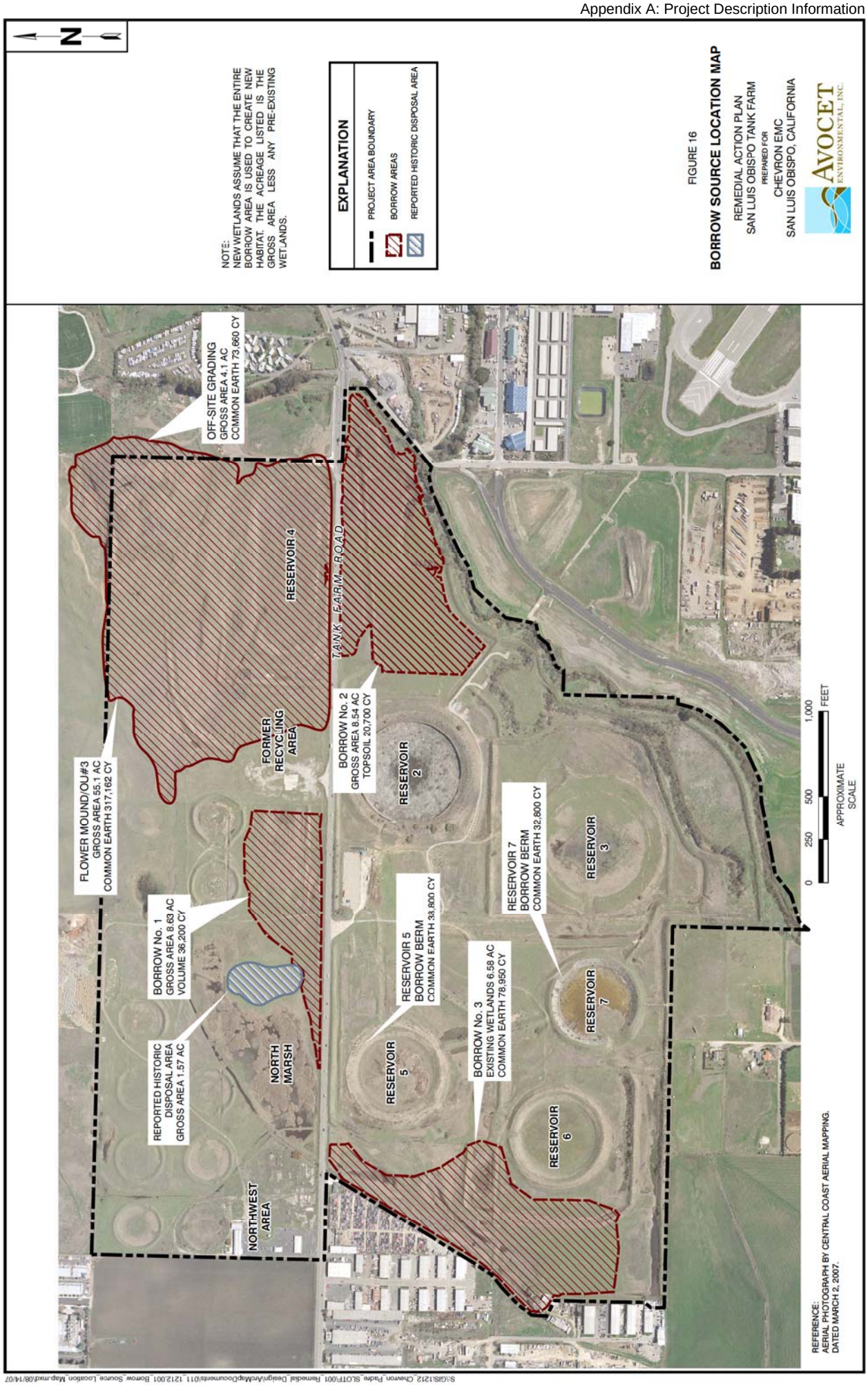

N
EXPLANATION
PROJECT AREA BOUNDARY
EPHEMERAL WATER
PROTECTED FAIRY SHRIMP NOT PRESENT
PROTECTED FAIRY SHRIMP PRESENT
DELINEATED WETLAND
PROTECTED FAIRY SHRIMP NOT PRESENT (75.95 acres)
PROTECTED FAIRY SHRIMP PRESENT (32.125 acres)
SMALL AREAS WITH LESS THAN 100 INDIVIDUALS
CONGDON'S TARPLANT
HOOVER'S BUTTON CELERY
PURPLE NEEDLEGRASS
SAN LUIS OBISPO MORNING GLORY
LARGE AREAS WITH GREATER THAN OR LESS THAN 1000 INDIVIDUALS
CONGDON'S TARPLANT
HOOVER'S BUTTON CELERY
PURPLE NEEDLEGRASS
SAN LUIS OBISPO MORNING GLORY
NOTE:
CRLF = CALIFORNIA RED LEGGED FROG
0 250 500 1,000 Feet
Approximate Scale
FIGURE 12
WETLANDS, FAIRY SHRIMP, AND RARE PLANT HABITATS
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET ENVIRONMENTAL, INC.
RESERVOIR 4
FORMER RECYCLING AREA
RESERVOIR 2
RESERVOIR 3
RESERVOIR 7
RESERVOIR 5
RESERVOIR 6
NORTHWEST AREA
REFERENCE: AERIAL PHOTOGRAPH BY CENTRAL COAST AERIAL MAPPING, DATED MARCH 2, 2007
SOURCE: BIOLOGICAL RESOURCES MAPPING CONDUCTED BY RINCON CONSULTANTS INC., 2003. FIELD STUDIES PERFORMED MAY THROUGH SEPTEMBER 2003.
S:\GIS\1212 Chevron Pipeline SLOTF\001 Remedial Design\MxdDocuments\013 1212.001 Wetlands_Fairy Shrimp Plant.mxd\12/17/07


N
EXPLANATION
SOIL SAMPLE SHOWING LEAD CONCENTRATION IN mg/kg
PROJECT AREA BOUNDARY
LNAPL OCCURANCE
SOLID, FORMER CRUDE OIL
PLIABLE, HIGHLY WEATHERED CRUDE OIL. NO EVIDENCE OF PLASTIC FLOW
PLIABLE, HIGHLY WEATHERED CRUDE OIL. EVIDENCE OF RECENT PLASTIC FLOW. (EVALUATED FOR REMEDIATION IN FEASIBILITY STUDY)
LIQUID CRUDE OIL. CAPABLE OF GENERATING "FREE" DROPLETS OF OIL. (EVALUATED FOR REMEDIATION IN FEASIBILITY STUDY)
EXTENT OF BTEX
TPH IN SOIL > 1,000 mg/kg
TPH IN SOIL > 100 mg/kg
0 250 500 1,000 Feet
Approximate Scale
FIGURE 13
SUMMARY OF ENVIRONMENTAL IMPACTS
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET ENVIRONMENTAL, INC.
RESERVOIR 4
FORMER RECYCLING AREA
T-17-0.5
488 mg/kg
RESERVOIR 2
WETLANDS IMPACTED BY ASPHALTIC CRUST
RESERVOIR 3
T-8-0.5
1,151 mg/kg
RESERVOIR 5
RESERVOIR 7
BETITA PROPERTY
RESERVOIR 6
T-2-0.5
801 mg/kg
NORTHWEST AREA
AREA OF ASENIC IMPACT (EVALUATED FOR REMEDIATION IN THE FEASIBILITY STUDY)
REFERENCE: AERIAL PHOTOGRAPH BY CENTRAL COAST AERIAL MAPPING. DATED MARCH 2, 2007
S:\GIS\1212 Chevron Plane SLOTF\001 Remedial Design\Arcmap\Documents\014 1212.001 Summary Environmental Impacts.mxd\12/17/07


N
EXPLANATION
PROJECT AREA BOUNDARY
FEDERAL AND STATE DELINEATED WETLANDS
PLIABLE, HIGHLY WEATHERED CRUDE OIL. NO EVIDENCE OF PLASTIC FLOW
PLIABLE, HIGHLY WEATHERED CRUDE OIL. EVIDENCE OF RECENT PLASTIC FLOW.
LIQUID CRUDE OIL, CAPABLE OF GENERATING "FREE" DROPLETS OF OIL.
EXTENT OF BTEX IN LNAPL
AREA OF CONCERN (AOC)
OPERABLE UNIT BOUNDARY (OU)
CITY OF SAN LUIS OBISPO LAND USE PLAN
PUBLIC
SERVICE & MANUFACTURING
BUSINESS PARK
RESIDENTIAL
OPEN SPACE
0 250 500 1,000 FEET
APPROXIMATE SCALE
FIGURE 14
OVERVIEW OF OPERABLE UNITS
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET ENVIRONMENTAL, INC.
OPERABLE UNIT #4 Surface Soils
OPERABLE UNIT #3
OPERABLE UNIT #2
OPERABLE UNIT #1
OPERABLE UNIT #5 Site-wide Groundwater (Outside OU#1)
OU #4 AOC 1 NORTH MARSH
OU #1 AOCs AOC-1 GROUNDWATER AOC-2 SOILS
NW OPERATIONS AREA
FORMER RECYCLING AREA
RESERVOIR 4
RESERVOIR 2
RESERVOIR 3
RESERVOIR 5
RESERVOIR 6
RESERVOIR 7
OU #4 AOC 3 OTHER PLASTIC HYDROCARBON SURFACE EXPRESSIONS
OU #4 AOC 2 RESERVOIR 3
OU #4 AOC 3 OTHER PLASTIC HYDROCARBON SURFACE EXPRESSIONS
OU #4 AOC 3 OTHER PLASTIC HYDROCARBON SURFACE EXPRESSIONS
REFERENCE: AERIAL PHOTOGRAPH BY CENTRAL COAST AERIAL MAPPING. DATED MARCH 2, 2007
S:\GIS\1212_Chevron_Paso_SLOTF\001_Remedial_Design\ArcMap\Documents\020_1212001_Overview_of_Operable_Units.mxd\12/17/07



S:\GIS\1212_Chevron_Parks_SLOTF\001_Remedial_Design\ArcMapDocuments\009_1212\001_Proposed_Impacted_Soil_Stockpile_Location.mxd\12/17/07


N
NOTE:
NEW WETLANDS ASSUME THAT THE ENTIRE BORROW AREA IS USED TO CREATE NEW HABITAT. THE ACREAGE LISTED IS THE GROSS AREA LESS ANY PRE-EXISTING WETLANDS.
EXPLANATION
PROJECT AREA BOUNDARY
BORROW AREAS
REPORTED HISTORIC DISPOSAL AREA
FIGURE 16
BORROW SOURCE LOCATION MAP
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET ENVIRONMENTAL, INC.
OFF-SITE GRADING
GROSS AREA 4.1 AC
COMMON EARTH 73,660 CY
RESERVOIR 4
TANK FARM ROAD
FLOWER MOUND/OU#3
GROSS AREA 55.1 AC
COMMON EARTH 317,162 CY
FORMER RECYCLING AREA
BORROW No. 2
GROSS AREA 8.54 AC
TOPSOIL 20,700 CY
RESERVOIR 2
RESERVOIR 3
RESERVOIR 7
BORROW BERM
COMMON EARTH 32,800 CY
BORROW No. 1
GROSS AREA 8.63 AC
VOLUME 36,200 CY
RESERVOIR 5
BORROW BERM
COMMON EARTH 33,800 CY
BORROW No. 3
EXISTING WETLANDS 6.58 AC
COMMON EARTH 78,950 CY
RESERVOIR 7
REPORTED HISTORIC DISPOSAL AREA
GROSS AREA 1.57 AC
NORTH MARSH
RESERVOIR 5
RESERVOIR 6
NORTHWEST AREA
0 250 500 1,000 FEET
APPROXIMATE SCALE
REFERENCE:
AERIAL PHOTOGRAPH BY CENTRAL COAST AERIAL MAPPING.
DATED MARCH 2, 2007.
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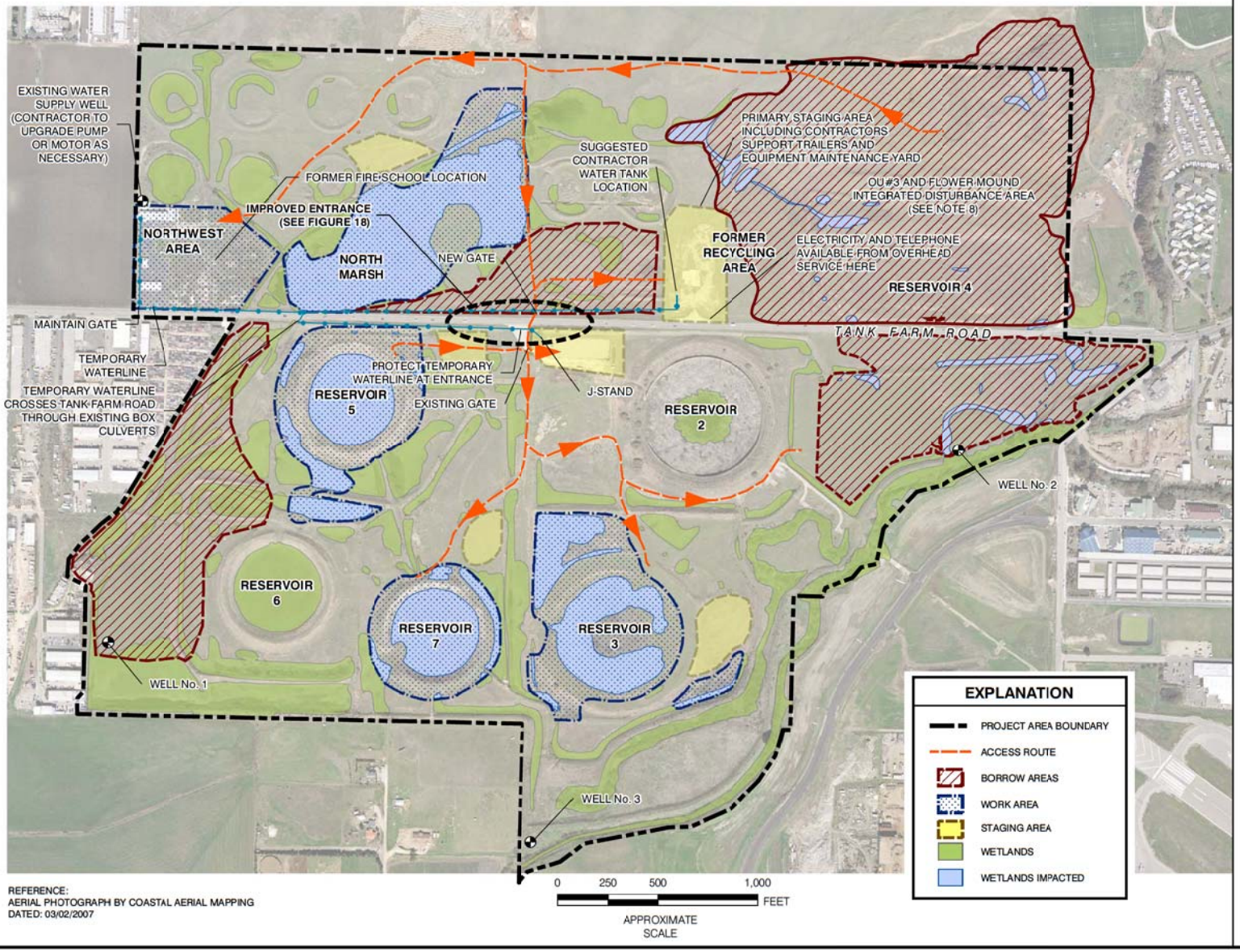

REFERENCE:
AERIAL PHOTOGRAPH BY COASTAL AERIAL MAPPING
DATED: 03/02/2007

NOTES:
1. PRIMARY STAGING AREA WILL BE LOCATED AT THE FORMER RECYCLING AREA TO TAKE ADVANTAGE OF EXISTING PAVEMENT, ELECTRICAL, AND TELEPHONE SERVICES.
2. ACCESS ROUTES WILL TO THE EXTENT PRACTICAL USE EXISTING TRAILS. ROUTES WILL BE WIDENED, AS NECESSARY, TO SAFELY ACCOMODATE 2-WAY TRAFFIC.
3. CONTRACTOR MAY SUGGEST ALTERNATIVE ROUTES, ESPECIALLY IF ONE-WAY TRAFFIC WILL PROVIDE SAFER ACCESS. ALTERNATIVE ROUTES MAY NOT CAUSE ADDITIONAL IMPACTS TO PROTECTED OR SENSITIVE HABITAT NOT OTHERWISED DESCRIBED FOR THEIS PROJECT.
4. CONSTRUCTION WATER MAY BE OBTAINED FROM THE EXISTING WATER SUPPLY WELL.
5. ON-SITE WATER FROM THE EXISTING WELL IS NOT POTABLE. CONTRACTOR WILL SUPPLY BOTTLED WATER FOR POTABLE USES
6. CONTRACTOR WILL PROVIDE PORTABLE SANITATION FACILITIES AT STAGING AND WORK AREAS, AS NEEDED.
7. WELL Nos. 1, 2, AND 3 ARE CONSTRUCTED, BUT ARE NOT EQUIPED WITH PUMPS OR OTHER ANCILLARY PRODUCTION EQUIPMENT. THEY MAY BE USED TO SUPPLY CONSTRUCTION WATER, BUT THE CONTRACTOR WILL NEED TO SUPPLY THE EQUIPMENT, POWER, AND TEMPORARY PIPELINES NECESSARY TO BRING THEM INTO SERVICE.
8. THE WORK AREA FOR OU#3 IS CONTIGUOUS WITH THE DISTURBANCE AREA FOR THE FLOWER MOUND BORROW AND GRADING. AS SUCH THEY ARE SHOWN AS A SINGLE AREA.

FIGURE 17

WORK AREAS, STAGING AREAS AND SITE ACCESS

REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA

AVOCET ENVIRONMENTAL, INC.

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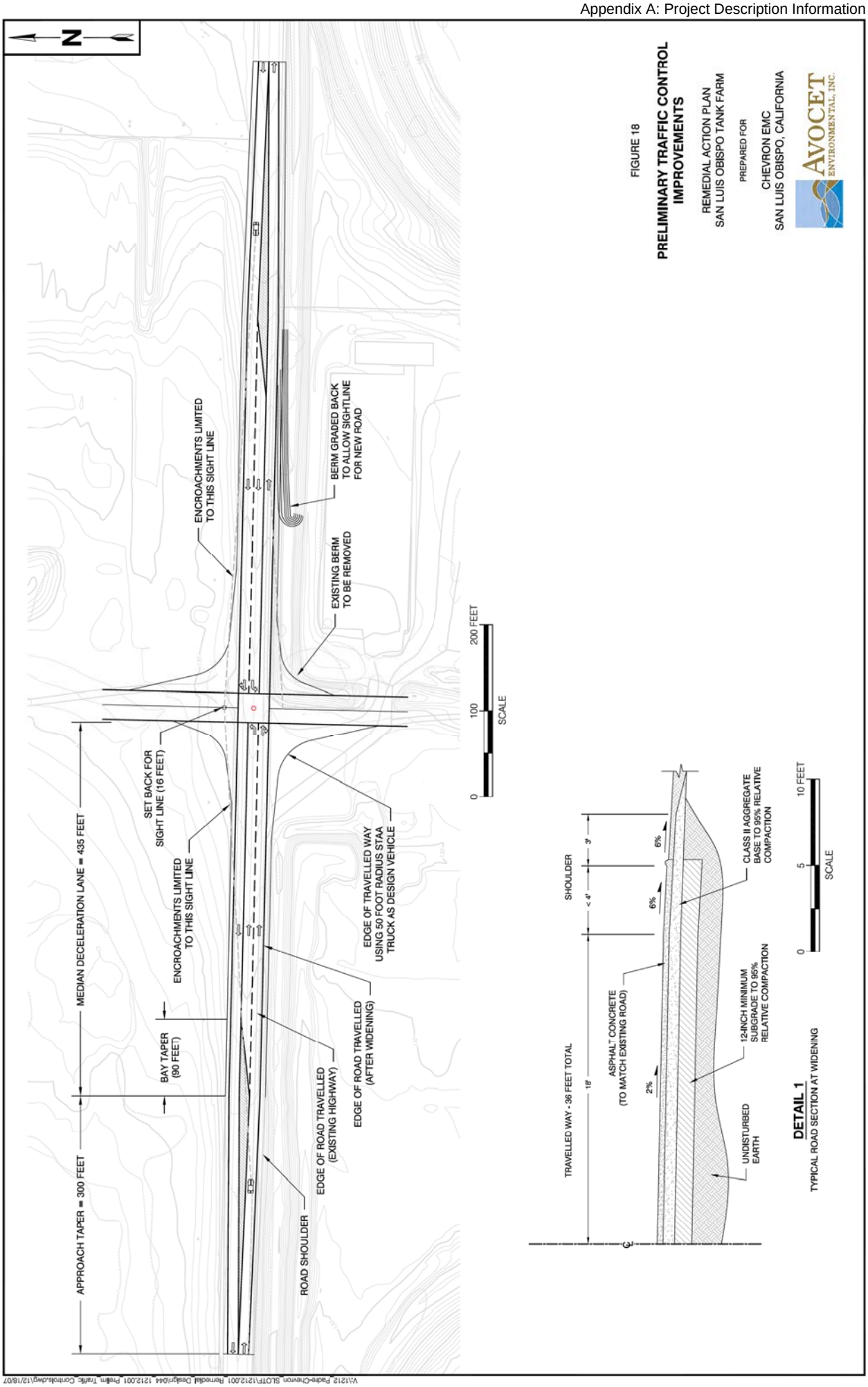
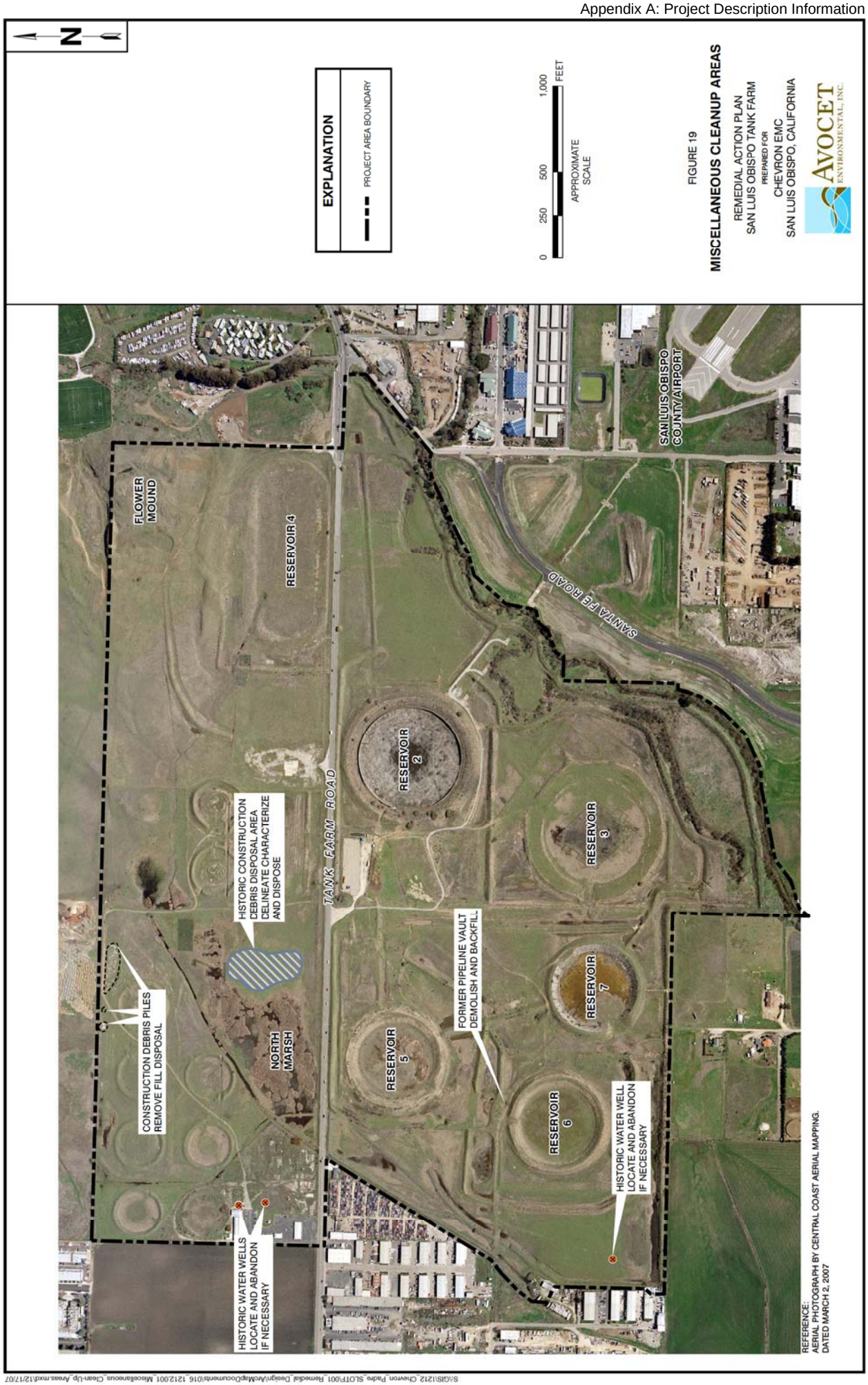

N
APPROACH TAPER = 300 FEET
MEDIAN DECELERATION LANE = 435 FEET
BAY TAPER (90 FEET)
ROAD SHOULDER
EDGE OF ROAD TRAVELLED (EXISTING HIGHWAY)
EDGE OF ROAD TRAVELLED (AFTER WIDENING)
ENCROACHMENTS LIMITED TO THIS SIGHT LINE
SET BACK FOR SIGHT LINE (16 FEET)
ENCROACHMENTS LIMITED TO THIS SIGHT LINE
EDGE OF TRAVELLED WAY USING 50 FOOT RADIUS STAA TRUCK AS DESIGN VEHICLE
EXISTING BERM TO BE REMOVED
BERM GRADED BACK TO ALLOW SIGHTLINE FOR NEW ROAD
0
100
200 FEET
SCALE
TRAVELLED WAY - 36 FEET TOTAL
18'
SHOULDER
< 4'
3'
6%
6%
2%
ASPHALT CONCRETE (TO MATCH EXISTING ROAD)
CLASS II AGGREGATE BASE TO 95% RELATIVE COMPACTION
12-INCH MINIMUM SUBGRADE TO 95% RELATIVE COMPACTION
UNDISTURBED EARTH
0
5
10 FEET
SCALE
DETAIL 1
TYPICAL ROAD SECTION AT WIDENING
FIGURE 18
PRELIMINARY TRAFFIC CONTROL IMPROVEMENTS
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET ENVIRONMENTAL, INC.



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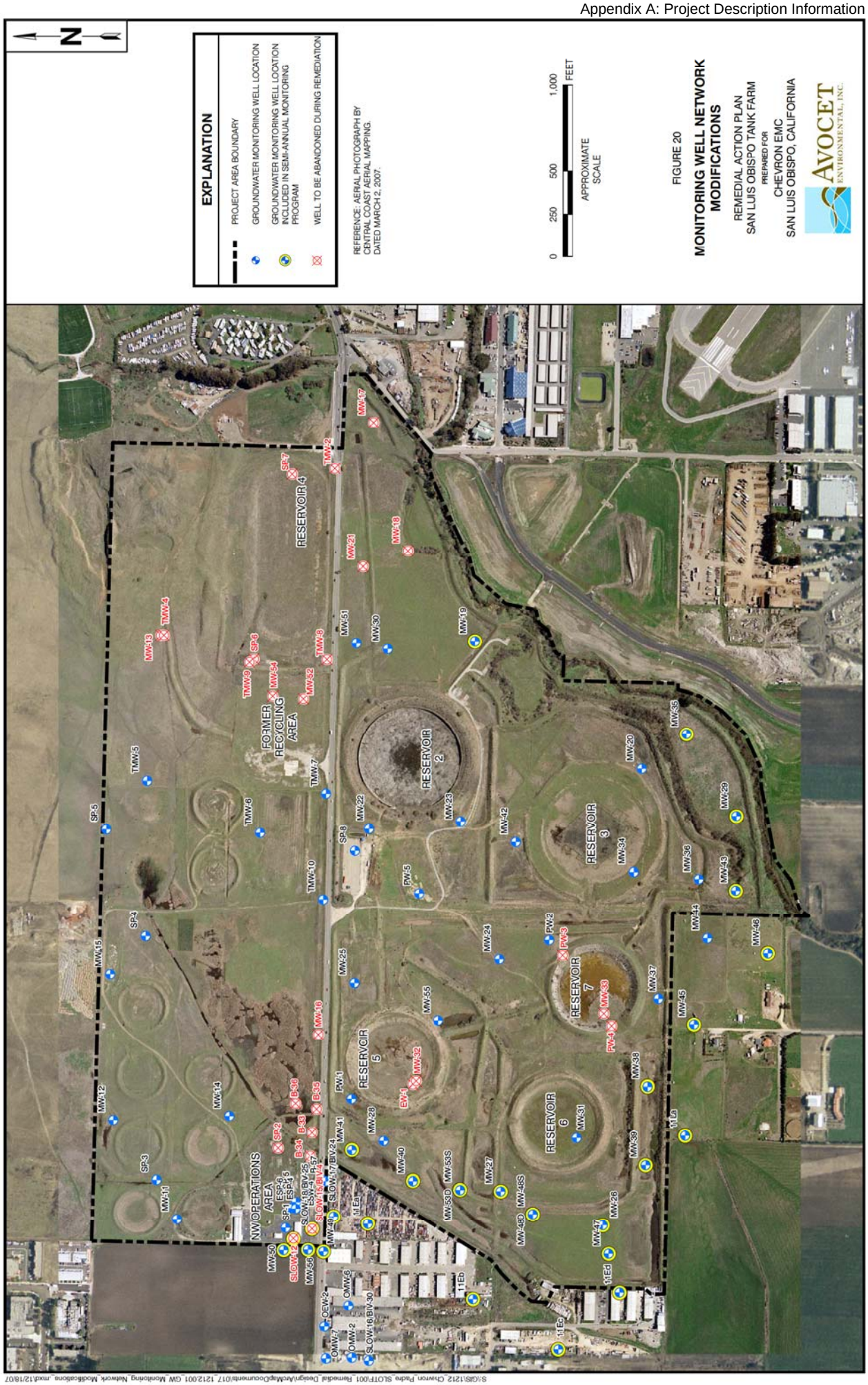
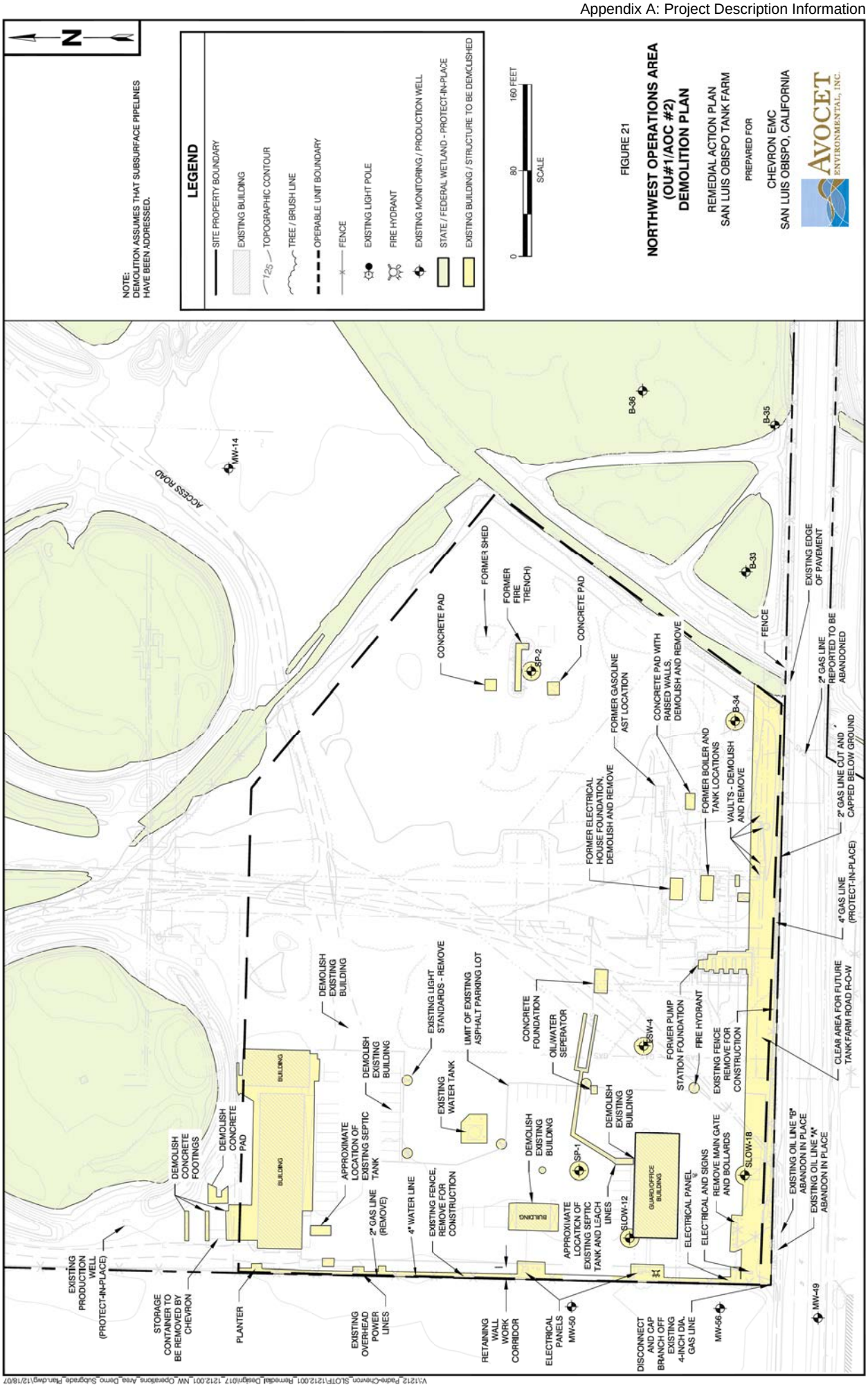

N
EXPLANATION
PROJECT AREA BOUNDARY
GROUNDWATER MONITORING WELL LOCATION
GROUNDWATER MONITORING WELL LOCATION INCLUDED IN SEMI-ANNUAL MONITORING PROGRAM
WELL TO BE ABANDONED DURING REMEDIATION
REFERENCE: AERIAL PHOTOGRAPH BY CENTRAL COAST AERIAL MAPPING, DATED MARCH 2, 2007.
0 250 500 1,000 FEET
APPROXIMATE SCALE
FIGURE 20
MONITORING WELL NETWORK MODIFICATIONS
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET ENVIRONMENTAL, INC.
NW OPERATIONS AREA
FORMER RECYCLING AREA
RESERVOIR 2
RESERVOIR 3
RESERVOIR 4
RESERVOIR 5
RESERVOIR 6
RESERVOIR 7
MW-11
MW-12
MW-13
MW-14
MW-15
MW-16
MW-17
MW-18
MW-19
MW-20
MW-21
MW-22
MW-23
MW-24
MW-25
MW-26
MW-27
MW-28
MW-29
MW-30
MW-31
MW-32
MW-33
MW-34
MW-35
MW-36
MW-37
MW-38
MW-39
MW-40
MW-41
MW-42
MW-43
MW-44
MW-45
MW-46
MW-47
MW-48
MW-48D
MW-48S
MW-50
MW-51
MW-52
MW-53D
MW-53S
MW-54
MW-55
MW-56
TMW-4
TMW-5
TMW-6
TMW-7
TMW-8
TMW-9
TMW-10
SP-2
SP-3
SP-4
SP-5
SP-6
SP-7
SP-8
SP-9
SP-12
ESP-6
ESP-45
B-33
B-34
B-35
B-36
B-37
SLOW-15 BV-4
SLOW-17 BV-24
SLOW-18 BV-25
SLOW-16 BV-30
SLOW-12
OMW-2
OMW-6
OEW-2
OMW-7
FW-1
FW-2
FW-3
FW-4
FW-5
EW-1
11Ea
11Eb
11Ec
11Ed
11Ee
11La


N
NOTE:
DEMOLITION ASSUMES THAT SUBSURFACE PIPELINES HAVE BEEN ADDRESSED.
LEGEND
SITE PROPERTY BOUNDARY
EXISTING BUILDING
TOPOGRAPHIC CONTOUR
TREE / BRUSH LINE
OPERABLE UNIT BOUNDARY
FENCE
EXISTING LIGHT POLE
FIRE HYDRANT
EXISTING MONITORING / PRODUCTION WELL
STATE / FEDERAL WETLAND - PROTECT-IN-PLACE
EXISTING BUILDING / STRUCTURE TO BE DEMOLISHED
0
80
160 FEET
SCALE
FIGURE 21
NORTHWEST OPERATIONS AREA
(OU#1/AOC #2)
DEMOLITION PLAN
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET
ENVIRONMENTAL, INC.
ACCESS ROAD
MW-14
B-36
B-35
B-33
B-34
FORMER SHED
FORMER FIRE TRENCH)
CONCRETE PAD
SP-2
CONCRETE PAD
FENCE
EXISTING EDGE OF PAVEMENT
2" GAS LINE REPORTED TO BE ABANDONED
FORMER GASOLINE AST LOCATION
CONCRETE PAD WITH RAISED WALLS, DEMOLISH AND REMOVE
FORMER BOILER AND TANK LOCATIONS
VAULTS - DEMOLISH AND REMOVE
2" GAS LINE CUT AND CAPPED BELOW GROUND
FORMER ELECTRICAL HOUSE FOUNDATION, DEMOLISH AND REMOVE
4"GAS LINE (PROTECT-IN-PLACE)
DEMOLISH EXISTING BUILDING
EXISTING LIGHT STANDARDS - REMOVE
LIMIT OF EXISTING ASPHALT PARKING LOT
CONCRETE FOUNDATION
OIL/WATER SEPERATOR
SW-4
FORMER PUMP STATION FOUNDATION
FIRE HYDRANT
EXISTING FENCE REMOVE FOR CONSTRUCTION
CLEAR AREA FOR FUTURE TANK FARM ROAD R-O-W
DEMOLISH EXISTING BUILDING
EXISTING WATER TANK
DEMOLISH EXISTING BUILDING
SP-1
DEMOLISH EXISTING BUILDING
BUILDING
BUILDING
DEMOLISH CONCRETE FOOTINGS
DEMOLISH CONCRETE PAD
APPROXIMATE LOCATION OF EXISTING SEPTIC TANK
2" GAS LINE (REMOVE)
4" WATER LINE
EXISTING FENCE, REMOVE FOR CONSTRUCTION
APPROXIMATE LOCATION OF EXISTING SEPTIC TANK AND LEACH LINES
SLOW-12
GUARD/OFFICE BUILDING
ELECTRICAL PANEL
ELECTRICAL AND SIGNS REMOVE MAIN GATE AND BOLLARDS
SLOW-18
EXISTING OIL LINE "B" ABANDON IN PLACE
EXISTING OIL LINE "A" ABANDON IN PLACE
EXISTING PRODUCTION WELL (PROTECT-IN-PLACE)
STORAGE CONTAINER TO BE REMOVED BY CHEVRON
PLANTER
EXISTING OVER-HEAD POWER LINES
RETAINING WALL WORK CORRIDOR
ELECTRICAL PANELS
MW-50
DISCONNECT AND CAP BRANCH OFF EXISTING 4-INCH DIA. GAS LINE
MW-56
MW-49
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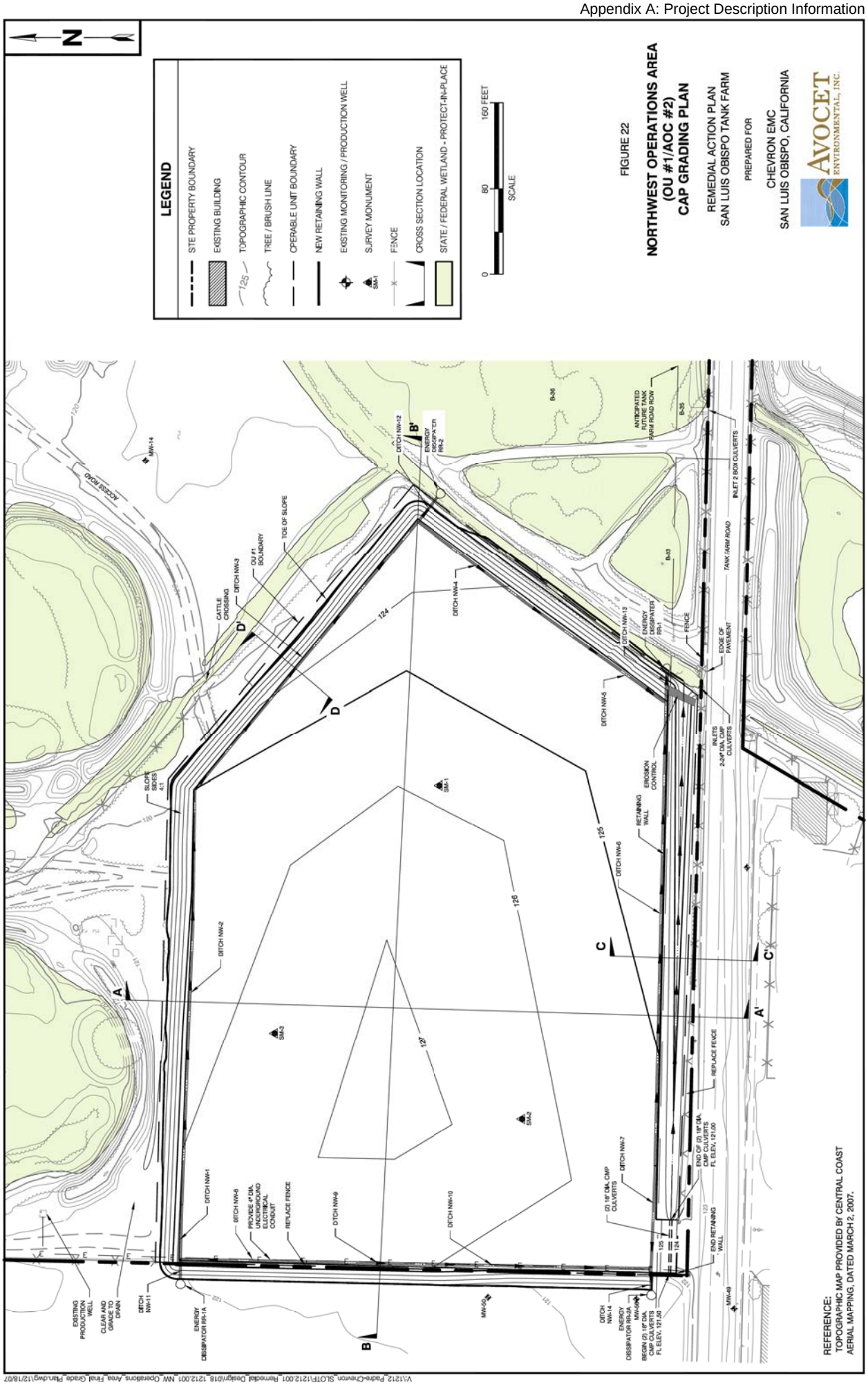
N
LEGEND
SITE PROPERTY BOUNDARY
EXISTING BUILDING
TOPOGRAPHIC CONTOUR
TREE / BRUSH LINE
OPERABLE UNIT BOUNDARY
NEW RETAINING WALL
EXISTING MONITORING / PRODUCTION WELL
SURVEY MONUMENT
FENCE
CROSS SECTION LOCATION
STATE / FEDERAL WETLAND - PROTECT-IN-PLACE
0
80
160 FEET
SCALE
FIGURE 22
NORTHWEST OPERATIONS AREA
(OU #1/AOC #2)
CAP GRADING PLAN
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET
ENVIRONMENTAL, INC.
REFERENCE:
TOPOGRAPHIC MAP PROVIDED BY CENTRAL COAST
AERIAL MAPPING, DATED MARCH 2, 2007.
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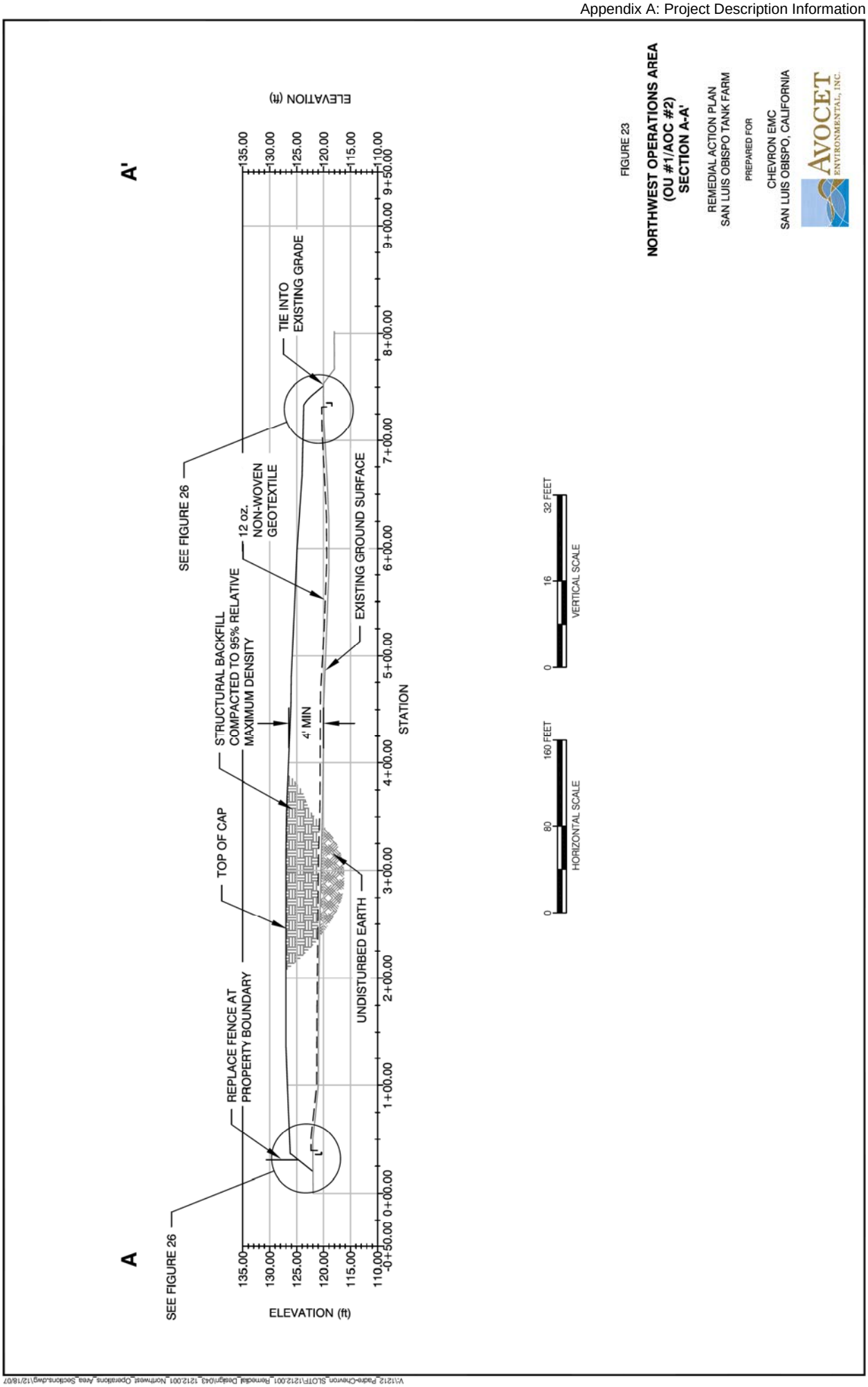
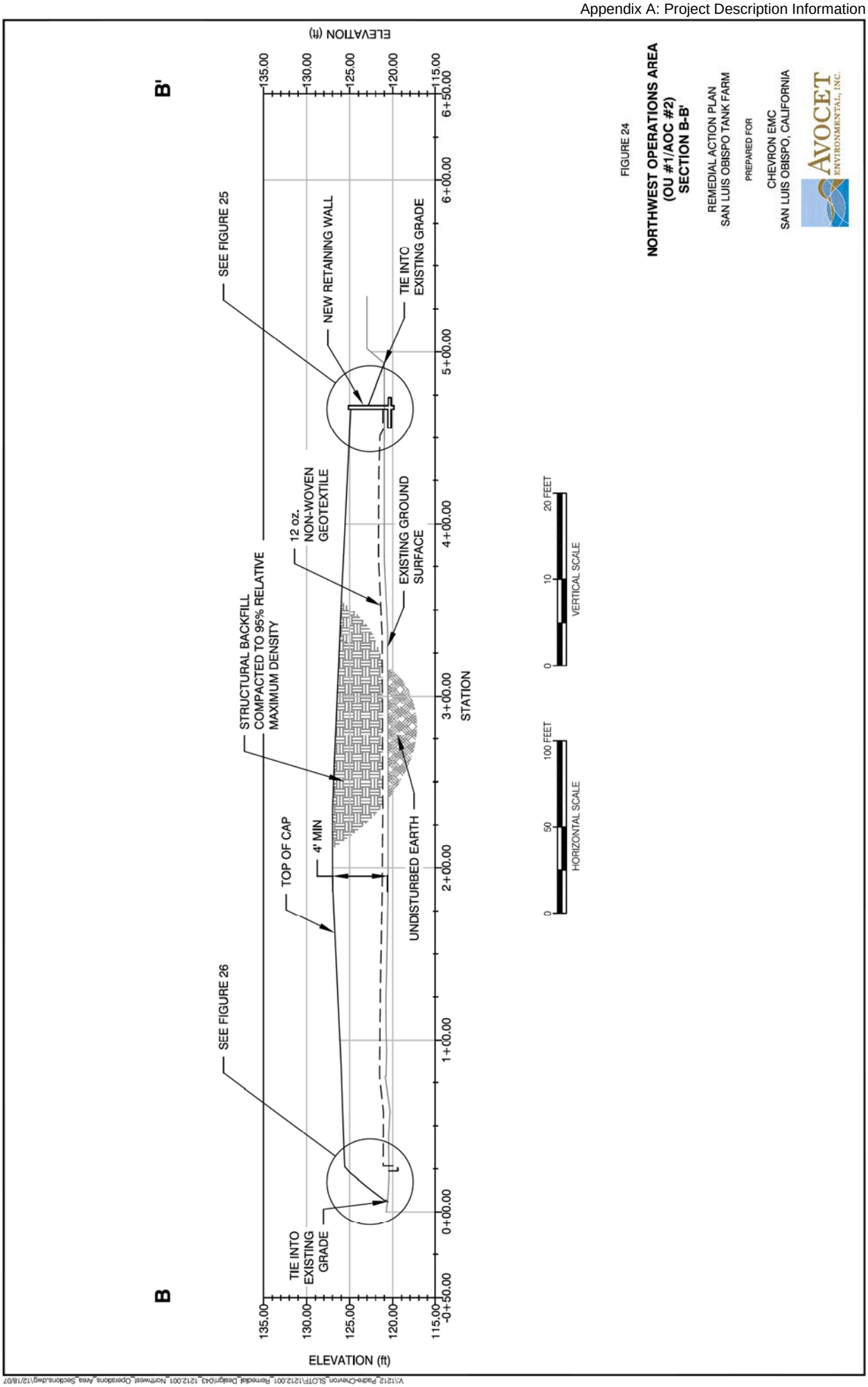

A
A'
SEE FIGURE 26
SEE FIGURE 26
REPLACE FENCE AT PROPERTY BOUNDARY
TOP OF CAP
STRUCTURAL BACKFILL COMPACTED TO 95% RELATIVE MAXIMUM DENSITY
12 oz. NON-WOVEN GEOTEXTILE
TIE INTO EXISTING GRADE
4' MIN
UNDISTURBED EARTH
EXISTING GROUND SURFACE
ELEVATION (ft)
135.00
130.00
125.00
120.00
115.00
110.00
-0+50.00
0+00.00
1+00.00
2+00.00
3+00.00
4+00.00
5+00.00
6+00.00
7+00.00
8+00.00
9+00.00
9+50.00
STATION
0
80
160 FEET
HORIZONTAL SCALE
0
16
32 FEET
VERTICAL SCALE
FIGURE 23
NORTHWEST OPERATIONS AREA
(OU #1/AOC #2)
SECTION A-A'
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET
ENVIRONMENTAL, INC.



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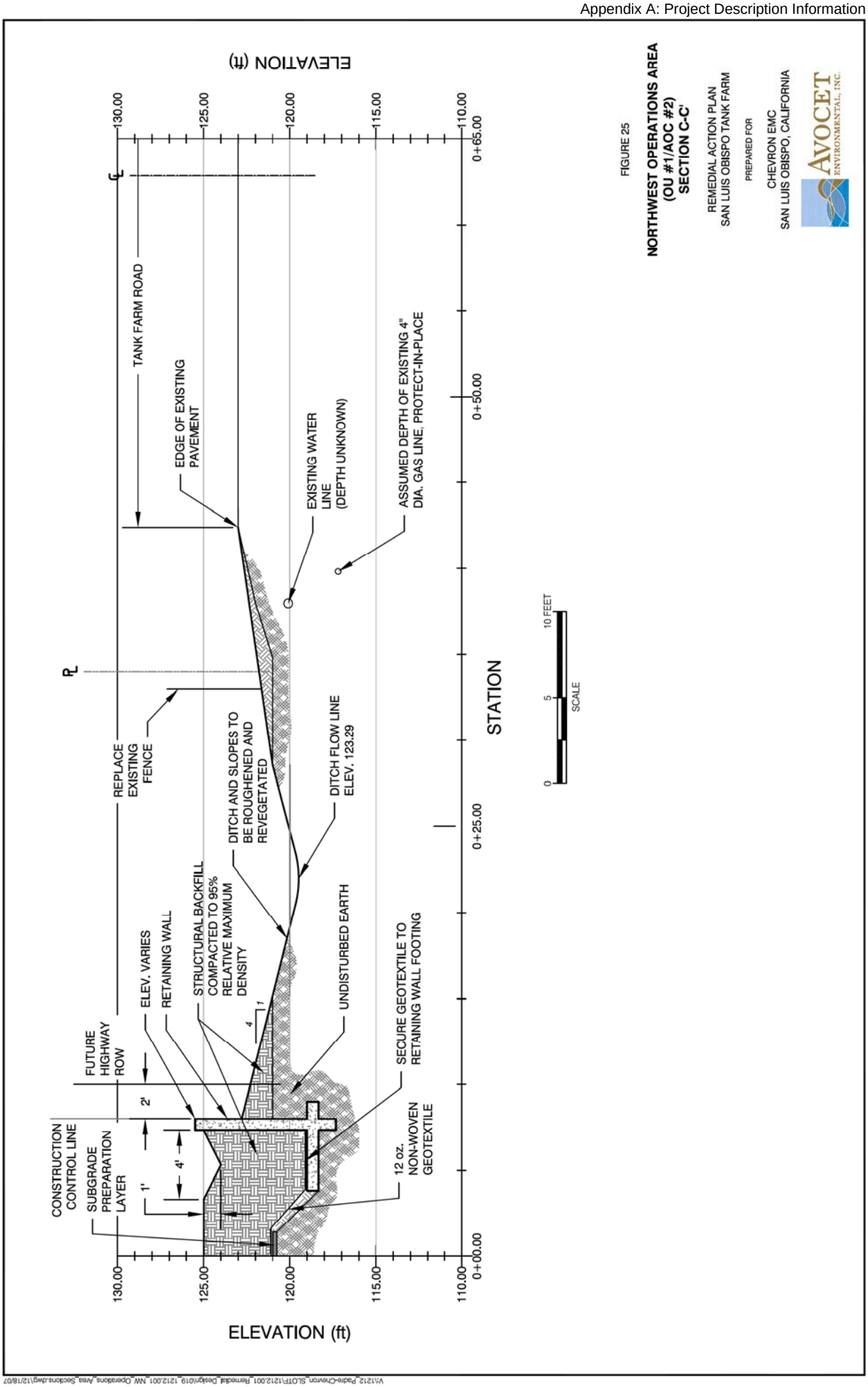
ELEVATION (ft)
130.00
125.00
120.00
115.00
110.00
0+00.00
0+25.00
0+50.00
0+65.00
STATION
CONSTRUCTION CONTROL LINE
SUBGRADE PREPARATION LAYER
FUTURE HIGHWAY ROW
ELEV. VARIES
RETAINING WALL
STRUCTURAL BACKFILL COMPACTED TO 95% RELATIVE MAXIMUM DENSITY
REPLACE EXISTING FENCE
DITCH AND SLOPES TO BE ROUGHENED AND REVEGETATED
DITCH FLOW LINE ELEV. 123.29
UNDISTURBED EARTH
SECURE GEOTEXTILE TO RETAINING WALL FOOTING
12 oz. NON-WOVEN GEOTEXTILE
EDGE OF EXISTING PAVEMENT
TANK FARM ROAD
EXISTING WATER LINE (DEPTH UNKNOWN)
ASSUMED DEPTH OF EXISTING 4" DIA. GAS LINE, PROTECT-IN-PLACE
1'
2'
4'
4
1
0
5
10 FEET
SCALE
FIGURE 25
NORTHWEST OPERATIONS AREA
(OU #1/AOC #2)
SECTION C-C'
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET
ENVIRONMENTAL, INC.

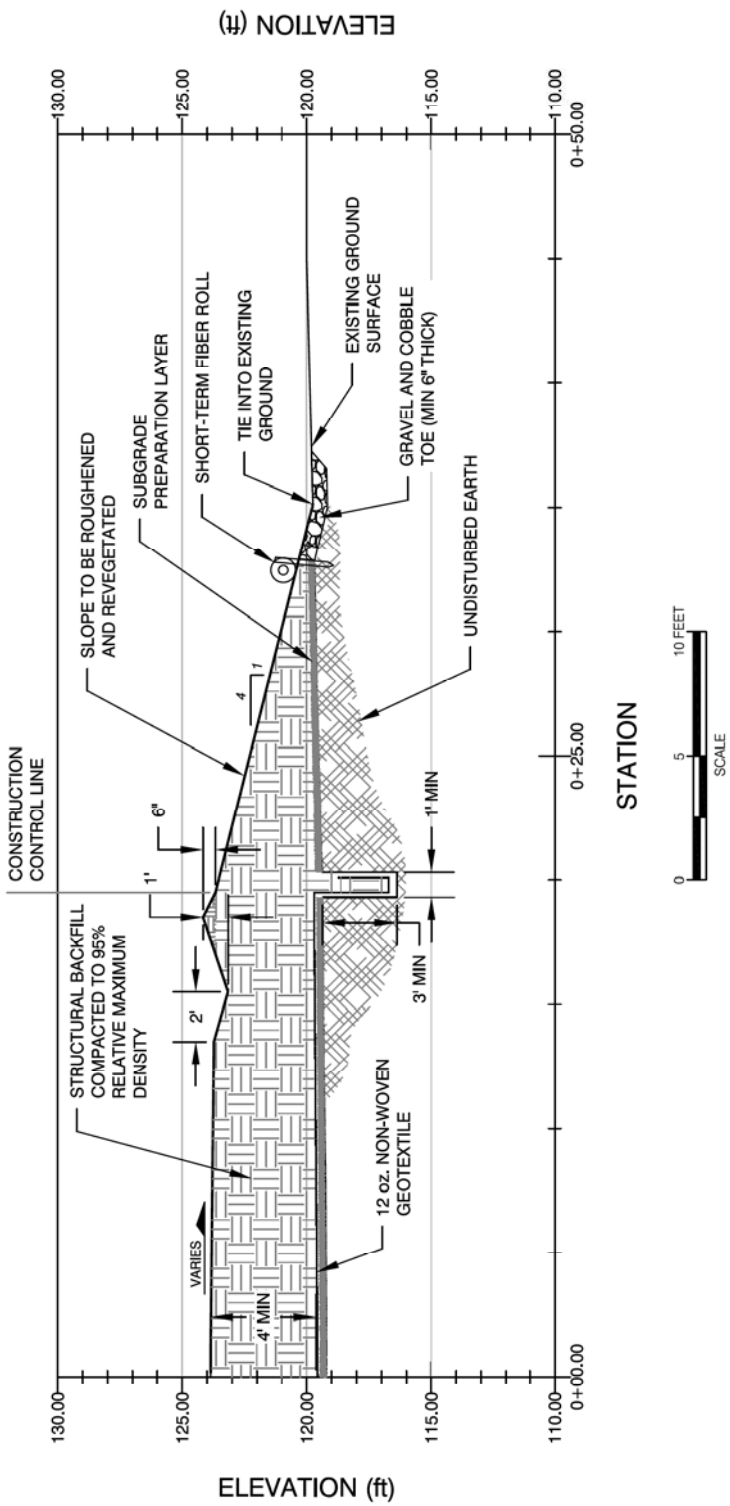

FIGURE 26

NORTHWEST OPERATIONS AREA (OU #1/AOC #2) SECTION D-D'

REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM

PREPARED FOR

CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA

AVOCET ENVIRONMENTAL, INC.

REFERENCE:
TOPOGRAPHIC MAP PROVIDED BY CENTRAL COAST AERIAL MAPPING, DATED MARCH 2, 2007.

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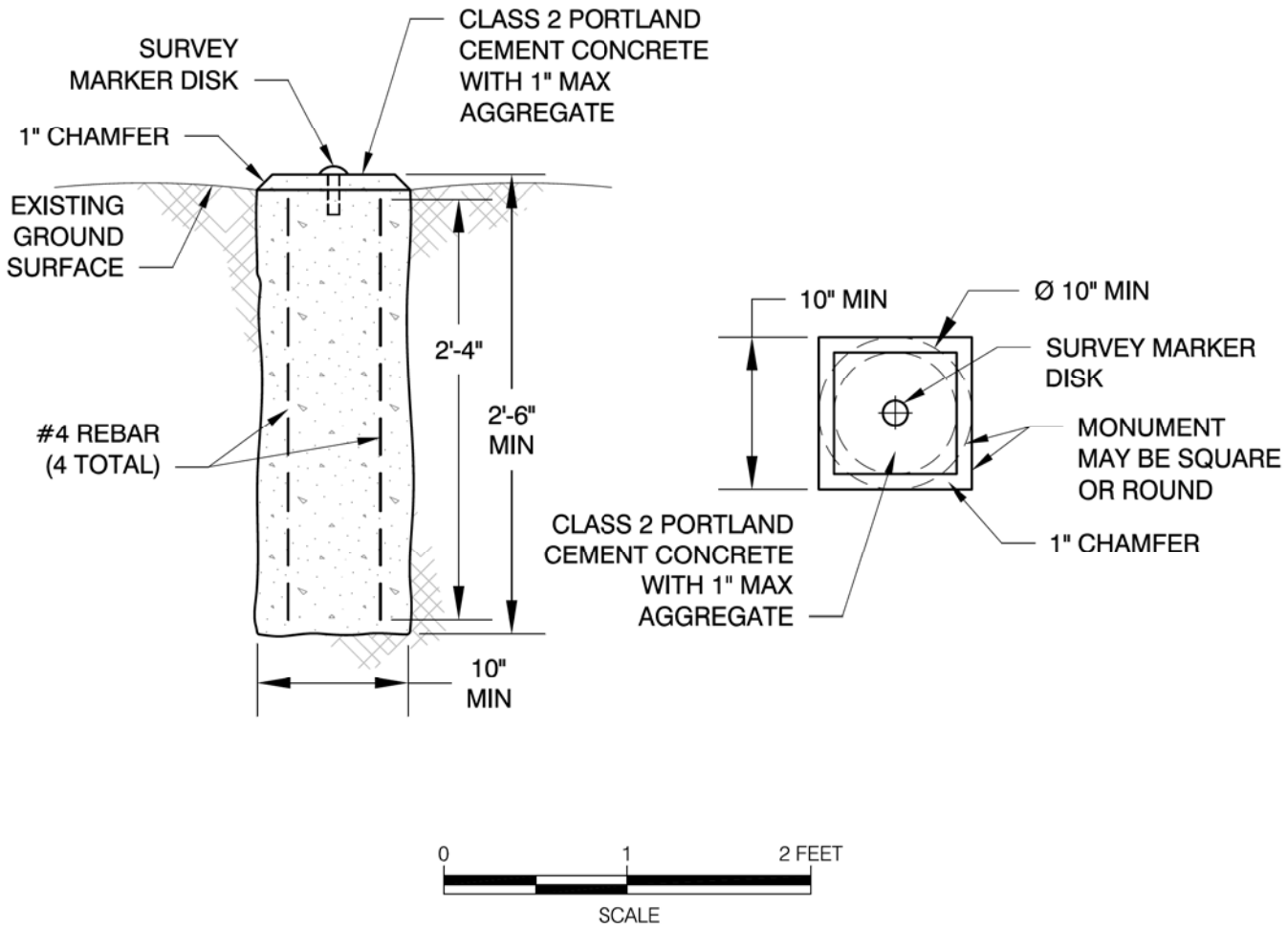


FIGURE 27

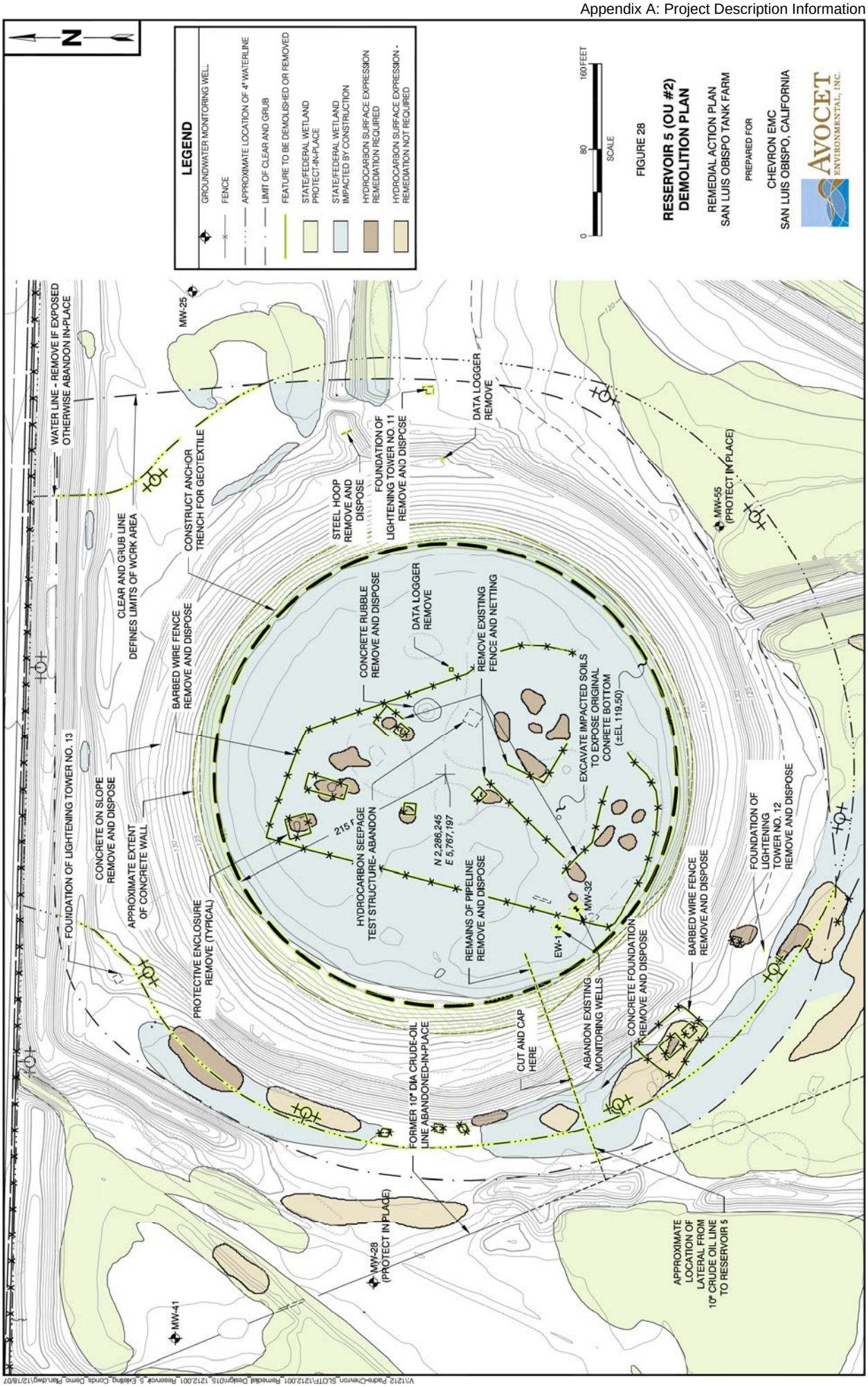
TYPICAL SURVEY MONUMENT

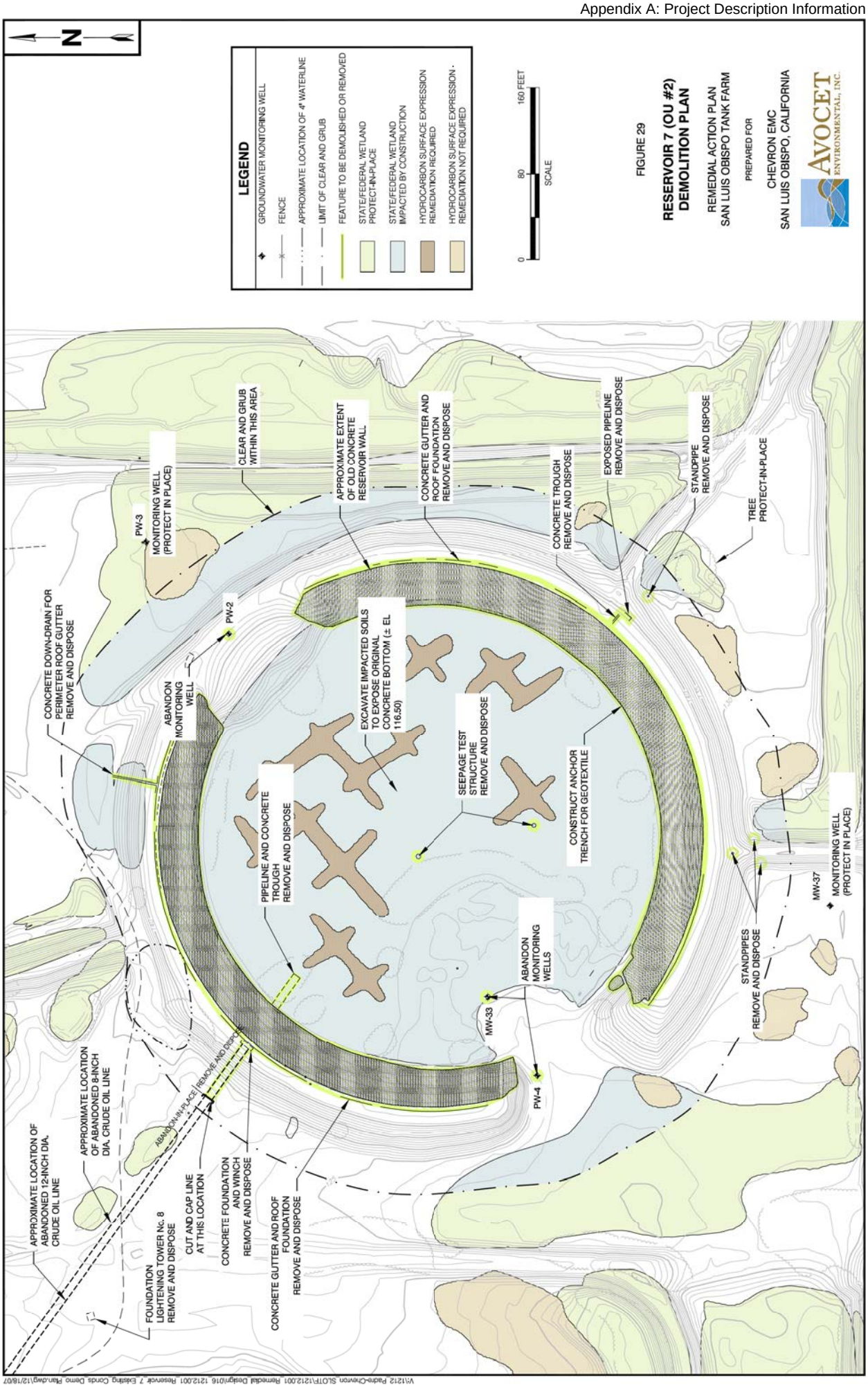
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM

PREPARED FOR

CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA

AVOCET
ENVIRONMENTAL, INC.


N
LEGEND
GROUNDWATER MONITORING WELL
FENCE
APPROXIMATE LOCATION OF 4" WATERLINE
LIMIT OF CLEAR AND GRUB
FEATURE TO BE DEMOLISHED OR REMOVED
STATE/FEDERAL WETLAND PROTECT-IN-PLACE
STATE/FEDERAL WETLAND IMPACTED BY CONSTRUCTION
HYDROCARBON SURFACE EXPRESSION REMEDIATION REQUIRED
HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED
0
80
160 FEET
SCALE
FIGURE 28
RESERVOIR 5 (OU #2)
DEMOLITION PLAN
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET
ENVIRONMENTAL, INC.
MW-25
WATER LINE - REMOVE IF EXPOSED OTHERWISE ABANDON IN-PLACE
CONSTRUCT ANCHOR TRENCH FOR GEOTEXTILE
CLEAR AND GRUB LINE DEFINES LIMITS OF WORK AREA
STEEL HOOP REMOVE AND DISPOSE
FOUNDATION OF LIGHTENING TOWER NO. 11 REMOVE AND DISPOSE
DATA LOGGER REMOVE
MW-55 (PROTECT IN PLACE)
BARBED WIRE FENCE REMOVE AND DISPOSE
CONCRETE RUBBLE REMOVE AND DISPOSE
DATA LOGGER REMOVE
REMOVE EXISTING FENCE AND NETTING
EXCAVATE IMPACTED SOILS TO EXPOSE ORIGINAL CONFETE BOTTOM (±EL 119.50)
FOUNDATION OF LIGHTENING TOWER NO. 13
CONCRETE ON SLOPE REMOVE AND DISPOSE
APPROXIMATE EXTENT OF CONCRETE WALL
215 ft
N 2,286,245
E 5,767,197
HYDROCARBON SEEPAGE TEST STRUCTURE- ABANDON
REMAINS OF PIPELINE REMOVE AND DISPOSE
MW-32
EW-1
FOUNDATION OF LIGHTENING TOWER NO. 12 REMOVE AND DISPOSE
BARBED WIRE FENCE REMOVE AND DISPOSE
PROTECTIVE ENCLOSURE REMOVE (TYPICAL)
CONCRETE FOUNDATION REMOVE AND DISPOSE
ABANDON EXISTING MONITORING WELLS
CUT AND CAP HERE
FORMER 10" DIA CRUDE-OIL LINE ABANDONED-IN-PLACE
MW-28 (PROTECT IN PLACE)
MW-41
APPROXIMATE LOCATION OF LATERAL FROM 10" CRUDE OIL LINE TO RESERVOIR 5
V:\1212_Pacific-Chevron_SLOTF\1212.001_Remedial_Design\015_1212.001_Reservoir_5_Existing_Conds_Demo_Plan.dwg\12/18/07


N
LEGEND
GROUNDWATER MONITORING WELL
FENCE
APPROXIMATE LOCATION OF 4" WATERLINE
LIMIT OF CLEAR AND GRUB
FEATURE TO BE DEMOLISHED OR REMOVED
STATE/FEDERAL WETLAND PROTECT-IN-PLACE
STATE/FEDERAL WETLAND IMPACTED BY CONSTRUCTION
HYDROCARBON SURFACE EXPRESSION REMEDIATION REQUIRED
HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED
0
80
160 FEET
SCALE
FIGURE 29
RESERVOIR 7 (OU #2) DEMOLITION PLAN
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET ENVIRONMENTAL, INC.
PW-3
MONITORING WELL (PROTECT IN PLACE)
CLEAR AND GRUB WITHIN THIS AREA
APPROXIMATE EXTENT OF OLD CONCRETE RESERVOIR WALL
CONCRETE GUTTER AND ROOF FOUNDATION REMOVE AND DISPOSE
CONCRETE TROUGH REMOVE AND DISPOSE
EXPOSED PIPELINE REMOVE AND DISPOSE
STANDPIPE REMOVE AND DISPOSE
TREE PROTECT-IN-PLACE
CONCRETE DOWN-DRAIN FOR PERIMETER ROOF GUTTER REMOVE AND DISPOSE
PW-2
ABANDON MONITORING WELL
EXCAVATE IMPACTED SOILS TO EXPOSE ORIGINAL CONCRETE BOTTOM (± EL 116.50)
SEEPAGE TEST STRUCTURE REMOVE AND DISPOSE
CONSTRUCT ANCHOR TRENCH FOR GEOTEXTILE
PIPELINE AND CONCRETE TROUGH REMOVE AND DISPOSE
MW-37
MONITORING WELL (PROTECT IN PLACE)
STANDPIPES REMOVE AND DISPOSE
ABANDON MONITORING WELLS
MW-33
PW-4
APPROXIMATE LOCATION OF ABANDONED 12-INCH DIA. CRUDE OIL LINE
APPROXIMATE LOCATION OF ABANDONED 8-INCH DIA. CRUDE OIL LINE
ABANDON-IN-PLACE
REMOVE AND DISPOSE
CUT AND CAP LINE AT THIS LOCATION
CONCRETE FOUNDATION AND WINCH REMOVE AND DISPOSE
CONCRETE GUTTER AND ROOF FOUNDATION REMOVE AND DISPOSE
FOUNDATION LIGHTENING TOWER No. 8 REMOVE AND DISPOSE
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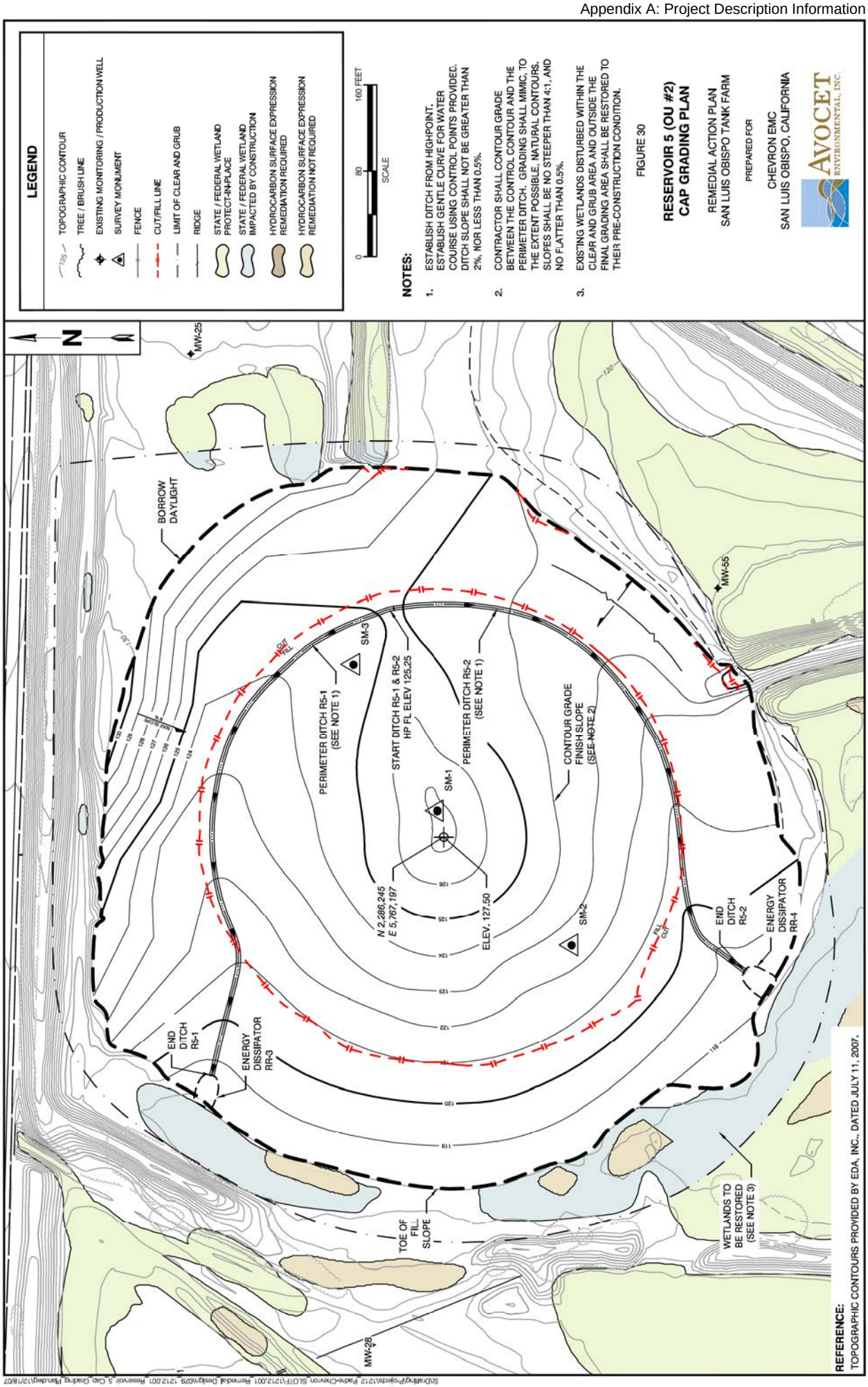
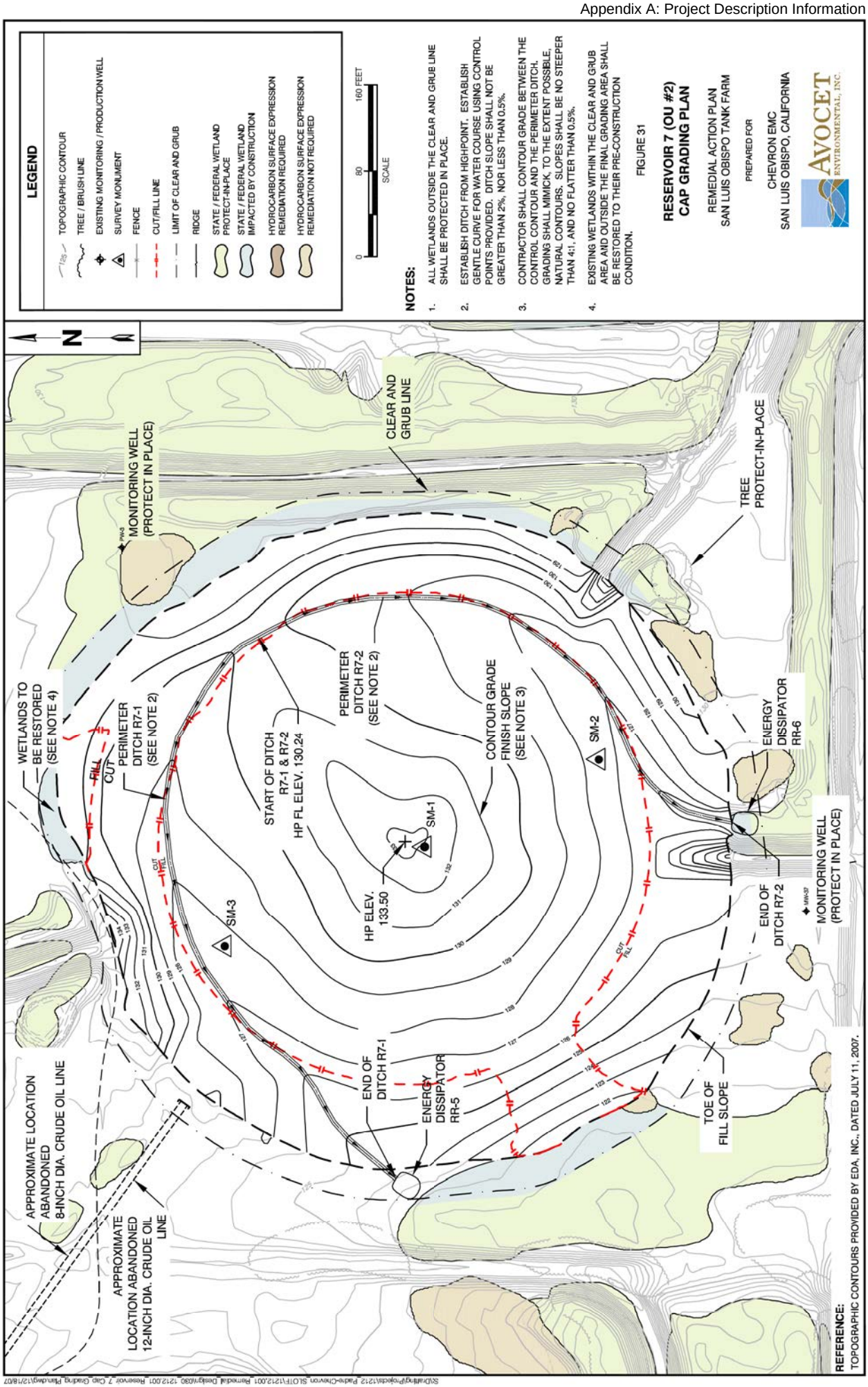
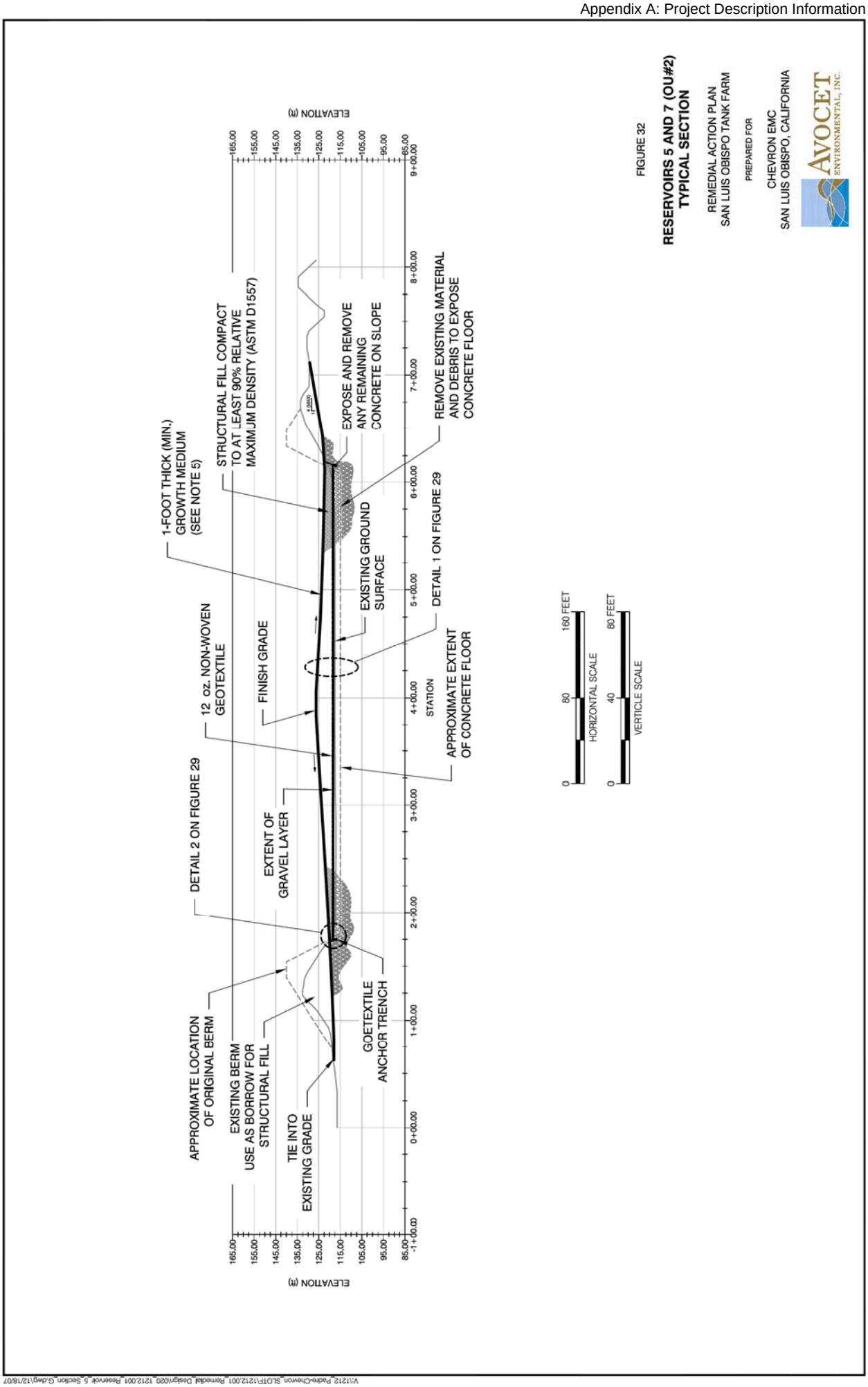
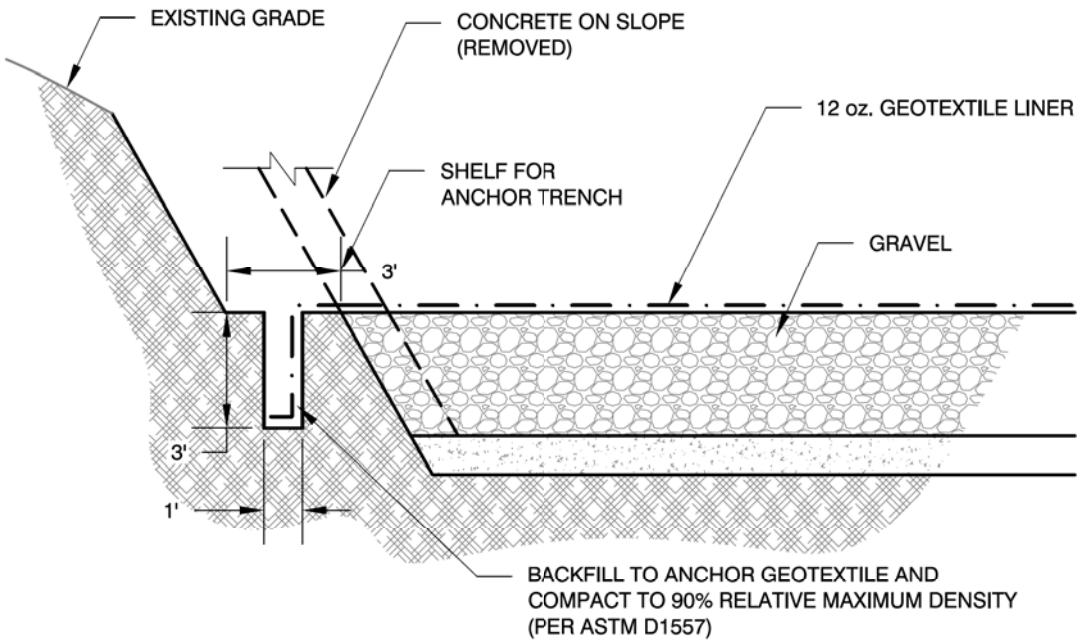

LEGEND
TOPOGRAPHIC CONTOUR
TREE / BRUSH LINE
EXISTING MONITORING / PRODUCTION WELL
SURVEY MONUMENT
FENCE
CUT/FILL LINE
LIMIT OF CLEAR AND GRUB
RIDGE
STATE / FEDERAL WETLAND PROTECT-IN-PLACE
STATE / FEDERAL WETLAND IMPACTED BY CONSTRUCTION
HYDROCARBON SURFACE EXPRESSION REMEDIATION REQUIRED
HYDROCARBON SURFACE EXPRESSION REMEDIATION NOT REQUIRED
0
80
160 FEET
SCALE
NOTES:
1. ESTABLISH DITCH FROM HIGHPOINT. ESTABLISH GENTLE CURVE FOR WATER COURSE USING CONTROL POINTS PROVIDED. DITCH SLOPE SHALL NOT BE GREATER THAN 2%, NOR LESS THAN 0.5%.
2. CONTRACTOR SHALL CONTOUR GRADE BETWEEN THE CONTROL CONTOUR AND THE PERIMETER DITCH. GRADING SHALL MIMIC, TO THE EXTENT POSSIBLE, NATURAL CONTOURS. SLOPES SHALL BE NO STEEPER THAN 4:1, AND NO FLATTER THAN 0.5%.
3. EXISTING WETLANDS DISTURBED WITHIN THE CLEAR AND GRUB AREA AND OUTSIDE THE FINAL GRADING AREA SHALL BE RESTORED TO THEIR PRE-CONSTRUCTION CONDITION.
FIGURE 30
RESERVOIR 5 (OU #2)
CAP GRADING PLAN
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET ENVIRONMENTAL, INC.
N
MW-25
MW-55
MW-28
BORROW DAYLIGHT
SM-3
SM-1
SM-2
PERIMETER DITCH R5-1 (SEE NOTE 1)
START DITCH R5-1 & R5-2 HP FL ELEV 125.25
PERIMETER DITCH R5-2 (SEE NOTE 1)
CONTOUR GRADE FINISH SLOPE (SEE NOTE 2)
N 2,286,245
E 5,767,197
ELEV. 127.50
END DITCH R5-1
ENERGY DISSIPATOR RR-3
END DITCH R5-2
ENERGY DISSIPATOR RR-4
TOE OF FILL SLOPE
WETLANDS TO BE RESTORED (SEE NOTE 3)
CUT
FILL
REFERENCE:
TOPOGRAPHIC CONTOURS PROVIDED BY EDA, INC., DATED JULY 11, 2007.


LEGEND
TOPOGRAPHIC CONTOUR
TREE / BRUSH LINE
EXISTING MONITORING / PRODUCTION WELL
SURVEY MONUMENT
FENCE
CUT/FILL LINE
LIMIT OF CLEAR AND GRUB
RIDGE
STATE / FEDERAL WETLAND PROTECT-IN-PLACE
STATE / FEDERAL WETLAND IMPACTED BY CONSTRUCTION
HYDROCARBON SURFACE EXPRESSION REMEDIATION REQUIRED
HYDROCARBON SURFACE EXPRESSION REMEDIATION NOT REQUIRED
0
80
160 FEET
SCALE
NOTES:
1. ALL WETLANDS OUTSIDE THE CLEAR AND GRUB LINE SHALL BE PROTECTED IN PLACE.
2. ESTABLISH DITCH FROM HIGHPOINT. ESTABLISH GENTLE CURVE FOR WATER COURSE USING CONTROL POINTS PROVIDED. DITCH SLOPE SHALL NOT BE GREATER THAN 2%, NOR LESS THAN 0.5%.
3. CONTRACTOR SHALL CONTOUR GRADE BETWEEN THE CONTROL CONTOUR AND THE PERIMETER DITCH. GRADING SHALL MIMICK, TO THE EXTENT POSSIBLE, NATURAL CONTOURS. SLOPES SHALL BE NO STEEPER THAN 4:1, AND NO FLATTER THAN 0.5%.
4. EXISTING WETLANDS WITHIN THE CLEAR AND GRUB AREA AND OUTSIDE THE FINAL GRADING AREA SHALL BE RESTORED TO THEIR PRE-CONSTRUCTION CONDITION.
FIGURE 31
RESERVOIR 7 (OU #2)
CAP GRADING PLAN
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET
ENVIRONMENTAL, INC.
N
MONITORING WELL (PROTECT IN PLACE)
CLEAR AND GRUB LINE
TREE PROTECT-IN-PLACE
WETLANDS TO BE RESTORED (SEE NOTE 4)
PERIMETER DITCH R7-1 (SEE NOTE 2)
FILL
CUT
PERIMETER DITCH R7-2 (SEE NOTE 2)
START OF DITCH R7-1 & R7-2
HP FL ELEV. 130.24
CONTOUR GRADE FINISH SLOPE (SEE NOTE 3)
SM-1
SM-2
SM-3
HP ELEV. 133.50
ENERGY DISSIPATOR RR-6
MONITORING WELL (PROTECT IN PLACE)
END OF DITCH R7-2
END OF DITCH R7-1
ENERGY DISSIPATOR RR-5
TOE OF FILL SLOPE
APPROXIMATE LOCATION ABANDONED 8-INCH DIA. CRUDE OIL LINE
APPROXIMATE LOCATION ABANDONED 12-INCH DIA. CRUDE OIL LINE
REFERENCE:
TOPOGRAPHIC CONTOURS PROVIDED BY EDA, INC., DATED JULY 11, 2007.


ELEVATION (ft)
165.00
155.00
145.00
135.00
125.00
115.00
105.00
95.00
85.00
-1+00.00
0+00.00
1+00.00
2+00.00
3+00.00
4+00.00
5+00.00
6+00.00
7+00.00
8+00.00
9+00.00
STATION
APPROXIMATE LOCATION OF ORIGINAL BERM
EXISTING BERM USE AS BORROW FOR STRUCTURAL FILL
TIE INTO EXISTING GRADE
DETAIL 2 ON FIGURE 29
EXTENT OF GRAVEL LAYER
GOETEXTILE ANCHOR TRENCH
12 oz. NON-WOVEN GEOTEXTILE
FINISH GRADE
1-FOOT THICK (MIN.) GROWTH MEDIUM (SEE NOTE 5)
STRUCTURAL FILL COMPACT TO AT LEAST 90% RELATIVE MAXIMUM DENSITY (ASTM D1557)
EXISTING GROUND SURFACE
APPROXIMATE EXTENT OF CONCRETE FLOOR
DETAIL 1 ON FIGURE 29
EXPOSE AND REMOVE ANY REMAINING CONCRETE ON SLOPE
REMOVE EXISTING MATERIAL AND DEBRIS TO EXPOSE CONCRETE FLOOR
0
80
160 FEET
HORIZONTAL SCALE
0
40
80 FEET
VERTICLE SCALE
FIGURE 32
RESERVOIRS 5 AND 7 (OU#2)
TYPICAL SECTION
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET
ENVIRONMENTAL, INC.

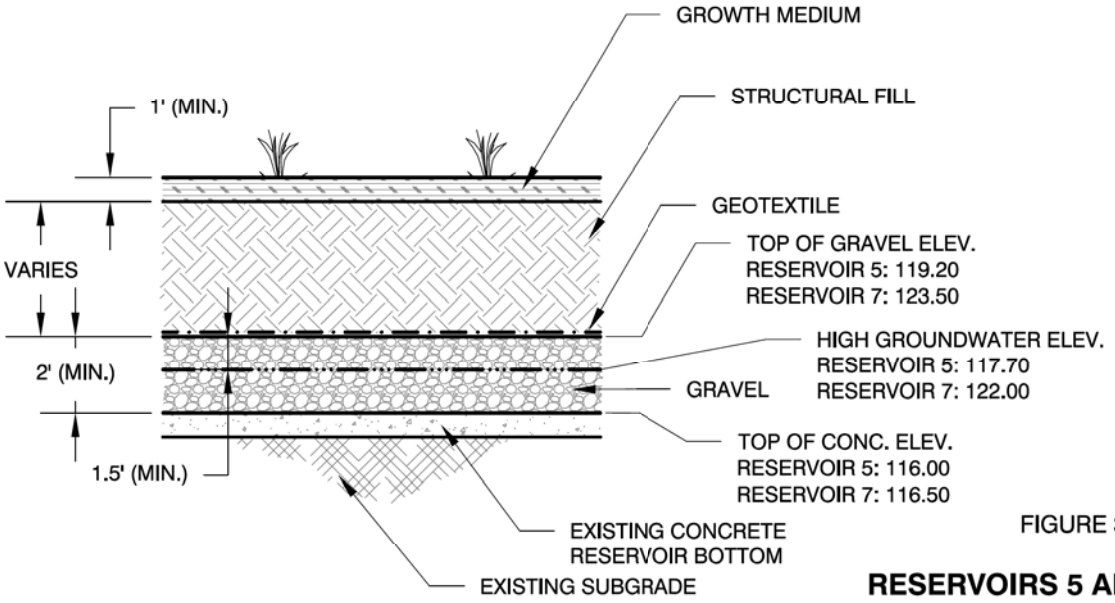
V:\1212_Padre-Chevron_SLOTF\1212.001_Remedial_Design\020_1212.001_Reservoir_5_Section_G.dwg\12/18/07



DETAIL 2

0 5 10 FEET

SCALE



DETAIL 1

0 8 16 FEET

SCALE

FIGURE 33

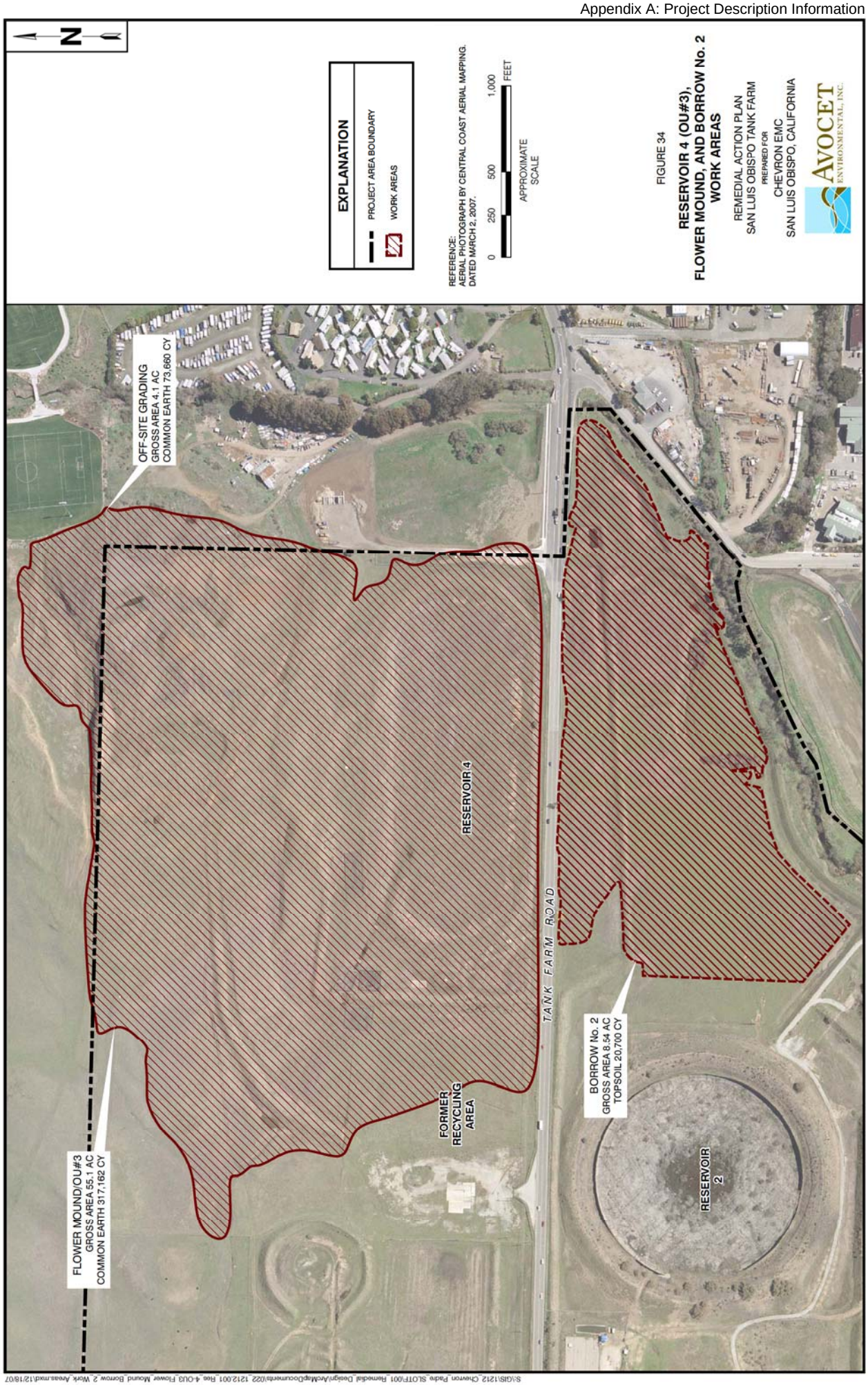
RESERVOIRS 5 AND 7 (OU#2)
TYPICAL CAP DETAILS

REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM

PREPARED FOR

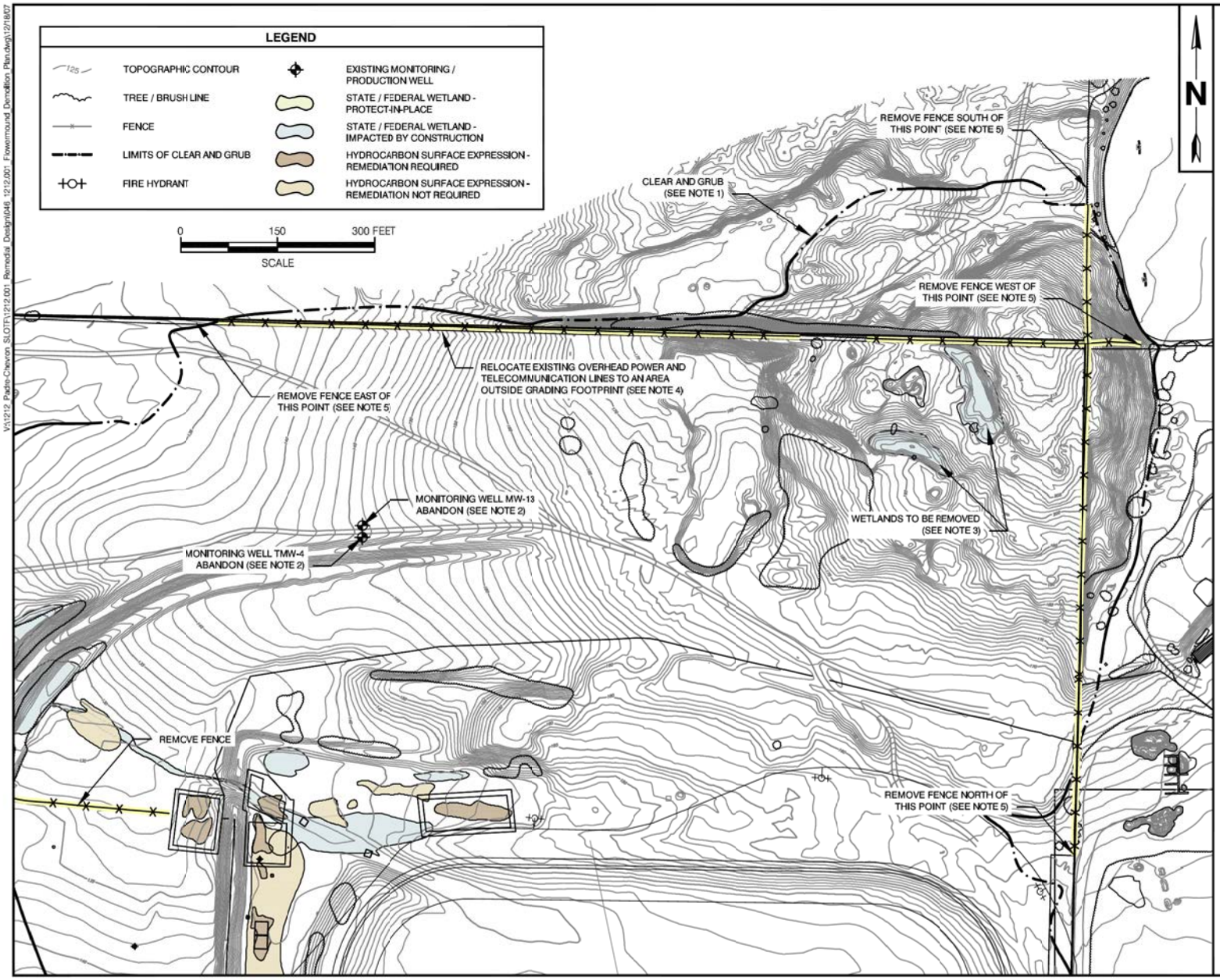
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA

AVOCET ENVIRONMENTAL, INC.



S:\GIS\1212_Chevron_Parks_SLOTF\001_Remedial_Design\ArcMapDocuments\022_1212\001_Rse_4-OU3_Flower_Mound_Borrow_2_Work_Areas.mxd\12/18/07

LEGEND
TOPOGRAPHIC CONTOUR
TREE / BRUSH LINE
EXISTING MONITORING / PRODUCTION WELL
FENCE
CUT/FILL LINE
LIMIT OF CLEAR AND GRUB
RIDGE
STATE/FEDERAL WETLAND PROTECT-IN-PLACE
STATE/FEDERAL WETLAND IMPACTED BY CONSTRUCTION
HYDROCARBON SURFACE EXPRESSION REMEDIATION REQUIRED
HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED
0
120
240 FEET
SCALE
N
FIGURE 35
RESERVOIR 4 (OU #3) DEMOLITION PLAN
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET ENVIRONMENTAL, INC.
REFERENCE:
TOPOGRAPHIC CONTOURS PROVIDED BY EDA, INC., DATED JULY 11, 2007.
CLEAR AND GRUB LINE
4" DIA. FIRE WATER DISTRIBUTION LINE
EXISTING BARBED-WIRE FENCE REMOVE AND DISPOSE
EXISTING WETLAND 0.027 Ac REMOVE
REMOVE AND DISPOSE
BARBED-WIRE FENCE REMOVE AND DISPOSE
CONCRETE FOUNDATION LIGHTENING TOWER No. 2 REMOVE AND DISPOSE
APPROXIMATE LOCATION OF FORMER CONCRETE FOUNDATION OF FORMER RESERVOIR WALL
FORMER CRUDE-OIL PIPELINE
EXISTING WETLAND 0.033 Ac REMOVE
SP-7 (2 CASINGS) ABANDON
EXISTING FENCE PROTECT-IN-PLACE
EXISTING FENCE REMOVE AND DISPOSE
EXISTING WETLAND 0.008 Ac REMOVE
ASPHALTIC MATERIAL
ASPHALTIC LOCATION OF ROOF FOUNDATION
MONITORING WELL TMW-2 ABANDON
NEW FENCE
EXISTING WETLAND 0.053 Ac REMOVE
WOOD FRAME TEST PLOT REMOVE AND DISPOSE
EXISTING WETLAND 0.318 Ac REMOVE TO CLEAR AND GRUB LINE
WOOD FRAME TEST PLOT REMOVE AND DISPOSE
MONITORING WELL TMW-9 ABANDON
SP-6 (2 CASINGS) ABANDON
WOOD FRAME TEST PLOTS REMOVE AND DISPOSE
CONCRETE FOUNDATION LIGHTENING TOWER No. 1 REMOVE AND DISPOSE
EXISTING WETLAND .0125 Ac REMOVE
EXISTING WETLAND .007 Ac REMOVE
FORMER 10-INCH CRUDE-OIL LINE REMOVE AND DISPOSE
FORMER PUMP-HOUSE CONCRETE FOUNDATIONS REMOVE AND DISPOSE
ABANDON FENCE
EXISTING UTILITY POLES PROTECT-IN-PLACE
EXISTING WETLAND 0.044 Ac REMOVE
CUT AND CAP WATERLINE
EXISTING WETLAND PROTECT-IN-PLACE
EXISTING PROPANE CANON TO BE REMOVED BY CHEVRON
APPROXIMATE LOCATION OF EXPOSED WATER LINE REMOVE AND DISPOSE
APPROXIMATE LOCATION OF FORMER TANK GAUGING CABLE
CUT AND CAP CRUDE-OIL LINE
TANK FARM ROAD
MONITORING WELL TMW-9 ABANDON
V:\1212_Pacific-Chevron_SLOTF\1212.001_Remedial_Design\001_1212.001_Reservoir_4_Demolition_Plan.dwg\12/18/07



SCHEDULE OF MONITORING WELL ABANDONMENT				
WELL I.D.	NORTHING (FT)	EASTING (FT)	TOTAL DEPTH (FT)	MATERIAL OF CONSTRUCTION
MW-13	2,287,606.00	5,769,671.00	117.57	PVC
TMW-4	2,287,558.00	5,769,671.00	147.62	PVC

NOTES:

1. CLEAR AND GRUB WITH THIS BOUNDARY. AREA WITHIN THIS BOUNDARY IS CONSIDERED THE WORK AREA FOR THIS PORTION OF THE PROJECT. CLEARING SHALL INCLUDE, IN ADDITION TO VEGETATION AND UNLESS OTHERWISE NOTED, REMOVAL AND DISPOSAL OF ALL CONCRETE DEBRIS, STRUCTURES, FEATURES, MONITORING WELLS, AND HYDROCARBON IMPACTED SOIL.
2. MONITORING WELLS WITHIN THE WORK AREA SHALL BE ABANDONED IN ACCORDANCE WITH THE REQUIREMENTS OF SAN LUIS OBISPO COUNTY DEPARTMENT OF ENVIRONMENTAL HEALTH AND WITH CALIFORNIA DEPARTMENT OF WATER RESOURCES BULLETIN NO. 74-81.
3. WETLANDS WITHIN THE CLEAR AND GRUB BOUNDARY SHALL BE PERMANENTLY REMOVED. WETLANDS OUTSIDE THE CLEAR AND GRUB LINE SHALL BE PROTECTED-IN-PLACE. THOSE WETLANDS ADJACENT TO THE WORK AREA SHALL BE PROTECTED AS DESCRIBED IN THE SPECIAL PROVISIONS.
4. THE EXISTING POWER POLES CARRY ACTIVE POWER LINES BELONGING TO PG&E, AND TELECOMMUNICATION LINES BELONGING TO AT&T OR CHARTER CABLE. CONTRACTOR SHALL TEMPORARILY RELOCATE LINES OUTSIDE THE WORK AREA DURING GRADING ACTIVITIES. THE CONTRACTOR SHALL COORDINATE WITH PG&E AND AT&T IF RELOCATION IS NECESSARY.
5. FENCE WITHIN THE CLEAR AND GRUB LINE SHALL BE REMOVED. FENCE OUTSIDE THE WORK AREA SHALL BE PROTECTED-IN-PLACE. GAPS IN THE FENCE ALLOWING ACCESS TO THE PROPERTY FROM OFF-SITE SHALL BE CLOSED BY NEW FENCE OUTSIDE THE WORK AREA.

REFERENCE:

TOPOGRAPHIC CONTOURS AND FEATURES PROVIDED BY EDA, INC., DATED JULY 11, 2007.

FIGURE 36

FLOWER MOUND DEMOLITION PLAN

REMEDIAL ACTION PLAN
SAN LUIS OBISPO, CALIFORNIA

PREPARED FOR

CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA

AVOCET ENVIRONMENTAL, INC.

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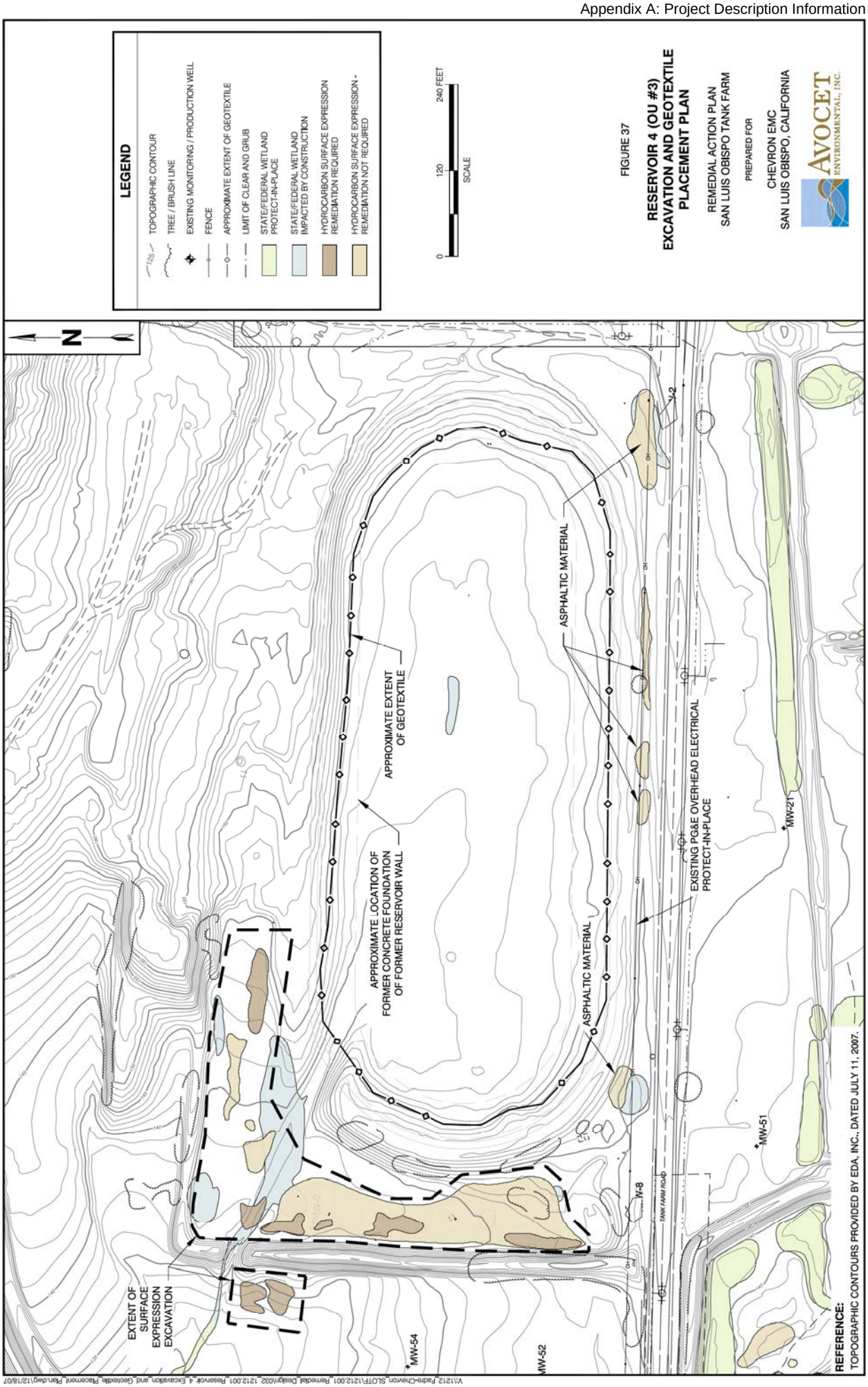
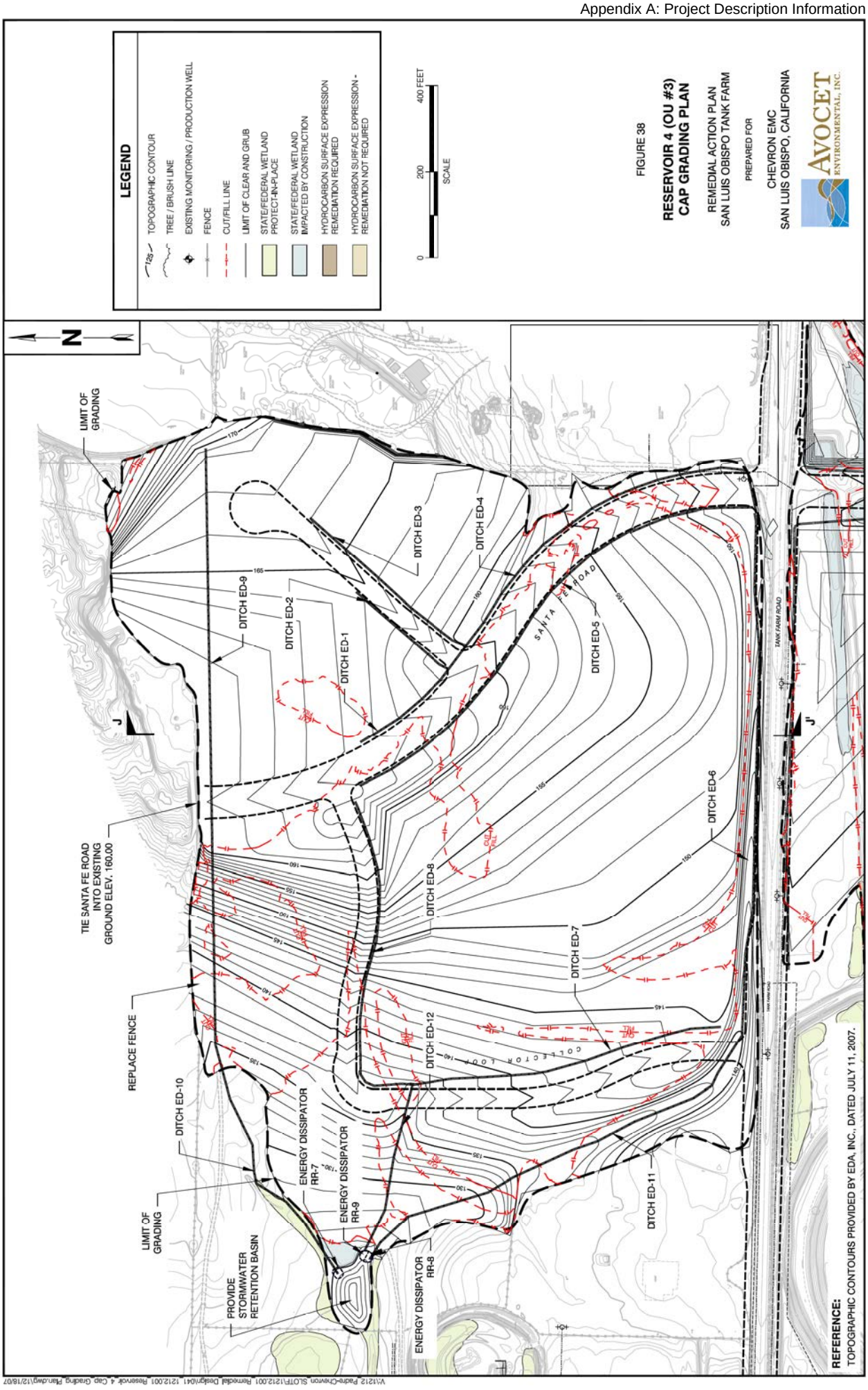
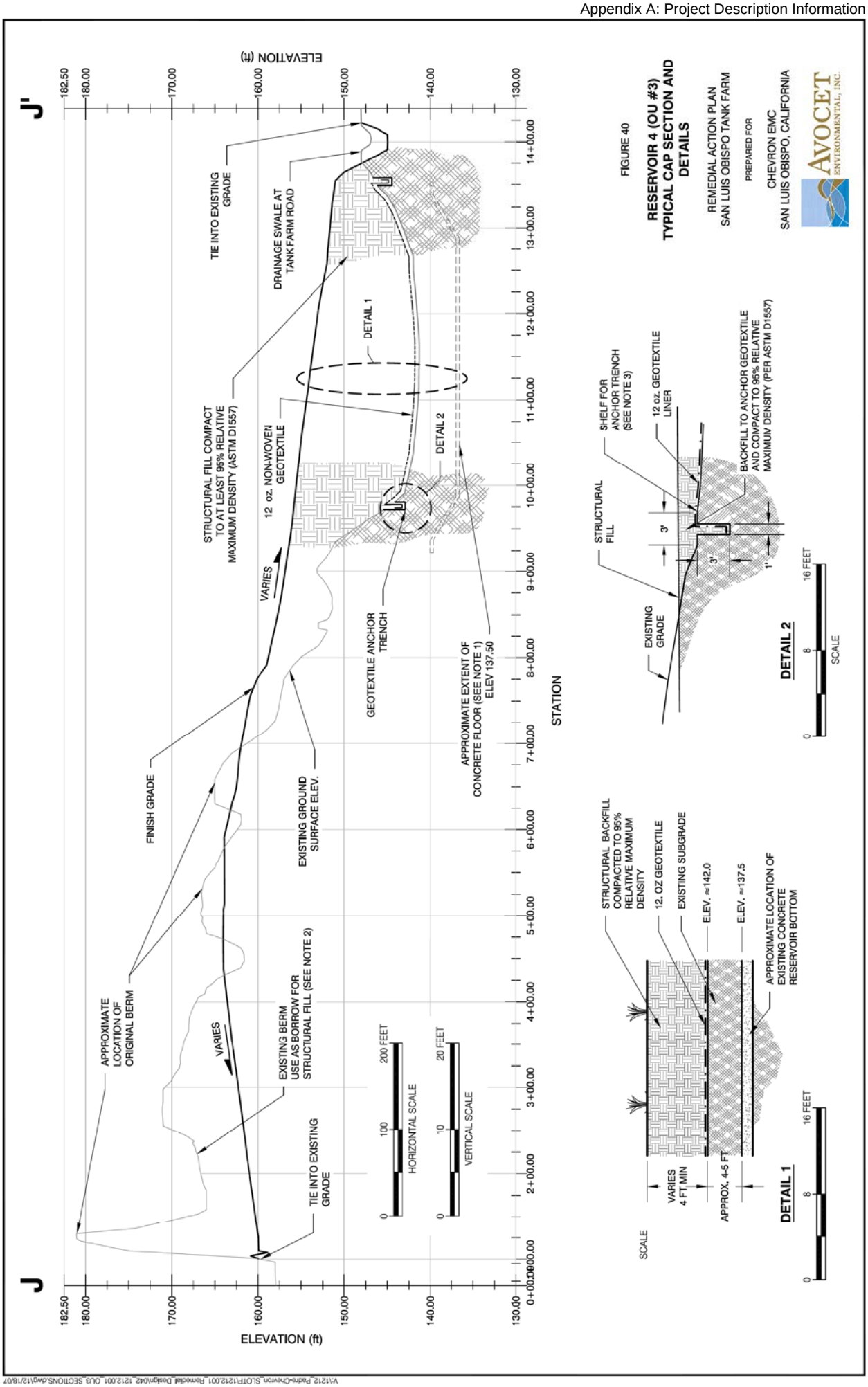
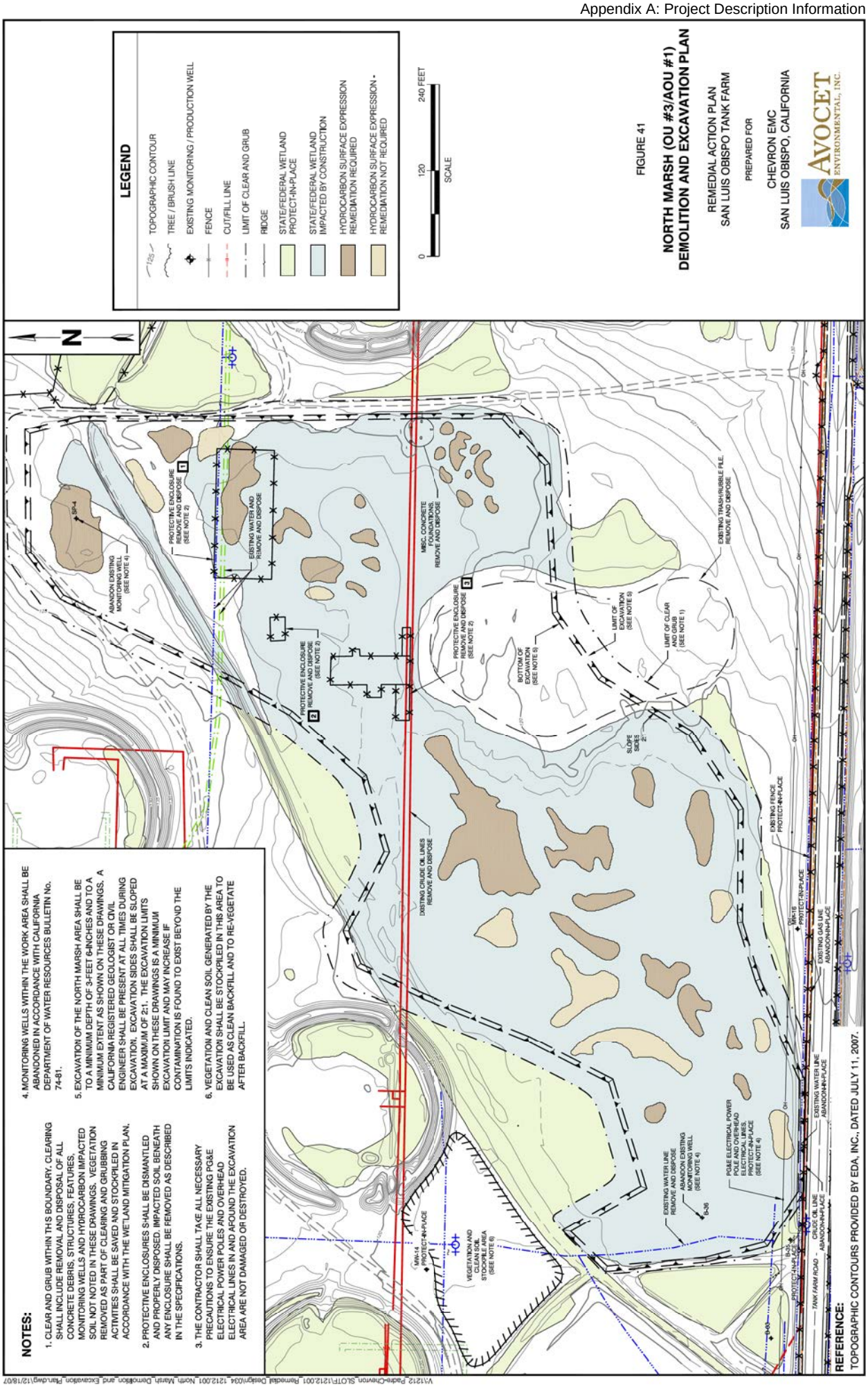
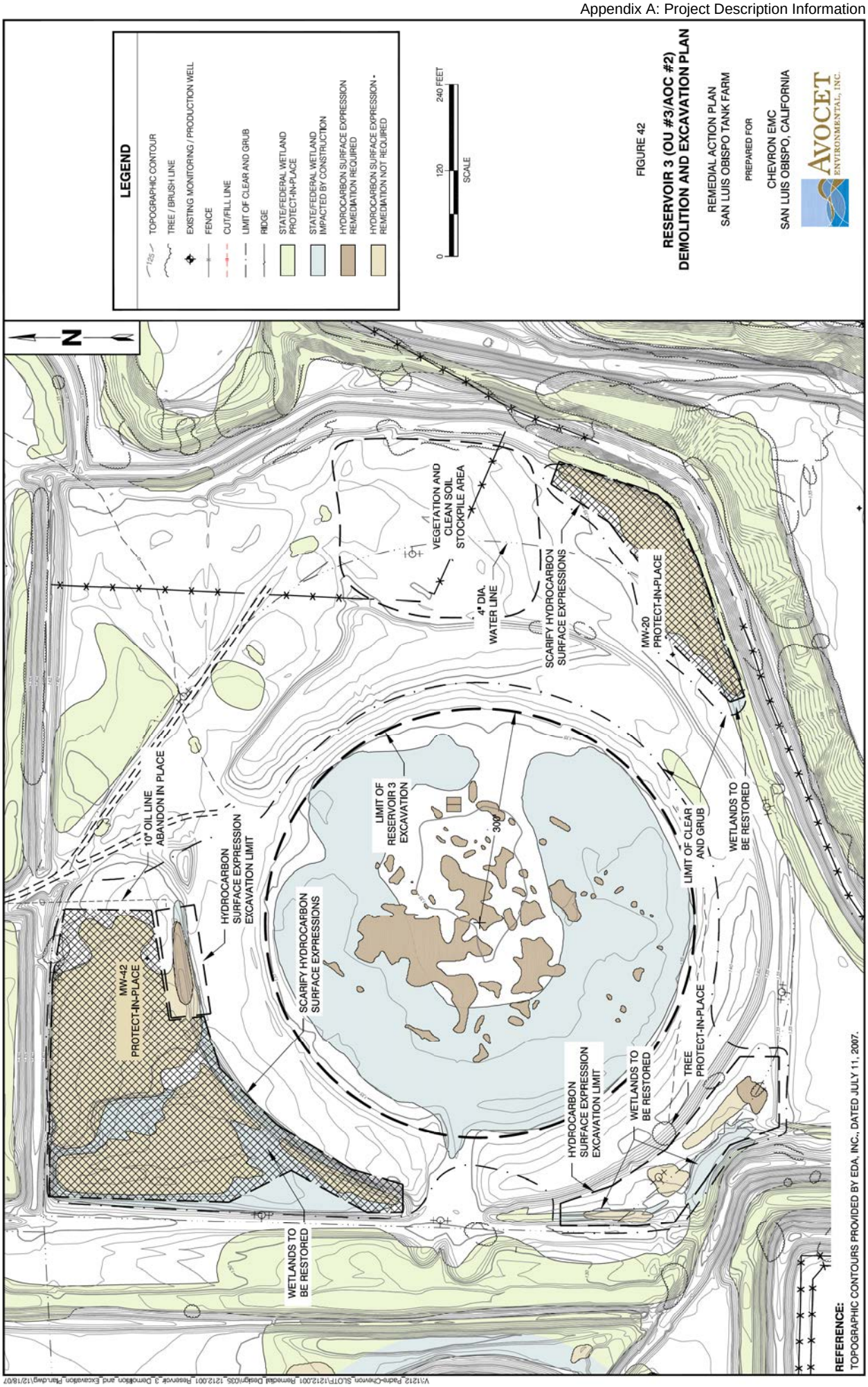

LEGEND
TOPOGRAPHIC CONTOUR
TREE / BRUSH LINE
EXISTING MONITORING / PRODUCTION WELL
FENCE
APPROXIMATE EXTENT OF GEOTEXTILE
LIMIT OF CLEAR AND GRUB
STATE/FEDERAL WETLAND PROTECT-IN-PLACE
STATE/FEDERAL WETLAND IMPACTED BY CONSTRUCTION
HYDROCARBON SURFACE EXPRESSION REMEDIATION REQUIRED
HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED
0
120
240 FEET
SCALE
FIGURE 37
RESERVOIR 4 (OU #3)
EXCAVATION AND GEOTEXTILE PLACEMENT PLAN
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET
ENVIRONMENTAL, INC.
N
APPROXIMATE EXTENT OF GEOTEXTILE
ASPHALTIC MATERIAL
APPROXIMATE LOCATION OF FORMER CONCRETE FOUNDATION OF FORMER RESERVOIR WALL
EXISTING PG&E OVERHEAD ELECTRICAL PROTECT-IN-PLACE
EXTENT OF SURFACE EXPRESSION EXCAVATION
MW-54
MW-52
MW-51
MW-21
W-8
W-2
TANK FARM ROAD
REFERENCE:
TOPOGRAPHIC CONTOURS PROVIDED BY EDA, INC., DATED JULY 11, 2007.


LEGEND
TOPOGRAPHIC CONTOUR
TREE / BRUSH LINE
EXISTING MONITORING / PRODUCTION WELL
FENCE
CUT/FILL LINE
LIMIT OF CLEAR AND GRUB
STATE/FEDERAL WETLAND PROTECT-IN-PLACE
STATE/FEDERAL WETLAND IMPACTED BY CONSTRUCTION
HYDROCARBON SURFACE EXPRESSION REMEDIATION REQUIRED
HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED
0
200
400 FEET
SCALE
FIGURE 38
RESERVOIR 4 (OU #3)
CAP GRADING PLAN
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET
ENVIRONMENTAL, INC.
N
LIMIT OF GRADING
TIE SANTA FE ROAD INTO EXISTING GROUND ELEV. 160.00
REPLACE FENCE
DITCH ED-10
LIMIT OF GRADING
PROVIDE STORMWATER RETENTION BASIN
ENERGY DISSIPATOR RR-7
ENERGY DISSIPATOR RR-9
ENERGY DISSIPATOR RR-8
DITCH ED-9
DITCH ED-2
DITCH ED-1
DITCH ED-3
DITCH ED-4
DITCH ED-5
DITCH ED-6
DITCH ED-7
DITCH ED-8
DITCH ED-12
DITCH ED-11
SANTA FE ROAD
COLLECTOR FOOT
TANK FARM ROAD
REFERENCE:
TOPOGRAPHIC CONTOURS PROVIDED BY EDA, INC., DATED JULY 11, 2007.

N
DITCH BA-7
DITCH BA-8
ENERGY DISSIPATOR RR-12
ENERGY DISSIPATOR RR-11
DITCH BA-2
DITCH BA-3
DITCH BA-4
DITCH BA-6
DITCH BA-5
ENERGY DISSIPATOR RR-10
HP 147.40
HP 148.50
TANK FARM ROAD
EXTENT OF PROPOSED TANK FARM ROAD EXPANSION
EXTENT OF EXISTING TANK FARM ROAD
DITCH ED-6
DITCH BA-1
CUT
FILL
LEGEND
TOPOGRAPHIC CONTOUR
TREE / BRUSH LINE
FENCE
SITE PROPERTY BOUNDARY
CUT/FILL LINE
EXISTING MONITORING / PRODUCTION WELL
STATE / FEDERAL WETLAND - PROTECT-IN-PLACE
STATE / FEDERAL WETLAND - IMPACTED BY CONSTRUCTION
HYDROCARBON SURFACE EXPRESSION - REMEDIATION REQUIRED
HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED
0
150
300 FEET
SCALE
FIGURE 39
BORROW AREA NO. 2 GRADING PLAN
REMEDIAL ACTION PLAN
SAN LUIS OBISPO, CALIFORNIA
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET
ENVIRONMENTAL, INC.


J
J'
ELEVATION (ft)
182.50
180.00
170.00
160.00
150.00
140.00
130.00
0+00.00
2+00.00
3+00.00
4+00.00
5+00.00
6+00.00
7+00.00
8+00.00
9+00.00
10+00.00
11+00.00
12+00.00
13+00.00
14+00.00
STATION
APPROXIMATE LOCATION OF ORIGINAL BERM
FINISH GRADE
VARIES
EXISTING BERM USE AS BORROW FOR STRUCTURAL FILL (SEE NOTE 2)
TIE INTO EXISTING GRADE
EXISTING GROUND SURFACE ELEV.
STRUCTURAL FILL COMPACT TO AT LEAST 95% RELATIVE MAXIMUM DENSITY (ASTM D1557)
12 oz. NON-WOVEN GEOTEXTILE
VARIES
GEOTEXTILE ANCHOR TRENCH
APPROXIMATE EXTENT OF CONCRETE FLOOR (SEE NOTE 1) ELEV 137.50
DETAIL 2
DETAIL 1
DRAINAGE SWALE AT TANK FARM ROAD
TIE INTO EXISTING GRADE
0
100
200 FEET
HORIZONTAL SCALE
0
10
20 FEET
VERTICAL SCALE
FIGURE 40
RESERVOIR 4 (OU #3)
TYPICAL CAP SECTION AND DETAILS
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET ENVIRONMENTAL, INC.
SHELF FOR ANCHOR TRENCH (SEE NOTE 3)
12 oz. GEOTEXTILE LINER
BACKFILL TO ANCHOR GEOTEXTILE AND COMPACT TO 95% RELATIVE MAXIMUM DENSITY (PER ASTM D1557)
STRUCTURAL FILL
EXISTING GRADE
3'
3'
1'
DETAIL 2
0
8
16 FEET
SCALE
STRUCTURAL BACKFILL COMPACTED TO 95% RELATIVE MAXIMUM DENSITY
12. OZ GEOTEXTILE
EXISTING SUBGRADE
ELEV. ≈142.0
ELEV. ≈137.5
APPROXIMATE LOCATION OF EXISTING CONCRETE RESERVOIR BOTTOM
VARIES 4 FT MIN
APPROX. 4-5 FT
DETAIL 1
0
8
16 FEET
SCALE


LEGEND
TOPOGRAPHIC CONTOUR
TREE / BRUSH LINE
EXISTING MONITORING / PRODUCTION WELL
FENCE
CUT/FILL LINE
LIMIT OF CLEAR AND GRUB
RIDGE
STATE/FEDERAL WETLAND PROTECT-IN-PLACE
STATE/FEDERAL WETLAND IMPACTED BY CONSTRUCTION
HYDROCARBON SURFACE EXPRESSION REMEDIATION REQUIRED
HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED
0
120
240 FEET
SCALE
FIGURE 41
NORTH MARSH (OU #3/AOU #1)
DEMOLITION AND EXCAVATION PLAN
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET
ENVIRONMENTAL, INC.
NOTES:
1. CLEAR AND GRUB WITHIN THIS BOUNDARY. CLEARING SHALL INCLUDE REMOVAL AND DISPOSAL OF ALL CONCRETE DEBRIS, STRUCTURES, FEATURES, MONITORING WELLS AND HYDROCARBON IMPACTED SOIL NOT NOTED IN THESE DRAWINGS. VEGETATION REMOVED AS PART OF CLEARING AND GRUBBING ACTIVITIES SHALL BE SAVED AND STOCKPILED IN ACCORDANCE WITH THE WETLAND MITIGATION PLAN.
2. PROTECTIVE ENCLOSURES SHALL BE DISMANTLED AND PROPERLY DISPOSED. IMPACTED SOIL BENEATH ANY ENCLOSURE SHALL BE REMOVED AS DESCRIBED IN THE SPECIFICATIONS.
3. THE CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO ENSURE THE EXISTING PG&E ELECTRICAL POWER POLES AND OVERHEAD ELECTRICAL LINES IN AND AROUND THE EXCAVATION AREA ARE NOT DAMAGED OR DESTROYED.
4. MONITORING WELLS WITHIN THE WORK AREA SHALL BE ABANDONED IN ACCORDANCE WITH CALIFORNIA DEPARTMENT OF WATER RESOURCES BULLETIN No. 74-81.
5. EXCAVATION OF THE NORTH MARSH AREA SHALL BE TO A MINIMUM DEPTH OF 3-FEET 6-INCHES AND TO A MINIMUM EXTENT AS SHOWN ON THESE DRAWINGS. A CALIFORNIA REGISTERED GEOLOGIST OR CIVIL ENGINEER SHALL BE PRESENT AT ALL TIMES DURING EXCAVATION. EXCAVATION SIDES SHALL BE SLOPED AT A MAXIMUM OF 2:1. THE EXCAVATION LIMITS SHOWN ON THESE DRAWINGS IS A MINIMUM EXCAVATION LIMIT AND MAY INCREASE IF CONTAMINATION IS FOUND TO EXIST BEYOND THE LIMITS INDICATED.
6. VEGETATION AND CLEAN SOIL GENERATED BY THE EXCAVATION SHALL BE STOCKPILED IN THIS AREA TO BE USED AS CLEAN BACKFILL AND TO RE-VEGETATE AFTER BACKFILL.
REFERENCE:
TOPOGRAPHIC CONTOURS PROVIDED BY EDA, INC., DATED JULY 11, 2007.
N
PROTECTIVE ENCLOSURE REMOVE AND DISPOSE (SEE NOTE 2)
EXISTING WATER AND REMOVE AND DISPOSE
ABANDON EXISTING MONITORING WELL (SEE NOTE 4)
SP-4
MISC. CONCRETE FOUNDATIONS REMOVE AND DISPOSE
EXISTING TRASH/RUBBLE PILE. REMOVE AND DISPOSE
LIMIT OF EXCAVATION (SEE NOTE 5)
LIMIT OF CLEAR AND GRUB (SEE NOTE 1)
BOTTOM OF EXCAVATION (SEE NOTE 5)
SLOPE SIDES 2:1
EXISTING CRUDE OIL LINES REMOVE AND DISPOSE
EXISTING FENCE PROTECT-IN-PLACE
MW-16
PROTECT-IN-PLACE
EXISTING GAS LINE ABANDON-IN-PLACE
EXISTING WATER LINE ABANDON-IN-PLACE
PG&E ELECTRICAL POWER POLE AND OVERHEAD ELECTRICAL LINES. PROTECT-IN-PLACE (SEE NOTE 4)
EXISTING WATER LINE REMOVE AND DISPOSE
ABANDON EXISTING MONITORING WELL (SEE NOTE 4)
B-36
VEGETATION AND CLEAN SOIL STOCKPILE AREA (SEE NOTE 6)
MW-14
PROTECT-IN-PLACE
B-35
B-34
PROTECT-IN-PLACE
B-33
TANK FARM ROAD
CRUDE OIL LINE ABANDON-IN-PLACE
V:\1212 Paderi-Chevron_SLOTF\1212.001 Remedial Design\034 1212.001 North Marsh Demolition and Excavation Plan.dwg\12/18/07


LEGEND
TOPOGRAPHIC CONTOUR
TREE / BRUSH LINE
EXISTING MONITORING / PRODUCTION WELL
FENCE
CUT/FILL LINE
LIMIT OF CLEAR AND GRUB
RIDGE
STATE/FEDERAL WETLAND PROTECT-IN-PLACE
STATE/FEDERAL WETLAND IMPACTED BY CONSTRUCTION
HYDROCARBON SURFACE EXPRESSION REMEDIATION REQUIRED
HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED
0
120
240 FEET
SCALE
FIGURE 42
RESERVOIR 3 (OU #3/AOC #2)
DEMOLITION AND EXCAVATION PLAN
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET
ENVIRONMENTAL, INC.
N
VEGETATION AND CLEAN SOIL STOCKPILE AREA
4" DIA. WATER LINE
SCARIFY HYDROCARBON SURFACE EXPRESSIONS
MW-20 PROTECT-IN-PLACE
10" OIL LINE ABANDON IN PLACE
HYDROCARBON SURFACE EXPRESSION EXCAVATION LIMIT
LIMIT OF RESERVOIR 3 EXCAVATION
300'
LIMIT OF CLEAR AND GRUB
WETLANDS TO BE RESTORED
MW-42 PROTECT-IN-PLACE
SCARIFY HYDROCARBON SURFACE EXPRESSIONS
TREE PROTECT-IN-PLACE
HYDROCARBON SURFACE EXPRESSION EXCAVATION LIMIT
WETLANDS TO BE RESTORED
WETLANDS TO BE RESTORED
REFERENCE:
TOPOGRAPHIC CONTOURS PROVIDED BY EDA, INC., DATED JULY 11, 2007.

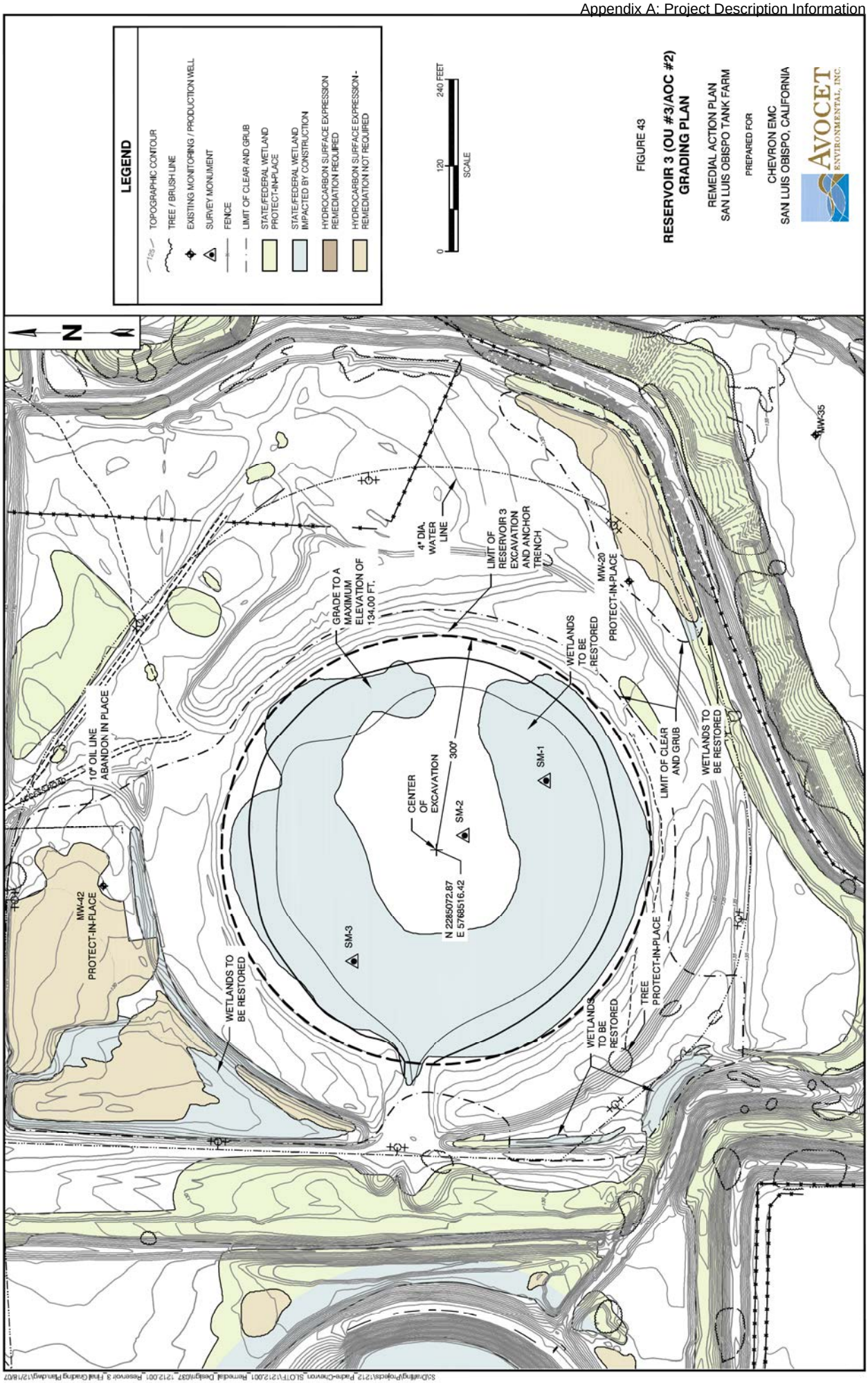


FIGURE 43

RESERVOIR 3 (OU #3/AOC #2) GRADING PLAN

REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM

PREPARED FOR

CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA

AVOCET ENVIRONMENTAL, INC.

S:\Drafting\Projects\1212 Parke-Chevron_SLOTF\1212001_Remedial_Design\037_1212001_Reservoir 3_Final Grading Plan.dwg\12/18/07

V:\1212_Padre-Chevron_SLOTF\1212.001_Remedial_Design\038_1212.001_Reservoir 3_Typical Section.dwg\12/18/07

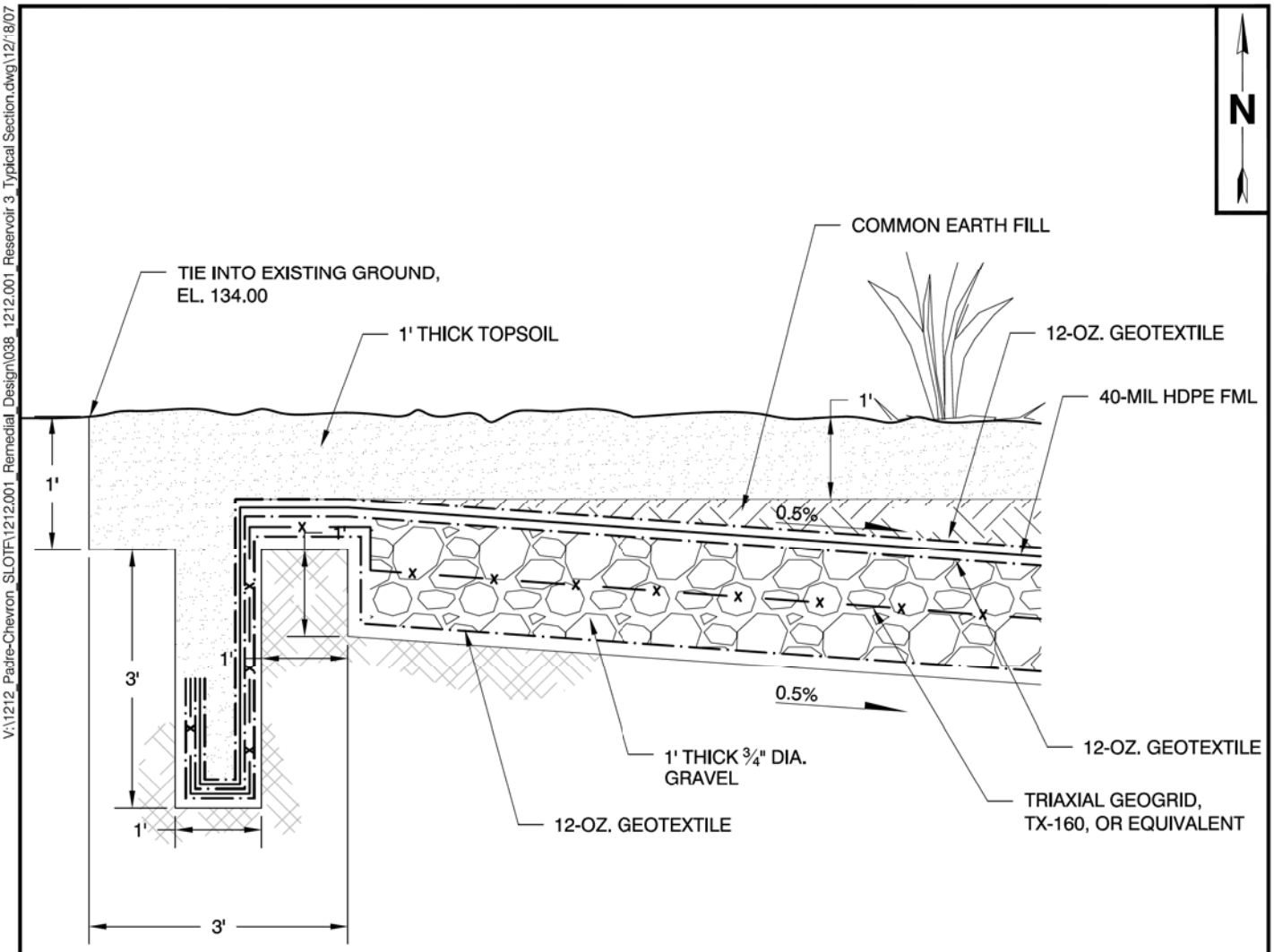


FIGURE 44

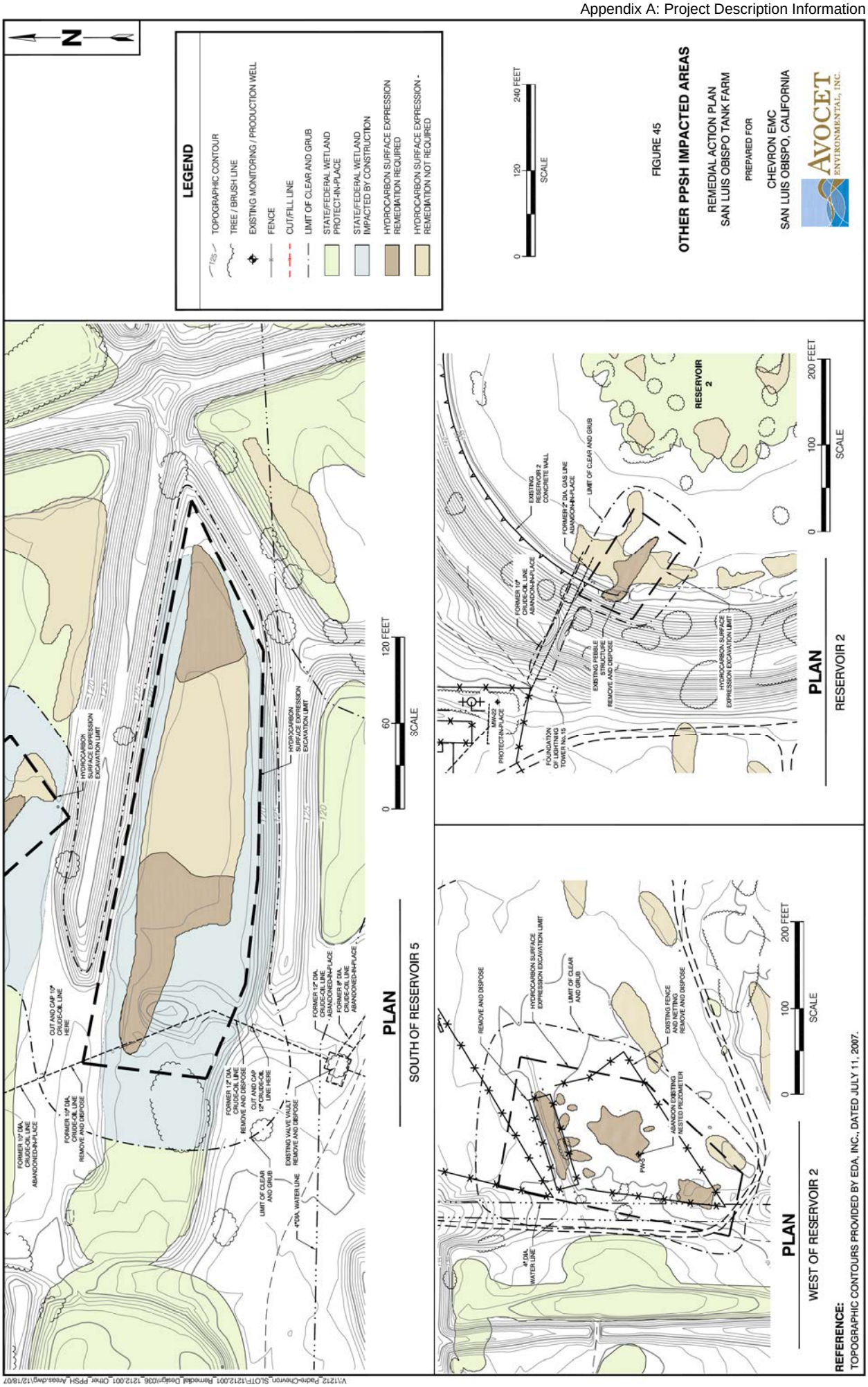
RESERVOIR 3 (OU #3/AOC #2)
TYPICAL SECTION

REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM

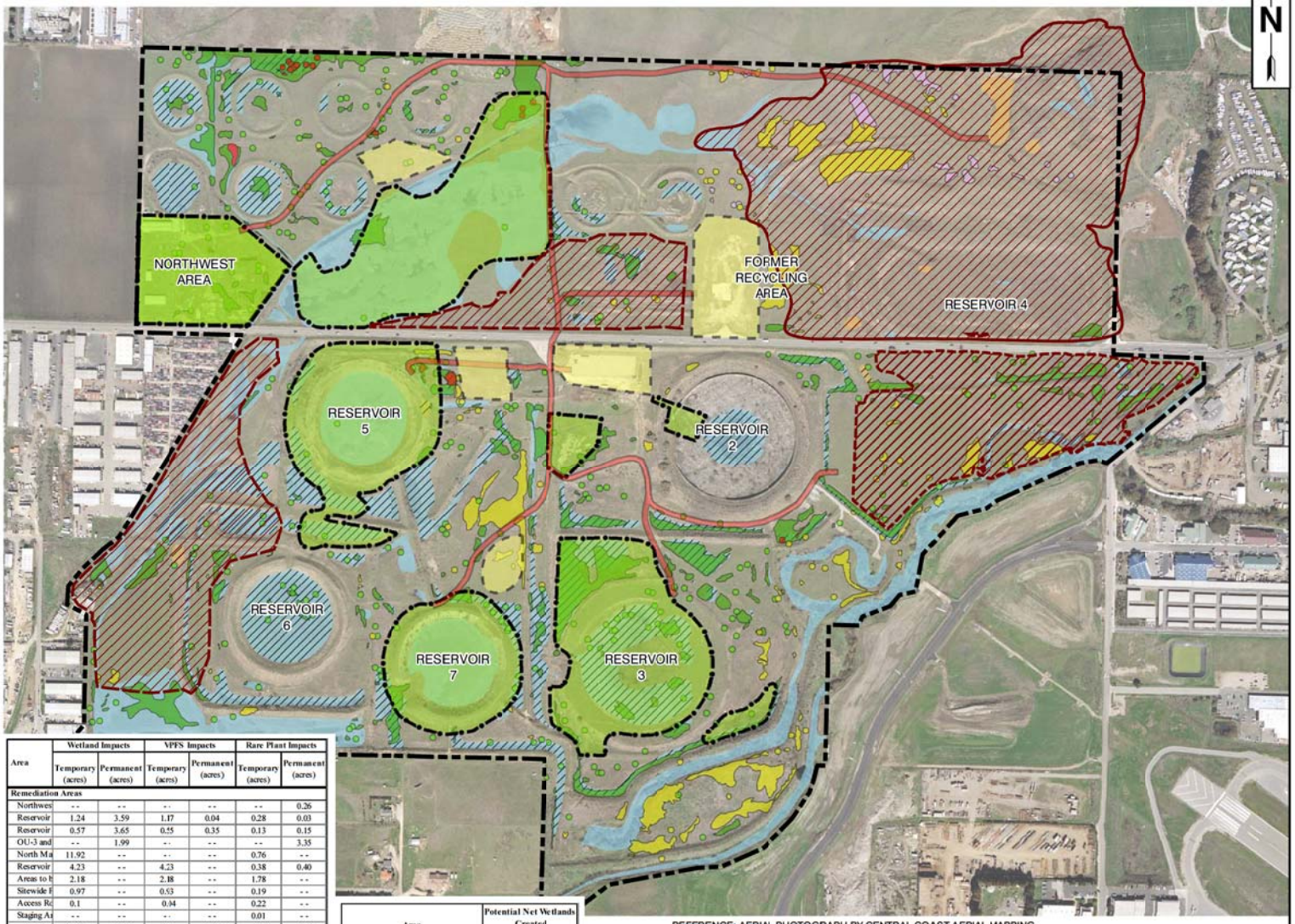
PREPARED FOR

CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA

AVOCET
ENVIRONMENTAL, INC.


N
LEGEND
TOPOGRAPHIC CONTOUR
TREE / BRUSH LINE
EXISTING MONITORING / PRODUCTION WELL
FENCE
CUT/FILL LINE
LIMIT OF CLEAR AND GRUB
STATE/FEDERAL WETLAND PROTECT-IN-PLACE
STATE/FEDERAL WETLAND IMPACTED BY CONSTRUCTION
HYDROCARBON SURFACE EXPRESSION REMEDIATION REQUIRED
HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED
0 120 240 FEET
SCALE
FIGURE 45
OTHER PPSH IMPACTED AREAS
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET ENVIRONMENTAL, INC.
PLAN
SOUTH OF RESERVOIR 5
0 60 120 FEET
SCALE
HYDROCARBON SURFACE EXPRESSION EXCAVATION LIMIT
CUT AND CAP 10" CRUDE-OIL LINE HERE
FORMER 10" DIA. CRUDE-OIL LINE ABANDONED-IN-PLACE
FORMER 10" DIA. CRUDE-OIL LINE REMOVE AND DISPOSE
FORMER 12" DIA. CRUDE-OIL LINE REMOVE AND DISPOSE
CUT AND CAP 12" CRUDE-OIL LINE HERE
LIMIT OF CLEAR AND GRUB
4" DIA. WATER LINE
EXISTING VALVE VAULT REMOVE AND DISPOSE
FORMER 12" DIA. CRUDE-OIL LINE - ABANDONED-IN-PLACE
FORMER 8" DIA. CRUDE-OIL LINE ABANDONED-IN-PLACE
PLAN
RESERVOIR 2
0 100 200 FEET
SCALE
RESERVOIR 2
EXISTING RESERVOIR 2 CONCRETE WALL
FORMER 2" DIA. GAS LINE ABANDON-IN-PLACE
LIMIT OF CLEAR AND GRUB
FORMER 10" CRUDE-OIL LINE ABANDON-IN-PLACE
EXISTING FRIABLE STRUCTURE REMOVE AND DISPOSE
HYDROCARBON SURFACE EXPRESSION EXCAVATION LIMIT
MW-22 PROTECT-IN-PLACE
FOUNDATION OF LATTICE TOWER No. 15
PLAN
WEST OF RESERVOIR 2
0 100 200 FEET
SCALE
REMOVE AND DISPOSE
HYDROCARBON SURFACE EXPRESSION EXCAVATION LIMIT
LIMIT OF CLEAR AND GRUB
EXISTING FENCE AND NETTING REMOVE AND DISPOSE
ABANDON EXISTING NESTED PIEZOMETER
PW-2
4" DIA. WATER LINE
REFERENCE:
TOPOGRAPHIC CONTOURS PROVIDED BY EDA, INC., DATED JULY 11, 2007.
V:\1212_Pacific-Chevron_SLOTF\121200.1_Remedial_Design\036_121200.1_Other_PPSH_Areas.dwg\12/18/07

S:\GIS\1212_Chevron_Pedro_SLOTF\001_Remedial_Design\ArcMapDocuments\018_1212\001_Areas_of_Habitat_Impact.mxd\12/18/07



Area	Wetland Impacts		VPFS Impacts		Rare Plant Impacts	
	Temporary (acres)	Permanent (acres)	Temporary (acres)	Permanent (acres)	Temporary (acres)	Permanent (acres)
Remediation Areas						
Northwes	- -	- -	- -	- -	- -	0.26
Reservoir	1.24	3.59	1.17	0.04	0.28	0.03
Reservoir	0.57	3.65	0.55	0.35	0.13	0.15
OU-3 and	- -	1.99	- -	- -	- -	3.35
North Ma	11.92	- -	- -	- -	0.76	- -
Reservoir	4.23	- -	4.23	- -	0.38	0.40
Areas to b	2.18	- -	2.18	- -	1.78	- -
Sitewide I	0.97	- -	0.93	- -	0.19	- -
Access Re	0.1	- -	0.04	- -	0.22	- -
Staging Ar	- -	- -	- -	- -	0.01	- -
Total	21.21	9.23	9.1	0.39	3.75	4.19
Borrow Areas						
Borrow A	0.77	- -	0.67	- -	0.37	- -
Borrow A	- -	0.98	- -	0.67	0.20	1.38
Borrow A	6.59	- -	3.12	- -	0.92	- -

Area	Potential Net Wetlands Created (acres)
Borrow Area No. 1	7.84
Borrow Area No. 3	10.92

REFERENCE: AERIAL PHOTOGRAPH BY CENTRAL COAST AERIAL MAPPING. DATED MARCH 2, 2007

SOURCE: BIOLOGICAL RESOURCES MAPPING CONDUCTED BY RINCON CONSULTANTS INC., 2003. FIELD STUDIES PERFORMED MAY THROUGH SEPTEMBER 2003.

EXPLANATION

PROJECT AREA BOUNDARY

EPHEMERAL WATER
- PROTECTED FAIRY SHRIMP NOT PRESENT
- PROTECTED FAIRY SHRIMP PRESENT

DELINEATED WETLAND
- PROTECTED FAIRY SHRIMP NOT PRESENT (75.95 acres)
- PROTECTED FAIRY SHRIMP PRESENT (32.125 acres)

SMALL AREAS WITH LESS THAN 100 INDIVIDUALS
- CONGDON'S TARPLANT
- HOOVER'S BUTTON CELERY
- PURPLE NEEDLEGRASS
- SAN LUIS OBISPO MORNING GLORY

LARGE AREAS WITH GREATER THAN OR LESS THAN 1000 INDIVIDUALS
- CONGDON'S TARPLANT
- HOOVER'S BUTTON CELERY
- PURPLE NEEDLEGRASS
- SAN LUIS OBISPO MORNING GLORY

HABITAT IMPACT
- WORK AREAS
- STAGING AREAS
- BORROW SOURCE AREAS
- ACCESS ROADS

0 250 500 1,000 Feet

Approximate Scale

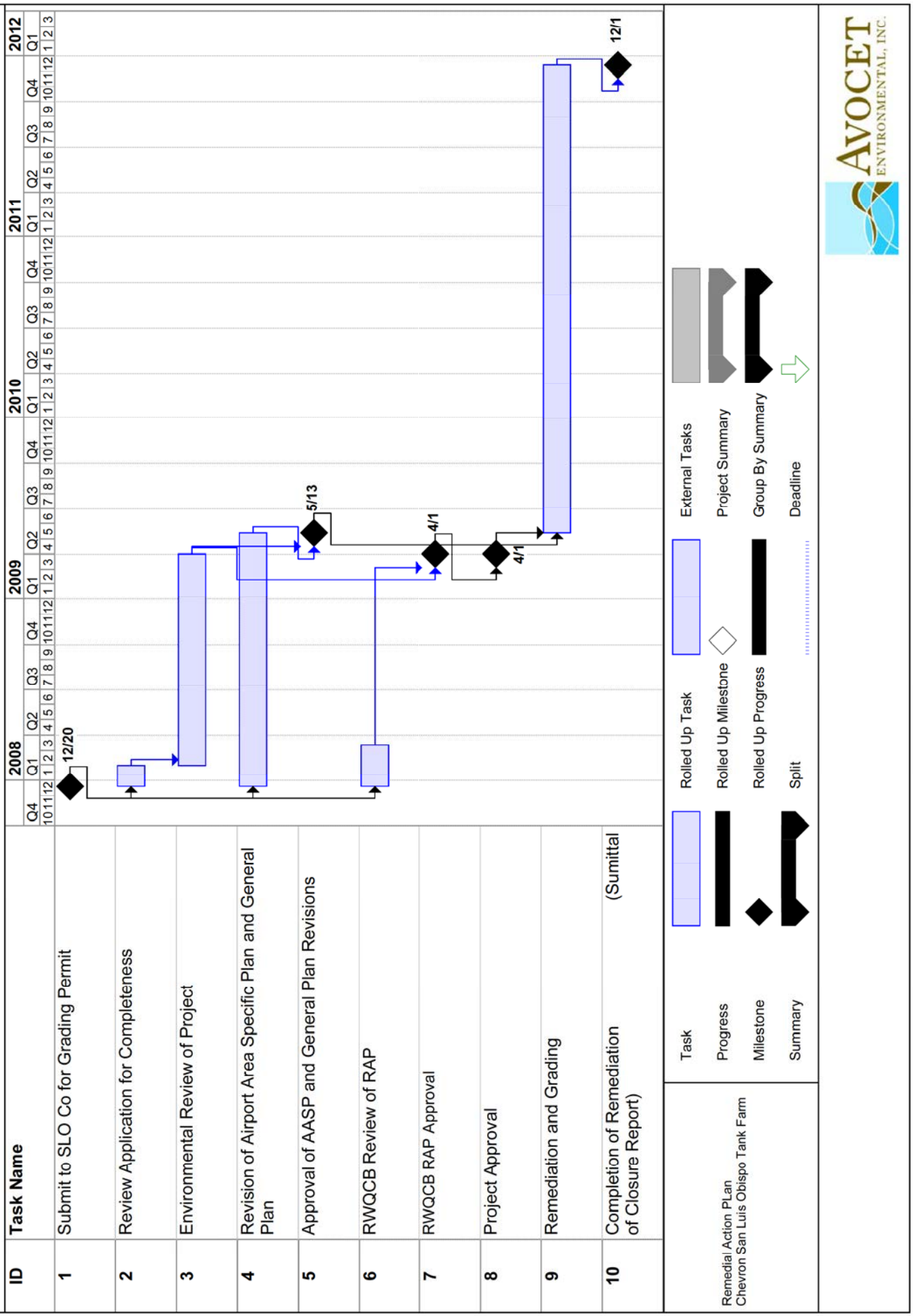
FIGURE 46

AREAS OF HABITAT IMPACT

REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA

AVOCET ENVIRONMENTAL, INC.

Figure 47
Preliminary Schedule



Appendix A

Report CD

Appendix B

Monitoring and Reporting Program 93-120 and Supporting Documents

Appendix C

Remedial Design Drawings

PREPARED FOR

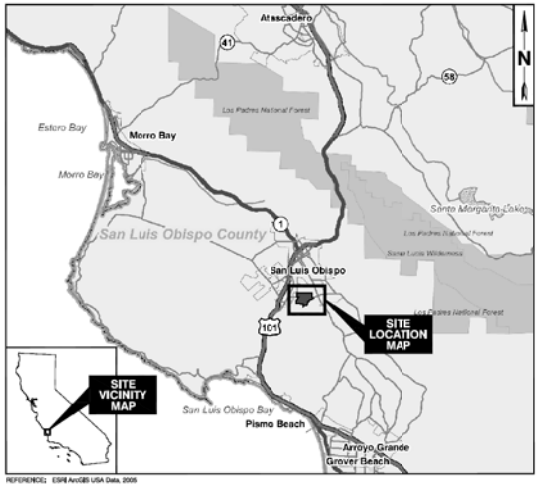
CHEVRON CORPORATION
SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN

SAN LUIS OBISPO TANK FARM
SAN LUIS OBISPO, CALIFORNIA

INDEX OF DRAWINGS

G01	INDEX OF DRAWINGS, SITE VICINITY MAP, AND SITE LOCATION MAP
G02	LEGEND AND ABBREVIATIONS
G03	GENERAL NOTES AND ESTIMATION OF CONSTRUCTION QUANTITIES
G04	SITE PLAN AND BORROW SOURCES
G05	SITE ACCESS AND STAGING
G06	MONITORING WELL ABANDONMENT PLAN
G07	EXISTING AND HISTORICAL SITEWIDE PIPELINE AND UTILITY PLAN
G08	EXISTING AND HISTORICAL OPERATIONS AREA PIPELINE AND UTILITY PLAN
G09	EXISTING NON-CHEVRON UTILITY MAP
G10	STORMWATER MANAGEMENT - BEST MANAGEMENT PRACTICES
G11	SHEET KEY
C01	OU #1 - NORTHWEST OPERATIONS AREA - EXISTING SITE PLAN
C02	OU #1 - NORTHWEST OPERATIONS AREA - DEMOLITION AND SUBGRADE PREPARATION PLAN
C03	OU #1 - NORTHWEST OPERATIONS AREA - FINAL GRADE PLAN
C04	OU #1 - NORTHWEST OPERATIONS AREA - CROSS SECTIONS
C05	OU #1 - NORTHWEST OPERATIONS AREA - SECTIONS AND DETAILS
C06	OU #2 - RESERVOIR 5 - EXISTING CONDITIONS AND DEMOLITION PLAN
C07	OU #2 - RESERVOIR 5 - EXCAVATION AND SUBGRADE PREPARATION PLAN
C08	OU #2 - RESERVOIR 5 - FINAL GRADE PLAN
C09	OU #2 - RESERVOIR 5 - SECTIONS AND DETAILS
C10	OU #2 - RESERVOIR 7 - EXISTING CONDITIONS AND DEMOLITION PLAN
C11	OU #2 - RESERVOIR 7 - EXCAVATION AND SUBGRADE PREPARATION PLAN
C12	OU #2 - RESERVOIR 7 - FINAL GRADE PLAN
C13	OU #2 - RESERVOIR 7 - SECTIONS AND DETAILS
C14	OU #3 - EXISTING CONDITIONS AND DEMOLITION PLAN
C15	OU #3 - EXISTING CONDITIONS AND DEMOLITION PLAN (CONT'D)
C16	OU #3 - EXCAVATION AND SUBGRADE PREPARATION PLAN
C17	OU #3 - FINAL GRADE PLAN
C18	OU #3 - SECTIONS AND DETAILS
C19	OU #3 - SANTA FE ROAD AND COLLECTOR LOOP PROFILES
C20	OU #4 - NORTH MARSH AREA - EXISTING CONDITIONS, DEMOLITION, AND EXCAVATION PLAN
C21	OU #4 - NORTH MARSH AREA - FINAL GRADE PLAN (PLACEHOLDER - NOT IN SET)
C22	OU #4 - RESERVOIR 3 - EXISTING CONDITIONS AND DEMOLITION PLAN
C23	OU #4 - RESERVOIR 3 - EXCAVATION AND SUBGRADE PREPARATION PLAN
C24	OU #4 - RESERVOIR 3 - FINAL GRADE PLAN
C25	OU #4 - REMAINING SITEWIDE PPSH AREAS - EXISTING CONDITIONS, DEMOLITION, AND EXCAVATION PLAN
C26	BORROW AREA NO. 2 - FINAL GRADE PLAN
C27	MISC. SECTIONS AND DETAILS
C28	MISC. SECTIONS AND DETAILS
C29	MISC. SECTIONS AND DETAILS
C30	WETLAND MITIGATION - SITE PLAN (PLACEHOLDER - NOT IN SET)
C31	WETLAND MITIGATION - SECTIONS AND DETAILS (PLACEHOLDER - NOT IN SET)
C32	WETLAND MITIGATION - SECTIONS AND DETAILS (PLACEHOLDER - NOT IN SET)

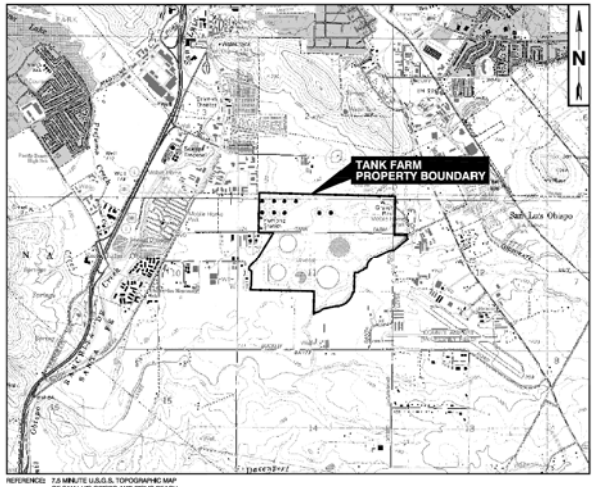
SITE VICINITY MAP



REFERENCE: ESRI ArcGIS USA Data, 2005

0 40 80 MILES
APPROXIMATE SCALE

SITE LOCATION MAP



REFERENCE: 7.5 MINUTE U.S.G.S. TOPOGRAPHIC MAP OF SAN LUIS OBISPO AND PISMO BEACH DATED: 1965/REVISED 1994

0 2000 4000 FEET
APPROXIMATE SCALE

REV	DATE	DESCRIPTION	BY	APPROVED
C	12/18/07	ISSUED FOR PERMIT APPLICATION	TMH	RVH
B	06/07/07	WORKING DRAFT	TMH	RVH
A	03/07/07	PRELIMINARY DESIGN SUBMITTAL	TMH	RVH

REVISION SUMMARY

SCALE: AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY

PREPARED FOR: Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583

PREPARED BY: AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DRIVE, SUITE 154
IRVINE, CALIFORNIA 92618-2327

padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

DESIGNER: T. HUNT
DRAWN BY: T. HUNT
CHECKED BY: R. VAN HYNING
APPROVED BY: R. VAN HYNING
DATE: 12/18/07

INDEX OF DRAWINGS, SITE VICINITY MAP, AND SITE LOCATION MAP
SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

PROJECT No. 1212.001 | FILE NAME: G01

SHEET No. G01
SHEET 1 OF 43
REVISION C

SYMBOL LEGEND

- UNDISTURBED EARTH
- COMMON FILL, COMPACTED TO 90% OF ITS RELATIVE MAXIMUM DENSITY PER ASTM D1557, UNLESS OTHERWISE SPECIFIED IN THE CONSTRUCTION DOCUMENTS.
- STRUCTURAL FILL, WILL BE COMPACTED TO 95% OF ITS RELATIVE MAXIMUM DENSITY PER ASTM D1557, UNLESS OTHERWISE SPECIFIED IN THE CONSTRUCTION DOCUMENTS.
- GRAVEL
- TOPSOIL
- CONCRETE
- ASPHALT
- 2 / C01 | C02 — DETAIL PLAN, DETAIL, OR SECTION LABEL. DETAIL PLANS AND DETAILS ARE IDENTIFIED WITH NUMBERS (e.g., 1, 2, 3) . SECTIONS ARE IDENTIFIED WITH LETTERS (e.g., A, B, C)
  - SHEET ON WHICH THE DETAIL PLAN, DETAIL, OR SECTION IS SHOWN
  - SHEET ON WHICH THE DETAIL PLAN, DETAIL, OR SECTION IS CALLED OUT
- SUBJECT LINE (PROPOSED CONSTRUCTION)
- EXISTING CONDITIONS
- SITE PROPERTY BOUNDARY
- 125 — TOPOGRAPHIC CONTOUR
- TREE / BRUSH LINE
- FENCE LINE
- CENTER LINE
- HIDDEN LINE
- CRUDE OIL LINE
- CRUDE OIL LINE (POTENTIALLY PRESENT)
- GASOLINE LINE
- GAS LINE
- GAS LINE (POTENTIALLY PRESENT)
- WATER LINE
- FOAMITE LINE
- FOAMITE LINE (POTENTIALLY PRESENT)
- LIMITS OF CLEAR AND GRUB
- OH — OVERHEAD ELECTRICAL POWER LINE
- T — OVERHEAD TELEPHONE LINE
- SANDBAG WALL
- SILT FENCE
- STATE / FEDERAL WETLAND - PROTECT-IN-PLACE
- STATE / FEDERAL WETLAND - IMPACTED BY CONSTRUCTION
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION REQUIRED
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED
- FIRE HYDRANT
- EXISTING MONITORING / PRODUCTION WELL

ABBREVIATIONS

ASPH.	ASPHALT
ASTM	AMERICAN SOCIETY OF TESTING & MATERIALS
AVG.	AVERAGE
AWWA	AMERICAN WATER WORKS ASSOCIATION
BGS	BELOW GROUND SURFACE
BMP	BEST MANAGEMENT PRACTICES
CMP	CORRUGATED METAL PIPE
CONC.	CONCRETE
CQA	CONSTRUCTION QUALITY ASSURANCE
CF	CUBIC FEET
CITY	CITY OF SAN LUIS OBISPO
CULV.	CULVERT
CY	CUBIC YARD
DI	DROP INLET
DIA	DIAMETER
E	EAST
ELEV.	ELEVATION
EOP	EDGE OF PAVEMENT
EXC.	EXCAVATION
FG	FINISHED GRADE
FL	FLOW LINE
FML	FLEXIBLE MEMBRANE LINER
HDPE	HIGH DENSITY POLYETHYLENE
MAX.	MAXIMUM
MIN.	MINIMUM
N	NORTH
NSF	NATIONAL SAFETY FOUNDATION
NTS	NOT TO SCALE
O/C	ON CENTER
PERF.	PERFORATED
PPSH	PLIABLE PLASTIC SURFICIAL HYDROCARBON
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PVC	POLYVINYL CHLORIDE
R	RADIUS
R/W	RIGHT-OF-WAY
RD.	ROAD
RES.	RESERVOIR
RET. WALL	RETAINING WALL
S	SOUTH
SCH	SCHEDULE
SEC.	SECTION
SF	SQUARE FEET
SLO CO.	SAN LUIS OBISPO COUNTY
STA	STATION
STD.	STANDARD
SY	SQUARE YARDS
SG	SUB-GRADE
TBD	TO BE DETERMINED
TOC	TOP OF CONCRETE
TYP.	TYPICAL
UBC	UNIFORM BUILDING CODE
W	WEST

REV	DATE	DESCRIPTION	BY	APPROVED
C	12/18/07	ISSUED FOR PERMIT APPLICATION	TMH	RVH
B	08/07/07	WORKING DRAFT	TMH	RVH
A	03/07/07	PRELIMINARY DESIGN SUBMITTAL	TMH	RVH

REVISION SUMMARY

SCALE: AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY

PREPARED FOR: Chevron — CHEVRON CORPORATION, 6001 BOLLINGER CANYON RD., SAN RAMON, CA 94583

PREPARED BY: AVOCET ENVIRONMENTAL, INC. — 16 TECHNOLOGY DRIVE, SUITE 154, IRVINE, CALIFORNIA 92618-2327

padre associates, inc. — ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

DESIGNER: T. HUNT
DRAWN BY: T. HUNT
CHECKED BY: R. VAN HYNING
APPROVED BY: R. VAN HYNING
DATE: 12/17/07

LEGEND AND ABBREVIATIONS

SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

PROJECT No. 1212.001 | FILE NAME: G02

SHEET No. G02 — SHEET 2 OF 43 — REVISION C

GENERAL NOTES

1. THESE DRAWINGS, TOGETHER WITH THE PROJECT SPECIFICATIONS, SPECIAL PROVISIONS, AND THE REMEDIAL DESIGN REPORT CONSTITUTE THE CONSTRUCTION DOCUMENTS FOR THIS PROJECT. THE CONTRACTOR SHALL KEEP AT LEAST ONE COPY OF THE LATEST APPROVED VERSION OF THESE DOCUMENTS ON-SITE AT ALL TIMES. THE ENGINEER SHALL HAVE ACCESS TO THE CONTRACTOR'S DOCUMENTS AT ALL TIMES. ADMINISTRATIVE REQUIREMENTS (E.G., PAYMENT) WILL BE AS SPECIFIED IN THE CONTRACT WITH CHEVRON.
2. THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS, TO COMPLETE THE PROJECT PRIOR TO START OF CONSTRUCTION.
3. ON FINDING A DISCREPANCY BETWEEN THE CONTRACT DOCUMENTS INTERNALLY, OR BETWEEN THE CONTRACT DOCUMENTS AND ACTUAL FIELD CONDITIONS, THE CONTRACTOR SHALL IMMEDIATELY BRING SAID DISCREPANCY TO THE ATTENTION OF THE ENGINEER.
4. THE ENGINEER SHALL MAINTAIN AN AS-BUILT SET OF PLANS. THE CONTRACTOR SHALL REVIEW THE AS-BUILT PLAN WITH THE ENGINEER PERIODICALLY TO ENSURE THAT CHANGES ARE KEPT UP TO DATE.
5. THE WORK AREA IS LOCATED WITHIN THE BOUNDARIES OF THE SAN LUIS OBISPO TANK FARM. THE SAN LUIS OBISPO TANK FARM CONSISTS OF 340 ACRES DIVIDED INTO NORTH AND SOUTH SECTIONS BY TANK FARM ROAD. STAGING AREAS AND ACCESS ROUTES SHALL BE AS DEFINED WITHIN THESE DRAWINGS TO THE EXTENT POSSIBLE.
6. NO WORK MAY BEGIN WITHOUT AN APPROVED TRAFFIC CONTROL PLAN. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PRODUCTION AND IMPLEMENTATION OF THE TRAFFIC CONTROL PLAN THROUGHOUT THE DURATION OF THEPROJECT. WARNING SIGNS, LIGHTS AND SAFETY DEVICES AND OTHER MEASURES REQUIRED FOR THE PUBLIC SAFETY, SHALL CONFORM TO THE REQUIREMENTS OF CALTRANS' MANUAL OF TRAFFIC CONTROLS. TRAFFIC CONTROL FOR DAY OR NIGHTTIME LANE CLOSURES SHALL BE IN COMPLIANCE WITH CALTRANS STANDARD PLANS FOR TRAFFIC CONTROL SYSTEMS.
7. ALL WORK SHALL BE PLANNED AND CARRIED OUT SO THAT THERE IS MINIMAL DISRUPTION TO TRAFFIC FLOW ALONG TANK FARM ROAD. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING FLAGGERS TO STOP AND WARN TRAFFIC. FLAGGING PROCEDURES SHALL BE IN COMPLIANCE WITH CALTRANS MANUAL OF TRAFFIC CONTROLS FOR CONSTRUCTION AND MAINTENANCE WORK ZONES.
8. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING A MEANS FOR CLEANING TRUCKS OF MUD PRIOR TO ENTERING PUBLIC STREETS. IT IS THE CONTRACTORS RESPONSIBILITY TO TAKE WHATEVER MEASURES ARE NECESSARY TO ENSURE THE CLEANLINESS OF TANK FARM ROAD DURING CONSTRUCTION ACTIVITIES.
9. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MINIMIZING DUST GENERATED BY CONSTRUCTION ACTIVITIES AT THE SITE. THE CONTRACTOR SHALL SUPPLY A WATER TRUCK TO APPLY WATER AS NECESSARY TO PREVENT OR ALLEVIATE DUST NUISANCE GENERATED BY CONSTRUCTION ACTIVITIES. THE CONTRACTOR SHALL APPLY WATER TO ALL DEMOLITION, EXCAVATION, AND GRADING SURFACES DURING CONSTRUCTION ACTIVITIES AND TO ANY SURFACE OBSERVED TO BE A SOURCE OF DUST.
10. THE CONTRACTOR SHALL SUPPLY AND CONNECT AN OVERHEAD STORAGE TANK AND J-STAND TO THE EXISTING WATER SUPPLY WELL LOCATED IN THE NORTHWEST CORNER OF THE OPERATIONS AREA TO SUPPLY WATER FOR DUST SUPPRESSION. THIS WATER SHALL BE CONSIDERED NONPOTABLE AND NOT FOR CONSUMPTION. POTABLE WATER SHALL CONSIST OF BOTTLED WATER BROUGHT ONSITE AND STATIONED AT WORK AND STAGING AREAS.
11. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE IMPLEMENTATION OF THE STORMWATER BMP FOR THE PROJECT. STORMWATER BMP SHALL CONFORM TO THE GUIDELINES OUTLINED WITHIN THE CALTRANS STORMWATER QUALITY HANDBOOK, CONSTRUCTION SITE BEST MANAGEMENT PRACTICES MANUAL. THE CONTRACTOR SHALL TAKE ALL NECESSARY AND PROPER PRECAUTIONS TO PROTECT ANY ADJACENT PROPERTY FROM DAMAGE THAT MAY OCCUR AS A RESULT OF STORMWATER RUNOFF AND/OR ANY DEPOSIT OF WATER RUNOFF AND/OR DEBRIS RESULTING FROM ANY AND ALL WORK IN CONNECTION WITH CONSTRUCTION ACTIVITIES.
12. PROPERTY BOUNDARY FENCES LOCATED ADJACENT TO EXCAVATIONS AND/OR CAPPING AREAS MAY BE REMOVED BY THE CONTRACTOR TO EASE IN EXCAVATING, GRADING, AND CONSTRUCTING CAPS. IT IS THE CONTRACTORS RESPONSIBILITY TO PROVIDE ANOTHER WAY OF SECURING THE SITE (I.E. TEMPORARY FENCES).
13. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE DEMOLITION OF STANDING STRUCTURES, CONCRETE PADS, LIGHTNING ROD FOUNDATIONS, AND ANY OTHER STRUCTURE LOCATED WITHIN CLEAR AND GRUB BOUNDARIES AND DESIGNATED FOR REMOVAL AS INDICATED ON THESE DRAWINGS. VOIDS CREATED AS A RESULT OF DEMOLITION SHALL BE FILLED IN WITH STRUCTURAL FILL OR GRAVEL. IF SUITABLE, CONCRETE REMOVED AS PART OF DEMOLITION MAY BE CRUSHED AND USED AS GRAVEL FILL.
14. UTILITY LINES CONNECTED TO STRUCTURES SCHEDULED TO BE DEMOLISHED SHALL BE DISCONNECTED AND ABANDONED. ABOVEGROUND UTILITY LINES SHALL BE REMOVED AND DISPOSED OF.
15. ALL UTILITY LINES FOUND WITHIN CLEAR AND GRUB BOUNDARIES, ABOVE GROUND AND BELOW GROUND, SHALL BE CUT AND CAPPED JUST OUTSIDE THE CLEAR AND GRUB BOUNDARY. THE PORTION OF UTILITY LINE REMAINING WITHIN THE CLEAR AND GRUB BOUNDARY SHALL BE ABANDONED IN PLACE UNLESS OTHERWISE NOTED ON THESE DRAWINGS.
16. ALL MONITORING WELLS AND SEEPAGE STRUCTURES SCHEDULED TO BE ABANDONED AS SHOWN ON THESE DRAWINGS SHALL BE ABANDONED IN ACCORDANCE WITH THE REMEDIAL DESIGN REPORT & THE CALIFORNIA DEPARTMENT OF WATER RESOURCES BULLETIN NO. 74-81.
17. THE CONTRACTOR SHALL CLEARLY MARK ALL PROPOSED EXCAVATIONS. THE WORK AREAS SHALL BE CLEARED BY UNDERGROUND ALERT AND THE OWNERS OF KNOWN UTILITIES IN THE AREA. SUBSURFACE WORK SHALL NOT COMMENCE UNTIL AN AREA HAS BEEN CLEARED.
18. THE CONTRACTOR SHALL EXERCISE CAUTION IN PERFORMING THE SUBSURFACE WORK. IF AN UNMARKED UTILITY IS ENCOUNTERED THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER, WHO WILL BE RESPONSIBLE FOR DETERMINING HOW TO PROCEED RELATIVE TO THE UNMARKED UTILITY.
19. EXCAVATION OF HYDROCARBON SURFACE EXPRESSIONS SHALL BE TO A DEPTH AS INDICATED ON THESE DRAWINGS UNLESS OTHERWISE DETERMINED BY THE ENGINEER. SURFACE EXPRESSIONS SHALL BE REMOVED TO A DEPTH OF NO MORE THAN 5-FEET AND BACKFILLED AS INDICATED ON THESE DRAWINGS.
20. EVERY LOCATION WITH A PROTECTIVE ENCLOSURE (FENCE WITH NETTING ROOF) IS PRESUMED TO OVERLIE A HYDROCARBON SURFACE EXPRESSION. THE CONTRACTOR SHALL REMOVE EACH PROTECTIVE ENCLOSURE FOUND ON SITE AND EXCAVATE ALL VISIBLE HYDROCARBON SURFACE EXPRESSIONS TO A DEPTH OF NO MORE THAN 5-FEET.
21. EARTHWORK STOCKPILES ARE NOT TO EXCEED A HEIGHT OF 20-FEET. SIDE SLOPES OF EARTHWORK STOCKPILES SHALL NOT BE STEEPER THAN 2:1.
22. EARTHWORK QUANTITIES SHOWN ON THESE PLANS DO NOT INCLUDE ALLOWANCES FOR COMPACTION, EXPANSION, OR SETTLEMENT.
23. ALL CUT SLOPES (EXCAVATION) SHALL BE A MAXIMUM 2:1 (HORIZONTAL TO VERTICAL) UNLESS OTHERWISE NOTED ON THESE DRAWINGS. ALL FILL SLOPES (EMBANKMENTS) SHALL BE A MAXIMUM 4:1 (HORIZONTAL TO VERTICAL) UNLESS OTHERWISE NOTED ON THESE DRAWINGS.
24. THE CONTRACTOR SHALL GRADE CAPS WITHIN RESERVOIRS 5, 7, AND 3 TO MIMIC, TO THE EXTENT POSSIBLE, NATURAL GRADE AND SHALL ENSURE DRAINAGE AS SHOWN ON THESE PLANS.
25. ALL DEVELOPMENT BUILDING PADS CONSTRUCTED IN AND AROUND RESERVOIR 4 AND WITHIN THE OPERATIONS AREA AS A RESULT OF THESE PLANS SHALL BE COMPACTED TO 95% OF ITS RELATIVE MAXIMUM DENSITY. ALL OTHER BACKFILL PERFORMED AS A RESULT OF REMEDIAL ACTIVITIES SHALL BE COMPACTED TO 90% OF ITS RELATIVE MAXIMUM DENSITY.
26. TREES, FOLIAGE, SIGNS, AND OTHER IMPROVEMENTS NOT FALLING WITHIN DESIGNATED CLEAR AND GRUB BOUNDARIES SHALL BE PROTECTED IN PLACE AND ANY DAMAGE TO EXISTING IMPROVEMENTS SHALL BE REPAIRED OR REPLACED AT THE CONTRACTORS EXPENSE TO THE SATISFACTION OF THE ENGINEER.
27. ALL SOIL DATA, GROUND WATER ELEVATIONS AND SOIL ANALYSES SHOWN ON THE DRAWINGS, OR INCLUDED IN THE SPECIFICATIONS APPLY ONLY AT THE LOCATIONS OF THE BORINGS OR MONITORING WELLS AND TO THE DEPTHS INDICATED. SOIL TEST REPORTS FOR BORINGS THAT HAVE BEEN DRILLED ARE AVAILABLE FOR INSPECTION AT THE OFFICE OF THE ENGINEER. ANY ADDITIONAL SUBSURFACE EXPLORATION SHALL BE DONE AT THE CONTRACTORS EXPENSE.
28. THE INDICATED ELEVATION OF GROUND WATER IS THAT WHICH EXISTED ON THE DATE WHEN MONITORING TOOK PLACE. IT IS THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE AND ALLOW FOR THE ELEVATION AT THE DATE OF PROJECT CONSTRUCTION. A DIFFERENCE IN ELEVATION BETWEEN GROUND WATER SHOWN IN THE PROJECT DOCUMENTS AND ACTUALLY ENCOUNTERED DURING CONSTRUCTION SHALL NOT BE CONSIDERED AS A BASIS FOR EXTRA WORK.
29. THE CONTRACTOR SHALL PERFORM ALL WORK NECESSARY TO COMPLETE THE PROJECT IN A SATISFACTORY MANNER, UNLESS OTHERWISE PROVIDED, THE CONTRACTOR SHALL FURNISH ALL MATERIALS, EQUIPMENT, TOOLS, LABOR, AND INCIDENTALS NECESSARY TO COMPLETE THE WORK.
30. THE CONTRACTOR SHALL NOT DISTURB SURVEY MONUMENTS, LOT STAKES (TAGGED), OR BENCHMARKS WITHOUT THE CONSENT OF THE ENGINEER. THE CONTRACTOR SHALL BEAR THE EXPENSE OF REPLACING ANY THAT MAY BE DISTURBED WITHOUT PERMISSION. REPLACEMENT SHALL BE DONE UNDER THE SUPERVISION OF THE ENGINEER BY A REGISTERED LAND SURVEYOR LICENSED TO PRACTICE IN THE STATE OF CALIFORNIA.
31. ALL WORK SHALL CONFORM TO THE LINE, GRADE AND ELEVATIONS SHOWN ON THESE PLANS. ANY DISCREPANCY, ERROR, OR OMISSION DISCOVERED BY THE CONTRACTOR SHALL BE IMMEDIATELY BROUGHT TO THE ATTENTION OF THE ENGINEER.
32. ANY WORK DONE WITHOUT THE APPROVAL OF THE ENGINEER IS SUBJECT TO REMOVAL AND REPLACEMENT AT THE CONTRACTOR'S EXPENSE.
33. ALL MATERIALS, PARTS, AND EQUIPMENT FURNISHED BY THE CONTRACTOR FOR THIS PROJECT SHALL BE NEW, HIGH GRADE AND FREE FROM DEFECTS. QUALITY OF WORK SHALL BE TO GENERALLY ACCEPTED STANDARDS. MATERIALS AND WORK QUALITY ARE SUBJECT TO THE ENGINEERS APPROVAL. MATERIALS AND WORK NOT CONFORMING TO THE REQUIREMENTS OF THE CONSTRUCTION DOCUMENTS SHALL BE CONSIDERED DEFECTIVE AND SUBJECT TO REJECTION. DEFECTIVE WORK OR MATERIAL, WHETHER IN PLACE OR NOT, SHALL BE REMOVED IMMEDIATELY FROM THE SITE BY THE CONTRACTOR, AT ITS EXPENSE, WHEN SO DIRECTED BY THE ENGINEER. IF THE CONTRACTOR FAILS TO REPLACE ANY DEFECTIVE OR DAMAGED WORK OR MATERIAL AFTER REASONABLE NOTICE, THE ENGINEER MAY CAUSE SUCH WORK OR MATERIALS TO BE REPLACED, THE COST OF WHICH WILL BE DEDUCTED FROM PAYMENTS DUE THE CONTRACTOR.
34. UNLESS SPECIFIED OTHERWISE SUBMITTALS WILL BE REQUIRED FOR ALL MATERIALS TO BE USEDFOR CONSTRUCTION. SHOP DRAWINGS WILL BE REQUIRED FOR ALL ITEMS THAT WILL BE FABRICATED FOR THE WORK. THE ENGINEER CAN WAIVE THIS REQUIREMENT FOR MINOR ITEMS AT HIS DISCRETION.
35. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ESTABLISHING LOCAL SURVEYING CONTROL. SUCH CONTROL SHALL USE THE CALIFORNIA STATE PLANE COORDINATE SYSTEM (ZONE 5). THE HORIZONTAL DATUM FOR THE PROJECT SHALL BE THE NORTH AMERICAN DATUM OF 1983 (NAD 83). THE VERTICAL DATUM SHALL BE THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD 29).
36. ALL EXISTING TOPOGRAPHIC CONTOURS, FENCE LINES, STRUCTURES, TREE AND BRUSH LINES, AND ACCESS ROADS SHOWN ON THESE PLANS WERE PREPARED BY ENGINEERING DEVELOPMENT ASSOCIATES (EDA) ON JULY 11 2007.
37. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE REMOVAL OF ALL DEBRIS GENERATED BY CONSTRUCTION ACTIVITIES THROUGHOUT THE DURATION OF THE PROJECT.

ESTIMATED CONSTRUCTION QUANTITIES

OU #1 - NORTHWEST OPERATIONS AREA	
COMMON EARTH FILL	53,400 CY
12 oz. GEOTEXTILE	280,300 SF
OU #2 - RESERVOIR 5	
EXCAVATE TO EXISTING CONCRETE FLOOR (CUT)	15,300 CY
GRAVEL LAYER	20,100 CY
FINAL GRADE COMMON EARTH CUT	32,800 CY
FINAL GRADE COMMON EARTH FILL	24,500 CY
FINAL GRADE TOPSOIL (1-FOOT THICK)	11,800 CY
12 oz. GEOTEXTILE	54,100 SF
OU #2 - RESERVOIR 7	
EXCAVATE TO EXISTING CONCRETE FLOOR (CUT)	11,000 CY
GRAVEL LAYER	39,000 CY
FINAL GRADE COMMON EARTH CUT	32,800 CY
FINAL GRADE COMMON EARTH FILL	24,500 CY
FINAL GRADE TOPSOIL (1-FOOT THICK)	11,000 CY
12 oz. GEOTEXTILE	160,460 SF
OU #3 AND FLOWER MOUND BORROW AREA	
FINAL GRADE COMMON EARTH CUT	401,400 CY
FINAL GRADE COMMON EARTH FILL	262,800 CY
12 oz. GEOTEXTILE	342,886 SF
OU #4 - NORTH MARSH AREA	
EXCAVATE HYDROCARBON SURFACE EXPRESSIONS (CUT)	75,300 CY
BACKFILL WITH COMMON EARTH (FILL)	53,800 CY
FINAL GRADE TOPSOIL (1-FOOT THICK)	21,500 CY
OU #4 - RESERVOIR 3	
EXCAVATE TO A DEPTH OF 2 FT.	26,700 CY
GRAVEL LAYER	10,500 CY
BACKFILL WITH COMMON EARTH	5,100 CY
BACKFILL WITH TOPSOIL (1-FOOT THICK)	11,100 CY
8 oz. GEOTEXTILE	871,002 SF
40-mil HDPE FML	290,334 SF
TRIAXIAL GEOGRID	290,334 SF
OU #4 - SITEWIDE PPSH AREAS	
EXCAVATE HYDROCARBON SURFACE EXPRESSIONS (CUT)	28,700 CY
BACKFILL WITH COMMON EARTH (FILL)	19,200 CY
FINAL GRADE TOPSOIL (1-FOOT THICK)	9,500 CY
BORROW AREA NO. 2	
TOTAL CUT	4,850 CY
TOTAL CUT	57,900 CY
TOTAL CUT	53,050 CY
TOTAL ESTIMATED SITEWIDE VOLUMES	
TOTAL CUT	635,350 CY
TOTAL CONTAMINATED SOIL	157,000 CY
TOTAL COMMON EARTH FILL	489,200 CY
TOTAL TOPSOIL BORROW	65,700 CY
TOTAL COMMON EARTH BORROW	10,850 CY

OWNER
CHEVRON, INC.
276 TANK FARM ROAD
SAN LUIS OBISPO, CA 93406
CONTACT: MARLEA HARMON
PHONE: (805) 547-5513

ENGINEER
AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DR. SUITE 154
IRVINE, CA 92618
CONTACT: ROBERT VAN HYNING, P.E.
PHONE: (949) 933-4905

GEOTECHNICAL ENGINEER
TBD

CONSTRUCTION MANAGER
TBD

SURVEYOR
TBD

REV	DATE	DESCRIPTION	BY	APPROVED
C	12/18/07	ISSUED FOR PERMIT	TMH	RVH
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A	03/01/07	PRELIMINARY DESIGN SUBMITTAL	TMH	RVH

REVISION SUMMARY

SCALE: AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY

PREPARED FOR: Chevron — CHEVRON CORPORATION, 6001 BOLLINGER CANYON RD., SAN RAMON, CA 94583

PREPARED BY: AVOCET ENVIRONMENTAL, INC. — 16 TECHNOLOGY DRIVE, SUITE 154, IRVINE, CALIFORNIA 92618-2327

padre associates, inc. — ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

DESIGNER: T. HUNT
DRAWN BY: T. HUNT
CHECKED BY: R. VAN HYNING
APPROVED BY: R. VAN HYNING
DATE: 12/18/07

GENERAL NOTES AND ESTIMATION OF CONSTRUCTION QUANTITIES
SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

PROJECT No. 1212,001 | FILE NAME: G03

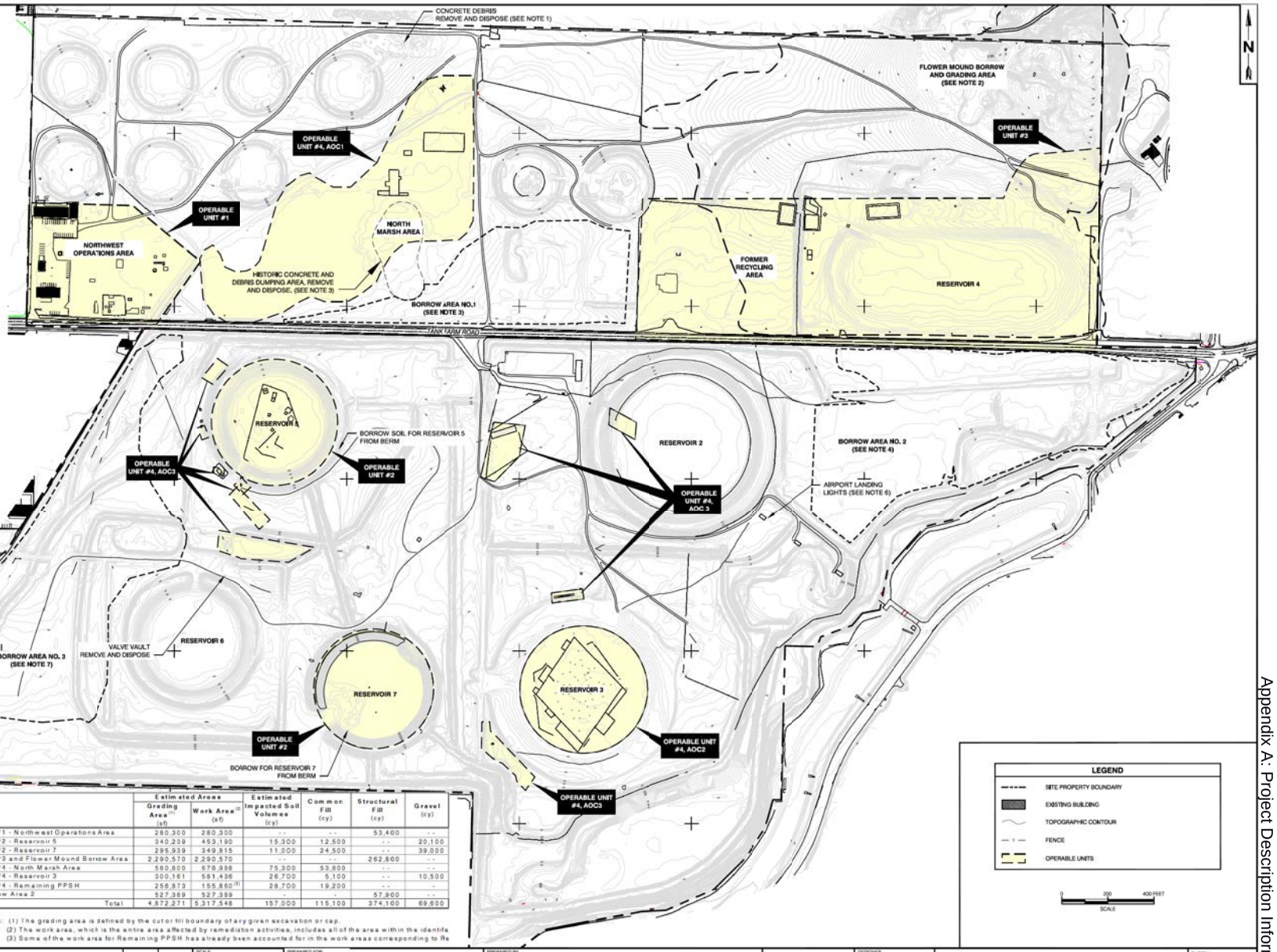
SHEET No. G03
SHEET 3 OF 43
REVISION C

NOTES:

1. THE CONTRACTOR SHALL REMOVE PILES OF CONCRETE RUBBLE AND OTHER DEBRIS FROM AREAS NOTED ON THIS MAP AND AS DIRECTED BY THE CONSTRUCTION MANAGER. CONCRETE MAY BE RECYCLED AT THE CONTRACTORS DISCRETION. MATERIALS NOT RECYCLED WILL BE REMOVED AND DISPOSED AT A FACILITY PERMITTED FOR THAT USE.
2. THE FLOWER MOUND BORROW AND GRADING AREA ENCOMPASSES THE IMPACTED AREAS OF OPERABLE UNIT 3. OFF-SITE GRADING EASEMENTS WILL BE ACQUIRED AS NECCESSARY. THE BORROW AND SURROUNDING AREA WILL BE FINISH GRADED TO SUPPORT FUTURE DEVELOPMENT. THE SOURCE FOR GRAVEL FILL USED IN RESERVOIRS 3, 5, & 7 SHALL BE CRUSHED MATERIAL TAKEN FROM THE FLOWER MOUND BORROW AREA.
3. BORROW AREA NO. 1 WILL PROVIDE ADDITIONAL FILL AS NEEDED FOR OPERABLE UNIT #1. A PORTION OF THIS BORROW AREA WAS HISTORICALLY USED FOR THE DISPOSAL OF CONCRETE AND OTHER DEBRIS. MATERIALS UNSUITABLE FOR FILL SHALL BE REMOVED AND MANAGED AT AN APPROPRIATELY PERMITTED FACILITY. HIGH ORGANIC CONTENT SOILS SHALL BE STRIPPED AND STOCKPILED FOR LATER REMOVAL. THE BORROW AREA SHALL BE EXCAVATED IN A MANNER THAT ADDS CONTIGUOUS AREA TO THE NORTH MARSH.
4. BORROW AREA NO. 2 WILL BE PRINCIPALLY USED TO GENERATE TOPSOIL. THE AREA WILL BE BACKFILLED AND REGRADED TO SUPPORT FUTURE DEVELOPMENT.
5. STRUCTURAL FILL FOR RESERVOIRS 3, 4, 5 AND 7 WILL BE SUPPLIED FROM THE ADJACENT BERMS AND SLOPES TO THE DEGREE POSSIBLE. SURPLUS FILL WILL BE USED IN RESERVOIR 3 AND TO BACKFILL BORROW AREA NO. 2.
6. SAN LUIS OBISPO COUNTY AIRPORT OPERATES AND MAINTAINS INFRASTRUCTURE CRITICAL TO ITS OPERATION ON THE TANK FARM PROPERTY. THE CONTRACTOR SHALL NOT DISTURB AND SHALL PROTECT-IN-PLACE, THIS EQUIPMENT.
7. BORROW AREA 3 MAY BE USED TO OBTAIN TOPSOIL OR COMMON EARTH AS NEEDED FOR THE PROJECT.
8. COMMON EARTH CAN BE USED FOR COMMON FILL OR STRUCTURAL FILL, AS REQUIRED.
9. OPERABLE UNIT #5 AND OPERABLE UNIT #1/AOC1 CONSIST OF GROUNDWATER AND ARE NOT SHOWN ON THESE DRAWINGS.
10. ACCESS ROAD GRAVEL ASSUMED NOT NEEDED MAY BE NECESSARY FOR ALL-WEATHER ACCESS.

REFERENCE:

1. TOPOGRAPHIC CONTOURS AND FEATURES PROVIDED BY EDA - DESIGN PROFESSIONALS, DATED JULY 11, 2007.
2. HYDROCARBON IMPACTED AREAS PROVIDED BY ENGLAND & ASSOCIATES, ADDITIONAL SITE CHARACTERIZATION, APRIL 1999.
3. WETLANDS DELINEATED BY JENESIS, STATE WETLAND DELINEATION REPORT, 2003.
4. LOCATION OF CHEVRON UTILITIES OBTAINED FROM HISTORICAL GENERAL PIPELINE ARRANGEMENT DRAWINGS, DATED 1950 AND 1981.
5. NON-CHEVRON UTILITIES PROVIDED BY AT&T, PG&E AND SEMPRA UTILITIES.
6. FLOWER MOUND BORROW VOLUME TAKEN FROM URS CORPORATION GRADING PLAN DATED JUNE 19, 2006.
7. OPERABLE UNIT BOUNDARIES TAKEN FROM FEASIBILITY STUDY, AVOCET ENVIRONMENTAL INC., DATED MARCH 15, 2007.



BORROW AREA VOLUMES

Area	Topsoil (cy)	Common Earth (cy)	Gravel (cy)	Off-Site Cut (cy)
Borrow Area - 1	9,000	27,200	0	0
Borrow Area - 2	20,700	0	0	0
Borrow Area - 3	19,700	59,250	0	0
Borrow Area - Flower Mound	0	262,850	65,400	73,700
Reservoir 5 & 7 Berms	0	71,600	0	0
Total	49,400	420,900	65,400	73,700

Note: The Flower Mound borrow volume consists of on-site material only. The grading will generate approximately 73,700 cy of material outside of the property boundary.

Area	Estimated Areas: Grading Area (1) (sf)	Estimated Areas: Work Area (2) (sf)	Estimated Impacted Soil Volumes (cy)	Common Fill (cy)	Structural Fill (cy)	Gravel (cy)
OU #1 - Northwest Operations Area	280,300	280,300	- -	- -	53,400	- -
OU #2 - Reservoir 5	340,239	453,190	15,300	12,500	- -	20,100
OU #2 - Reservoir 7	295,939	349,815	11,000	24,500	- -	39,000
OU #3 and Flower Mound Borrow Area	2,290,570	2,290,570	- -	- -	262,800	- -
OU #4 - North Marsh Area	580,800	676,988	75,300	53,800	- -	- -
OU #4 - Reservoir 3	300,161	581,436	26,700	5,100	- -	10,500
OU #4 - Remaining PPSH	256,873	155,860 (3)	28,700	19,200	- -	-
Borrow Area 2	527,389	527,389	-	-	57,900	- -
Total	4,872,271	5,317,548	157,000	115,100	374,100	69,600

Notes: (1) The grading area is defined by the cut or fill boundary of any given excavation or cap.
(2) The work area, which is the entire area affected by remediation activities, includes all of the area within the identifie
(3) Some of the work area for Remaining PPSH has already been accounted for in the work areas corresponding to Re

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CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583

PREPARED BY: AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DRIVE, SUITE 154
IRVINE, CALIFORNIA 92618-2327

padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

DESIGNER: T. HUNT
DRAWN BY: T. HUNT
CHECKED BY: R. VAN HYNING
APPROVED BY: R. VAN HYNING
DATE: 12/18/07

SITE PLAN AND BORROW SOURCES

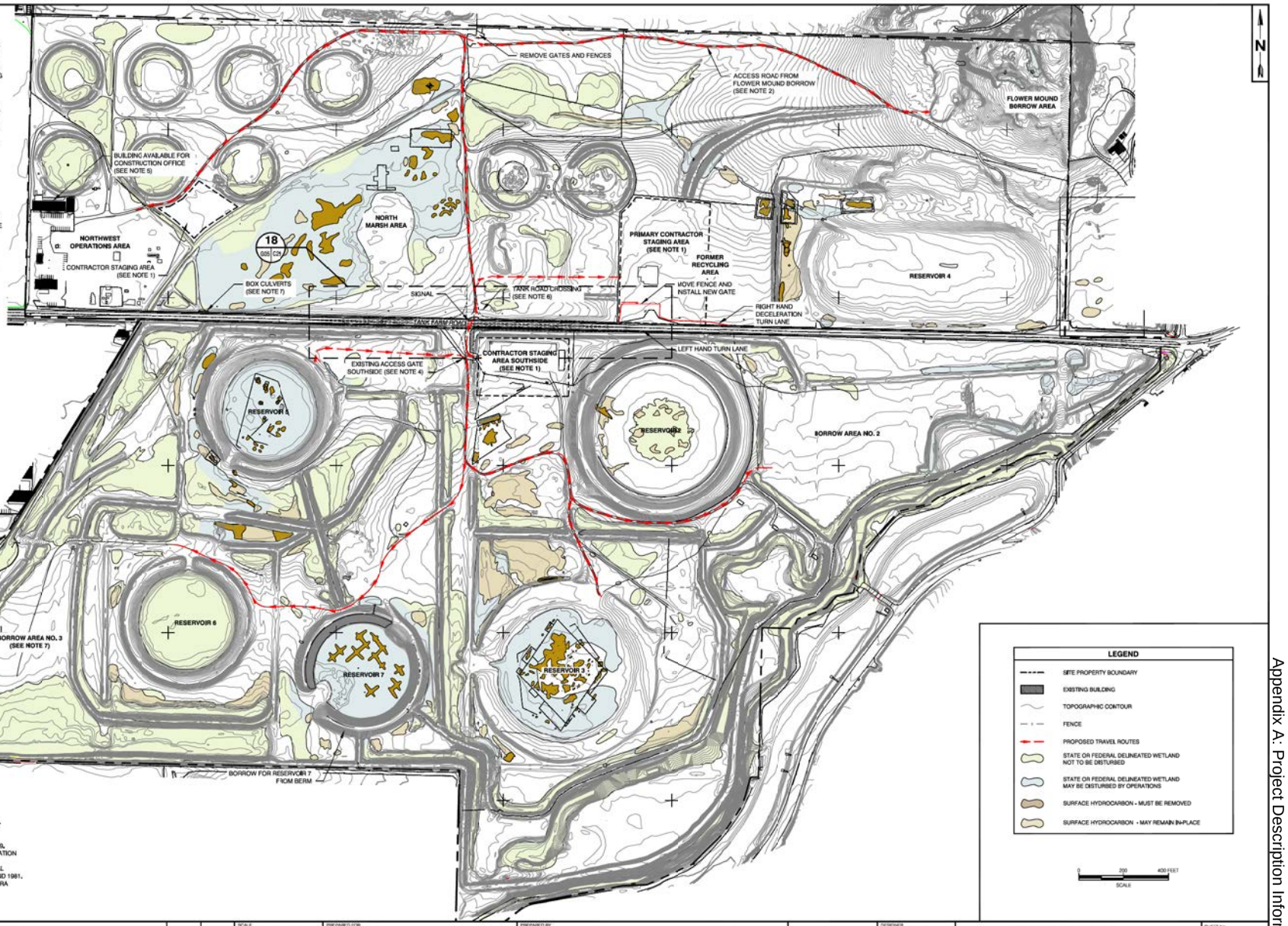
SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

PROJECT No. 1212,001 | FILE NAME: G04

SHEET No. G04
SHEET 4 OF 43
REVISION C

NOTES:

1. CONTRACTOR STAGING AREAS WILL BE USED BY THE CONTRACTOR FOR TEMPORARY FIELD OFFICES, EQUIPMENT PARKING AND MAINTENANCE, MATERIAL STORAGE (INCLUDING FUEL AND LUBRICANTS), AND PERSONAL VEHICLE PARKING. THE CONTRACTOR SHALL PROTECT-IN-PLACE NON-CHEVRON UTILITIES, CHEVRON UTILITIES THAT WILL BE MAINTAINED, AND WETLANDS. THE CONTRACTOR MAY PROPOSE OTHER STAGING AREAS. USE OF ALTERNATIVE STAGING AREAS MUST BE APPROVED BY THE CONSTRUCTION MANAGER.
2. THE CONTRACTOR SHALL LIMIT VEHICLE TRAFFIC TO THE STAGING AREAS AND TO THE ACCESS ROADS SHOWN ON THIS PLAN. THE CONTRACTOR MAY WIDEN THE ACCESS ROADS TO ALLOW TWO-WAY TRAFFIC. THE CONTRACTOR IS AT ALL TIMES RESPONSIBLE FOR THE SAFETY OF PERSONNEL AND EQUIPMENT ON THE ACCESS ROADS DURING THE PROJECT. WIDENING SHALL BE THE MINIMUM NECESSARY CONSISTENT WITH SAFE TWO-WAY ACCESS AND SHALL WHERE-EVER POSSIBLE AVOID IMPACTING WETLANDS.
3. THE CONTRACTOR SHALL EMPLOY BEST MANAGEMENT PRACTICES TO PROTECT WETLANDS ADJACENT TO WORK AREAS, STAGING AREAS, AND ACCESS ROADS.
4. CONTRACTOR SHALL MAINTAIN THE SOUTHSIDE ACCESS GATE AND SHALL PROVIDE A SIMILAR GATE ON THE NORTH SIDE OF TANK FARM ROAD TO FACILITATE THE MOVEMENT OR EQUIPMENT AND MATERIAL. THE CONTRACTOR SHALL PROVIDE TRAFFIC CONTROL AT THIS LOCATION TO ENSURE PUBLIC SAFETY AND THE SAFE EXECUTION OF THIS PROJECT.
5. DEPENDING ON THE SEQUENCE OF WORK, AND AT THE CONVENIENCE OF THE OWNER, THE DESIGNATED BUILDING MAY BE USED BY THE CONTRACTOR FOR TEMPORARY OFFICE SPACE. DURING CONSTRUCTION, MAINTENANCE AND THE PAYMENT OF UTILITIES WILL BE THE CONTRACTOR'S RESPONSIBILITY.
6. THE CONTRACTOR WILL LIMIT ALL VEHICLE TRAFFIC ACCESSING OR CROSSING TANK FARM ROAD TO THE INDICATED SIGNAL CONTROLLED TRAFFIC CROSSING.
7. THE CONTRACTOR SHALL EMPLOY BEST MANAGEMENT PRACTICES TO PROTECT BOX CULVERTS UNDERLYING TANK FARM ROAD.



REFERENCE:

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2. HYDROCARBON IMPACTED AREAS PROVIDED BY ENGLAND & ASSOCIATES, ADDITIONAL SITE CHARACTERIZATION, APRIL 1999.
3. WETLANDS DELINEATED BY JENESIS, STATE WETLAND DELINEATION REPORT, 2003.
4. LOCATION OF CHEVRON UTILITIES OBTAINED FROM HISTORICAL GENERAL PIPELINE ARRANGEMENT DRAWINGS, DATED 1950 AND 1981.
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APPROVED BY: R. VAN HYNING
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SITE ACCESS AND STAGING

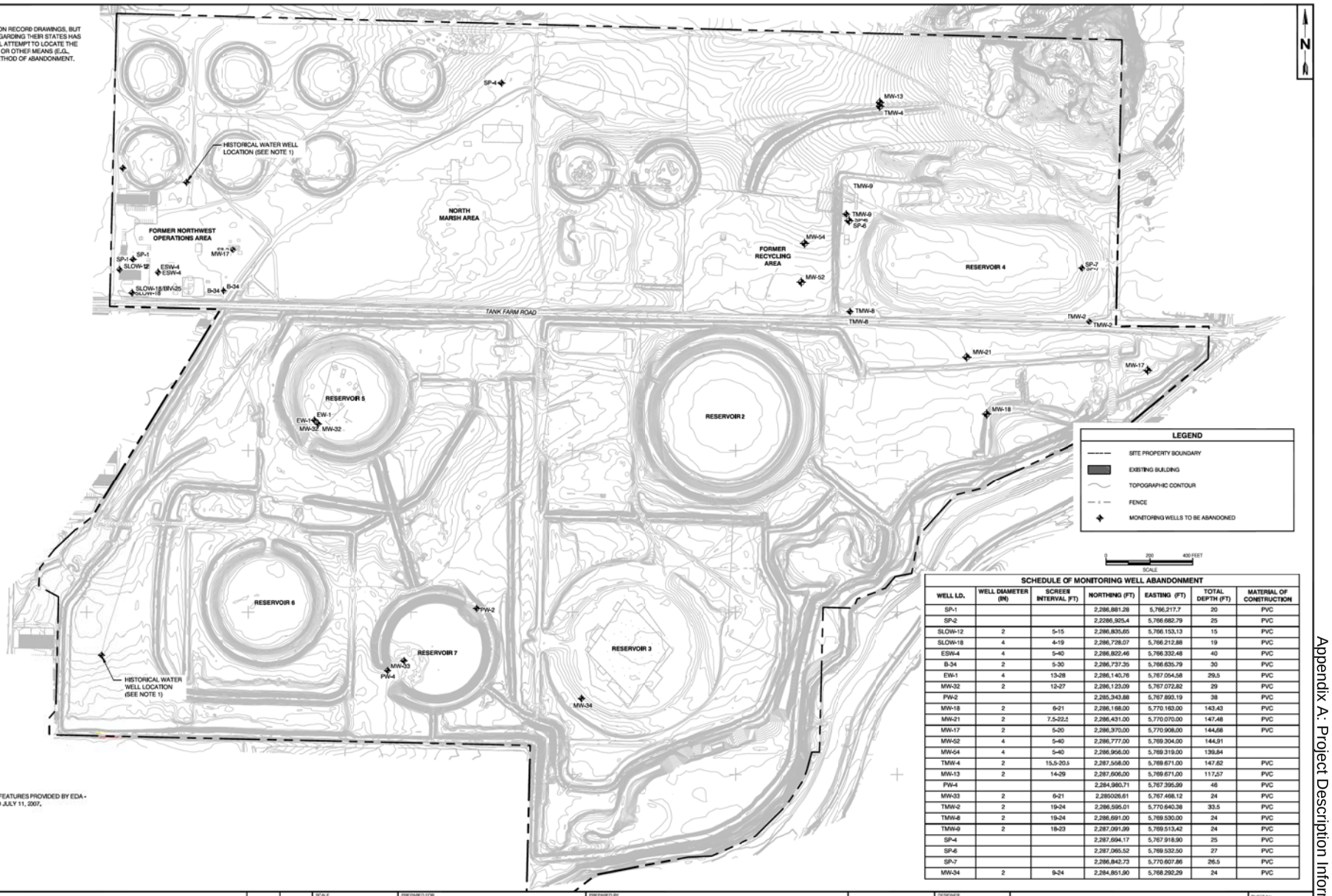
SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

PROJECT No. 1212.001 | FILE NAME: G05

SHEET No. G05
SHEET 5 OF 43
REVISION C

NOTES:

1. HISTORICAL WELLS ARE NOTED ON RECORD DRAWINGS, BUT NO OTHER DOCUMENTATION REGARDING THEIR STATES HAS BEEN FOUND. CONTRACTOR WILL ATTEMPT TO LOCATE THE WELLS THROUGH GEOPHYSICAL OR OTHER MEANS (E.G., BACKHOE) & DETERMINE THE METHOD OF ABANDONMENT.



REFERENCE:

1. TOPOGRAPHIC CONTOURS AND FEATURES PROVIDED BY EDA - DESIGN PROFESSIONALS, DATED JULY 11, 2007.

SCHEDULE OF MONITORING WELL ABANDONMENT

WELL I.D.	WELL DIAMETER (IN)	SCREEN INTERVAL (FT)	NORTHING (FT)	EASTING (FT)	TOTAL DEPTH (FT)	MATERIAL OF CONSTRUCTION
SP-1			2,286,881.28	5,766,217.7	20	PVC
SP-2			2,2286,925.4	5,766,682.79	25	PVC
SLOW-12	2	5-15	2,286,835.65	5,766,153.13	15	PVC
SLOW-18	4	4-19	2,286,728.07	5,766,212.88	19	PVC
ESW-4	4	5-40	2,286,822.46	5,766,332.48	40	PVC
B-34	2	5-30	2,286,737.35	5,766,635.79	30	PVC
EW-1	4	13-28	2,286,140.76	5,767,054.58	29.5	PVC
MW-32	2	12-27	2,286,123.09	5,767,072.82	29	PVC
PW-2			2,285,343.88	5,767,893.19	38	PVC
MW-18	2	6-21	2,286,168.00	5,770,163.00	143.43	PVC
MW-21	2	7.5-22.5	2,286,431.00	5,770,070.00	147.48	PVC
MW-17	2	5-20	2,286,370.00	5,770,908.00	144.68	PVC
MW-52	4	5-40	2,286,777.00	5,769,304.00	144.91	
MW-54	4	5-40	2,286,956.00	5,769,319.00	139.84	
TMW-4	2	15.5-20.5	2,287,558.00	5,769,671.00	147.62	PVC
MW-13	2	14-29	2,287,606.00	5,769,671.00	117.57	PVC
PW-4			2,284,980.71	5,767,395.99	46	PVC
MW-33	2	6-21	2,285026.61	5,767,468.12	24	PVC
TMW-2	2	19-24	2,286,595.01	5,770,640.38	33.5	PVC
TMW-8	2	19-24	2,286,691.00	5,769,530.00	24	PVC
TMW-9	2	18-23	2,287,091.99	5,769,513.42	24	PVC
SP-4			2,287,694.17	5,767,918.90	25	PVC
SP-6			2,287,065.52	5,769,532.50	27	PVC
SP-7			2,286,842.73	5,770,607.86	26.5	PVC
MW-34	2	9-24	2,284,851.90	5,768,292.29	24	PVC

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REVISION SUMMARY

SCALE: AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY

PREPARED FOR: Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583

PREPARED BY: AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DRIVE, SUITE 154
IRVINE, CALIFORNIA 92618-2327

padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

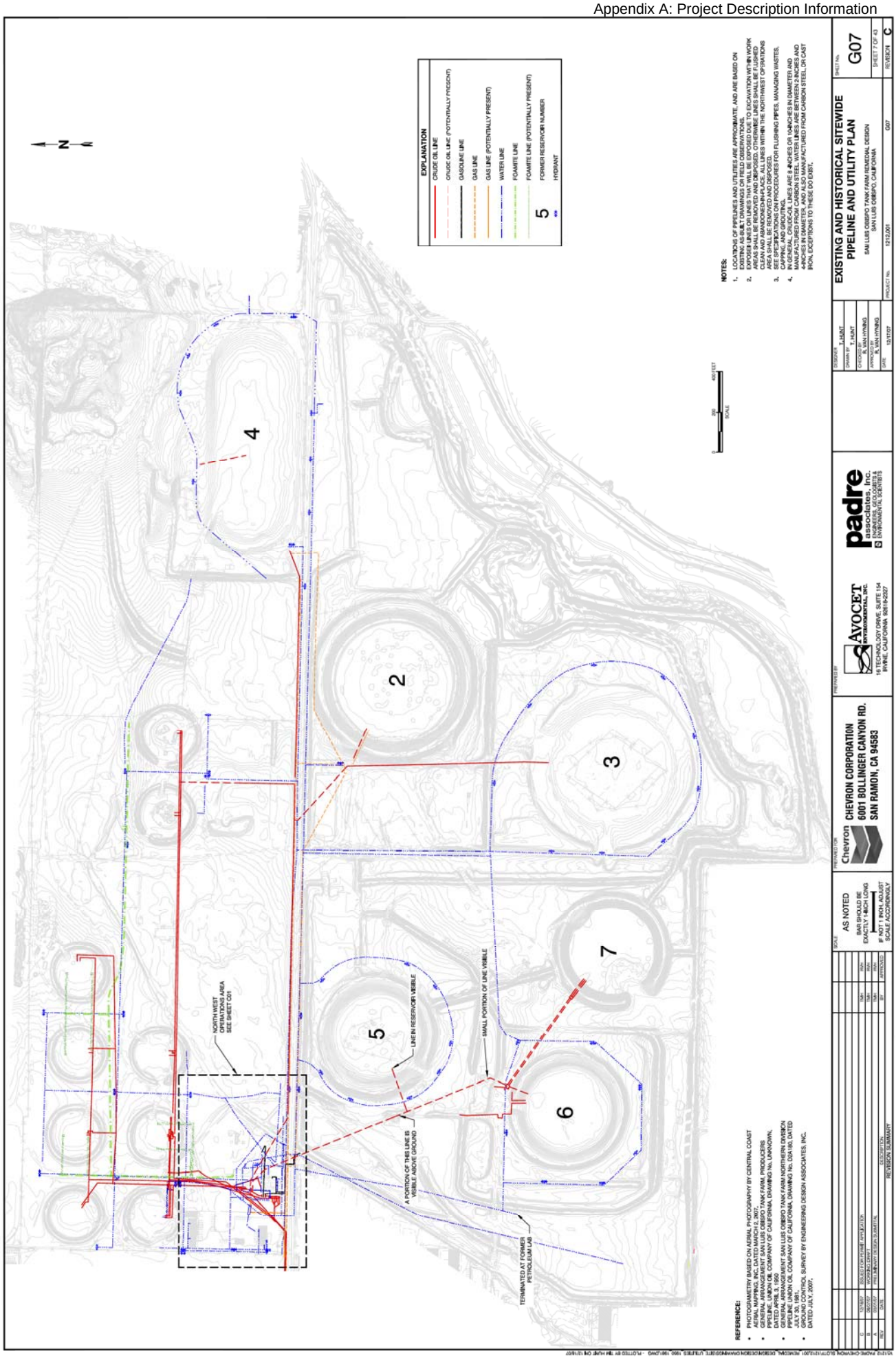
DESIGNER: T. HUNT
DRAWN BY: T. HUNT
CHECKED BY: R. VAN HYNING
APPROVED BY: R. VAN HYNING
DATE: 12/17/07

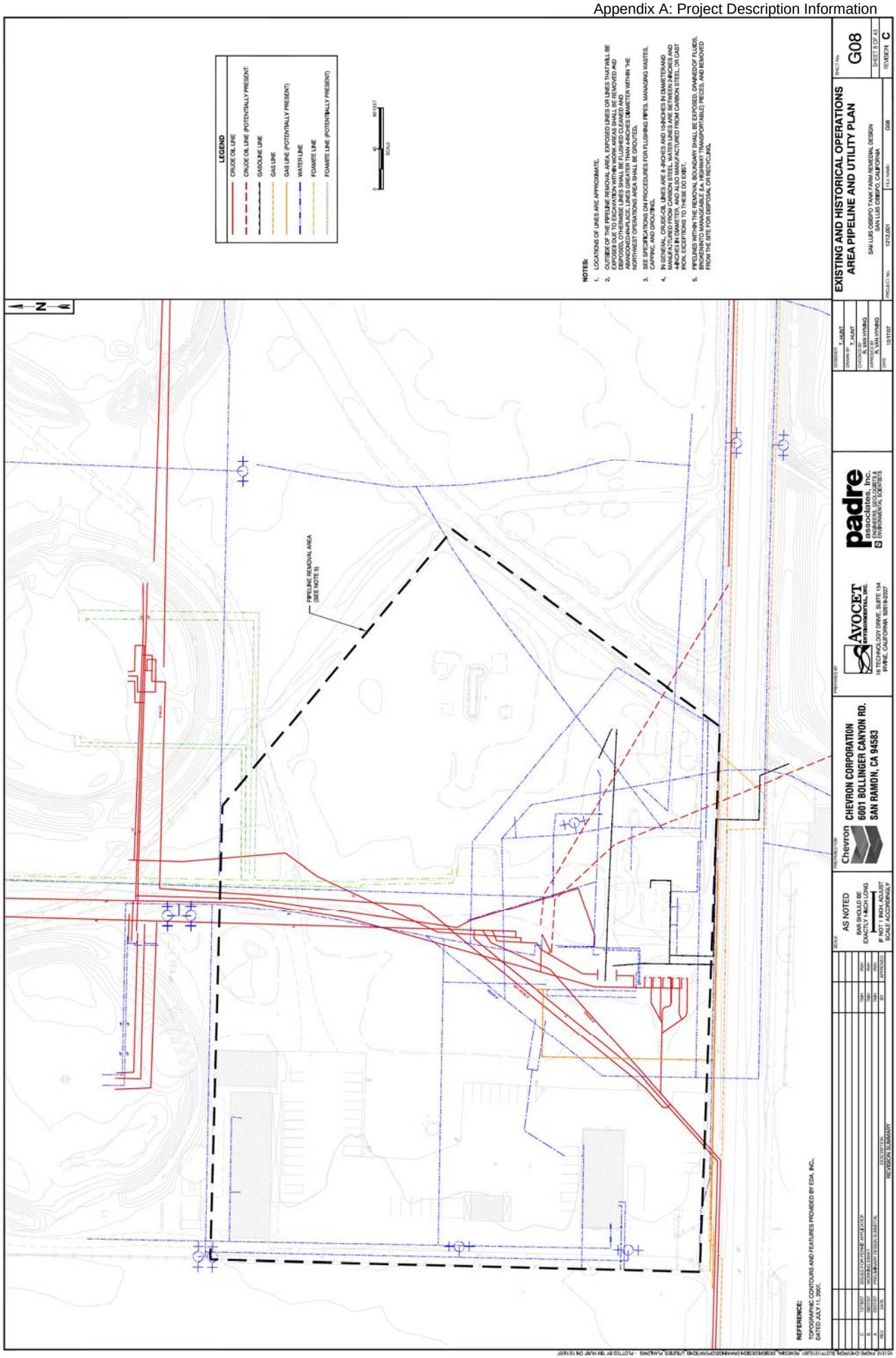
MONITORING WELL ABANDONMENT PLAN

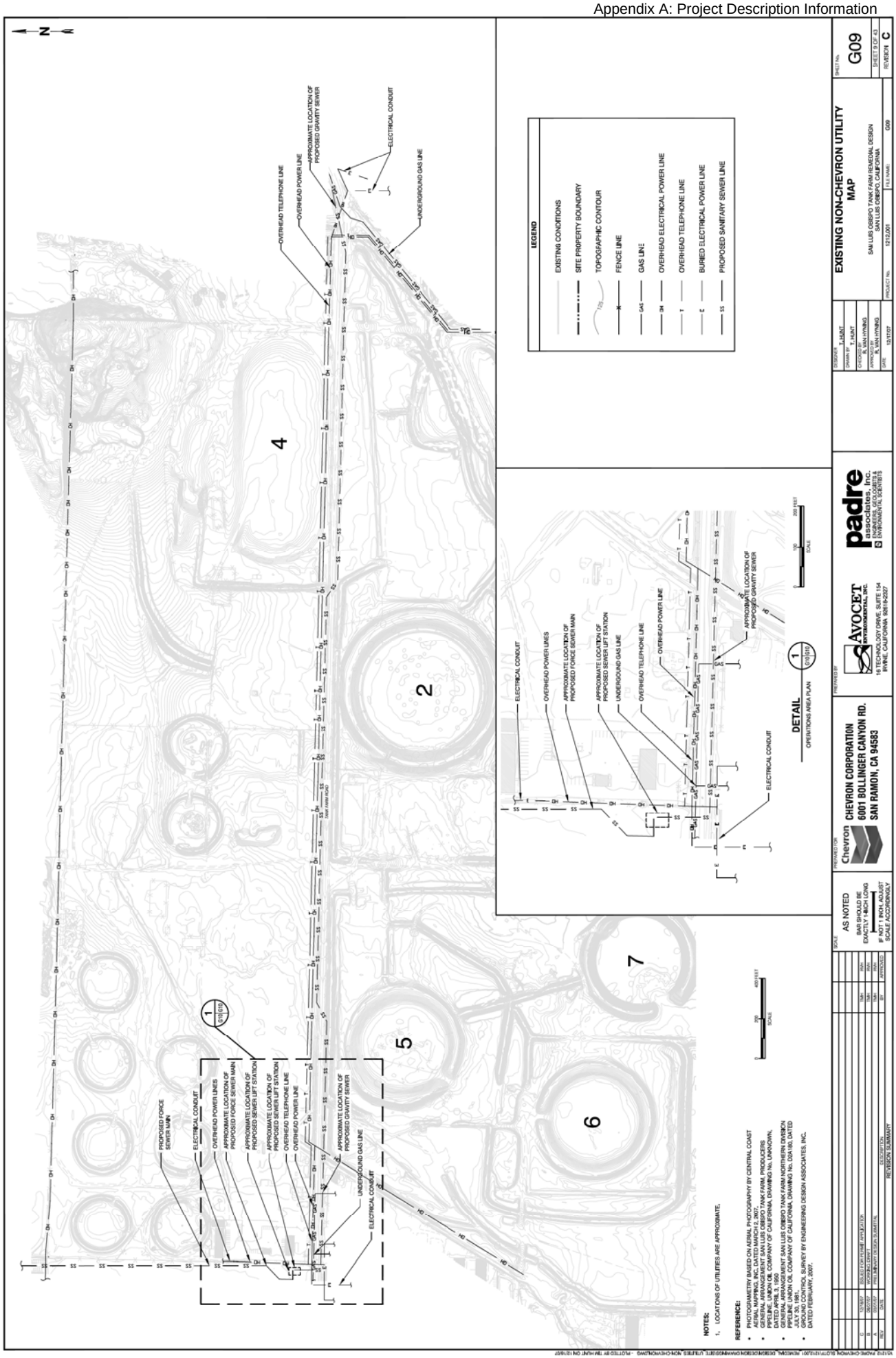
SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

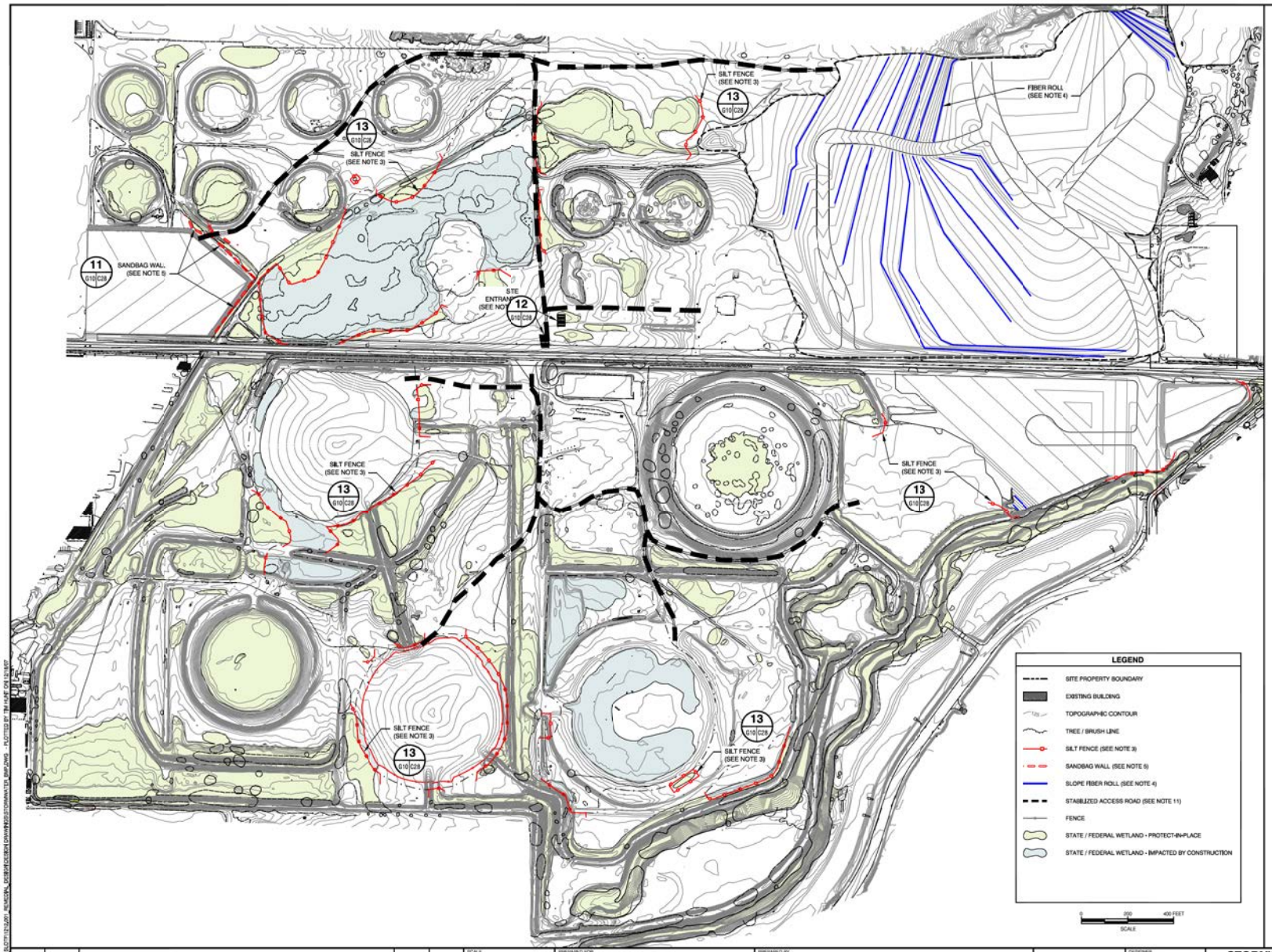
PROJECT No. 1212.001 | FILE NAME: G06

SHEET No. G06
SHEET 6 OF 43
REVISION C


N
EXPLANATION
CRUDE OIL LINE
CRUDE OIL LINE (POTENTIALLY PRESENT)
GASOLINE LINE
GAS LINE
GAS LINE (POTENTIALLY PRESENT)
WATER LINE
FOAMITE LINE
FOAMITE LINE (POTENTIALLY PRESENT)
5 FORMER RESERVOIR NUMBER
HYDRANT
NOTES:
1. LOCATIONS OF PIPELINES AND UTILITIES ARE APPROXIMATE, AND ARE BASED ON EXISTING AS-BUILT DRAWINGS OR FIELD OBSERVATIONS.
2. EXPOSED LINES OR LINES THAT WILL BE EXPOSED DUE TO EXCAVATION WITHIN WORK AREAS SHALL BE REMOVED AND DISPOSED. OTHERWISE LINES SHALL BE FLUSHED CLEAN AND PLUGGED AT THE WORK AREA. ALL LINES WITHIN THE NORTHWEST OPERATIONS AREA SHALL BE REMOVED AND DISPOSED.
3. SEE SPECIFICATIONS ON PROCEDURES FOR FLUSHING PIPES, MANAGING WASTES, CLEANING AND DISPOSAL.
4. IN GENERAL, CRUDE-OIL LINES ARE 8-INCHES OR 10-INCHES IN DIAMETER AND MANUFACTURED FROM CARBON STEEL. WATER LINES ARE BETWEEN 2-INCHES AND 4-INCHES IN DIAMETER, AND ALSO MANUFACTURED FROM CARBON STEEL, OR CAST IRON. EXCEPTIONS TO THESE DO EXIST.
REFERENCE:
• PHOTOGRAMETRY BASED ON AERIAL PHOTOGRAPHY BY CENTRAL COAST AERIAL MAPPING, INC. DATED MARCH 2, 2007.
• CIVIL DRAWING SAN LUIS OBISPO TANK FARM, PRODUCERS PIPELINE, UNION OIL COMPANY OF CALIFORNIA, DRAWING No. UNKNOWN, DATED APRIL 3, 1950.
• CIVIL DRAWING SAN LUIS OBISPO TANK FARM NORTHERN DIVISION PIPELINE, UNION OIL COMPANY OF CALIFORNIA, DRAWING No. 0204 IBL DATED JULY 30, 1981.
• GROUND CONTROL SURVEY BY ENGINEERING DESIGN ASSOCIATES, INC. DATED JULY, 2007.
NORTH WEST OPERATIONS AREA SEE SHEET C01
LINE IN RESERVOIR VISIBLE
SMALL PORTION OF LINE VISIBLE
A PORTION OF THIS LINE IS VISIBLE ABOVE GROUND
TERMINATED AT FORMER PETROLEUM LAB
1
2
3
4
5
6
7
0
200
400 FEET
SCALE
REVISION SUMMARY
REV DATE DESCRIPTION BY APPROVED
A 10/05/07 PRELIMINARY DESIGN SUBMITTAL TMH RSH
B 12/10/07 ISSUED FOR PRELIMINARY REVIEW TMH RSH
C 12/18/07 ISSUED FOR PERMIT TMH RSH
SCALE AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY
PREPARED FOR Chevron CHEVRON CORPORATION 6001 BOLLINGER CANYON RD. SAN RAMON, CA 94583
PREPARED BY AVOCET ENVIRONMENTAL, INC. 16 TECHNOLOGY DRIVE, SUITE 154 IRVINE, CALIFORNIA 92618-2327
padre associates, inc. ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS
DESIGNER T. HUNT
DRAWN BY T. HUNT
CHECKED BY R. VAN HYNING
APPROVED BY R. VAN HYNING
DATE 12/17/07
EXISTING AND HISTORICAL SITEWIDE PIPELINE AND UTILITY PLAN
SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA
PROJECT No. 12112.001 G07
SHEET No. G07
SHEET 7 OF 43
REVISION C


LEGEND
CRUDE OIL LINE
CRUDE OIL LINE (POTENTIALLY PRESENT)
GASOLINE LINE
GAS LINE
GAS LINE (POTENTIALLY PRESENT)
WATER LINE
FOAMITE LINE
FOAMITE LINE (POTENTIALLY PRESENT)
0 80 FEET
SCALE
NOTES:
1. LOCATIONS OF LINES ARE APPROXIMATE.
2. OUTSIDE OF THE PIPELINE REMOVAL AREA, EXPOSED LINES OR LINES THAT WILL BE EXPOSED DUE TO EXCAVATION WITHIN WORK AREAS SHALL BE REMOVED AND DISPOSED, OTHERWISE LINES SHALL BE FLUSHED CLEANED AND ABANDONED IN PLACE. LINES 6-INCHES IN DIAMETER WITHIN THE NORTHWEST OPERATIONS AREA SHALL BE GROUTED.
3. SEE SPECIFICATIONS ON PROCEDURES FOR FLUSHING PIPES, MANAGING WASTES, CAPPING, AND GROUTING.
4. IN GENERAL, CRUDE-OIL LINES ARE 8-INCHES AND 10-INCHES IN DIAMETER AND MANUFACTURED FROM CARBON STEEL. WATER LINES ARE BETWEEN 2-INCHES AND 4-INCHES IN DIAMETER AND GENERALLY MANUFACTURED FROM CARBON STEEL OR CAST IRON. EXCEPTIONS TO THESE DO EXIST.
5. PIPELINES WITHIN THE REMOVAL BOUNDARY SHALL BE EXPOSED, DRAINED OF FLUIDS, BROKEN INTO MANAGEABLE (I.e. HIGHWAY TRANSPORTABLE) PIECES, AND REMOVED FROM THE SITE FOR DISPOSAL OR RECYCLING.
N
PIPELINE REMOVAL AREA (SEE NOTE 5)
REFERENCE:
TOPOGRAPHIC CONTOURS AND FEATURES PROVIDED BY EDA, INC. DATED JULY 11, 2002.
REV DATE DESCRIPTION
A 10/25/07 PRELIMINARY DESIGN SUBMITTAL
B 12/18/07 ISSUED FOR PRELIMINARY REVIEW
C 12/18/07 ISSUED FOR PRELIMINARY REVIEW
REVISION SUMMARY
SCALE
AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY
PREPARED FOR
Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583
PREPARED BY
AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DRIVE, SUITE 154
IRVINE, CALIFORNIA 92618-2327
padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS
DESIGNER T. HUNT
DRAWN BY T. HUNT
CHECKED BY R. VAN HYNING
APPROVED BY R. VAN HYNING
DATE 12/17/07
EXISTING AND HISTORICAL OPERATIONS AREA PIPELINE AND UTILITY PLAN
SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA
PROJECT No. 12112.001
FILE NAME G08
SHEET No. G08
SHEET 8 OF 43
REVISION C


N
OVERHEAD TELEPHONE LINE
OVERHEAD POWER LINE
APPROXIMATE LOCATION OF PROPOSED GRAVITY SEWER
ELECTRICAL CONDUIT
UNDERGROUND GAS LINE
4
2
5
6
7
PROPOSED FORCE SEWER MAIN
ELECTRICAL CONDUIT
OVERHEAD POWER LINES
APPROXIMATE LOCATION OF PROPOSED FORCE SEWER MAIN
APPROXIMATE LOCATION OF PROPOSED SEWER LIFT STATION
APPROXIMATE LOCATION OF PROPOSED SEWER LIFT STATION
OVERHEAD TELEPHONE LINE
OVERHEAD POWER LINE
APPROXIMATE LOCATION OF PROPOSED GRAVITY SEWER
UNDERGROUND GAS LINE
ELECTRICAL CONDUIT
SAN RAMON PADS
LEGEND
EXISTING CONDITIONS
SITE PROPERTY BOUNDARY
TOPOGRAPHIC CONTOUR
FENCE LINE
GAS LINE
OVERHEAD ELECTRICAL POWER LINE
OVERHEAD TELEPHONE LINE
BURIED ELECTRICAL POWER LINE
PROPOSED SANITARY SEWER LINE
DETAIL
OPERATIONS AREA PLAN
NOTES:
1. LOCATIONS OF UTILITIES ARE APPROXIMATE.
REFERENCE:
• PHOTOGRAMETRY BASED ON AERIAL PHOTOGRAPHY BY CENTRAL COAST AERIAL MAPPING, INC. DATED MARCH 2, 2007.
• CONTROL BASED ON SAN LUIS OBISPO TANK FARM, PRODUCERS PIPELINE, UNION OIL COMPANY OF CALIFORNIA, DRAWING No. UNKNOWN, DATED APRIL 3, 1950.
• GROUND CONTROL BASED ON SAN LUIS OBISPO TANK FARM NORTHERN DIVISION PIPELINE, UNION OIL COMPANY OF CALIFORNIA, DRAWING No. 0204-180, DATED JULY 30, 1981.
• GROUND CONTROL SURVEY BY ENGINEERING DESIGN ASSOCIATES, INC. DATED FEBRUARY, 2007.
REVISION SUMMARY
AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY
Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583
AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DRIVE, SUITE 154
IRVINE, CALIFORNIA 92618-2327
padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS
EXISTING NON-CHEVRON UTILITY MAP
SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA
G09
SHEET 9 OF 43
REVISION C



NOTES:

1. ALL GRADING ACTIVATES ARE TO BE SCHEDULED DURING DRY MONTHS WHEN PRACTICAL. THE CONTRACTOR SHALL ALLOW ENOUGH TIME BEFORE RAINFALL BEGINS TO STABILIZE DISTURBED SOIL WITH VEGETATION OR PHYSICAL MEANS OR TO INSTALL SEDIMENT TRAPPING DEVICES. ALL NON-ACTIVE AREAS SHALL BE STABILIZED AS SOON AS PRACTICAL AFTER SOIL DISTURBING ACTIVITIES HAVE CEASED. THE CONTRACTOR SHALL MONITOR THE WEATHER FORCAST TO PREPARE FOR RAINY OR WINDY CONDITIONS AND SUPPLY EROSION CONTROL MEASURES APPROPRIATELY. WHEN RAINFALL IS PREDICTED, THE CONTRACTOR SHALL ADJUST THE CONSTRUCTION SCHEDULE TO ALLOW FOR THE IMPLEMENTATION OF SOIL STABILIZATION AND SEDIMENT CONTROLS PRIOR TO THE ONSET OF RAIN. THE CONTRACTOR SHALL APPLY PERMANENT EROSION CONTROL TO AREAS DEEMED SUBSTANTIALLY COMPLETE AS SOON AS PRACTICAL.
2. AREAS WITHIN THE SITE WHERE NO CONSTRUCTION ACTIVITIES ARE SCHEDULED TO OCCUR OR ARE SCHEDULED TO OCCUR AT A LATER DATE SHALL BE PRESERVED TO THE EXTENT POSSIBLE. ALL DESIGNATED WETLANDS AS SHOWN ON THESE DRAWINGS NOT INCLUDED WITHIN THE CLEAR AND GRUB LINES SHALL BE UNDISTURBED AND PRESERVED IN THEIR CURRENT STATE. ALL AREAS TO BE PRESERVED THAT ARE IN CLOSE PROXIMITY TO WORK ZONES SHALL BE FENCED OFF WITH ORANGE COLORED PLASTIC MESH FENCING.
3. SILT FENCES SHALL BE INSTALLED AROUND PROTECTED WETLANDS ADJACENT TO CONSTRUCTION ACTIVITIES TO PREVENT SEDIMENT BUILD-UP WITHIN THE WETLANDS DURING HEAVY RAIN.
4. THE CONTRACTOR SHALL INCORPORATE FIBER ROLLS ALONG DOWN-SLOPES OF EXPOSED SOIL UNTIL A MORE PERMANENT EROSION CONTROL MEASURE SUCH AS VEGETATION IS IN PLACE. FIBER ROLLS SHALL BE PLACED AT A MAXIMUM INTERVAL OF 20-FEET ALONG SLOPES OF 4:1 OR FLATTER, 15-FEET ALONG SLOPES BETWEEN 4;1 AND 2:1, AND 10-FEET ALONG SLOPES OF 2:1 OR GREATER AND SHALL BE INSTALLED WITH THE ENDS TURNED UP SLOPE.
5. THE CONTRACTOR SHALL PROVIDE SANDBAG BARRIERS AT ALL CULVERT/PIPE OUTLETS AND ALONG ALL STREAMS AND CHANNELS IN THE VICINITY OF CONSTRUCTION ACTIVITIES. SANDBAGS SHALL BE STACKED AT LEAST THREE BAGS HIGH USING A PYRAMID APPROACH. IN NON-TRAFFICE AREAS SANDBAGS SHALL BE STACKED TO A MINIMUM HEIGHT OF 18-INCHES. IN CONSTRUCTION TRAFFIC AREAS SANDBAGS SHALL BE STACKED TO A MINIMUM HEIGHT OF 12-INCHES.
6. THE CONTRACTOR SHALL SUPPLY A WATER TRUCK TO APPLY WATER AS NECESSARY TO PREVENT OR ALLEVIATE DUST NUISANCE GENERATED BY CONSTRUCTION ACTIVITIES. THE CONTRACTOR SHALL APPLY WATER TO ALL DEMOLITION, EXCAVATION, AND GRADING SURFACES DURING CONSTRUCTION ACTIVITIES AND TO ANY SURFACE OBSERVED TO BE A SOURCE OF DUST.
7. ALL VEHICULAR TRAFFIC ON-SITE SHALL BE LIMITED TO A SPEED OF 15 MPH.
8. THE CONTRACTOR SHALL ENSURE THAT SOIL HAULING TRUCKS TRAVELING OFF-SITE ARE COVERED BEFORE LEAVING THE SITE.
9. THE CONTRACTOR SHALL PROVIDE A STABILIZED CONSTRUCTION ENTRANCE AND EXIT ACCESS TO THE SITE TO REDUCE THE TRACKING OF MUD AND DIRT ONTO TANK FARM ROAD BY CONSTRUCTION VEHICLES. THE STABILIZED CONSTRUCTION ENTRANCE SHALL CONSIST OF A PAD OF AGGREGATE 1-FOOT THICK RANGING IN SIZE FROM 3-INCHES TO 6-INCHES UNDERLAIN WITH AN 8 oz. NON-WOVEN GEOTEXTILE FABRIC LOCATED AT ANY POINT WHERE TRAFFIC WILL BE ENTERING OR LEAVING THE SITE TO OR FROM TANK FARM ROAD. THE STABILIZED ENTRANCE SHALL BE A MINIMUM OF 50-FEET LONG WITH A MINIMUM 24-FOOT SECTION OF CORRUGATED STEEL RUMBLE PANELS TO ASSIST IN THE REMOVAL OF MUD AND DUST. EACH ENTRANCE SHALL BE PROPERLY GRADED TO PREVENT RUNOFF FROM LEAVING THE CONSTRUCTION SITE.
10. THE CONTRACTOR SHALL IMPLEMENT A STREET SWEEPING AND VACUUMING PLAN FOR TANK FARM ROAD AS NEEDED.
11. THE CONTRACTOR SHALL WIDEN AND COMPACT ALL MAJOR ACCESS ROADS ON-SITE TO A MINIMUM WIDTH OF 25-FEET TO ACCOMMODATE TWO-WAY TRAFFIC. ALL ACCESS ROADS SHALL BE MOISTENED THROUGHOUT THE DAY TO REDUCE DUST GENERATED FROM CONSTRUCTION TRAFFIC.
12. TOPOGRAPHIC CONTOURS WITHIN THE NORTHWEST OPERATIONS AREA AND RESERVOIRS 3, 4, 5, AND 7 REPRESENT FINAL CAP CONTOURS AS SHOWN ON THESE DRAWINGS.

REV	DATE	DESCRIPTION	BY	APPROVED
C	12/18/07	ISSUED FOR PERMIT APPLICATION	TMH	RVH
B	06/07/07	WORKING DRAFT	TMH	RVH
A	03/01/07	PRELIMINARY DESIGN SUBMITTAL	TMH	RVH

REVISION SUMMARY

SCALE: AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY

PREPARED FOR: Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583

PREPARED BY: AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DRIVE, SUITE 154
IRVINE, CALIFORNIA 92618-2327

padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

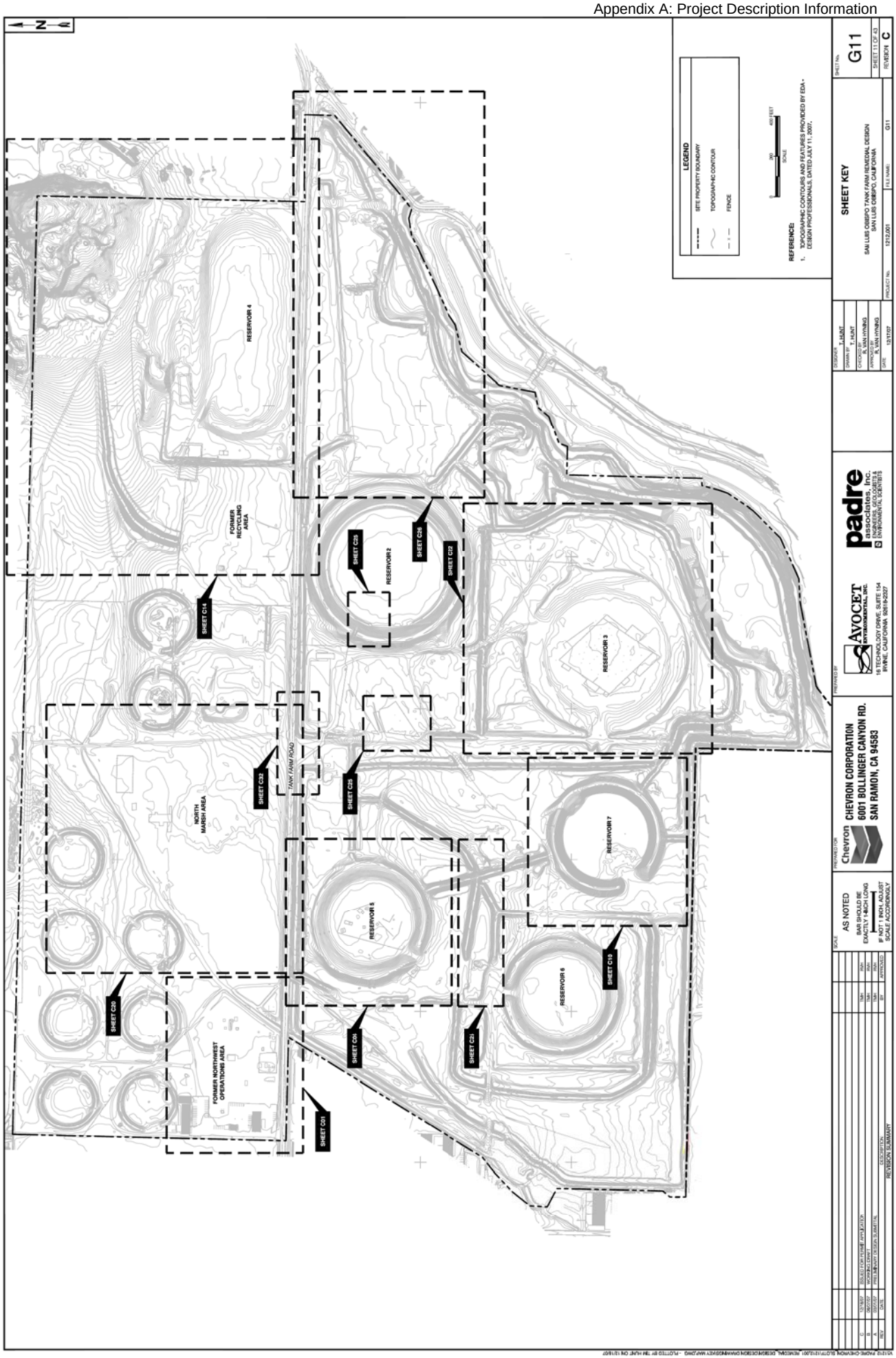
DESIGNER: T. HUNT
DRAWN BY: T. HUNT
CHECKED BY: R. VAN HYNING
APPROVED BY: R. VAN HYNING
DATE: 12/18/07

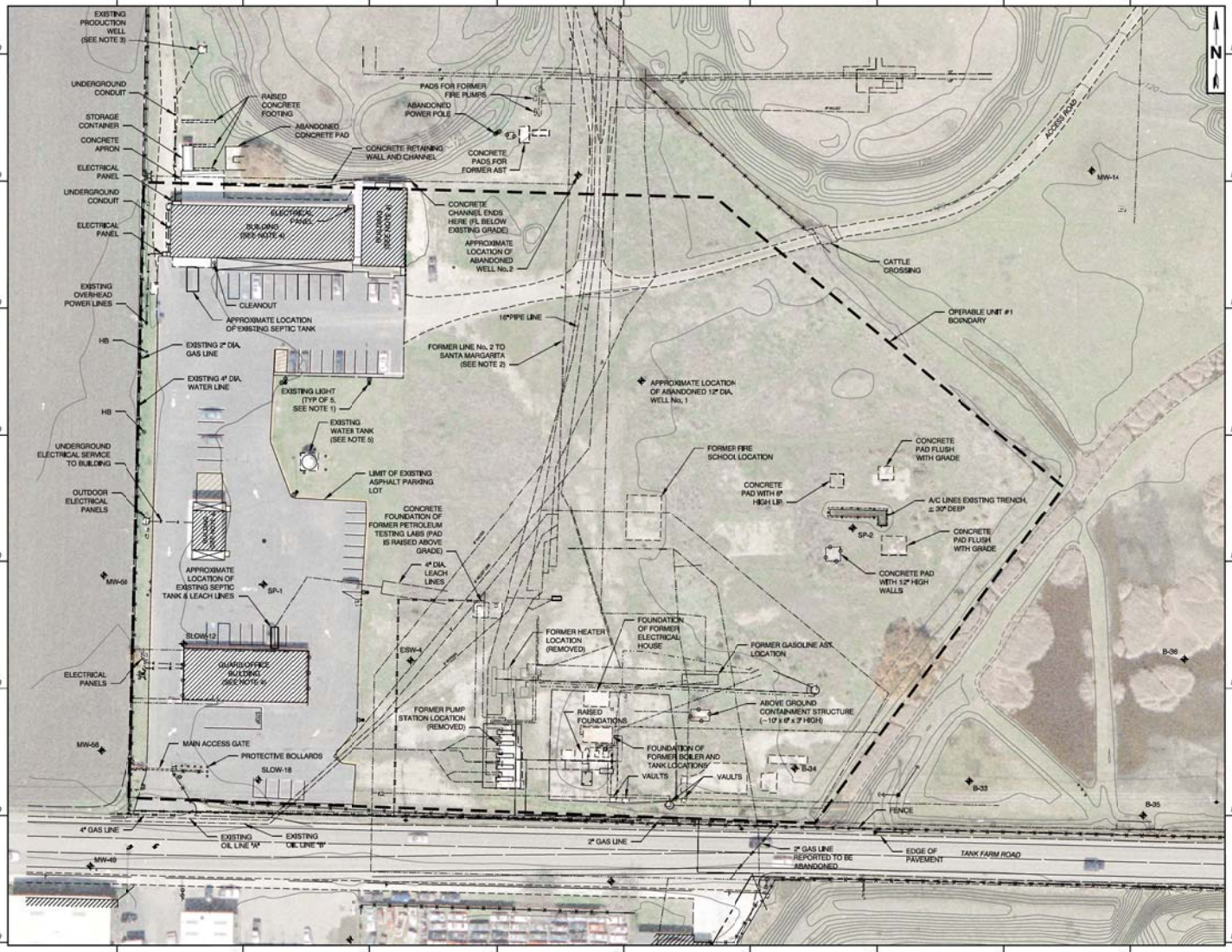
STORMWATER MANAGEMENT - BEST MANAGEMENT PRACTICES

SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

PROJECT No. 1212.001 | FILE NAME: G10

SHEET No. G10
SHEET 10 OF 43
REVISION C


N
RESERVOIR 4
FORMER RECYCLING AREA
SHEET C14
SHEET C25
RESERVOIR 2
SHEET C26
SHEET C22
RESERVOIR 3
NORTH MARSH AREA
SHEET C02
TANK FARM ROAD
SHEET C05
RESERVOIR 7
RESERVOIR 5
RESERVOIR 6
SHEET C10
SHEET C20
FORMER NORTHWEST OPERATIONS AREA
SHEET C01
SHEET C04
SHEET C03
LEGEND
SITE PROPERTY BOUNDARY
TOPOGRAPHIC CONTOUR
FENCE
0
200
400 FEET
SCALE
REFERENCE:
1. TOPOGRAPHIC CONTOURS AND FEATURES PROVIDED BY EDA - DESIGN PROFESSIONALS, DATED JULY 11, 2001.
SHEET KEY
SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA
12/12/2001
G11
SHEET 11 OF 43
REVISION C
padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS
AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DRIVE, SUITE 154
IRVINE, CALIFORNIA 92618-2327
Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583
AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY
REVISION SUMMARY



LEGEND

- SITE PROPERTY BOUNDARY
- EXISTING BUILDING
- TOPOGRAPHIC CONTOUR
- TREE / BRUSH LINE
- OPERABLE UNIT BOUNDARY
- FENCE
- EXISTING LIGHT POLE
- FIRE HYDRANT
- EXISTING MONITORING / PRODUCTION WELL
- WATER LINE
- DRAIN LINE
- CRUDE OIL
- GAS - CRUDE OIL
- GAS - OIL
- GAS
- GASOLINE

0 40 80 FEET
SCALE

NOTES:

1. LIGHT STANDARDS ARE APPROXIMATELY 15-FEET TALL. POWER IS PROVIDED BY CONDUCTORS IN UNDERGROUND CONDUITS.
2. A DILIGENT EFFORT HAS BEEN MADE TO IDENTIFY THE LOCATIONS OF THE UNDERGROUND PIPING. IT IS ANTICIPATED THAT MOST OF THE LINES ARE STILL IN-PLACE. SOME LINES MAY HAVE BEEN REMOVED. LINE No. 2 THAT CONNECTED THE TANK FARM TO SANTA MARGARITA WAS NOT FOUND DURING EXTENSIVE INVESTIGATION WORK ON THE PARCEL JUST NORTH OF THE TANK FARM.
3. THE EXISTING PRODUCTION WELL WAS INSTALLED TO SUPPLEMENT THE FIRE SUPPRESSION SYSTEM.
4. THREE OF THE FOUR BUILDINGS ONSITE WERE CONSTRUCTED DIRECTLY AFTER THE 1926 FIRE. THE MOST NORTH EASTERN BUILDING WAS CONSTRUCTED IN 2004 TO PROVIDE TEMPORARY OFFICE SPACE.
5. THE TANK PROVIDES FIRE WATER FOR THE OPERATIONS AREA AND IS REPORTED TO BE CONNECTED TO THE EXISTING PRODUCTION WELL.

REFERENCE:

1. TOPOGRAPHIC MAP PROVIDED BY EDA, INC., DATED JULY 11, 2007.
2. SAN LUIS OBISPO TANK FARM MAP OF UTILITIES

REV	DATE	DESCRIPTION	BY	APPROVED
C	12/18/07	ISSUED FOR PERMIT APPLICATION	TMH	RVH
B	06/01/07	WORKING DRAFT	TMH	RVH
A	05/01/07	PRELIMINARY DESIGN SUBMITTAL	TMH	RVH

REVISION SUMMARY

SCALE: AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY

PREPARED FOR: Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583

PREPARED BY: AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DRIVE, SUITE 154
IRVINE, CALIFORNIA 92618-2327

padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

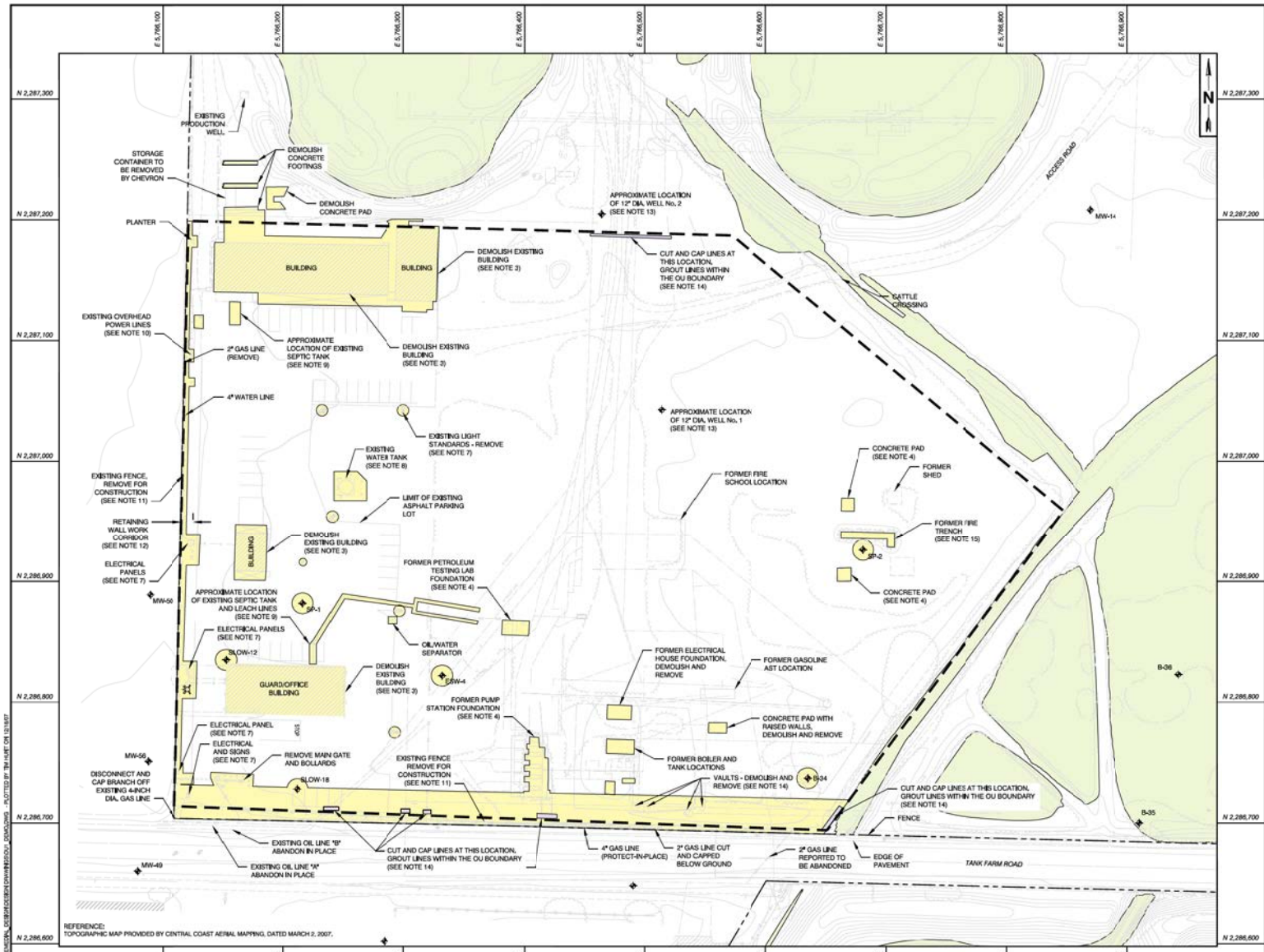
DESIGNER: T. HUNT
DRAWN BY: T. HUNT
CHECKED BY: R. VAN HYNING
APPROVED BY: R. VAN HYNING
DATE: 12/17/07

OU #1 - NORTHWEST OPERATIONS AREA - EXISTING SITE PLAN

SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

PROJECT No. 1212,001 | FILE NAME: C01

SHEET No. C01
SHEET 12 OF 43
REVISION C



REFERENCE:
TOPOGRAPHIC MAP PROVIDED BY CENTRAL COAST AERIAL MAPPING, DATED MARCH 2, 2007.

LEGEND

- SITE PROPERTY BOUNDARY
- EXISTING BUILDING
- TOPOGRAPHIC CONTOUR
- TREE / BRUSH LINE
- OPERABLE UNIT BOUNDARY
- FENCE
- EXISTING LIGHT POLE
- FIRE HYDRANT
- EXISTING MONITORING / PRODUCTION WELL
- STATE / FEDERAL WETLAND - PROTECT-IN-PLACE
- STATE / FEDERAL WETLAND - IMPACTED BY CONSTRUCTION
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION REQUIRED
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED
- EXISTING BUILDING / STRUCTURE TO BE DEMOLISHED
- CUT AND CAP PIPELINES AT THIS LOCATION

0 40 80 FEET
SCALE

SCHEDULE OF MONITORING WELL ABANDONMENT

WELL I.D.	NORTHING (FT)	EASTING (FT)	TOTAL DEPTH (FT)	MATERIAL OF CONSTRUCTION
SF-1	2,286,881.28	5,766,217.7	20	PVC
SF-2	2,2286,925.4	5,766,682.79	25	PVC
SLOW-12	2,286,835.65	5,766,153.13	15	PVC
SLOW-18	2,286,728.07	5,766,212.88	19	PVC
ESW-4	2,286,822.46	5,766,332.48	40	PVC
B-34	2,286,737.35	5,766,635.79	30	PVC

NOTES:

1. THE PURPOSE OF DEMOLITION AND SUBGRADE PREPARATION IS TO CREATE A CLEAR, FIRM, AND RELATIVELY SMOOTH SURFACE OVER WHICH THE CAP CAN BE CONSTRUCTED. THIS WILL INCLUDE DEMOLITION AND REMOVAL OF THE EXISTING BUILDINGS, LIGHT-STANDS, AND OTHER ABOVE GROUND STRUCTURES AND APPURTENANCES ASSOCIATED WITH ITS RECENT AND HISTORIC USES. FEATURES HIGHLIGHTED ON THIS DRAWING SHALL BE DEMOLISHED AND TAKEN OFF-SITE FOR DISPOSAL AT AN APPROPRIATE AND PERMITTED FACILITY.
2. THE AREA WITHIN THE CONSTRUCTION LIMITS SHALL BE CLEARED FOR CONSTRUCTION OF THE SOIL CAP. UNPAVED AREAS SHALL BE CLEARED OF VEGETATION AND SOIL GRUBBED TO A DEPTH OF 6-INCHES.
3. BUILDINGS SHALL BE DEMOLISHED AND HAULED OFFSITE FOR DISPOSAL. IT IS LIKELY THAT ONE OR MORE OF THE BUILDINGS CONTAIN ASBESTOS OR LEAD-BASED CONSTRUCTION MATERIALS. THIS CONTRACTOR SHALL SURVEY EACH OF THE BUILDINGS, REPORT THE FINDINGS, AND ABATE ANY ASBESTOS OR LEAD-BASED CONSTRUCTION MATERIALS PRIOR TO DEMOLISHING THE BUILDINGS.
4. WITHIN THE CONSTRUCTION AREA MOST OF THE ASPHALT WILL BE LEFT IN PLACE. BUILDING FOUNDATIONS REMAINING ABOVE GRADE SHALL BE BROKEN UP AND REMOVED SO THAT ANY FOUNDATION REMNANTS ARE AT LEAST 6-INCHES BELOW EXISTING GRADE. VOIDS RESULTING FROM CONCRETE REMOVAL SHALL BE FILLED WITH COMMON EARTH BACKFILL COMPACTED TO AT LEAST 90% OF ITS RELATIVE MAXIMUM DENSITY PER ASTM D1557.
5. WITHIN THE PAVED AREA THE CONTRACTOR SHALL REMOVE ALL CONCRETE CURBS, PARKING SIGNS, BOLLARDS, AND OTHER APPURTENANCES. THE CONTRACTOR SHALL LOCATE ALL VAULTS, BOXES, AND OTHER VOID SPACES ASSOCIATED OR RELATED TO THE UTILITIES THAT HAVE BEEN PREVIOUSLY ABANDONED OR WILL BE ABANDONED AS PART OF THIS PROJECT. ANY SUCH VOID SPACE WILL BE FILLED WITH A SAND-SLURRY CEMENT MIX.
6. MONITORING WELLS TO BE ABANDONED SHALL BE PERMITTED THROUGH THE SAN LUIS OBISPO COUNTY DEPARTMENT OF ENVIRONMENTAL HEALTH. ABANDONMENT SHALL BE IN ACCORDANCE WITH COUNTY STANDARDS AND WITH THE REQUIREMENTS OF THE STATE OF CALIFORNIA DEPARTMENT OF WATER RESOURCES BULLETIN No. 74-81.
7. THE CONTRACTOR SHALL REMOVE LIGHT POLES AND ABOVE GROUND ELECTRICAL FEATURES IN ACCORDANCE WITH THE SAN LUIS OBISPO COUNTY STANDARDS, THE UNIFORM BUILDING CODE, AND THE UNIFORM ELECTRICAL CODE. UNDERGROUND CONDUIT MAY BE ABANDONED IN-PLACE PROVIDING THAT ANY CONDUCTORS ARE REMOVED AND THE ENDS OF THE CONDUIT ARE SEALED AT LEAST 6-INCHES BELOW THE EXISTING GRADE.
8. DEMOLITION AND CONSTRUCTION OF THE CAP WILL REQUIRE REMOVAL OF THIS FIRE WATER TANK. DISCONNECTED WATER LINES SHALL BE CAPPED AT LEAST 6-INCHES BELOW GRADE. THE CONTRACTOR MUST COMPLETE THIS TASK PRIOR TO ANY OTHER WORK.
9. THE EXISTING SEPTIC TANKS SHALL BE ABANDONED IN ACCORDANCE WITH THE REQUIREMENTS OF SAN LUIS OBISPO COUNTY. EACH TANK WILL BE PUMPED AND A COPY OF THE PUMPING RECEIPT WILL BE GIVEN TO THE COUNTY'S AREA INSPECTOR. THE TANK AND LEACH LINES WILL BE PUMPED FULL WITH A SAND-CEMENT SLURRY.
10. THE OVERHEAD ELECTRICAL PROVIDE POWER TO THE EXISTING PRODUCTION WELL. THE OVERHEAD LINES WILL BE REMOVED AND REPLACED BY AN UNDERGROUND CONDUIT.
11. THE EXISTING FENCE WILL BE REMOVED DURING CONSTRUCTION TO FACILITATE INSTALLATION OF THE RETAINING WALL. THE CONTRACTOR SHALL ENSURE THAT THE SITE REMAINS SECURE FOR THE DURATION OF THE PROJECT.
12. WITHIN THE RETAINING WALL CORRIDOR REMOVE EXISTING UTILITIES AND TRANSPORT OFF-SITE FOR DISPOSAL AT AN APPROPRIATE AND PERMITTED DISPOSAL FACILITY. UNLESS OTHERWISE NOTED LINES THAT TERMINATE ALONG A WALL OF THE CORRIDOR SHALL BE CUT AT LEAST 12-INCHES FROM THE CORRIDOR WALL AND CAPPED.
13. IT IS UNCERTAIN HOW MANY YEARS AGO AND IN WHAT MANNER THESE WELLS WERE ABANDONED. THE CONTRACTOR SHALL ATTEMPT TO LOCATE THESE WELLS AND ASCERTAIN THE METHOD OF THEIR ABANDONMENT. IF NOT ABANDONED IN AN ACCEPTABLE MANNER THEY SHALL BE ABANDONED IN ACCORDANCE WITH CALIFORNIA DEPARTMENT OF WATER RESOURCES BULLETIN No. 74-81.
14. FORMER FLUID LINES SHALL BE EXPOSED AND OPENED. ANY RESIDUAL FLUIDS AND DEBRIS SHALL BE REMOVED TO AN APPROPRIATE AND PERMITTED FACILITY FOR DISPOSAL. REMOVAL SHALL BE BY HYDRAULIC FLUSHING OR OTHER APPROVED METHOD. THOSE PORTIONS OF THE LINES WITHIN THE OU BOUNDARY SHALL BE GROUTED. OUTSIDE THE OU BOUNDARY LINES MAY BE ABANDONED-IN-PLACE. EXPOSED PIPE ENDS SHALL BE CAPPED AND SEALED.
15. ASPHALT AND DEBRIS SHALL BE REMOVED FROM THE TRENCH TO AN APPROPRIATE AND PERMITTED FACILITY FOR DISPOSAL. THE TRENCH SHALL BE BACKFILLED WITH COMMON EARTH COMPACTED TO AT LEAST 90% OF ITS RELATIVE MAXIMUM DENSITY PER ASTM D1557.

REV	DATE	DESCRIPTION	BY	APPROVED
C	12/18/07	ISSUED FOR PERMIT APPLICATION	TMH	RVH
B	09/07/07	WORKING DRAFT	TMH	RVH
A	03/07/07	PRELIMINARY DESIGN SUBMITTAL	TMH	RVH

REVISION SUMMARY

SCALE: AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY

PREPARED FOR: Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583

PREPARED BY: AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DRIVE, SUITE 154
IRVINE, CALIFORNIA 92618-2327

padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

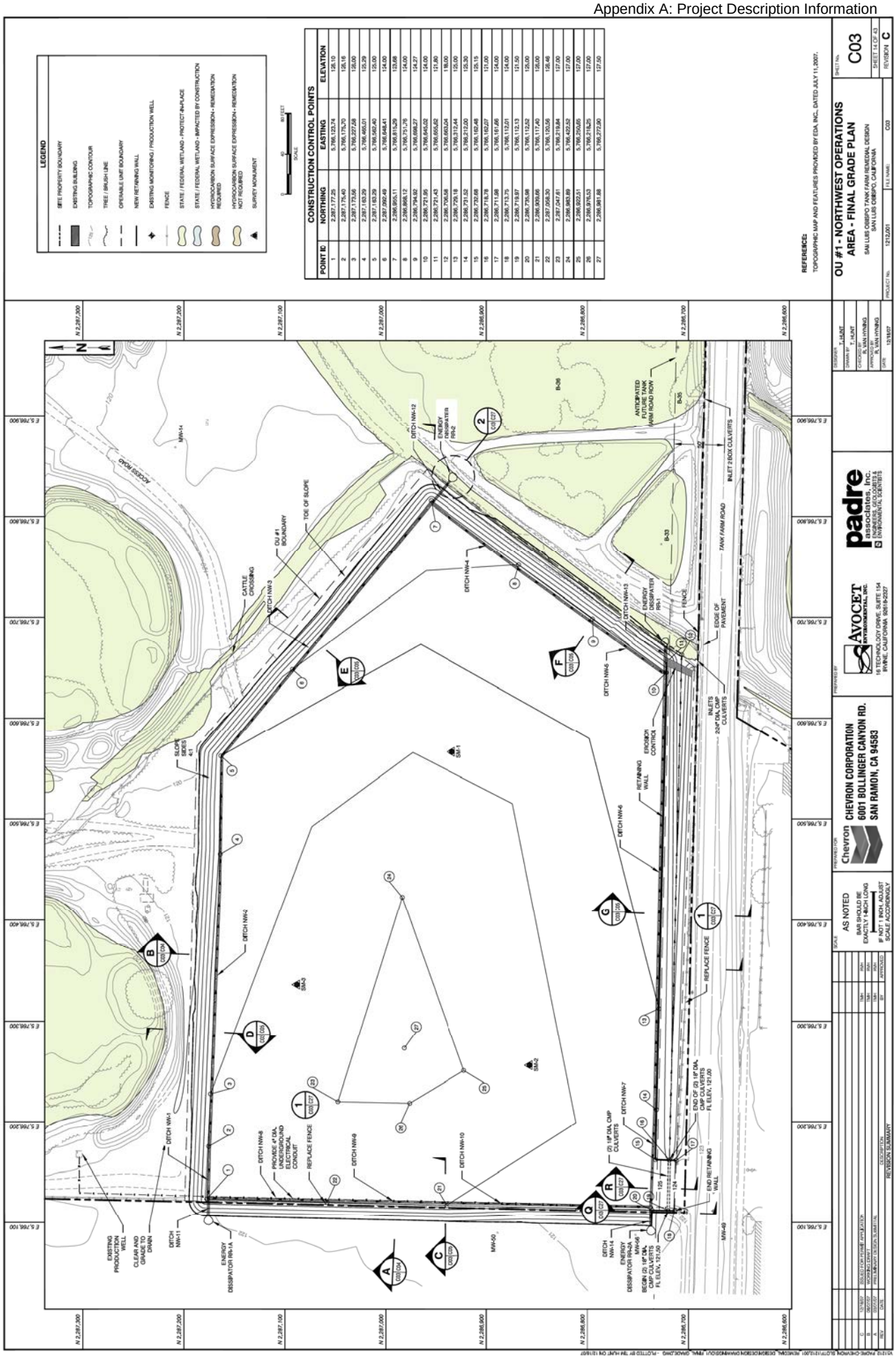
DESIGNER: T. HUNT
DRAWN BY: T. HUNT
CHECKED BY: R. VAN HYNING
APPROVED BY: R. VAN HYNING
DATE: 12/17/07

OU #1 - NORTHWEST OPERATIONS AREA - DEMOLITION AND SUBGRADE PREPARATION PLAN

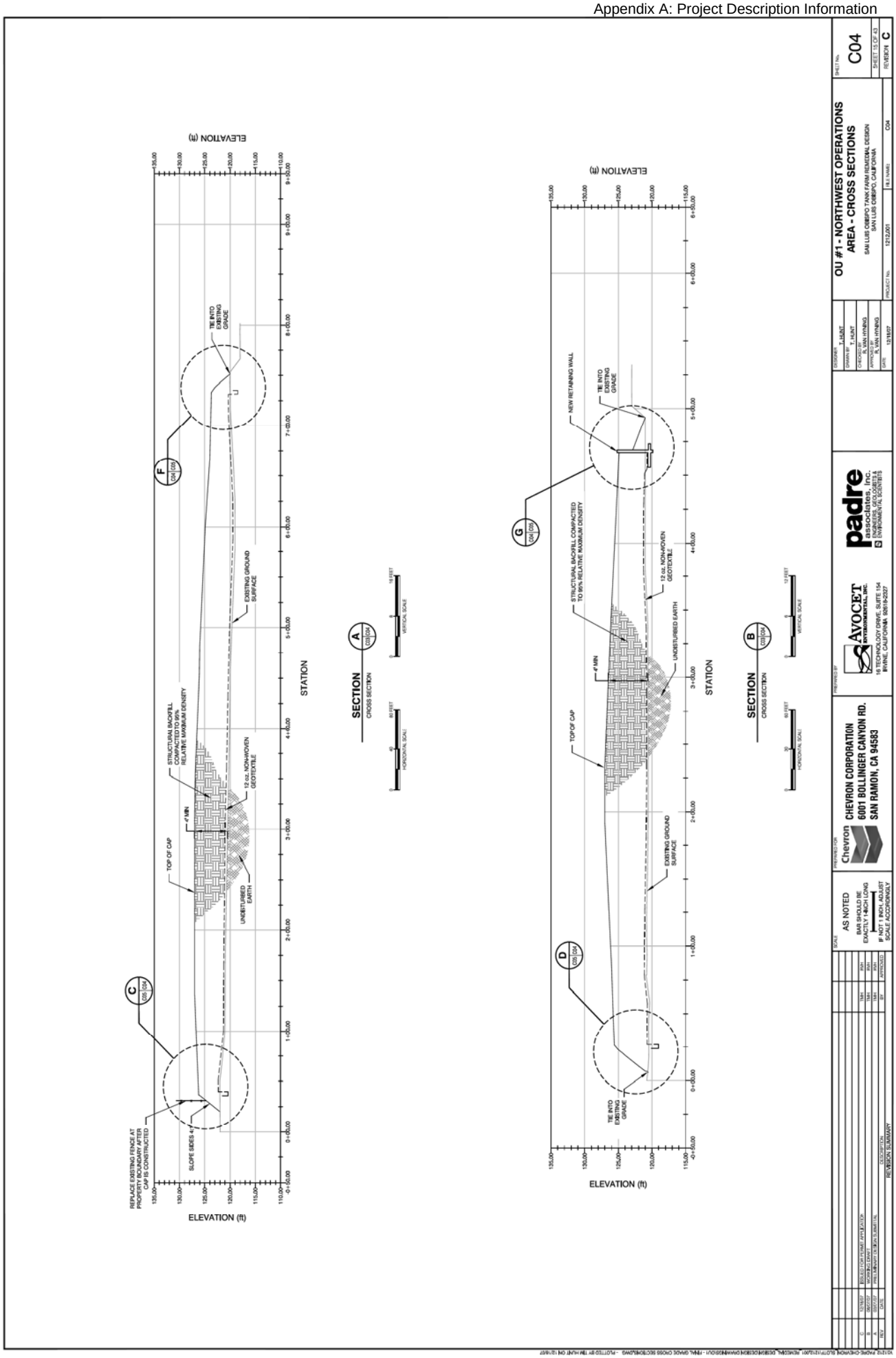
SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

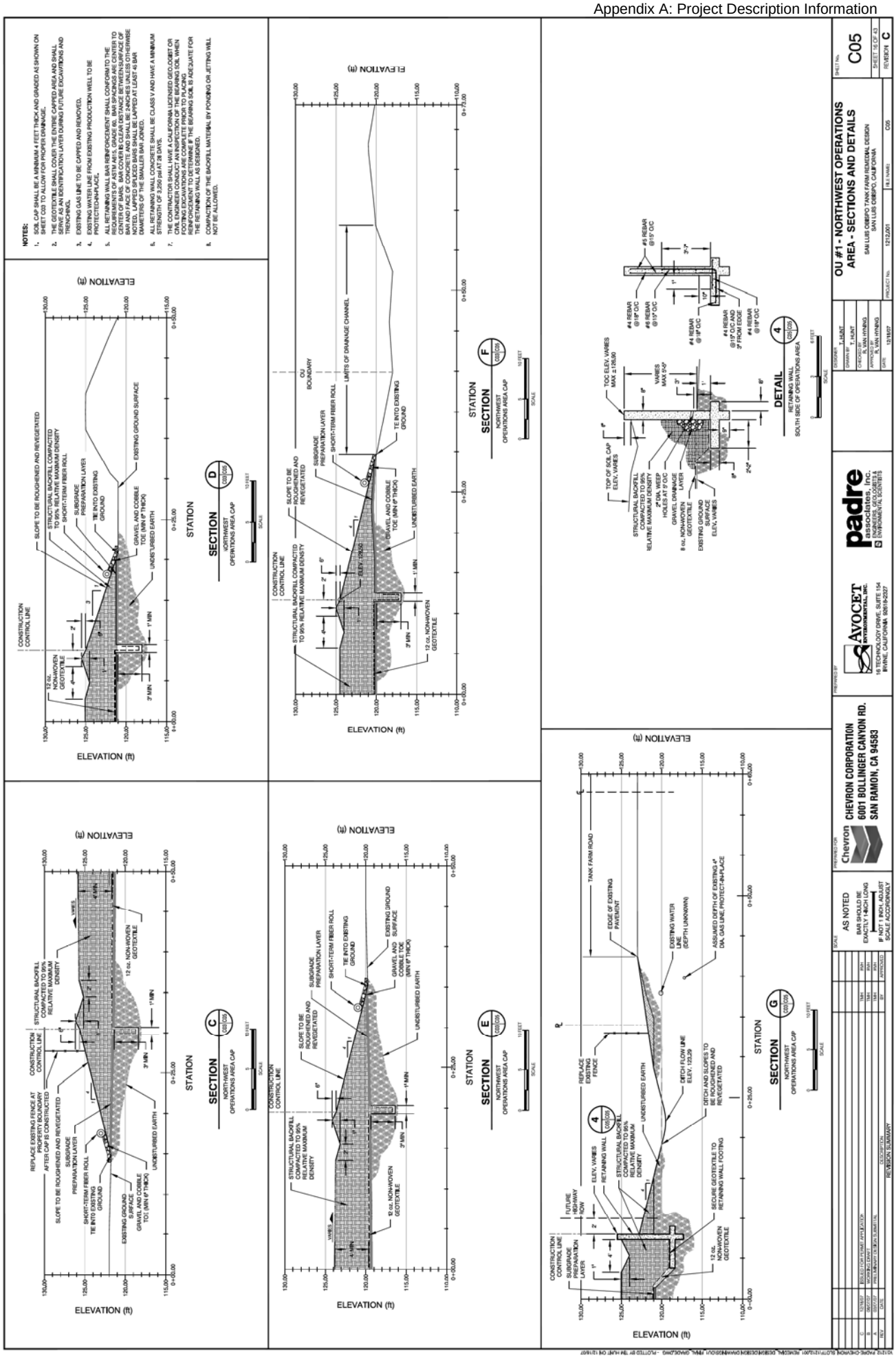
PROJECT No. 1212,001 | FILE NAME: C02

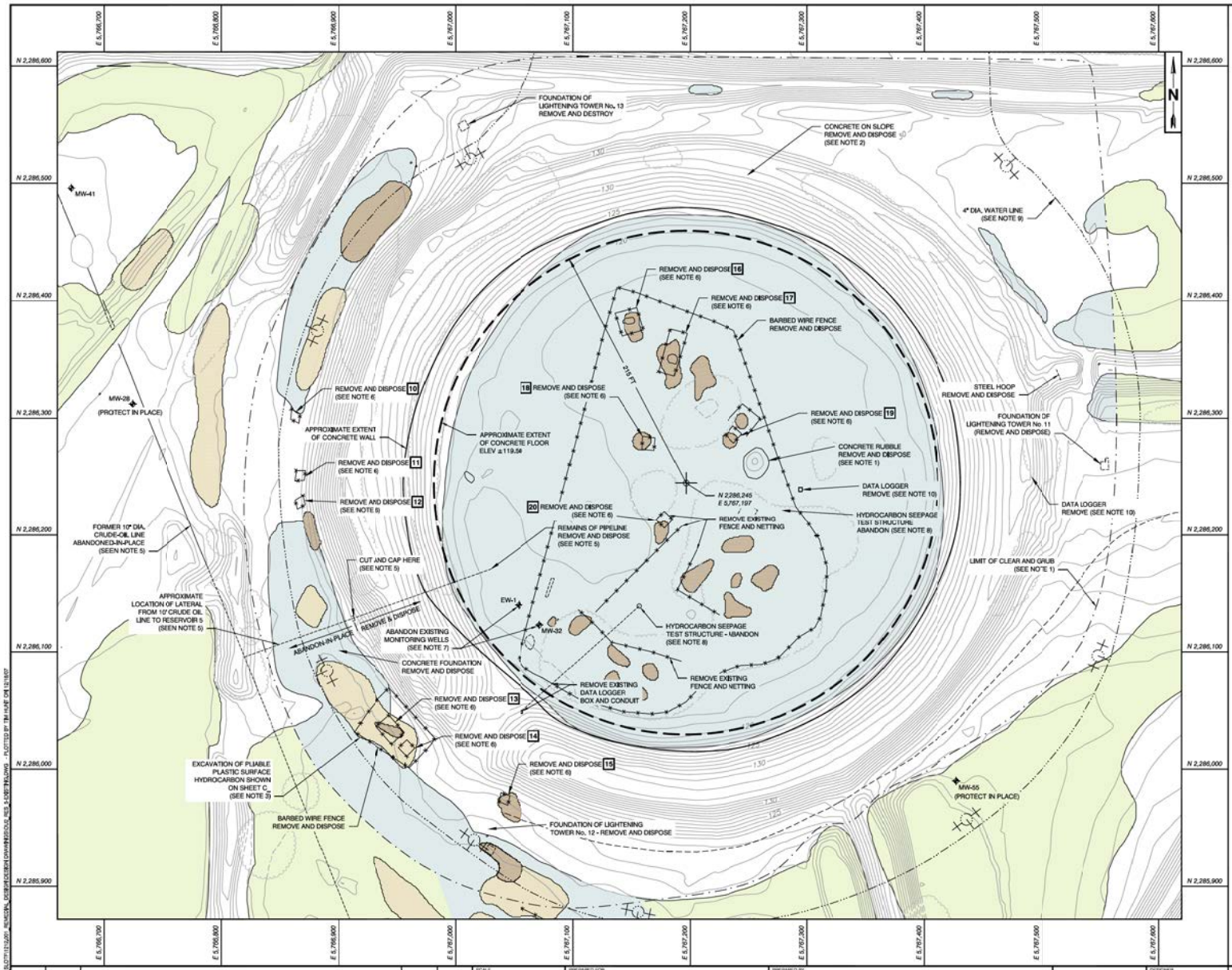
SHEET No. C02
SHEET 13 OF 43
REVISION C



POINT ID	NORTHING	EASTING	ELEVATION
1	2,287,177.25	5,766,123.74	126.10
2	2,287,176.40	5,766,176.70	126.16
3	2,287,176.56	5,766,227.68	126.00
4	2,287,183.29	5,766,460.01	125.29
5	2,287,183.29	5,766,562.40	125.00
6	2,287,092.49	5,766,648.41	124.00
7	2,286,950.11	5,766,815.29	123.68
8	2,286,898.12	5,766,751.76	124.00
9	2,286,794.92	5,766,698.27	124.27
10	2,286,771.95	5,766,645.02	124.00
11	2,286,771.43	5,766,615.42	121.80
12	2,286,706.68	5,766,653.24	118.00
13	2,286,729.18	5,766,712.44	125.00
14	2,286,731.52	5,766,713.20	125.30
15	2,286,732.68	5,766,183.48	125.15
16	2,286,716.78	5,766,183.27	121.00
17	2,286,711.68	5,766,151.66	124.00
18	2,286,713.75	5,766,113.01	124.00
19	2,286,718.87	5,766,112.13	121.50
20	2,286,735.88	5,766,112.52	125.00
21	2,286,939.65	5,766,117.40	125.00
22	2,287,058.30	5,766,120.56	126.48
23	2,287,047.61	5,766,219.84	127.00
24	2,286,983.89	5,766,422.52	127.00
25	2,286,922.51	5,766,550.65	127.00
26	2,286,976.53	5,766,218.25	127.00
27	2,286,981.88	5,766,272.90	127.50


ELEVATION (ft)
STATION
REPLACE EXISTING FENCE AT PROPERTY BOUNDARY AFTER CAP IS CONSTRUCTED
SLOPE SIDES 4:1
TOP OF CAP
4' MIN
STRUCTURAL BACKFILL COMPACTED TO 95% RELATIVE MAXIMUM DENSITY
12 oz. NON-WOVEN GEOTEXTILE
UNDISTURBED EARTH
EXISTING GROUND SURFACE
TIE INTO EXISTING GRADE
SECTION
CROSS SECTION
HORIZONTAL SCALE
VERTICAL SCALE
NEW RETAINING WALL
padre associates, inc.
AVOCET ENVIRONMENTAL, INC.
Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583
OU #1 - NORTHWEST OPERATIONS AREA - CROSS SECTIONS
SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA
C04
SHEET 15 OF 43
REVISION C
AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY
REVISION SUMMARY


NOTES:
1. SOIL CAP SHALL BE A MINIMUM 4 FEET THICK AND GRADED AS SHOWN ON SHEET C03 TO ALLOW FOR PROPER DRAINAGE.
2. THE GEOTEXTILE SHALL COVER THE ENTIRE CAPPED AREA AND SHALL BE USED AS A DEVICE TO IDENTIFICATION LAYER DURING FUTURE EXCAVATIONS AND TRENCHING.
3. EXISTING GAS LINE TO BE CAPPED AND REMOVED.
4. EXISTING WATER LINE FROM EXISTING PRODUCTION WELL TO BE PROTECTED-IN-PLACE.
5. ALL RETAINING WALL BAR REINFORCEMENT SHALL CONFORM TO THE REQUIREMENTS OF ASTM A615, GRADE 60. BAR SPACINGS ARE CENTER TO CENTER OF BARS. BAR COVER IS CLEAR DISTANCE BETWEEN SURFACE OF BAR AND SURFACE OF CONCRETE. ALL REINFORCEMENT SHALL BE CONTINUOUS UNLESS NOTED. LAPPED SPLICED BARS SHALL BE LAPPED AT LEAST 45 BAR DIAMETERS OF THE SMALLER BAR JOINED.
6. ALL RETAINING WALL CONCRETE SHALL BE CLASS V AND HAVE A MINIMUM STRENGTH OF 3,250 psi AT 28 DAYS.
7. THE CONTRACTOR SHALL HAVE A CALIFORNIA LICENSED GEO,OBST OR CIVIL ENGINEER CONDUCT AN INSPECTION OF THE BEARING SOIL WHEN EXCAVATIONS ARE MADE FOR THE FOOTINGS. THE ENGINEER MAY REQUIRE REINFORCEMENT TO DETERMINE IF THE BEARING SOIL IS ADEQUATE FOR THE RETAINING WALL AS DESIGNED.
8. COMPACTION OF THE BACKFILL MATERIAL BY PONDING OR JETTING WILL NOT BE ALLOWED.
SECTION C
NORTHWEST OPERATIONS AREA CAP
SECTION D
NORTHWEST OPERATIONS AREA CAP
SECTION E
NORTHWEST OPERATIONS AREA CAP
SECTION F
NORTHWEST OPERATIONS AREA CAP
SECTION G
NORTHWEST OPERATIONS AREA CAP
DETAIL 4
RETAINING WALL
SOUTH SIDE OF OPERATIONS AREA
ELEVATION (ft)
STATION
SCALE
padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS
AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DRIVE, SUITE 154
IRVINE, CALIFORNIA 92618-2327
Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583
OU #1 - NORTHWEST OPERATIONS AREA - SECTIONS AND DETAILS
SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA
C05
SHEET 16 OF 43
REVISION C
AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY
REVISION SUMMARY



LEGEND

- TOPOGRAPHIC CONTOUR
- FENCE
- 20 PROTECTIVE ENCLOSURE NUMBER
- APPROXIMATE LOCATION OF 4" WATERLINE
- LIMIT OF CLEAR AND GRUB (SEE NOTE 1)
- STATE / FEDERAL WETLAND - PROTECT-IN-PLACE
- STATE / FEDERAL WETLAND - IMPACTED BY CONSTRUCTION
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION REQUIRED
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED

0 40 80 FEET
SCALE

SCHEDULE OF MONITORING WELL ABANDONMENT

WELL I.D.	NORTHING (FT)	EASTING (FT)	TOTAL DEPTH (FT)	MATERIAL OF CONSTRUCTION
EW-1	2,286,140.76	5,767,054.58	29.5	PVC
MW-32	2,286,123.09	5,767,072.82	29	PVC

NOTES:

1. CLEAR AND GRUB WITHIN THIS BOUNDARY. CLEARING SHALL INCLUDE REMOVAL AND DISPOSAL OF ALL CONCRETE DEBRIS, STRUCTURES, FEATURES, MONITORING WELLS AND HYDROCARBON IMPACTED SOIL NOT NOTED IN THESE DRAWINGS.
2. RESERVOIR 5 WAS CONSTRUCTED WITH CONCRETE LINED SLOPES. IT IS ANTICIPATED THAT MUCH OF THE ORIGINAL CONCRETE WITH ITS WIRE MESH REINFORCEMENT IS STILL ON THE SLOPE, ALTHOUGH COVERED WITH SOIL AND VEGETATION. THE CONTRACTOR SHALL REMOVE SLOPE CONCRETE AS THE BERM SOIL IS NEEDED AS BORROW MATERIAL FOR THE CAP CONSTRUCTION. IF PRACTICAL, THE CONTRACTOR MAY CRUSH THE CONCRETE FOR USE AS FILL MATERIAL. OTHERWISE MANAGE OFF-SITE AT AN APPROPRIATE FACILITY PERMITTED FOR THAT USE..
3. HYDROCARBON SURFACE EXPRESSIONS SOUTHWEST AND WEST OF THE RESERVOIR ARE SHOWN FOR CLARITY. PRIOR TO WORKING IN RESERVOIR 5 EXCAVATION OF THOSE SURFACE EXPRESSIONS DESIGNATED FOR REMOVAL SHALL BE COMPLETED. IF THAT WORK IS OUTSIDE OF THE CLEAR AND GRUB LINE FOR RESERVOIR THEN BACK FILL WORK SHALL BE COMPLETED AS WELL.
4. ALL WETLANDS, UNLESS IN A DESIGNATED WORK AREA SHALL BE PROTECTED, UNDER NO CIRCUMSTANCES SHALL PERSONNEL, EQUIPMENT, OR MATERIALS BE ALLOWED WITHIN THE BOUNDARY OF A PROTECTED WETLAND.
5. THERE IS AN ABOVEGROUND SECTION OF THE 10" DIA. LINE THAT TRANSPORTED CRUDE TO AND FROM RESERVOIR 5 DIRECTLY WEST OF THE RESERVOIR. THAT LINE SHALL BE ABANDONED IN-PLACE CONSISTENT WITH THE FINISHING AND CAPPING REQUIREMENTS. THE POSITION OF THE LATERAL IS APPROXIMATE AND IS BASED ON THE EXPOSED PIPE REMNANT IN THE RESERVOIR. THE REMNANT AND BURIED PORTION OF THE LATER WITHIN THE BERM SHALL BE REMOVED AND DISPOSED OF. THE REMAINING SECTION OF LATER SHALL BE FLUSHED AND CAPPED.
6. PROTECTIVE ENCLOSURES SHALL BE DISMANTLED AND PROPERLY DISPOSED. IMPACTED SOIL BENEATH ANY ENCLOSURE SHALL BE REMOVED AS DESCRIBED IN THE SPECIFICATIONS. THOSE AREAS WITHIN RESERVOIR 5 SHALL BE HANDLED IN ACCORDANCE WITH THE REQUIREMENTS FOR THE BOTTOM EXCAVATION.
7. MONITORING WELLS WITHIN THE WORK AREA SHALL BE ABANDONED IN ACCORDANCE WITH CALIFORNIA DEPARTMENT OF WATER RESOURCES BULLETIN No. 74-81.
8. TO ABANDON THE HYDROCARBON SEEPAGE STRUCTURES THE CONTRACTOR SHALL REMOVE ANY ACCUMULATED FLUID OR HYDROCARBON IMPACTED RESIDUE FROM THE INTERIOR BOTTOM, IF ANY. DISPOSE OF FLUIDS OR RESIDUE AT AN APPROPRIATE FACILITY PERMITTED FOR THAT USE. PULL THE CASING AND DISPOSE OF PROPERLY. IF CASING SEPARATES ENSURE THAT UPPER END OF THE REMAINING CASINGS AT LEAST 12-INCHES BELOW EXCAVATION GRADE FOR RESERVOIR 5 BOTTOM.
9. IT IS NOT KNOWN IF THE 4" DIA. WATERLINE IS STILL CHARGED. IF THE LINE IS CHARGED IT SHALL BE DEPRESSURIZED, DRAINED, AND ABANDONED. IF THE LINE IS ENCOUNTERED IN A CLEARING, GRUBBING OR EXCAVATION AREA THE CONTRACTOR SHALL CUT AND REMOVE THE LINE FROM THE IMMEDIATE WORK AREA SO THAT FUTURE EFFORTS ARE NOT IMPEDED. THE REMAINING PIPE SECTIONS SHALL BE PROPERLY CAPPED AND ABANDONED.
10. DATA LOGGER, TRANSDUCERS AND OTHER RELATED EQUIPMENT SHALL BE CLEANED AND RETURNED TO CHEVRON.
11. THE CONTRACTOR SHALL REMOVE ALL SOIL, DEBRIS, AND OTHER MATERIAL UNTIL THE CONCRETE FLOOR OF RESERVOIR 5 IS EXPOSED. THIS SHALL INCLUDE REMOVING ANY MATERIAL COVERING THE CONCRETE ON THE SLOPE. ONCE EXPOSED ALL SLOPE CONCRETE SHALL BE REMOVED.
12. GRAVEL SHALL BE PLACE OVER THE EXPOSED CONCRETE BOTTOM AND NOMINALLY COMPACTED. COMPACTION SHALL REDUCE THE POTENTIAL FOR SETTLEMENT, BUT LEAVE THE MAXIMUM VOID SPACE POSSIBLE CONSISTENT WITH PROVIDING A FIRM FOUNDATION. LATERAL LIMITS OF THE GRAVEL FILL ARE INITIALLY BASED ON BUILDING A SURFACE TO AN ELEVATION OF 119.20. THIS IS SUBJECT TO APPROVAL OF THE CONSTRUCTION MANAGER AND MAY REQUIRE MODIFICATION IN THE FIELD TO SUIT CONDITIONS ONCE THE CONCRETE FLOOR IS EXPOSED.

REFERENCE:

TOPOGRAPHIC CONTOURS AND FEATURES PROVIDED BY EDA, INC., DATED JULY 2007.

REV	DATE	DESCRIPTION	BY	APPROVED
C	12/18/07	ISSUED FOR PERMIT APPLICATION	TMH	RVH
B	09/07/07	WORKING DRAFT	TMH	RVH
A	03/07/07	PRELIMINARY DESIGN SUBMITTAL	TMH	RVH

REVISION SUMMARY

SCALE: AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY

PREPARED FOR: Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583

PREPARED BY: AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DRIVE, SUITE 154
IRVINE, CALIFORNIA 92618-2327

padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

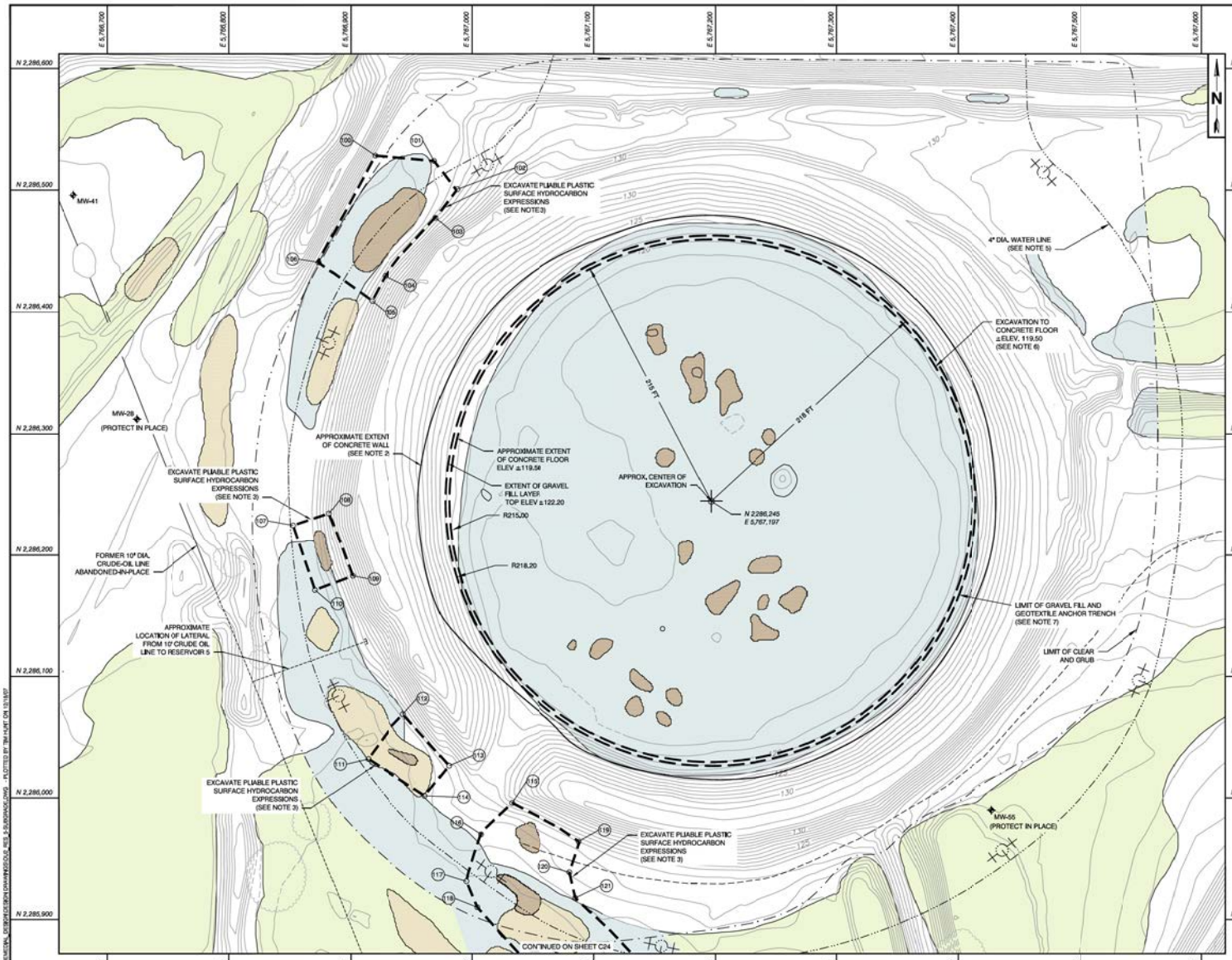
DESIGNER: T. HUNT
DRAWN BY: T. HUNT
CHECKED BY: R. VAN HYNING
APPROVED BY: R. VAN HYNING
DATE: 12/15/07

OU #2 - RESERVOIR 5 - EXISTING CONDITIONS AND DEMOLITION PLAN

SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

SHEET No. C06
SHEET 17 OF 43
REVISION C

PROJECT No. 1212,001 | FILE NAME: C06



LEGEND

- SITE PROPERTY BOUNDARY
- TOPOGRAPHIC CONTOUR
- TREE / BRUSH LINE
- EXISTING MONITORING / PRODUCTION WELL
- FENCE
- APPROXIMATE LOCATION OF 4" WATERLINE
- LIMIT OF CLEAR AND GRUB (SEE NOTE 1)
- STATE / FEDERAL WETLAND - PROTECT-IN-PLACE
- STATE / FEDERAL WETLAND - IMPACTED BY CONSTRUCTION
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION REQUIRED
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED

0 40 80 FEET
SCALE

CONSTRUCTION CONTROL POINTS

POINT ID	NORTHING	EASTING	ELEVATION
100	2,286,528.455	5,766,920.246	-
101	2,286,524.069	5,766,969.324	-
102	2,286,500.881	5,766,988.278	-
103	2,286,477.320	5,766,970.607	-
104	2,286,429.780	5,766,928.746	-
105	2,286,408.969	5,766,917.854	-
106	2,286,440.786	5,766,873.975	-
107	2,286,224.706	5,766,853.033	-
108	2,286,234.515	5,766,882.440	-
109	2,286,182.838	5,766,901.817	-
110	2,286,171.101	5,766,871.039	-
111	2,286,032.174	5,766,914.625	-
112	2,286,068.950	5,766,943.617	-
113	2,286,027.572	5,766,981.378	-
114	2,286,001.852	5,766,961.523	-
115	2,285,996.049	5,766,032.970	-
116	2,285,970.214	5,767,007.504	-
117	2,285,931.612	5,766,995.504	-
118	2,285,910.204	5,767,004.526	-
119	2,285,964.258	5,767,088.140	-
120	2,285,939.000	5,767,080.592	-
121	2,285,917.866	5,767,085.411	-

NOTES:

1. CLEAR AND GRUB WITHIN THIS BOUNDARY. CLEARING SHALL INCLUDE REMOVAL AND DISPOSAL OF ALL CONCRETE DEBRIS, STRUCTURES, FEATURES, MONITORING WELLS AND HYDROCARBON IMPACTED SOIL NOT NOTED IN THESE DRAWINGS.
2. RESERVOIR 5 WAS CONSTRUCTED WITH CONCRETE LINED SLOPES. IT IS ANTICIPATED THAT MUCH OF THE ORIGINAL CONCRETE WITH ITS WIRE MESH REINFORCEMENT IS STILL ON THE SLOPE, ALTHOUGH COVERED WITH SOIL AND VEGETATION. THE CONTRACTOR SHALL REMOVE SLOPE CONCRETE AS THE BERM SOIL IS NEEDED AS BORROW MATERIAL FOR THE CAP CONSTRUCTION. IF PRACTICAL, THE CONTRACTOR MAY CRUSH THE CONCRETE FOR USE AS FILL MATERIAL. OTHERWISE MANAGE OFF-SITE AT AN APPROPRIATE FACILITY PERMITTED FOR THAT USE.
3. HYDROCARBON SURFACE EXPRESSIONS SOUTHWEST AND WEST OF THE RESERVOIR ARE SHOWN FOR CLARITY. PRIOR TO WORKING IN RESERVOIR 5 EXCAVATION OF THOSE SURFACE EXPRESSIONS DESIGNATED FOR REMOVAL SHALL BE COMPLETED. IF THAT WORK IS OUTSIDE OF THE CLEAR AND GRUB LINE FOR RESERVOIR THEN BACK FILL WORK SHALL BE COMPLETED AS WELL.
4. ALL WETLANDS, UNLESS IN A DESIGNATED WORK AREA SHALL BE PROTECTED. UNDER NO CIRCUMSTANCES SHALL PERSONNEL, EQUIPMENT, OR MATERIALS BE ALLOWED WITHIN THE BOUNDARY OF A PROTECTED WETLAND.
5. IT IS NOT KNOWN IF THE 4" DIA. WATERLINE IS STILL CHARGED. IF THE LINE IS CHARGED IT SHALL BE DEPRESSURIZED, DRAINED, AND ABANDONED. IF THE LINE IS ENCOUNTERED IN A CLEARING, GRUBBING OR EXCAVATION AREA THE CONTRACTOR SHALL CUT AND REMOVE THE LINE FROM THE IMMEDIATE WORK AREA SO THAT FUTURE EFFORTS ARE NOT IMPEDED. THE REMAINING PIPE SECTIONS SHALL BE PROPERLY CAPPED AND ABANDONED.
6. THE CONTRACTOR SHALL REMOVE ALL SOIL, DEBRIS, AND OTHER MATERIAL UNTIL THE CONCRETE FLOOR OF RESERVOIR 5 IS EXPOSED. THIS SHALL INCLUDE REMOVING ANY MATERIAL COVERING THE CONCRETE ON THE SLOPE. ONCE EXPOSED ALL SLOPE CONCRETE SHALL BE REMOVED.
7. GRAVEL SHALL BE PLACE OVER THE EXPOSED CONCRETE BOTTOM AND NOMINALLY COMPACTED. COMPACTION SHALL REDUCE THE POTENTIAL FOR SETTLEMENT, BUT LEAVE THE MAXIMUM VOID SPACE POSSIBLE CONSISTENT WITH PROVIDING A FIRM FOUNDATION. LATERAL LIMITS OF THE GRAVEL FILL ARE INITIALLY BASED ON BUILDING A SURFACE TO AN ELEVATION OF 119.20. THIS IS SUBJECT TO APPROVAL OF THE CONSTRUCTION MANAGER AND MAY REQUIRE MODIFICATION IN THE FIELD TO SUIT CONDITIONS ONCE THE CONCRETE FLOOR IS EXPOSED.

REFERENCE:

TOPOGRAPHIC CONTOURS AND FEATURES PROVIDED BY EDA, INC., DATED JULY 11, 2007.

REV	DATE	DESCRIPTION	BY	APPROVED
C	12/18/07	ISSUED FOR PERMIT APPLICATION	TMH	RVH
B	06/07/07	WORKING DRAFT	TMH	RVH
A	05/01/07	PRELIMINARY DESIGN SUBMITTAL	TMH	RVH

REVISION SUMMARY

SCALE: AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY

PREPARED FOR: Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583

PREPARED BY: AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DRIVE, SUITE 154
IRVINE, CALIFORNIA 92618-2327

padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

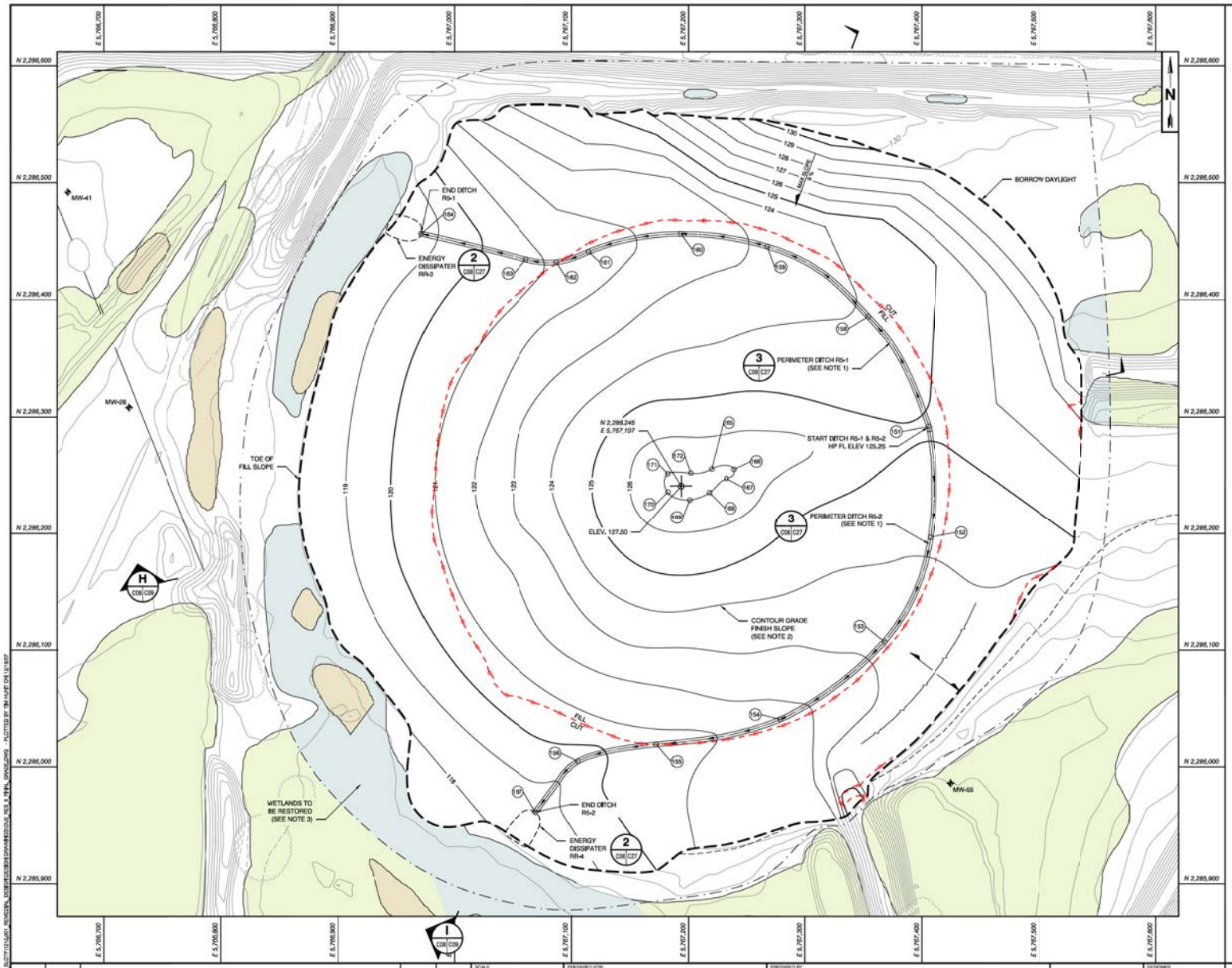
DESIGNER: T. HUNT
DRAWN BY: T. HUNT
CHECKED BY: R. VAN HYNING
APPROVED BY: R. VAN HYNING
DATE: 12/17/07

OU #2 - RESERVOIR 5 - EXCAVATION AND SUBGRADE PREPARATION PLAN

SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

PROJECT No. 1212,001 | FILE NAME: C07

SHEET No. C07
SHEET 18 OF 43
REVISION C



LEGEND

- SITE PROPERTY BOUNDARY
- TOPOGRAPHIC CONTOUR
- TREE / BRUSH LINE
- EXISTING MONITORING / PRODUCTION WELL
- FENCE
- CUT/FILL LINE
- LIMIT OF CLEAR AND GRUB
- RIDGE
- STATE / FEDERAL WETLAND - PROTECT-IN-PLACE
- STATE / FEDERAL WETLAND - IMPACTED BY CONSTRUCTION
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION REQUIRED
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED

0 40 80 FEET
SCALE

CONSTRUCTION CONTROL POINTS

POINT ID	NORTHING	EASTING	ELEVATION
151	2,286,295.793	5,767,408.466	125.25
152	2,286,200.747	5,767,410.369	124.15
153	2,286,111.157	5,767,370.765	123.21
154	2,286,044.728	5,767,281.920	121.56
155	2,286,023.216	5,767,175.582	120.45
156	2,286,008.877	5,767,108.395	119.50
157	2,285,965.241	5,767,072.241	118.50
158	2,286,389.657	5,767,357.321	124.13
159	2,286,449.437	5,767,271.106	123.15
160	2,286,460.477	5,767,196.337	122.39
161	2,286,446.067	5,767,117.733	121.48
162	2,286,435.985	5,767,090.584	121.14
163	2,286,438.475	5,767,064.089	120.65
164	2,286,460.525	5,766,974.816	118.64
165	2,286,259.334	5,767,222.759	127.00
166	2,286,259.096	5,767,242.543	127.00
167	2,286,251.293	5,767,235.696	127.00
168	2,286,239.053	5,767,220.886	127.00
169	2,286,232.832	5,767,204.063	127.00
170	2,286,239.707	5,767,185.754	127.00
171	2,286,255.397	5,767,185.601	127.00
172	2,286,255.974	5,767,204.881	127.00

NOTES:

1. ESTABLISH DITCH FROM HIGHPOINT. ESTABLISH GENTLE CURVE FOR WATER COURSE USING CONTROL POINTS PROVIDED. DITCH SLOPE SHALL NOT BE GREATER THAN 2%, NOR LESS THAN 0.5%.
2. CONTRACTOR SHALL CONTOUR GRADE BETWEEN THE CONTROL CONTOUR AND THE PERIMETER DITCH. GRADING SHALL MIMIC, TO THE EXTENT POSSIBLE, NATURAL CONTOURS. SLOPES SHALL BE NO STEEPER THAN 4:1, AND NO FLATTER THAN 0.5%.
3. EXISTING WETLANDS DISTURBED WITHIN THE CLEAR AND GRUB AREA AND OUTSIDE THE FINAL GRADING AREA SHALL BE RESTORED TO THEIR PRE-CONSTRUCTION CONDITION.

REFERENCE:

TOPOGRAPHIC CONTOURS PROVIDED BY EDA, INC., DATED JULY 11, 2007.

REV	DATE	DESCRIPTION	BY	APPROVED
C	12/18/07	ISSUED FOR PERMIT APPLICATION	TMH	RVH
B	09/07/07	WORKING DRAFT	TMH	RVH
A	03/07/07	PRELIMINARY DESIGN SUBMITTAL	TMH	RVH

REVISION SUMMARY

SCALE: AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY

PREPARED FOR: Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583

PREPARED BY: AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DRIVE, SUITE 154
IRVINE, CALIFORNIA 92618-2327

padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

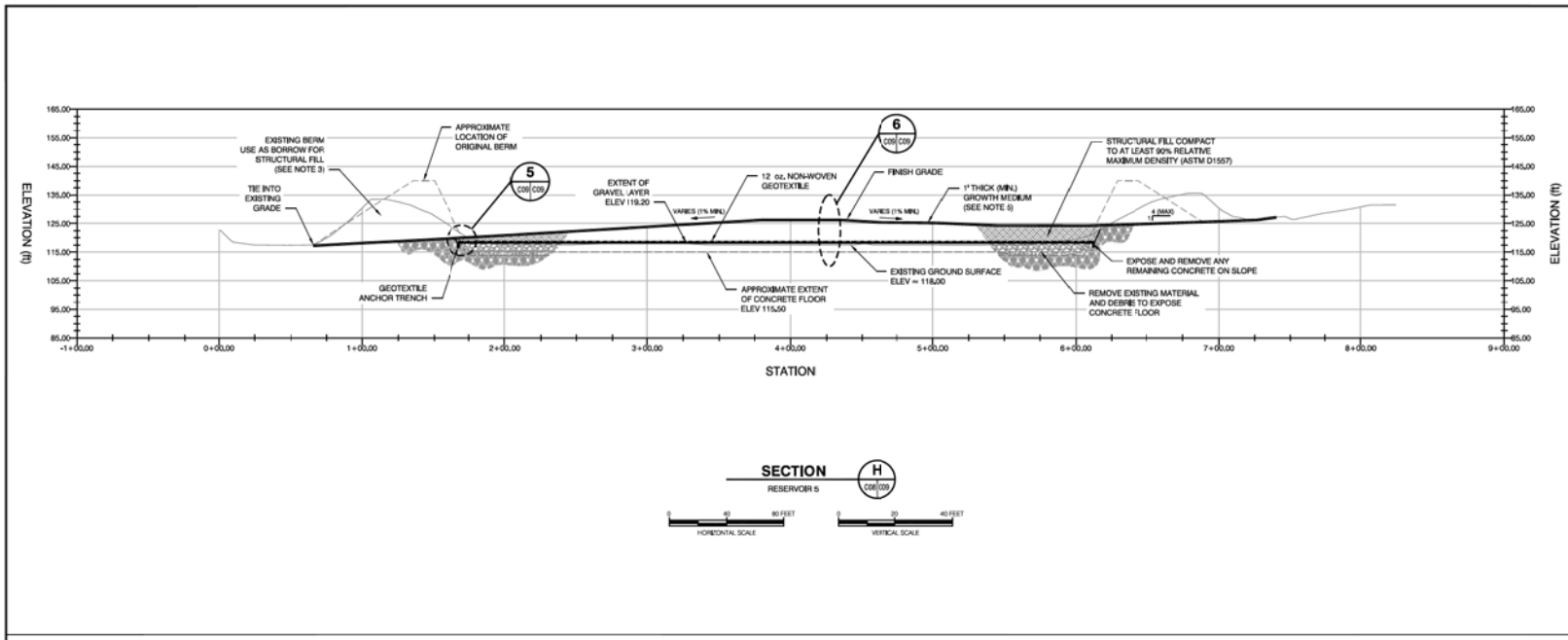
DESIGNER: T. HUNT
DRAWN BY: T. HUNT
CHECKED BY: R. VAN HYNING
APPROVED BY: R. VAN HYNING
DATE: 12/18/07

OU #2 - RESERVOIR 5 - FINAL GRADE PLAN

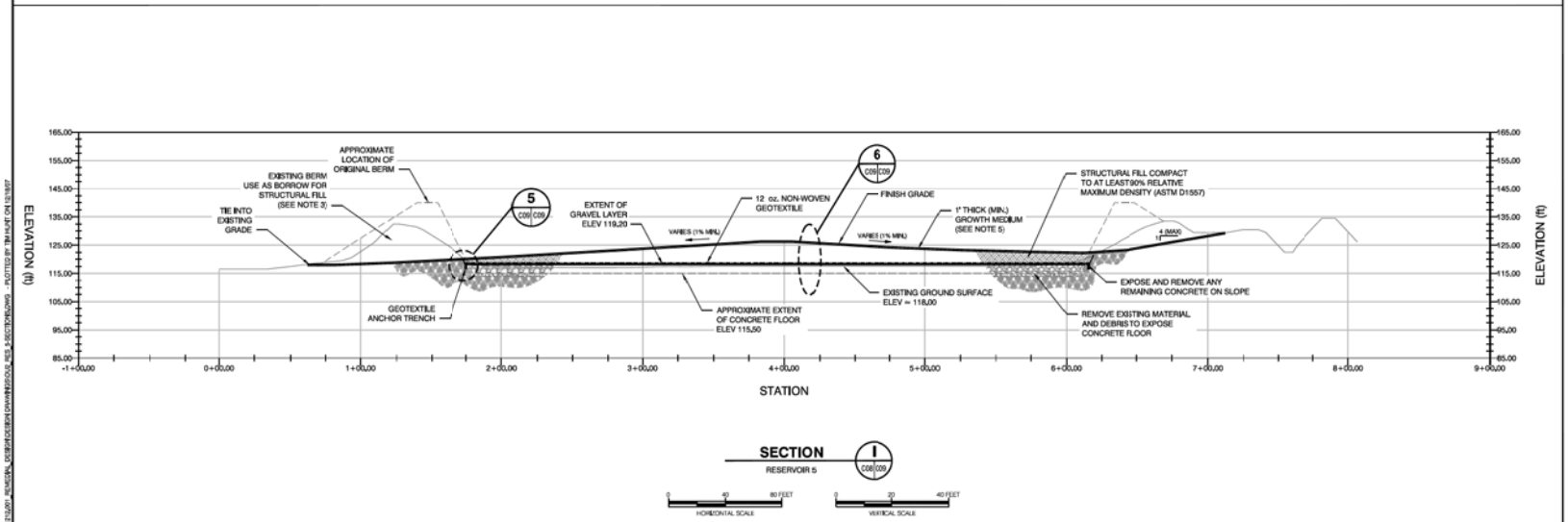
SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

PROJECT No. 1212.001 | FILE NAME: C08

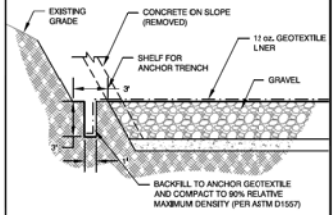
SHEET No. C08
SHEET 19 OF 43
REVISION C



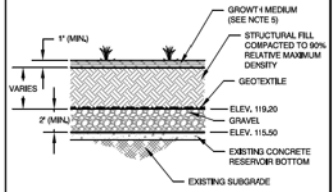
SECTION H (C08 C09)
RESERVOIR 5
HORIZONTAL SCALE 0 40 80 FEET
VERTICAL SCALE 0 20 40 FEET



SECTION I (C08 C09)
RESERVOIR 5
HORIZONTAL SCALE 0 40 80 FEET
VERTICAL SCALE 0 20 40 FEET



DETAIL 5 (C08 C09)
TYPICAL RESERVOIR 5 ANCHOR TRENCH
SCALE 0 5 10 FEET



DETAIL 6 (C08 C09)
TYPICAL RESERVOIR 5 CAP COMPONENTS
SCALE 0 5 10 FEET

NOTES:

1. THE CONTRACTOR NEED NOT REMOVE THE CONCRETE FLOOR. REMOVED MATERIAL SHALL BE MANAGED AT AN APPROPRIATE FACILITY PERMITTED FOR THE USE.
2. GRAVEL SHALL BE PLACED AND NOMINALLY COMPACTED. THE GRAVEL LAYER IS TO BE USED AS A PREFERENTIAL EXPANSION ZONE FOR THE UNDERLYING LNAPL WHEN IT IS LIFTED BY RISING GROUNDWATER. COMPACTION SHOULD ENSURE THAT THE POTENTIAL FOR SETTLEMENT IS MINIMIZED, BUT BREAKS OR FRACTURES THE GRAVEL AS LITTLE AS POSSIBLE IN ORDER TO PROVIDE THE LARGEST VOID SPACES POSSIBLE CONSISTENT WITH A FIRM FOUNDATION. THE GRAVEL SURFACE CAN BE FLAT BUT MUST NOT HAVE ANY DIPS OR HAVE AN UPPER SURFACE LESS THAN AN ELEVATION OF 119.20.
3. THE EXISTING BERM MAY BE USED FOR STRUCTURAL FILL. THE CONTRACTOR SHALL ENSURE THERE IS NO ORGANIC OR OTHER DELETERIOUS MATERIAL IN THE FILL. THE CONTRACTOR SHALL ALSO ENSURE THAT MATERIAL USED FOR STRUCTURAL FILL CONTAINS LESS THAN 1,000 mg/kg OF TPH AS MEASURED BY EPA METHOD 8015. UNSUITABLE MATERIAL SHALL BE IMMEDIATELY BROUGHT TO THE ATTENTION OF THE CONSTRUCTION MANAGER. ALTERNATIVE BORROW WILL BE APPROVED AS NECESSARY.
4. CONTRACTOR SHALL PROVIDE A SHELF WITHIN THE EXISTING BERM ON WHICH TO EXCAVATE AN ANCHOR TRENCH FOR THE GEOTEXTILE. SHELF MAY BE CUT AFTER GRAVEL HAS BEEN PLACED. CONTRACTOR SHALL PREVENT SOIL FROM CONTAMINATING GRAVEL TO EXTENT PRACTICAL. SECTIONS OF GRAVEL WILL BE REPLACED IF CONSTRUCTION MANAGER BELIEVES THAT FUNCTION OF GRAVEL LAYER HAS BEEN IMPAIRED.
5. GROWTH MEDIUM SHALL BE AN APPROVED SOIL WITH HIGH ORGANIC CONTENT AND AMENDED, AS NECESSARY. AFTER PLACEMENT, SOIL SHALL BE SCARIFIED TO A DEPTH OF 3-INCHES. CONTRACTOR SHALL PLACE AN APPROVED NATIVE-PLANT MIX OVER THE SCARIFIED SOIL JUST PRIOR TO THE RAIN SEASON STARTING.

REV	DATE	DESCRIPTION	BY	APPROVED
C	12/18/07	ISSUED FOR PERMIT APPLICATION	TMH	RVH
B	09/07/07	WORKING DRAFT	TMH	RVH
A	03/01/07	PRELIMINARY DESIGN SUBMITTAL	TMH	RVH

REVISION SUMMARY

SCALE: AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY

PREPARED FOR: Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583

PREPARED BY: AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DRIVE, SUITE 154
IRVINE, CALIFORNIA 92618-2327

padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

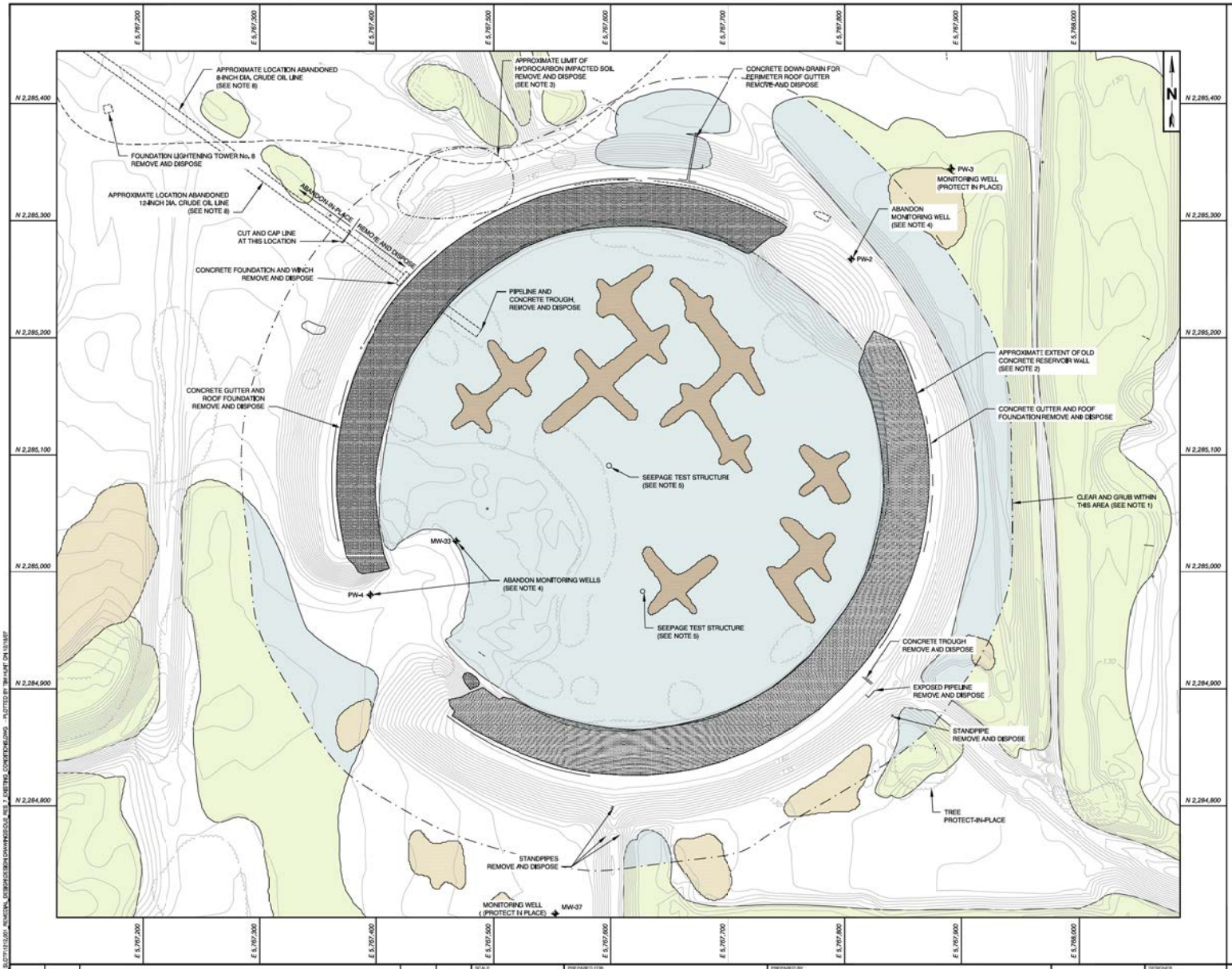
DESIGNER: T. HUNT
DRAWN BY: T. HUNT
CHECKED BY: R. VAN HYNING
APPROVED BY: R. VAN HYNING
DATE: 12/17/07

OU #2 - RESERVOIR 5 - SECTIONS AND DETAILS

SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

PROJECT No. 1212.001 | FILE NAME: C09

SHEET No. C09
SHEET 20 OF 43
REVISION C



LEGEND

- TOPOGRAPHIC CONTOUR
- FENCE
- 20 PROTECTIVE ENCLOSURE NUMBER
- LIMIT OF CLEAR AND GRUB (SEE NOTE 1)
- STATE / FEDERAL WETLAND - PROTECT-IN-PLACE
- STATE / FEDERAL WETLAND - IMPACTED BY CONSTRUCTION
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION REQUIRED
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED

0 40 80 FEET
SCALE

SCHEDULE OF MONITORING WELL ABANDONMENT

WELL I.D.	NORTHING (FT)	EASTING (FT)	TOTAL DEPTH (FT)	MATERIAL OF CONSTRUCTION
PW-2	2,285,343.88	5,767,803.19	38	PVC
PW-4	2,284,980.71	5,767,395.99	46	PVC
MW-33	2,285026.61	5,767,468.12	24	PVC

NOTES:

1. CLEAR AND GRUB WITHIN THIS BOUNDARY. CLEARING SHALL INCLUDE REMOVAL AND DISPOSAL OF ALL CONCRETE DEBRIS, STRUCTURES, FEATURES, MONITORING WELLS AND HYDROCARBON IMPACTED SOIL NOT NOTED IN THESE DRAWINGS.
2. THE SLOPE CONCRETE WITHIN RESERVOIR 7 IS LARGELY INTACT. THIS CONCRETE MUST BE REMOVED TO ACCESS THE BERM AS A BORROW SURFACE AND TO CONSTRUCT THE CAP. THE CONTRACTOR SHALL REMOVE THE CONCRETE AND MAY RECYCLE THE MATERIAL FOR USE AS AGGREGATE BASE. IF RECYCLING IS IMPRACTICAL DUE TO THE WIRE MESH, OR OTHER CONSIDERATIONS, THE CONTRACTOR SHALL DISPOSE OF MATERIAL AT AN APPROPRIATE FACILITY PERMITTED FOR THAT USE. ALL WETLANDS, UNLESS IN A DESIGNATED WORK AREA SHALL BE PROTECTED. UNDER NO CIRCUMSTANCES SHALL PERSONNEL, EQUIPMENT, OR MATERIALS BE ALLOWED WITHIN THE BOUNDARY OF A PROTECTED WETLAND.
3. HYDROCARBON IMPACTED SOIL SHALL BE REMOVED FROM THIS AREA TO A DEPTH OF APPROXIMATELY 3 FEET AS SHOWN ON SHEET C10. THIS DEPTH IS APPROXIMATE AND MAY BE MODIFIED IN THE FIELD.
4. MONITORING WELLS WITHIN THE WORK AREA SHALL BE ABANDONED IN ACCORDANCE WITH CALIFORNIA DEPARTMENT OF WATER RESOURCES BULLETIN No. 74-81.
5. TO ABANDON THE HYDROCARBON SEEPAGE STRUCTURES THE CONTRACTOR SHALL REMOVE ANY ACCUMULATED FLUID OR HYDROCARBON IMPACTED RESIDUE FROM THE INTERIOR BOTTOM, IF ANY, DISPOSE OF FLUIDS OR RESIDUE AT AN APPROPRIATE FACILITY PERMITTED FOR THAT USE. PULL THE CASING AND DISPOSE OF PROPERLY. IF CASING SEPARATES ENSURE THAT UPPER END OF THE REMAINING CASINGIS AT LEAST 12-INCHES BELOW EXCAVATION GRADE FOR RESERVOIR 7 BOTTOM.
6. THE CONTRACTOR SHALL REMOVE ALL SOIL, DEBRIS, AND OTHER MATERIAL UNTIL THE CONCRETE FLOOR OF RESERVOIR 7 IS EXPOSED. THIS SHALL INCLUDE REMOVING ANY MATERIAL COVERING THE CONCRETE ON THE SLOPE. ONCE EXPOSED ALL SLOPE CONCRETE SHALL BE REMOVED.
7. GRAVEL SHALL BE PLACE OVER THE EXPOSED CONCRETE BOTTOM AND NOMINALLY COMPACTED. COMPACTION SHALL REDUCE THE POTENTIAL FOR SETTLEMENT, BUT LEAVE THE MAXIMUM VOID SPACE POSSIBLE CONSISTENT WITH PROVIDING A FIRM FOUNDATION. LATERAL LIMITS OF THE GRAVEL FILL ARE INITIALLY BASED ON BUILDING A SURFACE TO AN ELEVATION OF 123.50. THIS IS SUBJECT TO APPROVAL OF THE CONSTRUCTION MANAGER AND MAY REQUIRE MODIFICATION IN THE FIELD TO SUIT CONDITIONS ONCE THE CONCRETE FLOOR IS EXPOSED.
8. THE 12-INCH DIAMETER AND 8-INCH DIAMETER CRUDE OIL LINES ARE REPORTED TO BE ABANDONED. IT IS LIKELY THAT THEY WERE ABANDONED IN PLACE. THE LINES SHALL BE FLUSHED AND CLEANED, AND THEN SHALL BE CAPPED AND ABANDONED IN-PLACE. SECTIONS OF THE PIPE WITHIN THE CLEAR AND GRUB LINE, OR AS NOTED ON THE PLAN SHALL BE REMOVED AND DISPOSED.

REFERENCE:

TOPOGRAPHIC CONTOURS AND FEATURES PROVIDED BY EDA, INC., DATED JULY 11, 2007.

REV	DATE	DESCRIPTION	BY	APPROVED
C	12/18/07	ISSUED FOR PERMIT APPLICATION	TMH	RVH
B	06/07/07	WORKING DRAFT	TMH	RVH
A	05/01/07	PRELIMINARY DESIGN SUBMITTAL	TMH	RVH

REVISION SUMMARY

SCALE: AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY

PREPARED FOR: Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583

PREPARED BY: AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DRIVE, SUITE 154
IRVINE, CALIFORNIA 92618-2327

padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

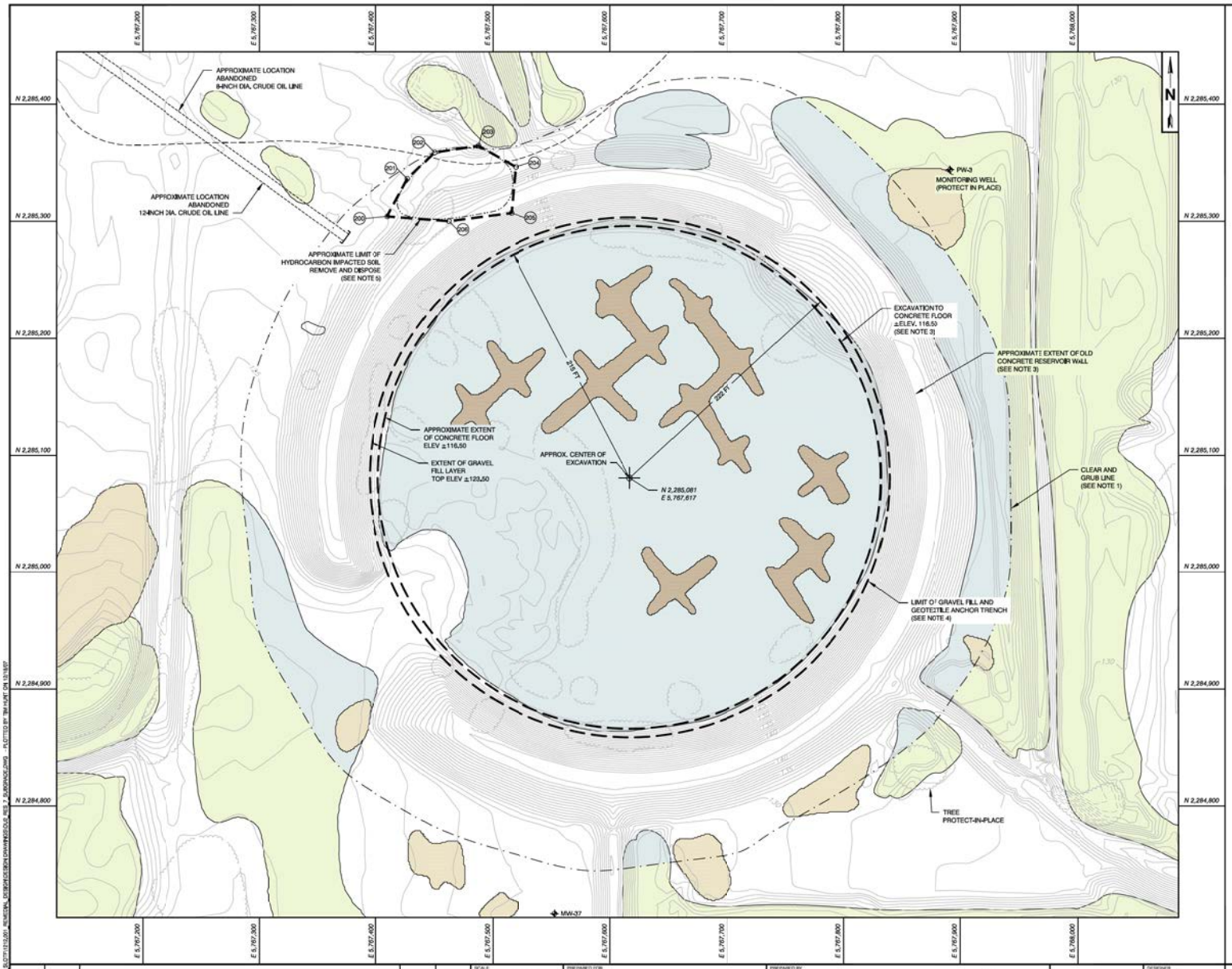
DESIGNER: T. HUNT
DRAWN BY: T. HUNT
CHECKED BY: R. VAN HYNING
APPROVED BY: R. VAN HYNING
DATE: 12/17/07

OU #2 - RESERVOIR 7 - EXISTING CONDITIONS AND DEMOLITION PLAN

SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

SHEET No. C10
SHEET 21 OF 43
REVISION C

PROJECT No. 1212.001 | FILE NAME: C10



LEGEND

- SITE PROPERTY BOUNDARY
- TOPOGRAPHIC CONTOUR
- TREE / BRUSH LINE
- EXISTING MONITORING / PRODUCTION WELL
- FENCE
- LIMIT OF CLEAR AND GRUB (SEE NOTE 1)
- STATE / FEDERAL WETLAND - PROTECT-IN-PLACE
- STATE / FEDERAL WETLAND - IMPACTED BY CONSTRUCTION
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION REQUIRED
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED

0 40 80 FEET
SCALE

CONSTRUCTION CONTROL POINTS

POINT ID	NORTHING	EASTING	ELEVATION
200	2,285,304.108	5,767,410.222	-
201	2,285,336.332	5,767,427.150	-
202	2,285,358.697	5,767,450.278	-
206	2,285,364.439	5,767,487.616	-
204	2,285,346.305	5,767,519.210	-
205	2,285,307.015	5,767,515.582	-
206	2,285,300.064	5,767,462.371	-

NOTES:

1. CLEAR AND GRUB WITHIN THIS BOUNDARY. CLEARING SHALL INCLUDE REMOVAL AND DISPOSAL OF ALL CONCRETE DEBRIS, STRUCTURES, FEATURES, MONITORING WELLS AND HYDROCARBON IMPACTED SOIL NOT NOTED IN THESE DRAWINGS.
2. ALL WETLANDS, UNLESS IN A DESIGNATED WORK AREA SHALL BE PROTECTED. UNDER NO CIRCUMSTANCES SHALL PERSONNEL, EQUIPMENT, OR MATERIALS BE ALLOWED WITHIN THE BOUNDARY OF A PROTECTED WETLAND.
3. THE CONTRACTOR SHALL REMOVE ALL SOIL, DEBRIS, AND OTHER MATERIAL UNTIL THE CONCRETE FLOOR OF RESERVOIR 7 IS EXPOSED. THIS SHALL INCLUDE REMOVING ANY MATERIAL COVERING THE CONCRETE ON THE SLOPE. ONCE EXPOSED ALL SLOPE CONCRETE SHALL BE REMOVED.
4. GRAVEL SHALL BE PLACE OVER THE EXPOSED CONCRETE BOTTOM AND NOMINALLY COMPACTED. COMPACTION SHALL REDUCE THE POTENTIAL FOR SETTLEMENT, BUT LEAVE THE MAXIMUM VOID SPACE POSSIBLE CONSISTENT WITH PROVIDING A FIRM FOUNDATION. LATERAL LIMITS OF THE GRAVEL FILL ARE INITIALLY BASED ON BUILDING A SURFACE TO AN ELEVATION OF 123.50. THIS IS SUBJECT TO APPROVAL OF THE CONSTRUCTION MANAGER AND MAY REQUIRE MODIFICATION IN THE FIELD TO SUIT CONDITIONS ONCE THE CONCRETE FLOOR IS EXPOSED.
5. HYDROCARBON IMPACTED SOIL SHALL BE REMOVED FROM THIS AREA TO A DEPTH OF 3 FEET. THIS DEPTH IS APPROXIMATE AND MAY BE MODIFIED IN THE FIELD.

REFERENCE:

TOPOGRAPHIC CONTOURS AND FEATURES PROVIDED BY EDA, INC., DATED JULY 2007.

REV	DATE	DESCRIPTION	BY	APPROVED
C	12/18/07	ISSUED FOR PERMIT APPLICATION	TMH	RVH
B	08/07/07	WORKING DRAFT	TMH	RVH
A	05/01/07	PRELIMINARY DESIGN SUBMITTAL	TMH	RVH

REVISION SUMMARY

SCALE: AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY

PREPARED FOR: Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583

PREPARED BY: AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DRIVE, SUITE 154
IRVINE, CALIFORNIA 92618-2327

padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

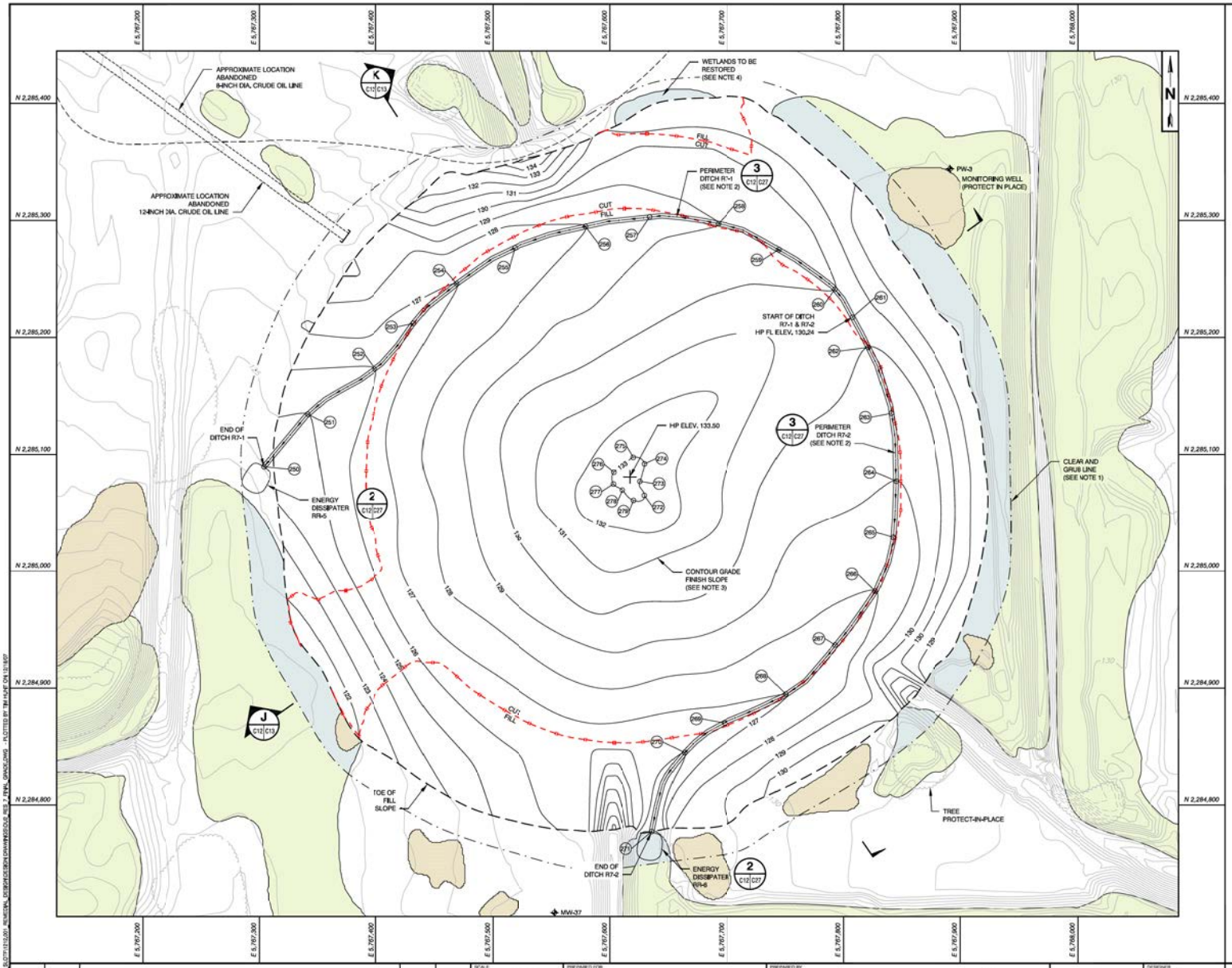
DESIGNER: T. HUNT
DRAWN BY: T. HUNT
CHECKED BY: R. VAN HYNING
APPROVED BY: R. VAN HYNING
DATE: 12/17/07

OU #2 - RESERVOIR 7 - EXCAVATION AND SUBGRADE PREPARATION PLAN

SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

PROJECT No. 1212.001 | FILE NAME: C11

SHEET No. C11
SHEET 22 OF 43
REVISION C



LEGEND

- SITE PROPERTY BOUNDARY
- TOPOGRAPHIC CONTOUR
- TREE / BRUSH LINE
- EXISTING MONITORING / PRODUCTION WELL
- FENCE
- CUT/FILL LINE
- LIMIT OF CLEAR AND GRUB
- STATE / FEDERAL WETLAND - PROTECT-IN-PLACE
- STATE / FEDERAL WETLAND - IMPACTED BY CONSTRUCTION
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION REQUIRED
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED

0 40 80 FEET
SCALE

CONSTRUCTION CONTROL POINTS

POINT ID	NORTHING	EASTING	ELEVATION
250	2,285,089.706	5,767,304.106	124.60
251	2,285,134.614	5,767,341.720	125.60
252	2,285,173.178	5,767,398.897	126.60
253	2,285,212.132	5,767,432.422	126.11
254	2,285,246.010	5,767,468.917	127.60
255	2,285,276.617	5,767,518.514	127.48
256	2,285,294.859	5,767,579.028	128.60
257	2,285,303.004	5,767,634.123	128.49
258	2,285,297.255	5,767,692.612	129.60
259	2,285,275.048	5,767,744.772	129.44
260	2,285,241.213	5,767,792.746	130.60
261	2,285,217.362	5,767,807.729	130.24
262	2,285,191.575	5,767,821.201	130.60
263	2,285,135.394	5,767,840.569	129.60
264	2,285,077.324	5,767,844.775	129.60
265	2,285,026.851	5,767,842.141	128.60
266	2,284,982.869	5,767,827.160	128.60
267	2,284,936.784	5,767,792.957	127.11
268	2,284,894.743	5,767,750.641	127.60
269	2,284,869.976	5,767,698.022	126.42
270	2,284,844.751	5,767,663.590	126.60
271	2,284,777.311	5,767,635.917	133.60
272	2,285,065.198	5,767,629.588	133.60
273	2,285,077.234	5,767,625.729	133.60
274	2,285,092.218	5,767,629.724	133.60
275	2,285,097.663	5,767,620.087	133.60
276	2,285,085.091	5,767,603.319	133.60
277	2,285,074.968	5,767,602.970	133.60
278	2,285,069.733	5,767,610.721	133.60
279	2,285,060.981	5,767,620.273	133.60

NOTES:

1. ALL WETLANDS, UNLESS IN A DESIGNATED WORK AREA SHALL BE PROTECTED, UNDER NO CIRCUMSTANCES SHALL PERSONNEL, EQUIPMENT, OR MATERIALS BE ALLOWED WITHIN THE BOUNDARY OF A PROTECTED WETLAND.
2. ESTABLISH DITCH FROM HIGHPOINT. ESTABLISH GENTLE CURVE FOR WATER COURSE USING CONTROL POINTS PROVIDED. DITCH SLOPE SHALL NOT BE GREATER THAN 2%, NOR LESS THAN 0.5%.
3. CONTRACTOR SHALL CONTOUR GRADE BETWEEN THE CONTROL CONTOUR AND THE PERIMETER DITCH. GRADING SHALL MIMIC, TO THE EXTENT POSSIBLE, NATURAL CONTOURS. SLOPES SHALL BE NO STEEPER THAN 4:1, AND NO FLATTER THAN 0.5%.
4. EXISTING WETLANDS WITHIN THE CLEAR AND GRUB AREA AND OUTSIDE THE FINAL GRADING AREA SHALL BE RESTORED TO THEIR PRE-CONSTRUCTION CONDITION.

REFERENCE:

TOPOGRAPHIC CONTOURS AND FEATURES PROVIDED BY EDA, INC., DATED JULY 2007.

REV	DATE	DESCRIPTION	BY	APPROVED
C	12/18/07	ISSUED FOR PERMIT APPLICATION	TMH	RVH
B	09/07/07	WORKING DRAFT	TMH	RVH
A	05/01/07	PRELIMINARY DESIGN SUBMITTAL	TMH	RVH

REVISION SUMMARY

SCALE: AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY

PREPARED FOR: Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583

PREPARED BY: AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DRIVE, SUITE 154
IRVINE, CALIFORNIA 92618-2327

padre associates, Inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

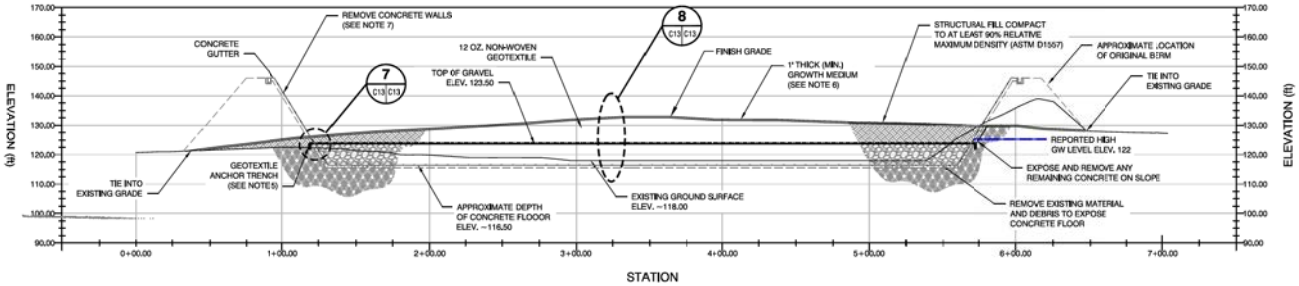
DESIGNER: T. HUNT
DRAWN BY: T. HUNT
CHECKED BY: R. VAN HYNING
APPROVED BY: R. VAN HYNING
DATE: 12/18/07

OU #2 - RESERVOIR 7 - FINAL GRADE PLAN

SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

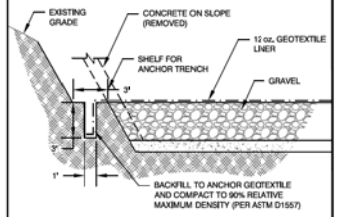
PROJECT No. 1212.001 | FILE NAME: C12

SHEET No. C12
SHEET 23 OF 43
REVISION C

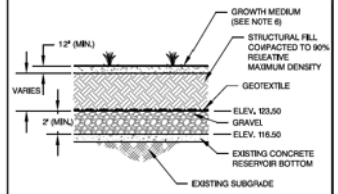


SECTION J (C12|C13) — RESERVOIR 7

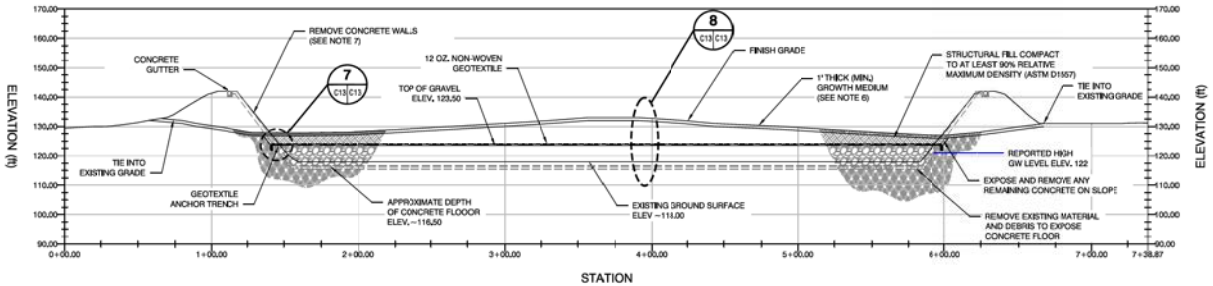
HORIZONTAL SCALE 0 40 80 FEET — VERTICAL SCALE 0 20 40 FEET



DETAIL 7 (C13|C13) — TYPICAL RESERVOIR 7 ANCHOR TRENCH



DETAIL 8 (C13|C13) — TYPICAL RESERVOIR 7 CAP COMPONENTS



SECTION K (C12|C13) — RESERVOIR 7

HORIZONTAL SCALE 0 40 80 FEET — VERTICAL SCALE 0 20 40 FEET

NOTES:

1. THE CONTRACTOR NEED NOT REMOVE THE CONCRETE FLOOR. REMOVED MATERIAL SHALL BE MANAGED AT AN APPROPRIATE FACILITY PERMITTED FOR THE USE.
2. GRAVEL SHALL BE PLACED AND NOMINALLY COMPACTED. THE GRAVEL LAYER IS TO BE USED AS A PREFERENTIAL EXPANSION ZONE FOR THE UNDERLYING LNAPL WHEN IT IS LIFTED BY RISING GROUNDWATER. COMPACTION SHOULD ENSURE THAT THE POTENTIAL FOR SETTLEMENT IS MINIMIZED, BUT BREAKS OR FRACTURES THE GRAVEL AS LITTLE AS POSSIBLE IN ORDER TO PROVIDE THE LARGEST VOID SPACES POSSIBLE CONSISTENT WITH A FIRM FOUNDATION. THE GRAVEL SURFACE CAN BE FLAT BUT MUST NOT HAVE ANY DIPS OR HAVE AN UPPER SURFACE LESS THAN ELEVATION 128.50.
3. THE EXISTING BERM MAY BE USED FOR STRUCTURAL FILL. THE CONTRACTOR SHALL ENSURE THERE IS NO ORGANIC OR OTHER DELETERIOUS MATERIAL IN THE FILL. THE CONTRACTOR SHALL ALSO ENSURE THAT MATERIAL USED FOR STRUCTURAL FILL CONTAINS LESS THAN 1,000 mg/kg OF TPH AS MEASURED BY EPA METHOD 8015. UNSUITABLE MATERIAL SHALL BE IMMEDIATELY BROUGHT TO THE ATTENTION OF THE CONSTRUCTION MANAGER. ALTERNATIVE BORROW WILL BE APPROVED AS NECESSARY.
4. CONTRACTOR SHALL PROVIDE A SHELF WITHIN THE EXISTING BERM ON WHICH TO EXCAVATE AN ANCHOR TRENCH FOR THE GEOTEXTILE. SHELF MAY BE CUT AFTER GRAVEL HAS BEEN PLACED. CONTRACTOR SHALL PREVENT SOIL FROM CONTAMINATING GRAVEL TO EXTENT PRACTICAL. SECTIONS OF GRAVEL WILL BE REPLACED IF CONSTRUCTION MANAGER BELIEVES THAT FUNCTION OF GRAVEL LAYER HAS BEEN IMPAIRED.
5. STRUCTURAL FILL ADJACENT TO TRENCH SHELF SHOULD BE IN PLACE PRIOR TO INSTALLATION OF GEOTEXTILE ANCHOR TRENCH.
6. GROWTH MEDIUM SHALL BE AN APPROVED SOIL WITH HIGH ORGANIC CONTENT AND AMENDED, AS NECESSARY. AFTER PLACEMENT, SOIL SHALL BE SCARIFIED TO A DEPTH OF 3-INCHES. CONTRACTOR SHALL PLACE AN APPROVED NATIVE-PLANT MIX OVER THE SCARIFIED SOIL JUST PRIOR TO THE RAIN SEASON STARTING.
7. THE CONTRACTOR SHALL REMOVE THE CONCRETE WALLS ON THE SLOPE. REMOVED MATERIAL SHALL BE MANAGED AT AN APPROPRIATE FACILITY PERMITTED FOR THE USE.

REV	DATE	DESCRIPTION	BY	APPROVED
C	12/18/07	ISSUED FOR PERMIT APPLICATION	TMH	RVH
B	06/07/07	WORKING DRAFT	TMH	RVH
A	03/07/07	PRELIMINARY DESIGN SUBMITTAL	TMH	RVH

REVISION SUMMARY

SCALE: AS NOTED — BAR SHOULD BE EXACTLY 1-INCH LONG — IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY

PREPARED FOR: Chevron — CHEVRON CORPORATION, 6001 BOLLINGER CANYON RD., SAN RAMON, CA 94583

PREPARED BY: AVOCET ENVIRONMENTAL, INC. — 16 TECHNOLOGY DRIVE, SUITE 154, IRVINE, CALIFORNIA 92618-2327

padre associates, inc. — ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

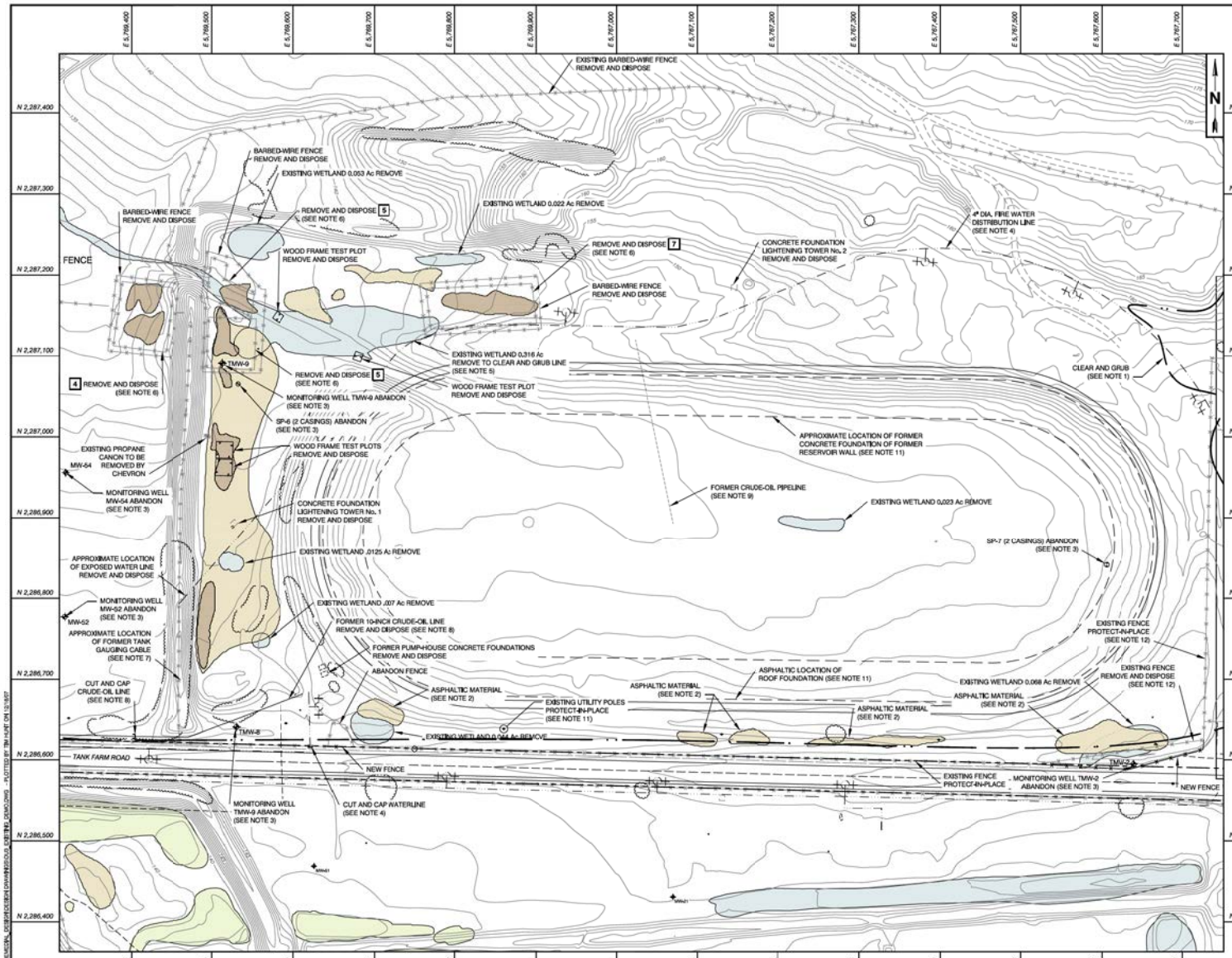
DESIGNER: T. HUNT; DRAWN BY: T. HUNT; CHECKED BY: R. VAN HYNING; APPROVED BY: R. VAN HYNING; DATE: 12/18/07

OU #2 - RESERVOIR 7 - SECTIONS AND DETAILS

SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

PROJECT No. 1212.001 — FILE NAME: C13

SHEET No. C13 — SHEET 24 OF 43 — REVISION C



LEGEND

- TOPOGRAPHIC CONTOUR
- TREE / BRUSH LINE
- FENCE
- LIMITS OF CLEAR AND GRUB
- FIRE HYDRANT
- EXISTING MONITORING / PRODUCTION WELL
- STATE / FEDERAL WETLAND - PROTECT-IN-PLACE
- STATE / FEDERAL WETLAND - IMPACTED BY CONSTRUCTION
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION REQUIRED
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED

0 60 120 FEET
SCALE

SCHEDULE OF MONITORING WELL ABANDONMENT

WELL I.D.	NORTHING (FT)	EASTING (FT)	TOTAL DEPTH (FT)	MATERIAL OF CONSTRUCTION
TMW-2	2,286,595.01	5,770,640.38	33.5	PVC
TMW-8	2,286,691.00	5,769,530.00	24	PVC
TMW-9	2,287,091.99	5,769,513.42	24	PVC
SP-6	2,287,065.52	5,769,532.50	27	PVC
SP-7	2,286,842.73	5,770,607.86	26.5	PVC
MW-52	2,286,777.00	5,769,304.00	144.91	PVC
MW-54	2,286,956.00	5,769,319.00	139.84	PVC

NOTES:

1. CLEAR AND GRUB WITH THIS BOUNDARY. AREA WITHIN THIS BOUNDARY IS CONSIDERED THE WORK AREA FOR THIS PORTION OF THE PROJECT. CLEARING SHALL INCLUDE, IN ADDITION TO VEGETATION AND UNLESS OTHERWISE NOTED, REMOVAL AND DISPOSAL OF ALL CONCRETE DEBRIS, STRUCTURES, FEATURES, MONITORING WELLS, AND HYDROCARBON IMPACTED SOIL. A SITE PLAN SHOWING OU #3 AND THE FLOWERMOUND BORROW AREA CLEAR AND GRUB BOUNDARY CAN BE FOUND ON SHEET C15.
2. ASPHALTIC MATERIAL MAY BE LEFT-IN-PLACE IF RELATIVELY UNDISTURBED BY REMEDIATION. IF MATERIAL WILL NOT BE MOVED THEN IT MAY BE LEFT AS-IS AFTER CLEARING AND GRUBBING. IF MATERIAL WOULD OTHERWISE BE MOVED AND INCORPORATED AS FILL ELSEWHERE ON THE SITE IT SHOULD INSTEAD BE SEGREGATED AND MANAGED APPROPRIATELY.
3. MONITORING WELLS WITHIN THE WORK AREA SHALL BE ABANDONED IN ACCORDANCE WITH THE REQUIREMENTS OF SAN LUIS OBISPO COUNTY DEPARTMENT OF ENVIRONMENTAL HEALTH AND WITH CALIFORNIA DEPARTMENT OF WATER RESOURCES BULLETIN NO. 74-81.
4. THE WATER LINE AND APPURTENANCES WITHIN THE CLEAN AND GRUB BOUNDARY SHALL BE REMOVED AND DISPOSED. AT THE CLEAR AND GRUB BOUNDARY THE LINE SHALL BE CAPPED. OUTSIDE THE BOUNDARY THE LINE SHALL BE ABANDONED IN-PLACE. THE CONTRACTOR SHALL ENSURE THAT THE LINE IS NOT PRESSURIZED PRIOR TO CUTTING THE LINE. IF IT IS PRESSURIZED THE CONTRACTOR SHALL TAKE MEASURES TO SAFELY DEPRESSURIZE THE LINE.
5. WETLANDS WITHIN THE CLEAR AND GRUB BOUNDARY SHALL BE PERMANENTLY REMOVED. WETLANDS OUTSIDE THE CLEAR AND GRUB LINE SHALL BE PROTECTED-IN-PLACE. THOSE WETLANDS ADJACENT TO THE WORK AREA SHALL BE PROTECTED AS DESCRIBED IN THE SPECIAL PROVISIONS.
6. DEMOLITION SHALL INCLUDE THE REMOVAL AND DISPOSAL OF ALL BARBED WIRE FENCING AND PROTECTIVE ENCLOSURES, SOIL BENEATH PROTECTIVE ENCLOSURES SHALL BE TREATED AS IMPACTED BY PLIABLE HYDROCARBON MATERIAL, EVEN IF NOT MARKED AS SUCH IN ANY OF THE DOCUMENTS.
7. A SIGN MARKS THE APPROXIMATE LOCATION OF AN UNDERGROUND CABLE USED BY THE FORMER AUTOMATIC TANK GAUGING SYSTEM. CABLE WITHIN A BORROW OR OTHER EXCAVATION AREA SHALL BE REMOVED AND MANAGED, OTHERWISE THE CABLE MAY BE ABANDONED-IN-PLACE.
8. THOSE PORTIONS OF THE FORMER 10-INCH CRUDE-OIL LINE WITHIN THE WORK AREA SHALL BE REMOVED AND MANAGED. AT THE CLEAR AND GRUB LINE THE LINE SHALL BE ABANDONED-IN-PLACE. THE CONTRACTOR SHALL ENSURE THAT THE LINE IS CLEANED AND FLUSHED IN ACCORDANCE WITH THE SPECIAL PROVISIONS.
9. IT IS UNCERTAIN WHETHER THIS FORMER SECTION OF LINE STILL EXISTS. THE CONTRACTOR SHALL DETERMINE WHETHER THE LINE HAS BEEN REMOVED. IF STILL IN PLACE THE CONTRACTOR SHALL REMOVE THAT PORTION OF THE LINE WITHIN THE WORK AREA.
10. THE EXITING POWER POLES CARRY ACTIVE POWER LINES BELONGING TO PG&E, AND TELECOMMUNICATION LINES BELONGING TO AT&T. CONTRACTOR SHALL PROTECT THE LINES IN-PLACE.
11. THE DASHED LINES ON THIS SHEET IDENTIFY THE APPROXIMATE LOCATION OF THE WALL AND ROOF FOUNDATIONS OF THE FORMER RESERVOIR. THE CONCRETE MAY BE ABANDONED-IN-PLACE AS LONG AS IT DOES NOT INTERFERE WITH ACHIEVING THE FINAL GRADES.
12. FENCE WITHIN THE CLEAR AND GRUB LINE SHALL BE REMOVED. FENCE OUTSIDE THE WORK AREA SHALL BE PROTECTED-IN-PLACE. GAPS IN THE FENCE ALLOWING ACCESS TO THE PROPERTY FROM OFF-SITE SHALL BE CLOSED BY NEW FENCE OUTSIDE THE WORK AREA.

REFERENCE:

TOPOGRAPHIC CONTOURS AND FEATURES PROVIDED BY EDA, INC., DATED JULY 11, 2007.

REV	DATE	DESCRIPTION	BY	APPROVED
C	12/18/07	ISSUED FOR PERMIT APPLICATION	TMH	RVH
B	09/07/07	WORKING DRAFT	TMH	RVH
A	03/07/07	PRELIMINARY DESIGN SUBMITTAL	TMH	RVH

REVISION SUMMARY

SCALE: AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY

PREPARED FOR: Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583

PREPARED BY: AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DRIVE, SUITE 154
IRVINE, CALIFORNIA 92618-2327

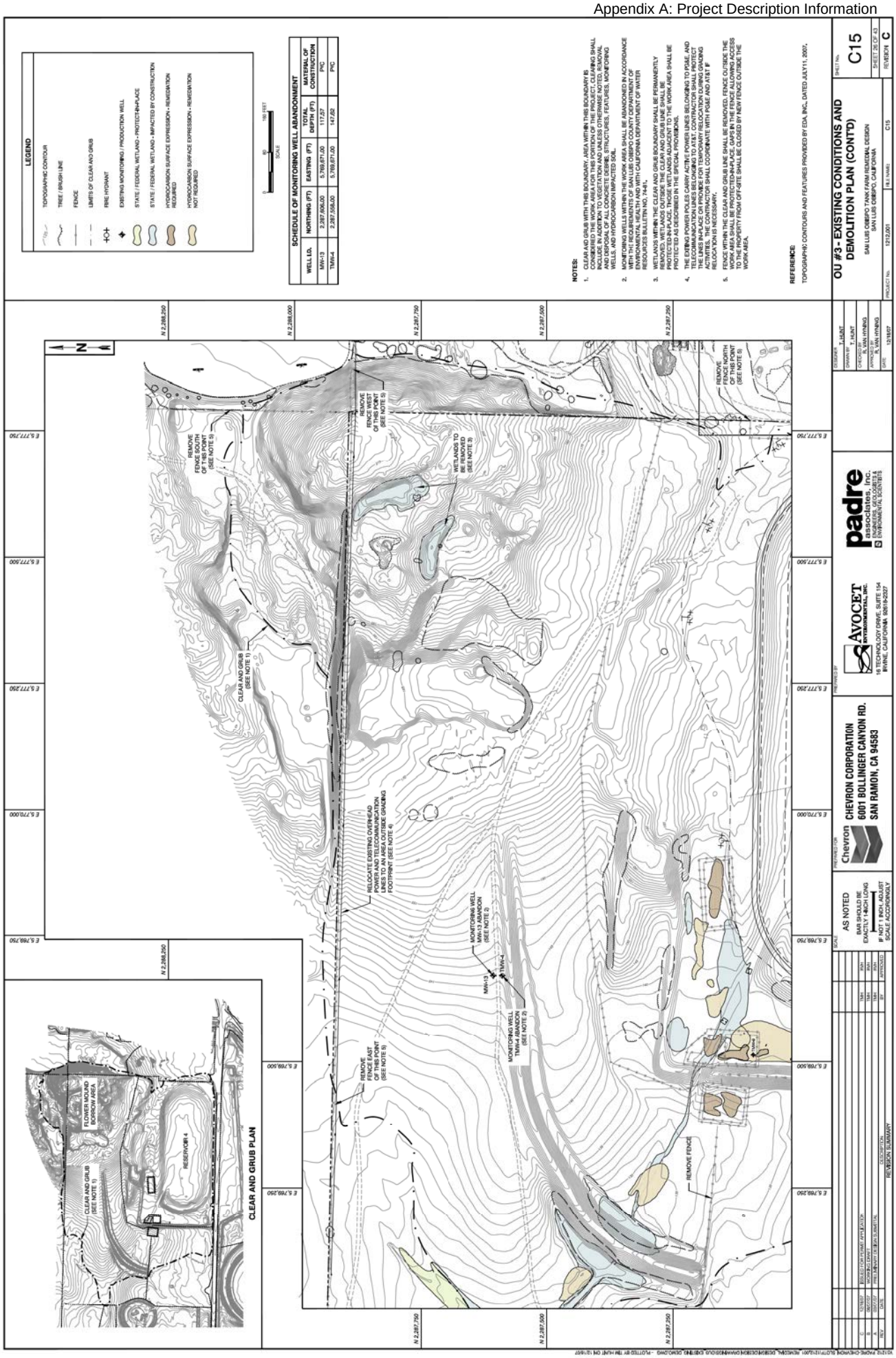
padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

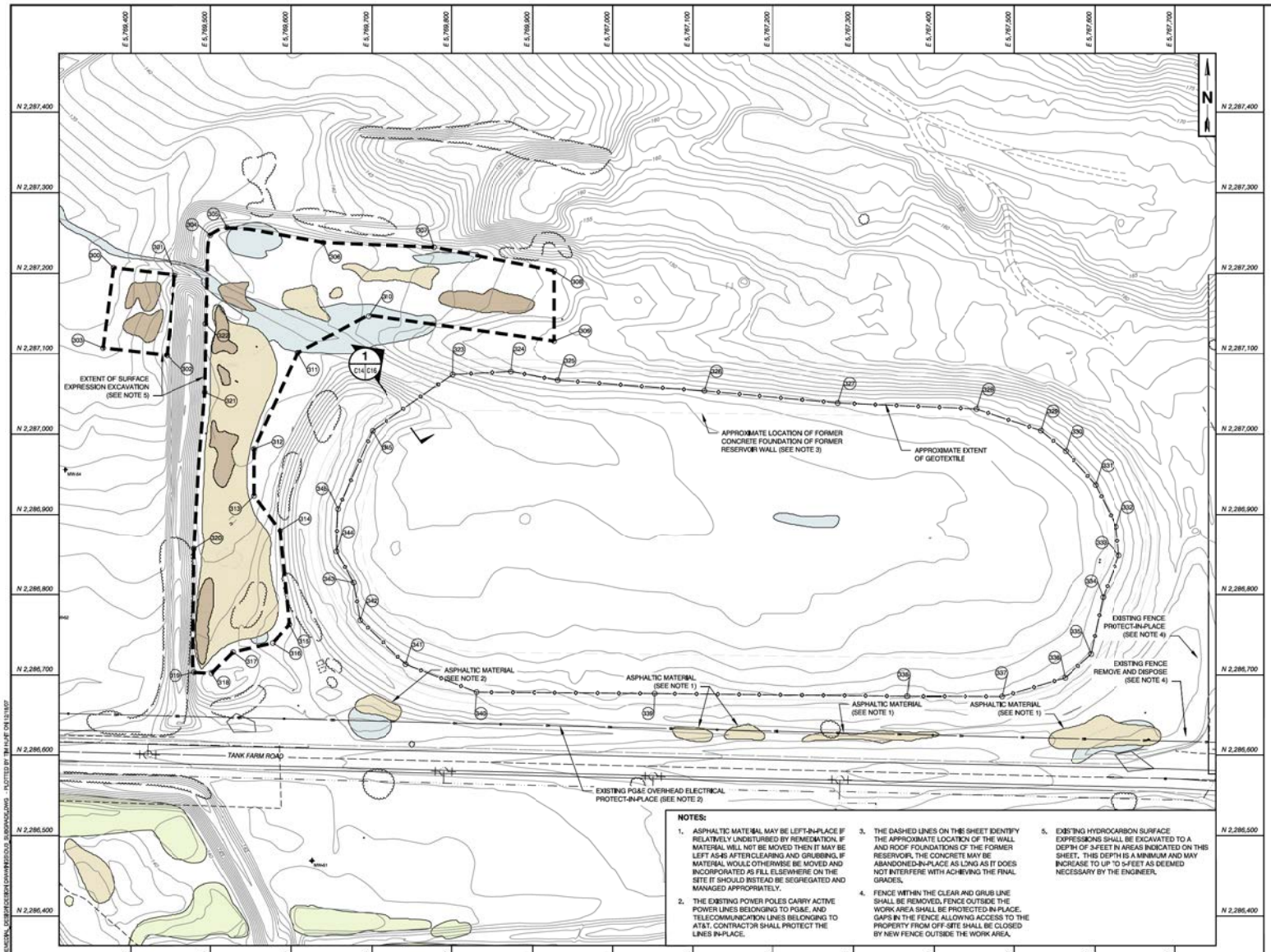
DESIGNER: T. HUNT
DRAWN BY: T. HUNT
CHECKED BY: R. VAN HYNING
APPROVED BY: R. VAN HYNING
DATE: 12/18/07

OU #3 - EXISTING CONDITIONS AND DEMOLITION PLAN

SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

SHEET No. C14
SHEET 25 OF 43
REVISION C
PROJECT No. 1212.001
FILE NAME: C14


LEGEND
TOPOGRAPHIC CONTOUR
TREE / BRUSH LINE
FENCE
LIMITS OF CLEAR AND GRUB
FIRE HYDRANT
EXISTING MONITORING / PRODUCTION WELL
STATE / FEDERAL WETLAND - PROTECT-IN-PLACE
STATE / FEDERAL WETLAND - IMPACTED BY CONSTRUCTION
HYDROCARBON SURFACE EXPRESSION - REMEDIATION REQUIRED
HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED
SCALE
0
100 FEET
SCHEDULE OF MONITORING WELL ABANDONMENT
WELL I.D.
NORTHING (FT)
EASTING (FT)
TOTAL DEPTH (FT)
MATERIAL OF CONSTRUCTION
MW-13
2,287,606.00
5,769,671.00
117.57
PVC
TMW-4
2,287,559.00
5,769,671.00
147.82
PVC
NOTES:
1. CLEAR AND GRUB WITH THIS BOUNDARY. AREA WITHIN THIS BOUNDARY IS CONSIDERED THE WORK AREA FOR THIS PORTION OF THE PROJECT. CLEARING SHALL INCLUDE REMOVAL OF VEGETATION, DEBRIS, STRUCTURES, FEATURES, MONITORING WELLS, AND HYDROCARBON IMPACTED SOIL.
2. MONITORING WELLS WITHIN THE WORK AREA SHALL BE ABANDONED IN ACCORDANCE WITH THE REQUIREMENTS OF SAN LUIS OBISPO COUNTY DEPARTMENT OF ENVIRONMENTAL HEALTH AND WITH CALIFORNIA DEPARTMENT OF WATER RESOURCES BULLETIN NO. 74-81.
3. WETLANDS WITHIN THE CLEAR AND GRUB BOUNDARY SHALL BE PERMANENTLY REMOVED. WETLANDS OUTSIDE THE CLEAR AND GRUB LINE SHALL BE PROTECTED-IN-PLACE. THOSE WETLANDS ADJACENT TO THE WORK AREA SHALL BE PROTECTED IN PLACE BY SILT FENCE OR EQUIVALENT.
4. THE CONTRACTOR SHALL COORDINATE WITH PG&E, AT&T, BELCHING TO PG&E AND TELECOMMUNICATION LINES BELONGING TO AT&T. CONTRACTOR SHALL PROTECT THE LINES IN-PLACE OR PROVIDE FOR TEMPORARY RELOCATION DURING GRADING ACTIVITIES. THE CONTRACTOR SHALL COORDINATE WITH PG&E AND AT&T IF RELOCATION IS REQUIRED.
5. FENCE WITHIN THE CLEAR AND GRUB LINE SHALL BE REMOVED. FENCE OUTSIDE THE WORK AREA SHALL BE PROTECTED-IN-PLACE. GAPS IN THE FENCE ALLOWING ACCESS TO THE PROPERTY FROM OFF-SITE SHALL BE CLOSED BY NEW FENCE OUTSIDE THE WORK AREA.
REFERENCE:
TOPOGRAPHIC CONTOURS AND FEATURES PROVIDED BY EDA, INC., DATED JULY 11, 2007.
N
N 2,288,250
N 2,288,000
N 2,287,750
N 2,287,500
N 2,287,250
E 5,777,750
E 5,777,500
E 5,777,250
E 5,770,000
E 5,768,750
E 5,768,500
E 5,768,250
REMOVE FENCE SOUTH OF THIS POINT (SEE NOTE 5)
REMOVE FENCE EAST OF THIS POINT (SEE NOTE 5)
WETLANDS TO BE REMOVED (SEE NOTE 3)
CLEAR AND GRUB (SEE NOTE 1)
RELOCATE EXISTING OVERHEAD POWER AND TELECOMMUNICATION LINES TO AN AREA OUTSIDE GRADING FOOTPRINT (SEE NOTE 4)
MONITORING WELL MW-13 ABANDON (SEE NOTE 2)
MW-13
TMW-4
MONITORING WELL TMW-4 ABANDON (SEE NOTE 2)
REMOVE FENCE
CLEAR AND GRUB PLAN
FLOWER MOUND BORROW AREA
RESERVOIR 4
OU #3 - EXISTING CONDITIONS AND DEMOLITION PLAN (CONTD)
SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA
C15
SHEET 26 OF 43
REVISION C
padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS
AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DRIVE, SUITE 154
IRVINE, CALIFORNIA 92618-2327
Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583
AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY
REVISION SUMMARY
REV
DATE
DESCRIPTION
APPROVED
C
12/18/07
ISSUED FOR HYDRAULIC CALCULATION
JKH
B
10/31/07
ISSUED FOR REVIEW
JKH
A
10/17/07
PRELIMINARY ISSUED FOR REVIEW
JKH
DESIGNER
T. HUNT
DRAWN BY
T. HUNT
CHECKED BY
K. VAN HYNING
APPROVED BY
K. VAN HYNING
DATE
12/18/07
PROJECT No.
12112.001
FILE NAME
C15



NOTES:

1. ASPHALTIC MATERIAL MAY BE LEFT-IN-PLACE IF RELATIVELY UNDISTURBED BY REMEDIATION. IF MATERIAL WILL NOT BE MOVED THEN IT MAY BE LEFT AS-IS AFTER CLEARING AND GRUBBING. IF MATERIAL WOULD OTHERWISE BE MOVED AND INCORPORATED AS FILL ELSEWHERE ON THE SITE IT SHOULD INSTEAD BE SEGREGATED AND MANAGED APPROPRIATELY.
2. THE EXISTING POWER POLES CARRY ACTIVE POWER LINES BELONGING TO PG&E, AND TELECOMMUNICATION LINES BELONGING TO AT&T. CONTRACTOR SHALL PROTECT THE LINES IN-PLACE.
3. THE DASHED LINES ON THIS SHEET IDENTIFY THE APPROXIMATE LOCATION OF THE WALL AND ROOF FOUNDATIONS OF THE FORMER RESERVOIR. THE CONCRETE MAY BE ABANDONED-IN-PLACE AS LONG AS IT DOES NOT INTERFERE WITH ACHIEVING THE FINAL GRADES.
4. FENCE WITHIN THE CLEAR AND GRUB LINE SHALL BE REMOVED. FENCE OUTSIDE THE WORK AREA SHALL BE PROTECTED-IN-PLACE. GAPS IN THE FENCE ALLOWING ACCESS TO THE PROPERTY FROM OFF-SITE SHALL BE CLOSED BY NEW FENCE OUTSIDE THE WORK AREA.
5. EXISTING HYDROCARBON SURFACE EXPRESSIONS SHALL BE EXCAVATED TO A DEPTH OF 3-FEET IN AREAS INDICATED ON THIS SHEET. THIS DEPTH IS A MINIMUM AND MAY INCREASE TO UP TO 5-FEET AS DEEMED NECESSARY BY THE ENGINEER.

LEGEND

- TOPOGRAPHIC CONTOUR
- TREE / BRUSH LINE
- EXISTING MONITORING / PRODUCTION WELL
- FENCE
- APPROXIMATE EXTENT OF GEOTEXTILE
- STATE / FEDERAL WETLAND - PROTECT-IN-PLACE
- STATE / FEDERAL WETLAND - IMPACTED BY CONSTRUCTION
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION REQUIRED
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED

0 40 80 FEET
SCALE

CONSTRUCTION CONTROL POINTS

POINT ID	NORTHING	EASTING	ELEVATION
300	5,769,378.992	2,287,206.742	-
301	5,769,455.261	2,287,197.210	-
302	5,769,445.076	2,287,098.207	-
303	5,769,336.011	2,287,107.173	-
304	5,769,499.862	2,287,247.219	-
305	5,769,519.917	2,287,256.669	-
306	5,769,639.965	2,287,238.153	-
307	5,769,778.541	2,287,232.305	-
308	5,769,927.790	2,287,202.928	-
309	5,769,927.781	2,287,115.757	-
310	5,769,695.995	2,287,146.072	-
311	5,769,608.382	2,287,101.118	-
312	5,769,553.666	2,286,981.799	-
313	5,769,553.661	2,286,923.474	-
314	5,769,586.319	2,286,880.094	-
315	5,769,598.160	2,286,762.701	-
316	5,769,576.999	2,286,739.591	-
317	5,769,527.612	2,286,728.272	-
318	5,769,501.519	2,286,701.991	-
319	5,769,479.538	2,286,703.367	-
320	5,769,479.595	2,286,857.136	-
321	5,769,493.036	2,287,052.228	-
322	5,769,493.806	2,287,137.306	-
323	5,769,801.022	2,287,074.253	-
324	5,769,873.183	2,287,077.961	-
325	5,769,932.338	2,287,067.187	-
326	5,770,113.753	2,287,054.040	-
327	5,770,280.182	2,287,038.864	-
328	5,770,435.652	2,287,031.448	-
329	5,770,532.557	2,287,004.479	-
330	5,770,583.348	2,286,979.163	-
331	5,770,601.115	2,286,937.025	-
332	5,770,626.742	2,286,885.112	-
333	5,770,630.468	2,286,848.574	-
334	5,770,610.235	2,286,796.661	-
335	5,770,595.399	2,286,725.869	-
336	5,770,562.651	2,286,696.392	-
337	5,770,485.431	2,286,673.132	-
338	5,770,366.736	2,286,673.469	-
339	5,770,052.533	2,286,676.624	-
340	5,769,830.764	2,286,678.509	-
341	5,769,743.092	2,286,713.231	-
342	5,769,685.343	2,286,767.896	-
343	5,769,677.250	2,286,814.753	-
344	5,769,655.805	2,286,853.557	-
345	5,769,657.961	2,286,907.157	-

REFERENCE:

TOPOGRAPHIC CONTOURS AND FEATURES PROVIDED BY EDA, INC., DATED JULY11, 2007.

REV	DATE	DESCRIPTION	BY	APPROVED
C	12/18/07	ISSUED FOR PERMIT APPLICATION	TMH	RVH
B	08/07/07	WORKING DRAFT	TMH	RVH
A	03/07/07	PRELIMINARY DESIGN SUBMITTAL	TMH	RVH

REVISION SUMMARY

SCALE: AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY

PREPARED FOR: Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583

PREPARED BY: AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DRIVE, SUITE 154
IRVINE, CALIFORNIA 92618-2327

padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

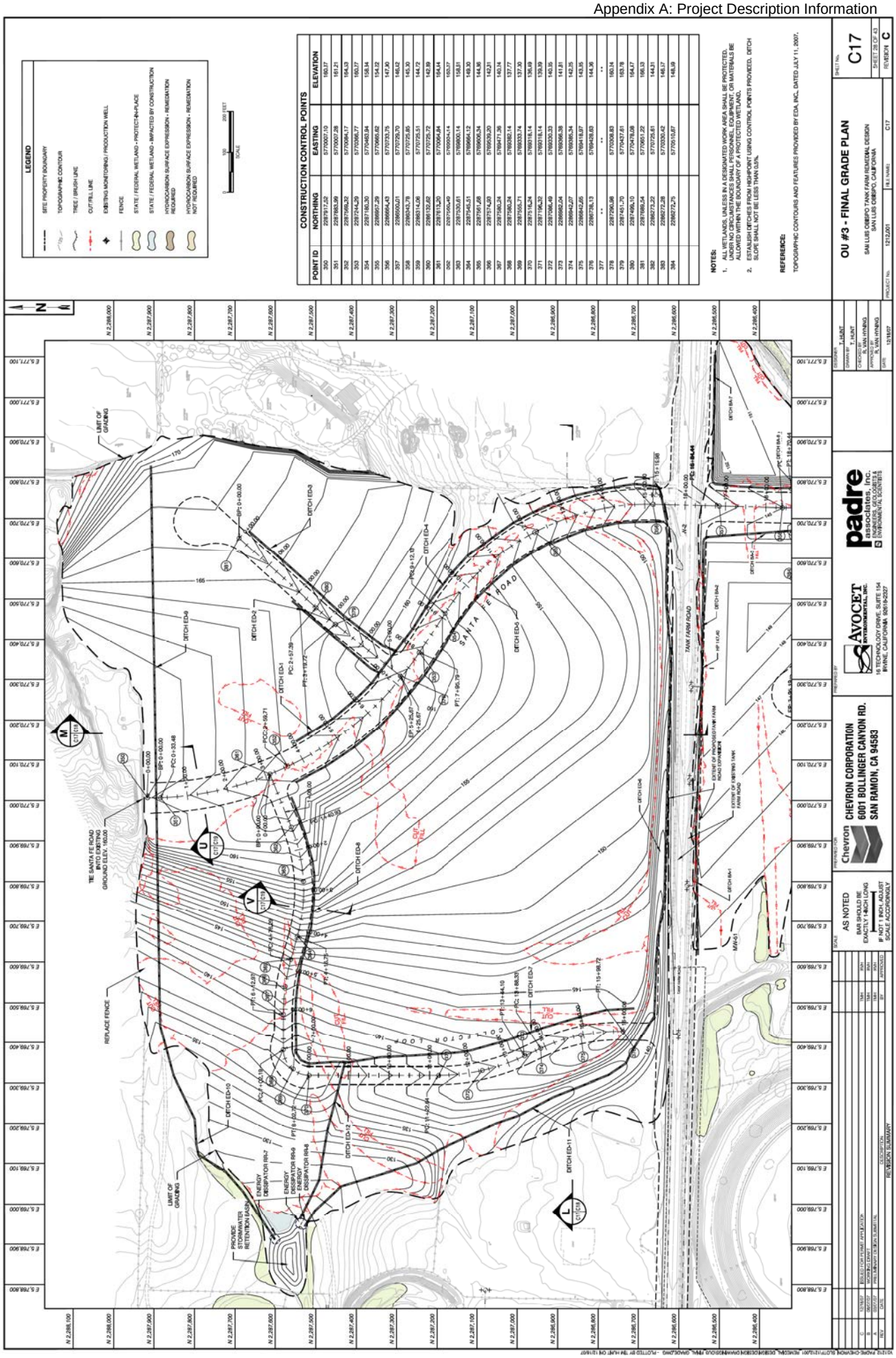
DESIGNER: T. HUNT
DRAWN BY: T. HUNT
CHECKED BY: R. VAN HYNING
APPROVED BY: R. VAN HYNING
DATE: 12/18/07

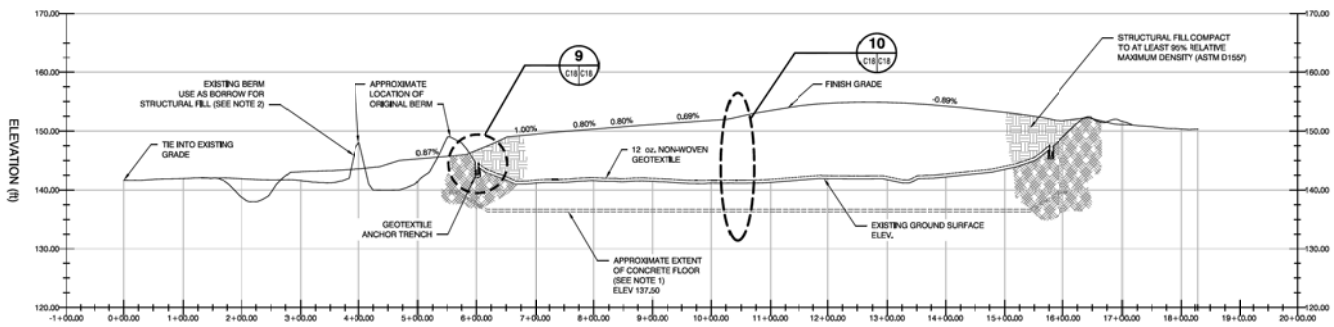
OU #3 - EXCAVATION AND SUBGRADE PREPARATION PLAN

SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

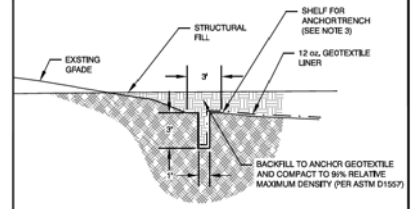
PROJECT No. 1212.001 | FILE NAME: C16

SHEET No. C16
SHEET 27 OF 43
REVISION C

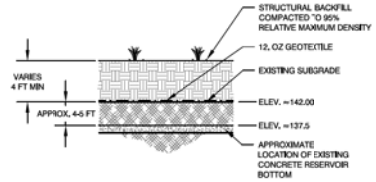

LEGEND
SITE PROPERTY BOUNDARY
TOPOGRAPHIC CONTOUR
TREE / BRUSH LINE
CUT/FILL LINE
EXISTING MONITORING / PRODUCTION WELL
FENCE
STATE / FEDERAL WETLAND - PROTECT-IN-PLACE
STATE / FEDERAL WETLAND - IMPACTED BY CONSTRUCTION
HYDROCARBON SURFACE EXPRESSION - REMEDIATION REQUIRED
HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED
100 200 FEET
SCALE
CONSTRUCTION CONTROL POINTS
POINT ID NORTHING EASTING ELEVATION
350 2287917.52 5770007.10 160.17
351 2287883.99 5770007.28 161.21
352 2287856.32 5770094.17 164.03
353 2287744.29 5770366.77 160.17
354 2287186.30 5770463.94 158.34
355 2286957.29 5770665.82 154.12
356 2286664.43 5770733.75 147.80
357 2286043.78 5770725.85 145.30
358 2286134.06 5770725.31 144.72
359 2286132.62 5770725.72 142.89
360 2287813.20 5769024.84 154.14
361 2287806.40 5769024.14 153.57
362 2287535.61 5768800.14 158.31
363 2287545.51 5768664.12 149.30
364 2287561.68 5768606.34 144.95
365 2287574.23 5768539.20 142.31
366 2287580.24 5768471.36 140.14
367 2287585.24 5768382.14 137.77
368 2287555.71 5768353.74 137.20
369 2287516.24 5768318.14 136.49
370 2287196.32 5768330.33 139.39
371 2287086.49 5768305.34 140.85
372 2286863.24 5768306.38 141.81
373 2286844.07 5768306.34 142.35
374 2286842.65 5768418.87 143.35
375 2286739.13 5768420.83 144.36
376 ** ** **
377 2287290.98 5770308.83 160.14
378 2287451.70 5770437.61 163.78
379 2287499.10 5770478.08 154.17
380 2287689.54 5770651.22 156.33
381 2287672.22 5770725.61 144.31
382 2286272.28 5770320.42 146.17
383 2286272.75 5770310.87 146.89
384
NOTES:
1. ALL WETLANDS, UNLESS IN A DESIGNATED WORK AREA SHALL BE PROTECTED. UNDER NO CIRCUMSTANCES SHALL PERSONNEL, EQUIPMENT, OR MATERIALS BE ALLOWED WITHIN THE BOUNDARY OF A PROTECTED WETLAND.
2. ESTABLISH DITCHES FROM HIGHPOINT USING CONTROL POINTS PROVIDED. DITCH SLOPE SHALL NOT BE LESS THAN 0.5%.
REFERENCE:
TOPOGRAPHIC CONTOURS AND FEATURES PROVIDED BY EDA, INC., DATED JULY 11, 2007.
OU #3 - FINAL GRADE PLAN
SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA
C17
SHEET 28 OF 43
REVISION C
12/12/2007
padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS
AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DRIVE, SUITE 154
IRVINE, CALIFORNIA 92618-2327
Chevron CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583
AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY
REVISION SUMMARY
SANTA FE ROAD
TANK FARM ROAD
LIMIT OF GRADING
REPLACE FENCE
PROVIDE STORMWATER RETENTION BASIN
TIE SANTA FE ROAD PROFILE TO GROUND ELEV. 160.00
DITCH ED-1
DITCH ED-2
DITCH ED-3
DITCH ED-4
DITCH ED-5
DITCH ED-6
DITCH ED-7
DITCH ED-8
DITCH ED-9
DITCH ED-10
DITCH ED-11
DITCH ED-12
ENERGY DISSIPATOR RR-7
ENERGY DISSIPATOR RR-8
ENERGY DISSIPATOR RR-9
COLLECTOR LOOP
EXTENT OF PROPOSED TANK FARM ROAD EXPANSION
EXTENT OF EXISTING TANK FARM ROAD
MW-61



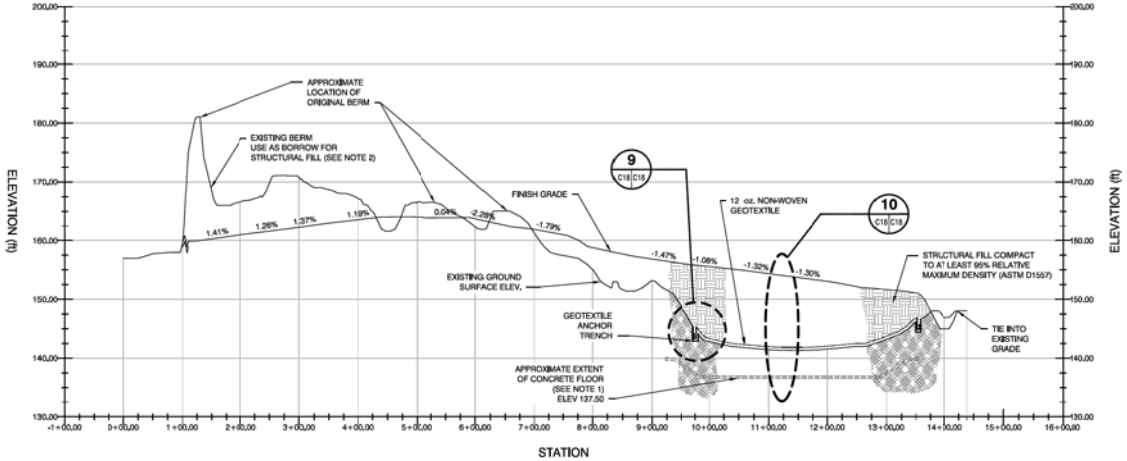
SECTION L (C17|C18)
OU #3 AND FLOWER MOUND BORROW AREA
HORIZONTAL SCALE 0 100 200 FEET — VERTICAL SCALE 0 10 20 FEET



DETAIL 9 (C18|C18)
TYPICAL ANCHOR TRENCH FOR RESERVOIR 4
SCALE 0 5 10 FEET



DETAIL 10 (C18|C18)
TYPICAL RESERVOIR 4 CAP COMPONENTS
SCALE 0 8 16 FEET



SECTION M (C17|C18)
OU #3 AND FLOWER MOUND BORROW AREA
HORIZONTAL SCALE 0 100 200 FEET — VERTICAL SCALE 0 10 20 FEET

NOTES:

1. THE CONTRACTOR NEED NOT REMOVE THE CONCRETE FLOOR. REMOVED MATERIAL SHALL BE MANAGED AT AN APPROPRIATE FACILITY PERMITTED FOR THE USE.
2. THE EXISTING BERM MAY BE USED FOR STRUCTURAL FILL. THE CONTRACTOR SHALL ENSURE THERE IS NO ORGANIC OR OTHER DELETERIOUS MATERIAL IN THE FILL. THE CONTRACTOR SHALL ALSO ENSURE THAT MATERIAL USED FOR STRUCTURAL FILL CONTAINS LESS THAN 1,000 mg/kg OF TPH AS MEASURED BY EPA METHOD 8015. UNSUITABLE MATERIAL SHALL BE IMMEDIATELY BROUGHT TO THE ATTENTION OF THE CONSTRUCTION MANAGER. ALTERNATIVE BORROW WILL BE APPROVED AS NECESSARY.
3. CONTRACTOR SHALL PROVIDE A SHELF WITHIN THE EXISTING BERM ON WHICH TO EXCAVATE AN ANCHOR TRENCH FOR THE GEOTEXTILE. SHELF MAY BE CUT AFTER GRAVEL HAS BEEN PLACED.

REV	DATE	DESCRIPTION	BY	APPROVED
C	12/18/07	ISSUED FOR PERMIT APPLICATION	TMH	RVH
B	06/07/07	WORKING DRAFT	TMH	RVH
A	03/07/07	PRELIMINARY DESIGN SUBMITTAL	TMH	RVH

REVISION SUMMARY

SCALE: AS NOTED — BAR SHOULD BE EXACTLY 1-INCH LONG — IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY

PREPARED FOR: Chevron — CHEVRON CORPORATION, 6001 BOLLINGER CANYON RD., SAN RAMON, CA 94583

PREPARED BY: AVOCET ENVIRONMENTAL, INC. — 16 TECHNOLOGY DRIVE, SUITE 154, IRVINE, CALIFORNIA 92618-2327

padre associates, inc. — ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

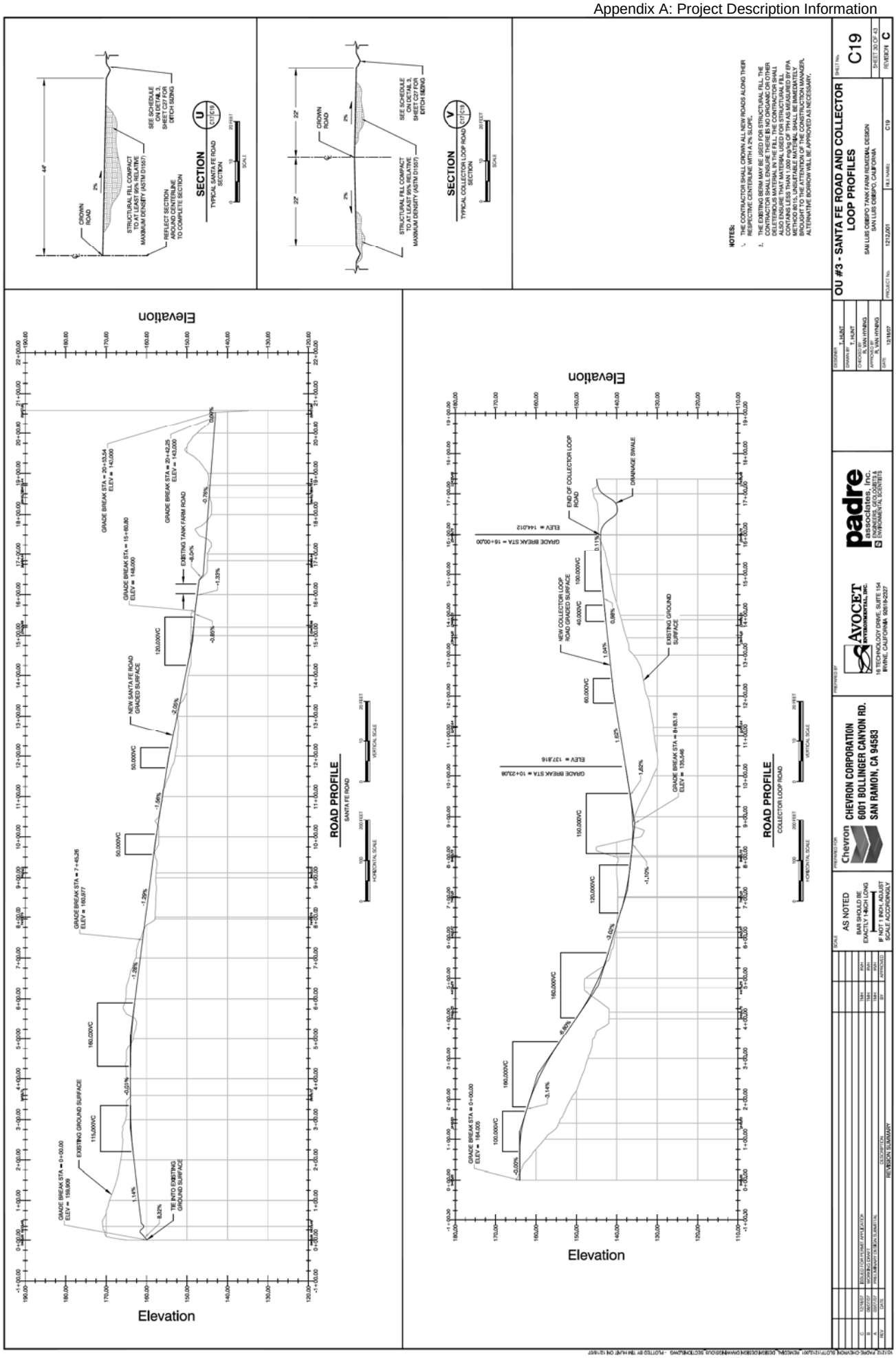
DESIGNER: T. HUNT
DRAWN BY: T. HUNT
CHECKED BY: R. VAN HYNING
APPROVED BY: R. VAN HYNING
DATE: 12/18/07

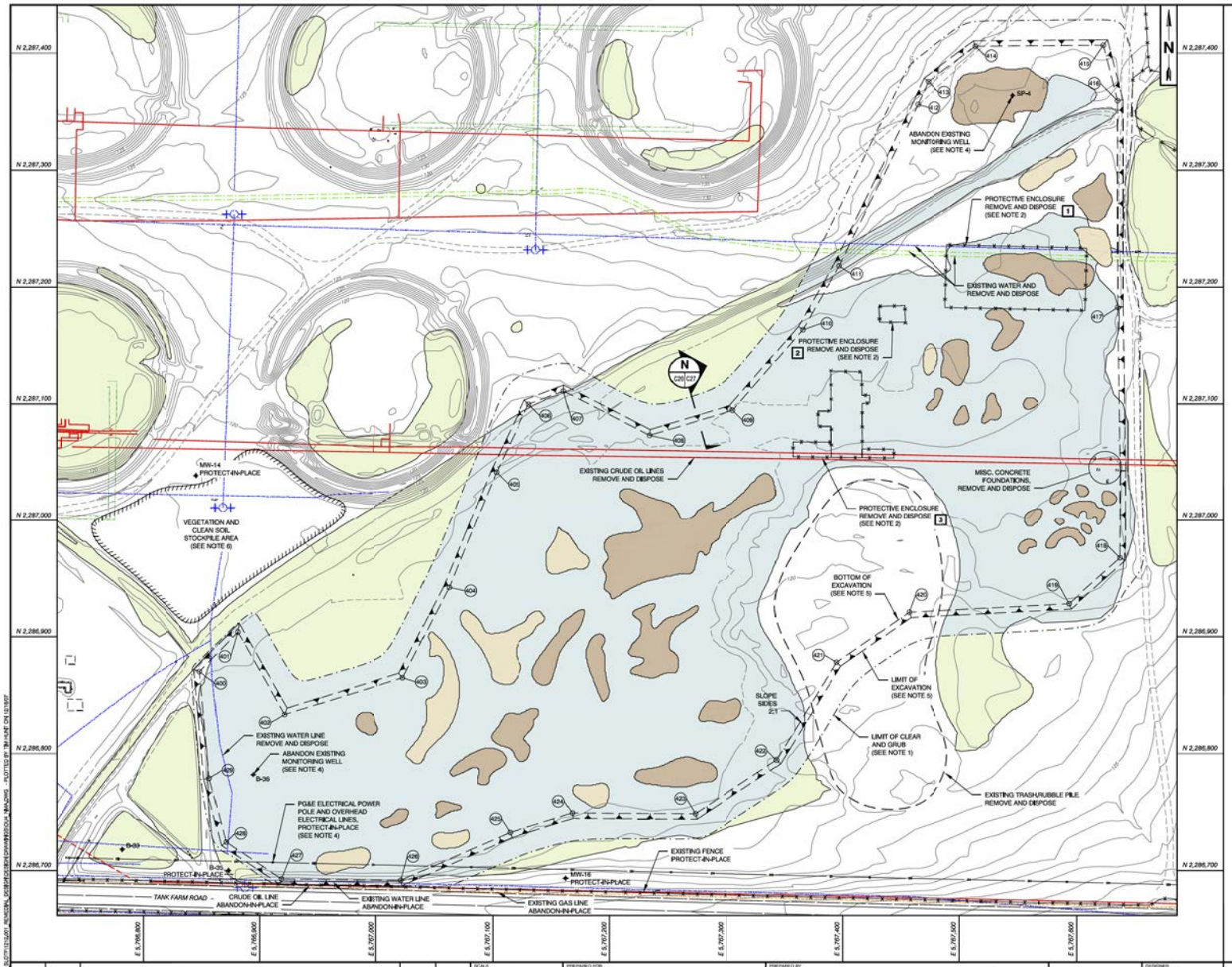
OU #3 - SECTIONS AND DETAILS

SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

PROJECT No. 1212.001 — FILE NAME: C18

SHEET No. C18 — SHEET 29 OF 43 — REVISION C


SECTION
TYPICAL SANTA FE ROAD SECTION
SECTION
TYPICAL COLLECTOR LOOP ROAD SECTION
NOTES:
1. THE CONTRACTOR SHALL CROWN ALL NEW ROADS ALONG THEIR RESPECTIVE CENTERLINE WITH A 2% SLOPE.
2. THE EXISTING BERM MAY BE USED FOR STRUCTURAL FILL. THE CONTRACTOR SHALL ENSURE THERE IS NO ORGANIC OR OTHER DELETERIOUS MATERIAL IN THE FILL. THE CONTRACTOR SHALL ALSO ENSURE THAT ANY MATERIAL TO BE USED AS FILL CONTAINS LESS THAN 1,000 mg/kg OF TPH AS MEASURED BY EPA METHOD 8015. UNSUITABLE MATERIAL SHALL BE IMMEDIATELY REMOVED AND TRANSPORTED TO A SUITABLE DISPOSAL LOCATION. ALTERNATIVE BORROW WILL BE APPROVED AS NECESSARY.
Elevation
ROAD PROFILE
SANTA FE ROAD
Elevation
ROAD PROFILE
COLLECTOR LOOP ROAD
padre associates, inc.
AVOCET ENVIRONMENTAL, INC.
Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583
OU #3 - SANTA FE ROAD AND COLLECTOR LOOP PROFILES
SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA
C19
AS NOTED
REVISION SUMMARY



LEGEND

- SITE PROPERTY BOUNDARY
- TOPOGRAPHIC CONTOUR
- TREE / BRUSH LINE
- EXISTING MONITORING / PRODUCTION WELL
- CRUDE OIL LINE
- GAS LINE
- WATER LINE
- FOAMITE LINE
- FOAMITE LINE (POTENTIALLY PRESENT)
- FENCE
- LIMITS OF CLEAR AND GRUB
- STATE / FEDERAL WETLAND - PROTECT-IN-PLACE
- STATE / FEDERAL WETLAND - IMPACTED BY CONSTRUCTION
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION REQUIRED
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED

0 60 120 FEET
SCALE

CONSTRUCTION CONTROL POINTS

POINT ID	NORTHING	EASTING
400	2,286,955.260	5,766,873.397
401	2,287,006.179	5,766,922.284
402	2,286,900.138	5,766,982.519
403	2,286,947.494	5,767,134.550
404	2,287,063.657	5,767,194.265
405	2,287,212.212	5,767,254.558
406	2,287,299.564	5,767,295.969
407	2,287,316.562	5,767,341.126
408	2,287,259.634	5,767,451.627
409	2,287,291.975	5,767,558.689
410	2,287,395.220	5,767,648.795
411	2,287,476.503	5,767,695.840
412	2,287,684.224	5,767,796.626
413	2,287,713.411	5,767,809.923
414	2,287,758.862	5,767,870.809
415	2,287,760.159	5,768,035.606
416	2,287,689.085	5,768,053.758
417	2,287,423.995	5,768,054.573
418	2,287,101.647	5,768,056.856
419	2,287,042.529	5,767,990.368
420	2,287,031.634	5,767,785.171
421	2,286,957.422	5,767,692.189
422	2,286,841.746	5,767,615.044
423	2,286,772.788	5,767,510.091
424	2,286,773.762	5,767,352.318
425	2,286,748.788	5,767,271.965
426	2,286,687.427	5,767,132.345
427	2,286,689.057	5,766,978.480
428	2,286,736.460	5,766,907.404
429	2,286,818.228	5,766,885.811

NOTES:

1. CLEAR AND GRUB WITHIN THIS BOUNDARY. CLEARING SHALL INCLUDE REMOVAL AND DISPOSAL OF ALL CONCRETE DEBRIS, STRUCTURES, FEATURES, MONITORING WELLS AND HYDROCARBON IMPACTED SOIL NOT NOTED IN THESE DRAWINGS. VEGETATION REMOVED AS PART OF CLEARING AND GRUBBING ACTIVITIES SHALL BE SAVED AND STOCKPILED IN ACCORDANCE WITH THE WETLAND MITIGATION PLAN.
2. PROTECTIVE ENCLOSURES SHALL BE DISMANTLED AND PROPERLY DISPOSED. IMPACTED SOIL BENEATH ANY ENCLOSURE SHALL BE REMOVED AS DESCRIBED IN THE SPECIFICATIONS.
3. THE CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO ENSURE THE EXISTING PG&E ELECTRICAL POWER POLES AND OVERHEAD ELECTRICAL LINES IN AND AROUND THE EXCAVATION AREA ARE NOT DAMAGED OR DESTROYED.
4. MONITORING WELLS WITHIN THE WORK AREA SHALL BE ABANDONED IN ACCORDANCE WITH CALIFORNIA DEPARTMENT OF WATER RESOURCES BULLETIN No. 74-81.
5. EXCAVATION OF THE NORTH MARSH AREA SHALL BE TO A MINIMUM DEPTH OF 3-FEET 6-INCHES AND TO A MINIMUM EXTENT AS SHOWN ON THESE DRAWINGS. A CALIFORNIA REGISTERED GEOLOGIST OR CIVIL ENGINEER SHALL BE PRESENT AT ALL TIMES DURING EXCAVATION. EXCAVATION SIDES SHALL BE SLOPED AT A MAXIMUM OF 2:1. THE EXCAVATION LIMITS SHOWN ON THESE DRAWINGS IS A MINIMUM EXCAVATION LIMIT AND MAY INCREASE IF CONTAMINATION IS FOUND TO EXIST BEYOND THE LIMITS INDICATED.
6. VEGETATION AND CLEAN SOIL GENERATED BY THE EXCAVATION SHALL BE STOCKPILED IN THIS AREA TO BE USED AS CLEAN BACKFILL AND TO RE-VEGETATE AFTER BACKFILL.

REV	DATE	DESCRIPTION	BY	APPROVED
C	12/18/07	ISSUED FOR PERMIT APPLICATION	TMH	RVH
B	09/07/07	WORKING DRAFT	TMH	RVH
A	03/07/07	PRELIMINARY DESIGN SUBMITTAL	TMH	RVH

REVISION SUMMARY

SCALE: AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY

PREPARED FOR: Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583

PREPARED BY: AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DRIVE, SUITE 154
IRVINE, CALIFORNIA 92618-2327

padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

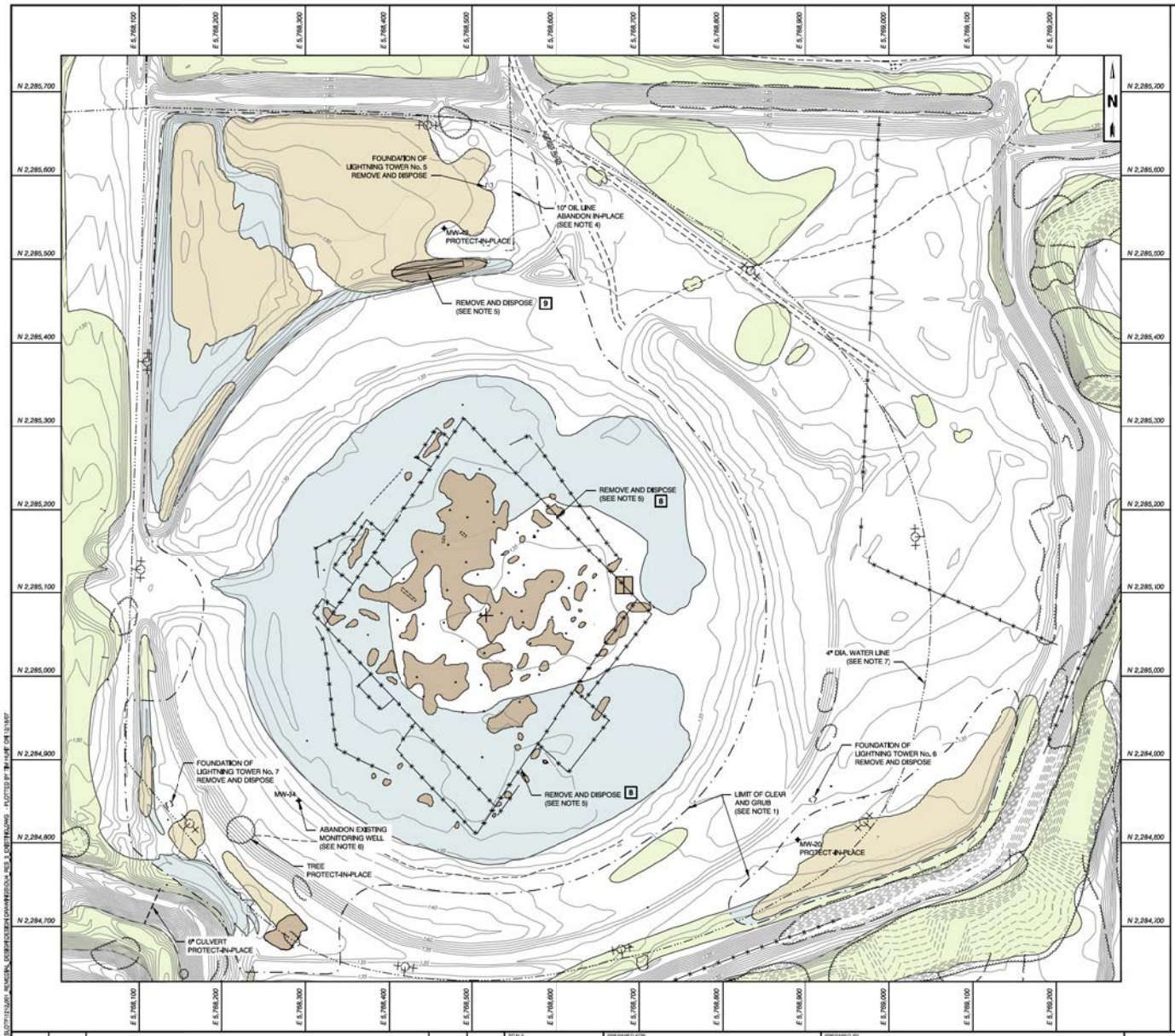
DESIGNER: T. HUNT
DRAWN BY: T. HUNT
CHECKED BY: R. VAN HYNING
APPROVED BY: R. VAN HYNING
DATE: 12/17/07

OU #4 - NORTH MARSH AREA - EXISTING CONDITIONS, DEMOLITION, AND EXCAVATION PLAN

SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

PROJECT No. 1212.001 | FILE NAME: C20

SHEET No. C20
SHEET 31 OF 43
REVISION C



LEGEND

- TOPOGRAPHIC CONTOUR
- FENCE
- 20 PROTECTIVE ENCLOSURE NUMBER
- APPROXIMATE LOCATION OF 4" WATERLINE
- LIMIT OF CLEAR AND GRUB (SEE NOTE 1)
- STATE / FEDERAL WETLAND - PROTECT-IN-PLACE
- STATE / FEDERAL WETLAND - IMPACTED BY CONSTRUCTION
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION REQUIRED
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED

0 60 120 FEET
SCALE

SCHEDULE OF MONITORING WELL ABANDONMENT

WELL I.D.	NORTHING (FT)	EASTING (FT)	TOTAL DEPTH (FT)	MATERIAL OF CONSTRUCTION
MW-34	2,284,851.90	5,768,292.29	24	PVC

NOTES:

1. CLEAR AND GRUB WITHIN THIS BOUNDARY. CLEARING SHALL INCLUDE REMOVAL AND DISPOSAL OF ALL CONCRETE DEBRIS, STRUCTURES, FEATURES, MONITORING WELLS AND HYDROCARBON IMPACTED SOIL NOT NOTED IN THESE DRAWINGS.
2. RESERVOIR 3 WAS CONSTRUCTED WITH CONCRETE LINED SLOPES. IT IS ANTICIPATED THAT MUCH OF THE ORIGINAL CONCRETE WITH ITS WIRE MESH REINFORCEMENT IS STILL ON THE SLOPE, ALTHOUGH COVERED WITH SOIL AND VEGETATION. THE CONTRACTOR SHALL REMOVE SLOPE CONCRETE AS THE BERM SOIL IS NEEDED AS BORROW MATERIAL FOR THE CAP CONSTRUCTION. IF PRACTICAL, THE CONTRACTOR MAY CRUSH THE CONCRETE FOR USE AS FILL MATERIAL. OTHERWISE MANAGE OFF-SITE AT AN APPROPRIATE FACILITY PERMITTED FOR THAT USE.
3. ALL WETLANDS, UNLESS IN A DESIGNATED WORK AREA SHALL BE PROTECTED. UNDER NO CIRCUMSTANCES SHALL PERSONNEL, EQUIPMENT, OR MATERIALS BE ALLOWED WITHIN THE BOUNDARY OF A PROTECTED WETLAND.
4. THERE IS A 10" DIA. LINE THAT TRANSPORTED CRUDE TO AND FROM RESERVOIR 3 DIRECTLY NORTH OF THE RESERVOIR. THAT LINE SHALL BE ABANDONED IN-PLACE CONSISTENT WITH THE FINISHING AND CAPPING REQUIREMENTS. THE POSITION OF THE LINE IS APPROXIMATE AND IS BASED ON HISTORICAL DRAWINGS OF PIPE ARRANGEMENTS.
5. PROTECTIVE ENCLOSURES SHALL BE DISMANTLED AND PROPERLY DISPOSED. IMPACTED SOIL BENEATH ANY ENCLOSURE SHALL BE REMOVED AS DESCRIBED IN THE SPECIFICATIONS.
6. MONITORING WELLS WITHIN THE WORK AREA SHALL BE ABANDONED IN ACCORDANCE WITH CALIFORNIA DEPARTMENT OF WATER RESOURCES BULLETIN No. 74-81.
7. IT IS NOT KNOWN IF THE 4" DIA. WATERLINE IS STILL CHARGED. IF THE LINE IS CHARGED IT SHALL BE DEPRESSURIZED, DRAINED, AND ABANDONED. IF THE LINE IS ENCOUNTERED IN A CLEARING, GRUBBING OR EXCAVATION AREA THE CONTRACTOR SHALL CUT AND REMOVE THE LINE FROM THE IMMEDIATE WORK AREA SO THAT FUTURE EFFORTS ARE NOT IMPEDED. THE REMAINING PIPE SECTIONS SHALL BE PROPERLY CAPPED AND ABANDONED.

REFERENCE:
TOPOGRAPHIC CONTOURS AND FEATURES PROVIDED BY EDA, INC., DATED JULY 2007.

REV	DATE	DESCRIPTION	BY	APPROVED
C	12/18/07	ISSUED FOR PERMIT APPLICATION	TMH	RVH
B	06/07/07	WORKING DRAFT	TMH	RVH
A	03/07/07	PRELIMINARY DESIGN SUBMITTAL	TMH	RVH

REVISION SUMMARY

SCALE: AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY

PREPARED FOR: Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583

PREPARED BY: AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DRIVE, SUITE 154
IRVINE, CALIFORNIA 92618-2327

padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

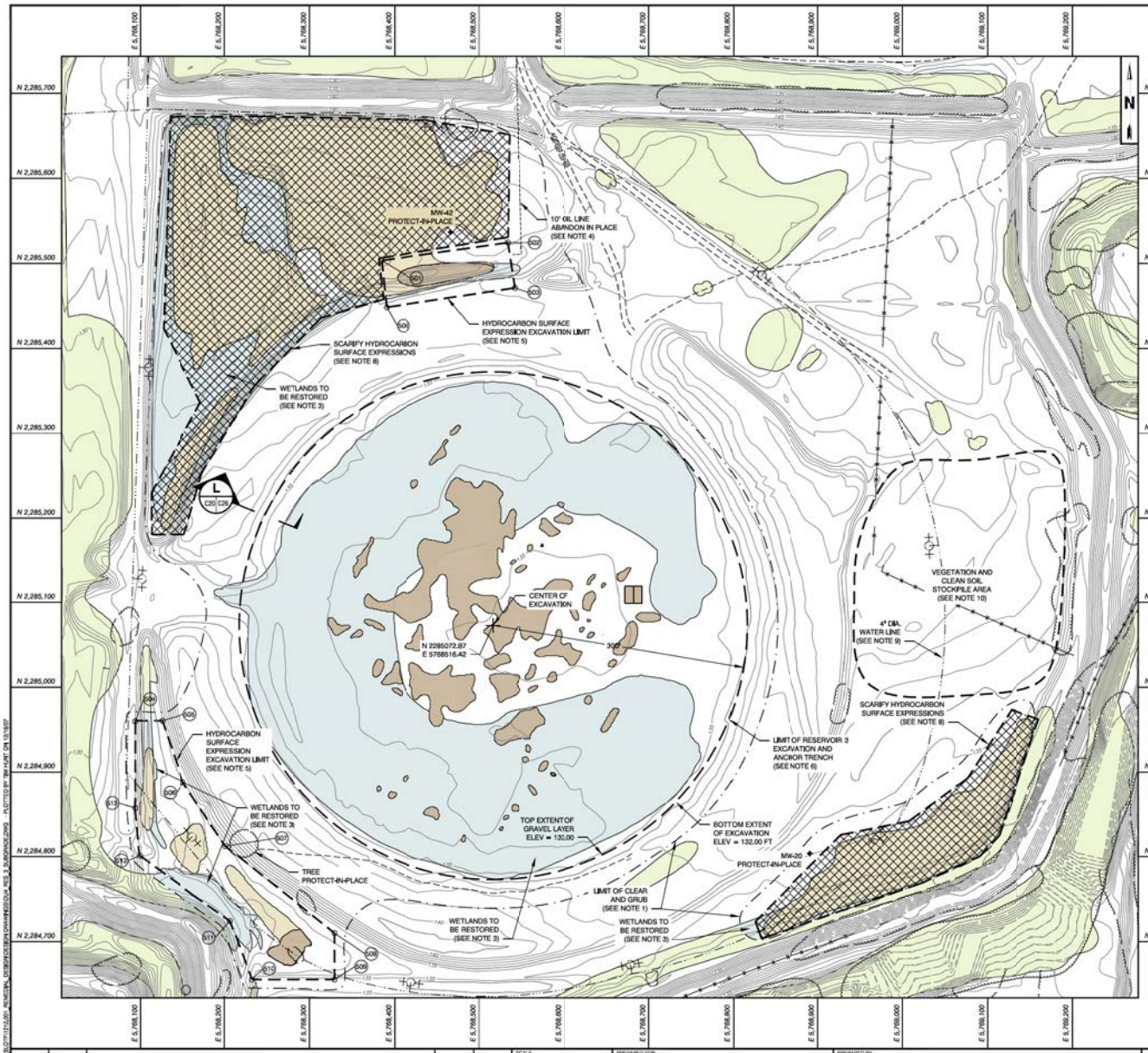
DESIGNER: T. HUNT
DRAWN BY: T. HUNT
CHECKED BY: R. VAN HYNING
APPROVED BY: R. VAN HYNING
DATE: 12/17/07

OU #4 - RESERVOIR 3 - EXISTING CONDITIONS AND DEMOLITION PLAN

SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

PROJECT No. 1212.001 | FILE NAME: C22

SHEET No. C22
SHEET 33 OF 43
REVISION C



LEGEND

- TOPOGRAPHIC CONTOUR
- FENCE
- 20 PROTECTIVE ENCLOSURE NUMBER
- APPROXIMATE LOCATION OF 4" WATERLINE
- LIMIT OF CLEAR AND GRUB (SEE NOTE 1)
- STATE / FEDERAL WETLAND - PROTECT-IN-PLACE
- STATE / FEDERAL WETLAND - IMPACTED BY CONSTRUCTION
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION REQUIRED
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED

0 60 120 FEET
SCALE

CONSTRUCTION CONTROL POINTS

POINT ID	NORTHING	EASTING
500	7,285,448.425	5,768,390.638
501	7,285,503.405	5,768,394.674
502	7,285,524.603	5,768,534.093
503	7,285,471.278	5,768,542.376
504	7,284,959.813	5,768,093.566
505	7,284,960.484	5,768,125.706
506	7,284,887.957	5,768,150.566
507	7,284,812.778	5,768,200.908
508	7,284,710.261	5,768,329.558
509	7,284,655.585	5,768,329.558
510	7,284,655.585	5,768,231.983
511	7,284,724.551	5,768,206.501
512	7,284,801.465	5,768,099.170
513	7,284,857.850	5,768,093.737

NOTES:

1. CLEAR AND GRUB WITHIN THIS BOUNDARY. CLEARING SHALL INCLUDE REMOVAL AND DISPOSAL OF ALL CONCRETE DEBRIS, STRUCTURES, FEATURES, MONITORING WELLS AND HYDROCARBON IMPACTED SOIL NOT NOTED IN THESE DRAWINGS.
2. ALL WETLANDS, UNLESS IN A DESIGNATED WORK AREA SHALL BE PROTECTED. UNDER NO CIRCUMSTANCES SHALL PERSONNEL, EQUIPMENT, OR MATERIALS BE ALLOWED WITHIN THE BOUNDARY OF A PROTECTED WETLAND.
3. ALL WETLANDS WITHIN RESERVOIR 3 AND THE SURROUNDING AREAS DISTURBED BY CLEARING AND GRUBBING, EXCAVATION, AND SCARIFYING ACTIVITIES SHALL BE RESTORED TO THEIR PRE-DISTURBED CONDITIONS.
4. THERE IS A 10" DIA. LINE THAT TRANSPORTED CRUDE TO AND FROM RESERVOIR 3 DIRECTLY NORTH OF THE RESERVOIR. THAT LINE SHALL BE ABANDONED IN-PLACE CONSISTENT WITH THE FINISHING AND CAPPING REQUIREMENTS. THE POSITION OF THE LINE IS APPROXIMATE AND IS BASED ON HISTORICAL DRAWINGS OF PIPE ARRANGEMENTS.
5. EXCAVATION OF HYDROCARBON SURFACE EXPRESSIONS IN THESE AREAS SHALL BE TO A MINIMUM DEPTH OF 3-FEET BELOW GROUND SURFACE AND TO A MINIMUM EXTENT AS INDICATED ON THESE DRAWINGS. A CALIFORNIA REGISTERED GEOLOGIST OR CIVIL ENGINEER SHALL BE PRESENT AT TIMES DURING EXCAVATION. EXCAVATION SIDES SHALL BE SLOPED TO A MAXIMUM OF 2:1. THE EXCAVATION LIMITS SHOWN ON THESE DRAWINGS IS A MINIMUM EXCAVATION LIMIT AND MAY INCREASE IF CONTAMINATION IS FOUND TO EXIST BEYOND THE LIMITS INDICATED.
6. RESERVOIR 3 SHALL BE EXCAVATED TO AN ELEVATION OF 132.00 FT. THIS IS ANTICIPATED TO REMOVE A BULK OF THE PLIABLE HYDROCARBON SURFACE EXPRESSIONS. THE EXCAVATION DEPTH MAY INCREASE IF NECESSARY. AS DETERMINED BY THE ENGINEER.
7. RESERVOIR 3 WAS CONSTRUCTED WITH CONCRETE LINED SLOPES. IT IS ANTICIPATED THAT MUCH OF THE ORIGINAL CONCRETE WITH ITS WIRE MESH REINFORCEMENT IS STILL ON THE SLOPE, ALTHOUGH COVERED WITH SOIL AND VEGETATION. THE CONTRACTOR SHALL REMOVE SLOPE CONCRETE AS THE BERM SOIL IS NEEDED AS BORROW MATERIAL FOR THE CAP CONSTRUCTION. IF PRACTICAL, THE CONTRACTOR MAY CRUSH THE CONCRETE FOR USE AS FILL MATERIAL. OTHERWISE MANAGE OFF-SITE AT AN APPROPRIATE FACILITY PERMITTED FOR THAT USE.
8. THESE AREAS SHALL BE RIPPED AND SCARIFIED AT THE SURFACE TO FACILITATE VEGETATIVE GROWTH.
9. IT IS NOT KNOWN IF THE 4" DIA. WATERLINE IS STILL CHARGED. IF THE LINE IS CHARGED IT SHALL BE DEPRESSURIZED, DRAINED, AND ABANDONED. IF THE LINE IS ENCOUNTERED IN A CLEARING, GRUBBING OR EXCAVATION AREA THE CONTRACTOR SHALL CUT AND REMOVE THE LINE FROM THE IMMEDIATE WORK AREA SO THAT FUTURE EFFORTS ARE NOT IMPEDED. THE REMAINING PIPE SECTIONS SHALL BE PROPERLY CAPPED AND ABANDONED.
10. VEGETATION AND CLEAN SOIL GENERATED BY EXCAVATION ACTIVITIES SHALL BE STOCKPILED IN THIS AREA TO BE USED AS CLEAN BACKFILL AND TO RE-VEGETATE AFTER BACKFILLING.

REFERENCE:
TOPOGRAPHIC CONTOURS AND FEATURES PROVIDED BY EDA, INC., DATED JULY 11, 2007.

REV	DATE	DESCRIPTION	BY	APPROVED
C	12/18/07	ISSUED FOR PERMIT APPLICATION	TMH	RVH
B	06/07/07	WORKING DRAFT	TMH	RVH
A	05/01/07	PRELIMINARY DESIGN SUBMITTAL	TMH	RVH

REVISION SUMMARY

SCALE: AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY

PREPARED FOR: Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583

PREPARED BY: AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DRIVE, SUITE 154
IRVINE, CALIFORNIA 92618-2327

padre associates, Inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

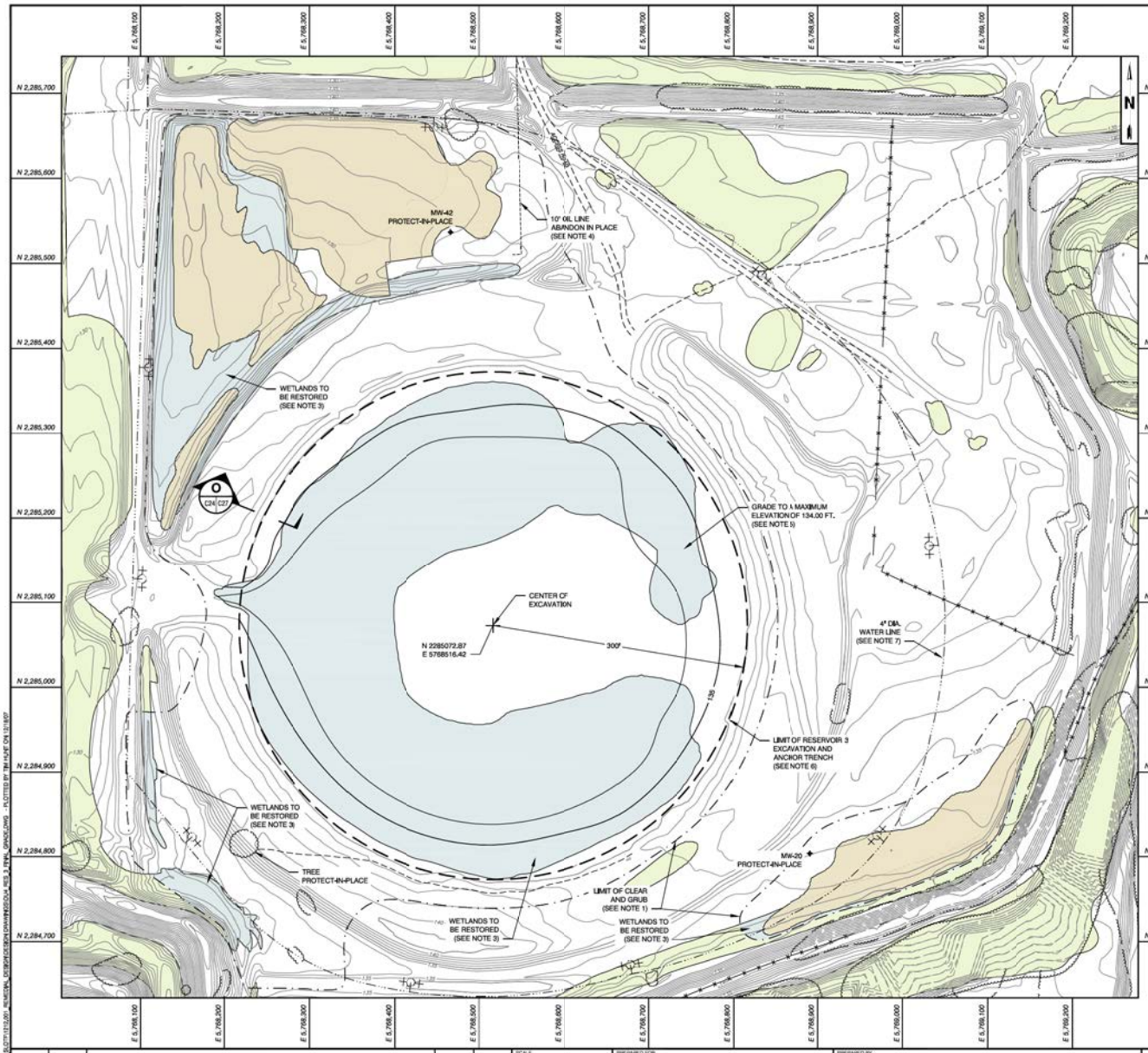
DESIGNER: T. HUNT
DRAWN BY: T. HUNT
CHECKED BY: R. VAN HYNING
APPROVED BY: R. VAN HYNING
DATE: 12/17/07

OU #4 - RESERVOIR 3 - EXCAVATION AND SUBGRADE PREPARATION PLAN

SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

PROJECT No. 1212.001 | FILE NAME: C23

SHEET No. C23
SHEET 34 OF 43
REVISION C



LEGEND

- TOPOGRAPHIC CONTOUR
- FENCE
- 20 PROTECTIVE ENCLOSURE NUMBER
- APPROXIMATE LOCATION OF 4" WATERLINE
- LIMIT OF CLEAR AND GRUB (SEE NOTE 1)
- STATE / FEDERAL WETLAND - PROTECT-IN-PLACE
- STATE / FEDERAL WETLAND - IMPACTED BY CONSTRUCTION
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION REQUIRED
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED

0 60 120 FEET
SCALE

NOTES:

1. CLEAR AND GRUB WITHIN THIS BOUNDARY. CLEARING SHALL INCLUDE REMOVAL AND DISPOSAL OF ALL CONCRETE DEBRIS, STRUCTURES, FEATURES, MONITORING WELLS AND HYDROCARBON IMPACTED SOIL NOT NOTED IN THESE DRAWINGS.
2. ALL WETLANDS, UNLESS IN A DESIGNATED WORK AREA SHALL BE PROTECTED. UNDER NO CIRCUMSTANCES SHALL PERSONNEL, EQUIPMENT, OR MATERIALS BE ALLOWED WITHIN THE BOUNDARY OF A PROTECTED WETLAND.
3. ALL WETLANDS WITHIN RESERVOIR 3 AND THE SURROUNDING AREAS DISTURBED BY CLEARING AND GRUBBING, EXCAVATION, AND SCARIFYING ACTIVITIES SHALL BE RESTORED TO THEIR PRE-DISTURBED CONDITIONS.
4. THERE IS A 10" DIA. LINE THAT TRANSPORTED CRUDE TO AND FROM RESERVOIR 3 DIRECTLY NORTH OF THE RESERVOIR. THAT LINE SHALL BE ABANDONED IN-PLACE CONSISTENT WITH THE FINISHING AND CAPPING REQUIREMENTS. THE POSITION OF THE LINE IS APPROXIMATE AND IS BASED ON HISTORICAL DRAWINGS OF PIPE ARRANGEMENTS.
5. RESERVOIR 3 SHALL BE EXCAVATED TO AN ELEVATION OF 132.00 FT AROUND THE EDGE AND SLOPED AT 0.5% TOWARDS THE MIDDLE TO AN ELEVATION OF APPROXIMATELY 130.50 FT. THIS IS ANTICIPATED TO REMOVE A BULK OF THE PLIABLE HYDROCARBON SURFACE EXPRESSIONS. UPON COMPLETION OF THE EXCAVATION, THE CONTRACTOR SHALL INSTALL AN 8 OZ. GEOTEXTILE OVERLAIN WITH 6-INCHES OF ¾" GRAVEL. A TRIAXIAL GEOGRID SHALL THEN BE INSTALLED DIRECTLY ABOVE THE 6-INCHES OF GRAVEL FOLLOWING BY ANOTHER 6-INCHES OF GRAVEL. THE CONTRACTOR SHALL PLACE A LAYER OF 8 OZ. GEOTEXTILE, FOLLOWED BY A LAYER OF 40-MIL HDPE FML, AND ANOTHER LAYER OF 8 OZ. GEOTEXTILE DIRECTLY ON TOP OF THE GRAVEL LAYER. COMMON EARTH BACKFILL SHALL THEN BE USED TO ESTABLISH A GRADE WITH AN ELEVATION OF APPROXIMATELY 133.00 FT. THE CONTRACTOR SHALL THEN PLACE A 1-FOOT THICK LAYER OF ORGANIC TOPSOIL AND RE-VEGETATE TO MATCH THE EXISTING PRE-CONSTRUCTION WETLAND HABITAT.
6. RESERVOIR 3 WAS CONSTRUCTED WITH CONCRETE LINED SLOPES. IT IS ANTICIPATED THAT MUCH OF THE ORIGINAL CONCRETE WITH IT'S WIRE MESH REINFORCEMENT IS STILL ON THE SLOPE, ALTHOUGH COVERED WITH SOIL AND VEGETATION. THE CONTRACTOR SHALL REMOVE SLOPE CONCRETE AS THE BERM SOIL IS NEEDED AS BORROW MATERIAL FOR THE CAP CONSTRUCTION. IF PRACTICAL, THE CONTRACTOR MAY CRUSH THE CONCRETE FOR USE AS FILL MATERIAL. OTHERWISE MANAGE OFF-SITE AT AN APPROPRIATE FACILITY PERMITTED FOR THAT USE.
7. IT IS NOT KNOWN IF THE 4" DIA. WATERLINE IS STILL CHARGED. IF THE LINE IS CHARGED IT SHALL BE DEPRESSURIZED, DRAINED, AND ABANDONED. IF THE LINE IS ENCOUNTERED IN A CLEARING, GRUBBING OR EXCAVATION AREA THE CONTRACTOR SHALL CUT AND REMOVE THE LINE FROM THE IMMEDIATE WORK AREA SO THAT FUTURE EFFORTS ARE NOT IMPEDED. THE REMAINING PIPE SECTIONS SHALL BE PROPERLY CAPPED AND ABANDONED.

REFERENCE:
TOPOGRAPHIC CONTOURS AND FEATURES PROVIDED BY EDA, INC., DATED JULY 11, 2007.

REV	DATE	DESCRIPTION	BY	APPROVED
C	12/18/07	ISSUED FOR PERMIT APPLICATION	TMH	RVH
B	06/07/07	WORKING DRAFT	TMH	RVH
A	05/01/07	PRELIMINARY DESIGN SUBMITTAL	TMH	RVH

REVISION SUMMARY

SCALE: AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY

PREPARED FOR: Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583

PREPARED BY: AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DRIVE, SUITE 154
IRVINE, CALIFORNIA 92618-2327

padre associates, Inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

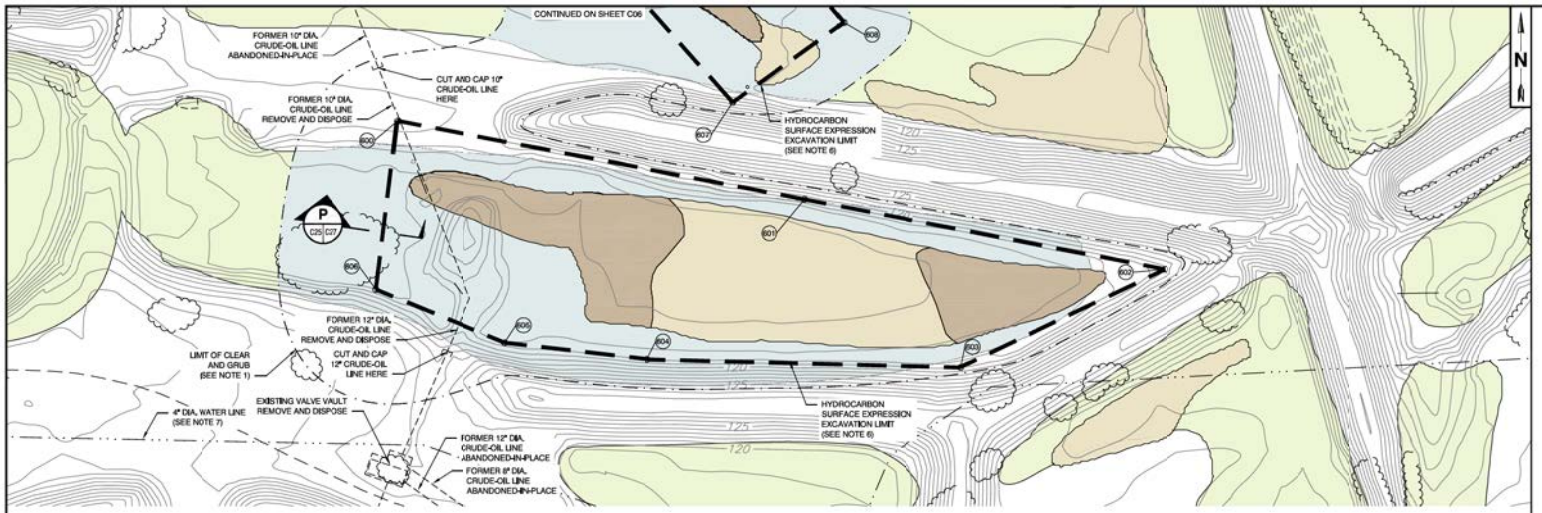
DESIGNER: T. HUNT
DRAWN BY: T. HUNT
CHECKED BY: R. VAN HYNING
APPROVED BY: R. VAN HYNING
DATE: 12/18/07

OU #4 - RESERVOIR 3 - FINAL GRADE PLAN

SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

PROJECT No. 1212,001 | FILE NAME: C24

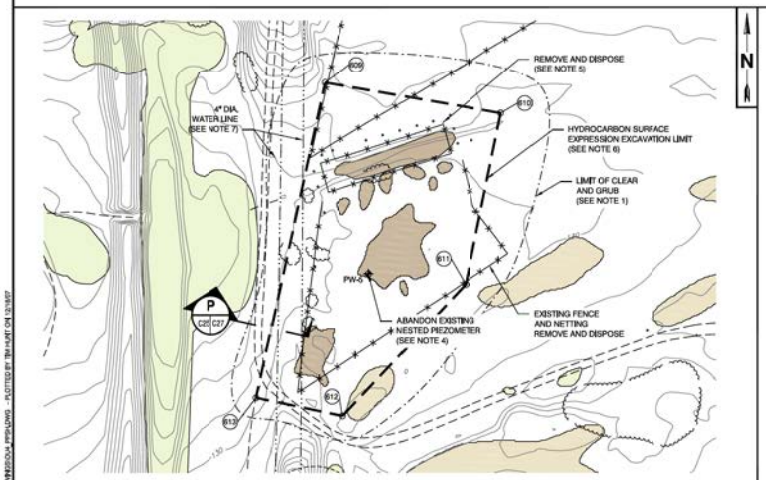
SHEET No. C24
SHEET 35 OF 43
REVISION C



PLAN A

SOUTH OF RESERVOIR 5

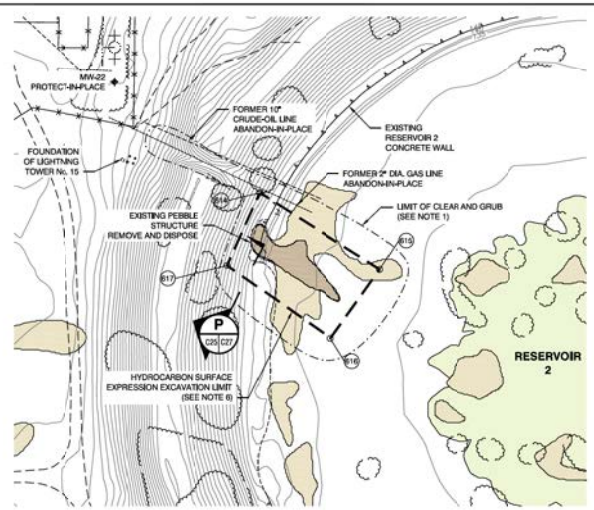
SCALE 0 30 60 FEET



PLAN B

WEST OF RESERVOIR 2

SCALE 0 50 100 FEET



PLAN C

RESERVOIR 2

SCALE 0 50 100 FEET

LEGEND

- SITE PROPERTY BOUNDARY
- TOPOGRAPHIC CONTOUR
- TREE / BRUSH LINE
- EXISTING MONITORING / PRODUCTION WELL
- FENCE
- APPROXIMATE LOCATION OF 4" WATERLINE
- LIMIT OF CLEAR AND GRUB (SEE NOTE 1)
- STATE / FEDERAL WETLAND - PROTECT-IN-PLACE
- STATE / FEDERAL WETLAND - IMPACTED BY CONSTRUCTION
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION REQUIRED
- HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED

SHEET KEY

SCALE 0 200 400 FEET

CONSTRUCTION CONTROL POINTS

POINT ID	NORTHING	EASTING
600	2,285,771.610	5,766,947.910
601	2,285,731.529	5,767,156.335
602	2,285,695.897	5,767,340.465
603	2,285,645.866	5,767,236.518
604	2,285,649.918	5,767,075.857
605	2,285,658.416	5,767,003.358
606	2,285,685.618	5,766,937.204
607	2,285,781.010	5,767,119.519
608	2,285,821.739	5,767,176.311
609	2,286,268.753	5,768,131.144
610	2,286,242.658	5,768,281.069
611	2,286,096.534	5,768,250.857
612	2,285,984.635	5,768,145.870
613	2,286,000.167	5,768,072.585
614	2,286,300.511	5,768,667.314
615	2,286,235.372	5,768,769.661
616	2,286,176.653	5,768,727.914
617	2,286,238.703	5,768,639.610

NOTES:

1. CLEAR AND GRUB WITHIN THIS BOUNDARY, CLEARING SHALL INCLUDE REMOVAL AND DISPOSAL OF ALL CONCRETE DEBRIS, STRUCTURES, FEATURES, MONITORING WELLS AND HYDROCARBON IMPACTED SOIL NOT NOTED IN THESE DRAWINGS.
2. ALL WETLANDS, UNLESS IN A DESIGNATED WORK AREA SHALL BE PROTECTED. UNDER NO CIRCUMSTANCES SHALL PERSONNEL, EQUIPMENT, OR MATERIALS BE ALLOWED WITHIN THE BOUNDARY OF A PROTECTED WETLAND.
3. ALL WETLANDS DISTURBED BY CLEARING AND GRUBBING AND EXCAVATION ACTIVITIES SHALL BE RESTORED TO THEIR PRE-DISTURBED CONDITIONS.
4. NESTED PIEZOMETER SHALL BE ABANDONED IN ACCORDANCE WITH CALIFORNIA DEPARTMENT OF WATER RESOURCES BULLETIN No. 74.
5. PROTECTIVE ENCLOSURES SHALL BE DISMANTLED AND PROPERLY DISPOSED. IMPACTED SOIL BENEATH ANY ENCLOSURE SHALL BE REMOVED AS DESCRIBED IN THE SPECIFICATIONS. THOSE AREAS WITHIN RESERVOIRS SHALL BE HANDLED IN ACCORDANCE WITH THE REQUIREMENTS FOR THE BOTTOM EXCAVATION.
6. EXCAVATION OF HYDROCARBON SURFACE EXPRESSIONS IN THESE AREAS SHALL BE TO A MINIMUM DEPTH OF 3 FEET BELOW GROUND SURFACE AND TO A MINIMUM EXTENT AS INDICATED ON THESE DRAWINGS. A CALIFORNIA REGISTERED GEOLOGIST OR CIVIL ENGINEER SHALL BE PRESENT AT TIMES DURING EXCAVATION. EXCAVATION SIDES SHALL BE SLOPED TO A MAXIMUM OF 2:1. THE EXCAVATION LIMITS SHOWN ON THESE DRAWINGS IS A MINIMUM EXCAVATION LIMIT AND MAY INCREASE IF CONTAMINATION IS FOUND TO EXIST BEYOND THE LIMITS INDICATED.
7. IT IS NOT KNOWN IF THE 4" DIA. WATERLINE IS STILL CHARGED. IF THE LINE IS CHARGED IT SHALL BE DEPRESSURIZED, DRAINED, AND ABANDONED. IF THE LINE IS ENCOUNTERED IN A CLEARING, GRUBBING OR EXCAVATION AREA THE CONTRACTOR SHALL CUT AND REMOVE THE LINE FROM THE IMMEDIATE WORK AREA SO THAT FUTURE EFFORTS ARE NOT IMPEDED. THE REMAINING PIPE SECTIONS SHALL BE PROPERLY CAPPED AND ABANDONED.

REFERENCE:

TOPOGRAPHIC CONTOURS AND FEATURES PROVIDED BY EDA, INC., DATED JULY 11, 2007.

REV	DATE	DESCRIPTION	BY	APPROVED
C	12/18/07	ISSUED FOR PERMIT APPLICATION	TMH	RVH
B	06/07/07	WORKING DRAFT	TMH	RVH
A	03/07/07	PRELIMINARY DESIGN SUBMITTAL	TMH	RVH

REVISION SUMMARY

SCALE: AS NOTED

BAR SHOULD BE EXACTLY 1-INCH LONG

IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY

PREPARED FOR: Chevron — CHEVRON CORPORATION, 6001 BOLLINGER CANYON RD., SAN RAMON, CA 94583

PREPARED BY: AVOCET ENVIRONMENTAL, INC. — 16 TECHNOLOGY DRIVE, SUITE 154, IRVINE, CALIFORNIA 92618-2327

padre associates, inc. — ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

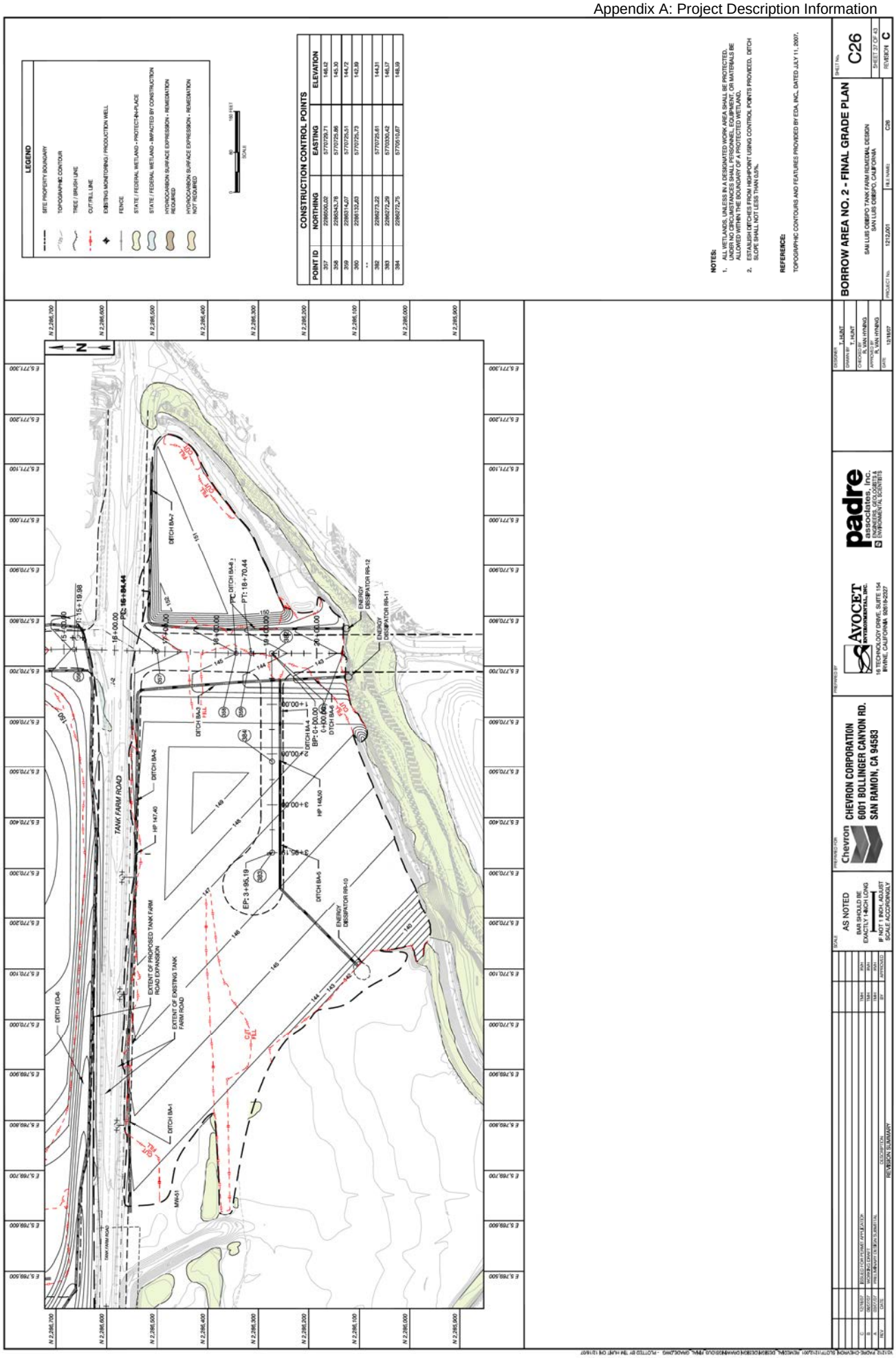
DESIGNER: T. HUNT
DRAWN BY: T. HUNT
CHECKED BY: R. VAN HYNING
APPROVED BY: R. VAN HYNING
DATE: 12/17/07

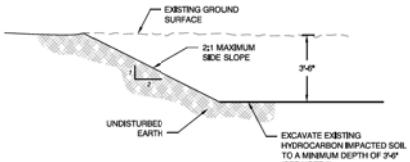
OU #4 - REMAINING SITEWIDE PPSH AREAS - EXISTING CONDITIONS, DEMOLITION, AND EXCAVATION PLAN

SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

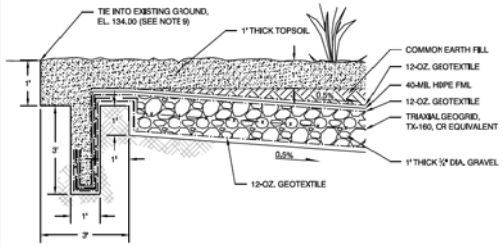
PROJECT No. 1212.001 | FILE NAME: C25

SHEET No. C25 — SHEET 36 OF 43 — REVISION C

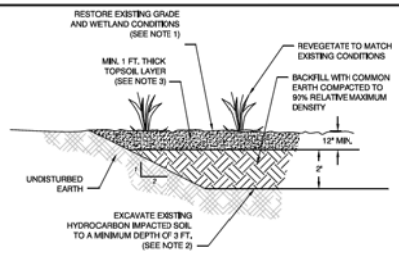

LEGEND
SITE PROPERTY BOUNDARY
TOPOGRAPHIC CONTOUR
TREE / BRUSH LINE
CUT/FILL LINE
EXISTING MONITORING / PRODUCTION WELL
FENCE
STATE / FEDERAL WETLAND - PROTECT-IN-PLACE
STATE / FEDERAL WETLAND - IMPACTED BY CONSTRUCTION
HYDROCARBON SURFACE EXPRESSION - REMEDIATION REQUIRED
HYDROCARBON SURFACE EXPRESSION - REMEDIATION NOT REQUIRED
SCALE
CONSTRUCTION CONTROL POINTS
POINT ID | NORTHING | EASTING | ELEVATION
357 | 2286000.02 | 5770729.71 | 146.12
358 | 2286343.78 | 5770725.86 | 145.30
359 | 2286314.07 | 5770725.31 | 144.72
360 | 2286133.49 | 5770725.79 | 142.89
" | | | |
362 | 2286273.22 | 5770725.61 | 144.31
363 | 2286272.29 | 5770730.42 | 146.17
364 | 2286272.75 | 5770610.87 | 148.89
NOTES:
1. ALL WETLANDS, UNLESS IN A DESIGNATED WORK AREA SHALL BE PROTECTED. UNDER NO CIRCUMSTANCES SHALL PERSONNEL, EQUIPMENT, OR MATERIALS BE ALLOWED WITHIN THE BOUNDARY OF A PROTECTED WETLAND.
2. ESTABLISH DITCHES FROM HIGHPOINT USING CONTROL POINTS PROVIDED. DITCH SLOPE SHALL NOT LESS THAN 0.5%.
REFERENCE:
TOPOGRAPHIC CONTOURS AND FEATURES PROVIDED BY EDA, INC., DATED JULY 11, 2007.
BORROW AREA NO. 2 - FINAL GRADE PLAN
SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA
C26
SHEET 37 OF 43
REVISION C
padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS
AVOCET ENVIRONMENTAL, INC.
16 TECHNOLOGY DRIVE, SUITE 154
IRVINE, CALIFORNIA 92618-2327
Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583
AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY
REVISION SUMMARY
TANK FARM ROAD
DITCH BA-7
DITCH BA-6
DITCH BA-2
DITCH BA-1
DITCH BA-3
DITCH BA-4
DITCH BA-5
DITCH ED-6
ENERGY DISSIPATOR RR-10
ENERGY DISSIPATOR RR-11
ENERGY DISSIPATOR RR-12
EXTENT OF PROPOSED TANK FARM ROAD EXPANSION
EXTENT OF EXISTING TANK FARM ROAD
MW-51
PC: 16+84.44
PT: 18+70.44
EP: 3+95.19
BP: 0+00.00
HP 147.40
HP 148.50



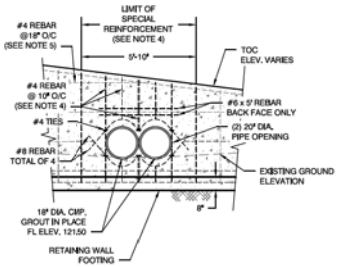
SECTION N (C26/C27)
NORTH MARSH AREA TYPICAL EXCAVATION AND BACKFILL



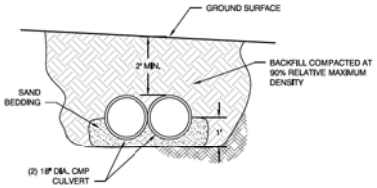
SECTION O (C24/C27)
RESERVOIR 3 TYPICAL ANCHOR TRENCH AND CAP



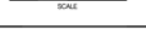
SECTION P (C25/C27)
REMAINING PPSH AREAS TYPICAL EXCAVATION AND BACKFILL

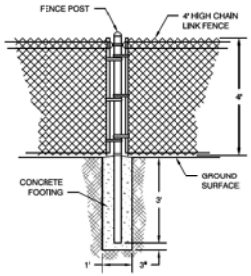


SECTION Q (C23/C27)
OPERATIONS AREA RETAINING WALL CULVERT REINFORCEMENT

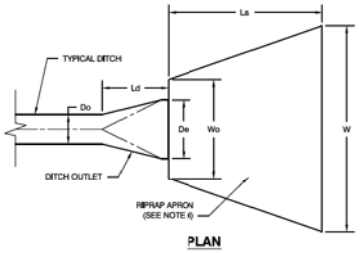


SECTION R (C23/C27)
OPERATIONS AREA CULVERT SECTION

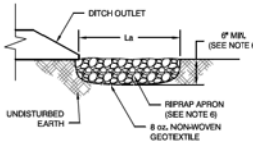




DETAIL 1 (MULT/C27)
TYPICAL FENCE DETAIL



PLAN



PROFILE

DETAIL 2 (MULT/C27)
TYPICAL DITCH OUTLET AND ENERGY DISSIPATER

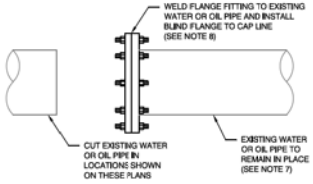
NOT TO SCALE

DITCH OUTLET AND RIPRAP APRON SCHEDULE

ID	Do (ft)	Ld (ft)	De (ft)	Wo (ft)	La (ft)	W (ft)	RIPRAP SIZE
RR-1	2	3	4	6	6	8	6"
RR-1A	2	3	4	6	6	8	6"
RR-2	2	3	4	6	6	8	6"
RR-2A	2	3	4	6	6	8	6"
RR-3	4	0	6	6	6	8	3"
RR-4	4	0	6	6	6	8	3"
RR-5	4	0	6	6	6	8	3"
RR-6	4	0	6	6	6	8	3"
RR-7	4	0	6	6	6	8	3"
RR-8	6	0	8	8	8	12	6"
RR-9	6	0	8	8	8	12	6"
RR-10	2	3	4	6	6	8	6"
RR-11	2	3	4	6	6	8	6"
RR-12	2	3	4	6	6	8	6"

TRIANGULAR DITCH SCHEDULE

DITCH ID	TYPE	W (ft)	D (ft)
NW-1	EARTHEN	2.00	0.50
NW-2	EARTHEN	2.00	0.50
NW-3	EARTHEN	4.00	0.50
NW-4	EARTHEN	2.00	0.50
NW-5	EARTHEN	2.00	0.50
NW-6	EARTHEN	4.00	0.50
NW-7	EARTHEN	2.00	0.50
NW-8	EARTHEN	2.00	0.50
NW-9	EARTHEN	2.00	0.50
NW-10	EARTHEN	2.00	0.50
NW-11	GUNITE	2.00	0.50
NW-12	GUNITE	2.00	0.50
NW-13	GUNITE	2.00	0.50
NW-14	GUNITE	2.00	0.50
RS-1	EARTHEN	4.00	0.50
RS-2	EARTHEN	4.00	0.50
R7-1	EARTHEN	4.00	0.50
R7-2	EARTHEN	4.00	0.50
ED-1	EARTHEN	2.00	0.50
ED-2	EARTHEN	2.00	0.50
ED-3	EARTHEN	3.00	1.00
ED-4	EARTHEN	5.00	1.67
ED-5	EARTHEN	4.00	1.00
ED-6	EARTHEN SWALE	REFER TO SHEET C17 CONTOURS AND NOTE 10	
ED-7	EARTHEN	4.00	1.67
ED-8	EARTHEN	2.00	0.50
ED-9	EARTHEN	4.00	1.00
ED-10	EARTHEN SWALE	4.00	1.50
ED-11	EARTHEN SWALE	REFER TO SHEET C17 CONTOURS AND NOTE 11	
ED-12	EARTHEN	6.00	2.00
BA-1	EARTHEN	2.00	0.50
BA-2	EARTHEN	2.00	0.50
BA-3	EARTHEN	2.00	0.50
BA-4	EARTHEN	2.00	0.50
BA-5	EARTHEN	2.00	0.50
BA-6	EARTHEN	2.00	0.50
BA-7	EARTHEN	2.00	0.50
BA-8	EARTHEN	2.00	0.50

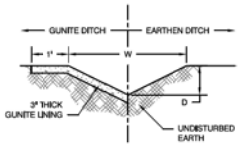


DETAIL 11 (MULT/C27)
TYPICAL UTILITY PIPE CUT AND CAP

NOT TO SCALE

NOTES:

1. THE CONTRACTOR SHALL RESTORE THE GRADE, WETLAND CONDITIONS, AND VEGETATION WITHIN THE RESERVOIR 3 EXCAVATION AREA TO MIMIC THEIR ORIGINAL PRE-CONSTRUCTION CONDITIONS TO THE BEST EXTENT POSSIBLE.
2. THE NORTH MARSH AREA SHALL BE EXCAVATED TO A DEPTH OF 3-FEET 6-INCHES BELOW GROUND SURFACE WHILE ALL OTHER PPSH AREAS SHALL BE EXCAVATED TO A DEPTH OF 3-FEET BELOW GROUND SURFACE. THESE DEPTHS ARE MINIMUM DEPTHS AND MAY INCREASE AS DEEMED NECESSARY BY THE ENGINEER OR GEOLOGIST. A CALIFORNIA REGISTERED GEOLOGIST OR CIVIL ENGINEER SHALL BE PRESENT DURING ALL EXCAVATION ACTIVITIES.
3. TOP SOIL LAYERS SHALL CONSIST OF A 1-FOOT THICK LAYER OF ORGANIC RICH SOIL. TOP SOILS SHALL BE ANY COMBINATION OF SILT-BASED OR CLAY-BASED SOIL FOUND ONSITE OR LOCALLY. ONSITE TOPSOIL SHALL CONTAIN A MINIMUM OF 10 PERCENT ORGANIC MATERIAL. ONSITE SOILS USED FOR TOP SOIL NOT MEETING THIS REQUIREMENT SHALL HAVE FERTILIZERS AND MULCH ADDED AND MEET A MINIMUM REQUIREMENT OF 15 PERCENT ORGANIC MATERIAL. TOP SOIL SHALL BE PLACED IN 12-INCH LIFTS. TOP SOIL THAT BECOMES COMPACTED DURING PLACEMENT SHALL BE SCARIFIED TO A DEPTH OF AT LEAST 4-INCHES PRIOR TO SEEDING OR PLANTING.
4. SPECIAL REINFORCEMENT SHALL CONSISTOF STANDARD VERTICAL REINFORCEMENT PLUS ADDITIONAL BARS CORRESPONDING IN SIZE AND NUMBER TO BARS CUT BY THE PIPE OPENING. THE ADDITIONAL BARS SHALL BE EXTENDED INTO THE FOOTING THE SAME AS THE STANDARD VERTICAL BARS AND TO A MINIMUM OF 60 BAR DIAMETERS ABOVE THE TOP OF THE PIPE OPENING IF WALL HEIGHT PERMITS. BARS SHALL BE BUNDLED AS REQUIRED.5. HORIZONTAL REINFORCEMENT SHALL BE STANDARD EXCEPT AS SHOWN. ALL REINFORCEMENT SHALL CLEAR THE PIPE OPENING BY A MINIMUM OF 2-INCHES.
6. RIPRAP SHALL CONSIST OF A WELL GRADED MIXTURE OF STONE WITH AN AVERAGE RIPRAP STONE SIZE AS SHOWN IN THE DITCH OUTLET AND RIPRAP APRON SCHEDULE. MAXIMUM RIPRAP SIZE SHALL NOT BE GREATER THAN 1.5 TIMES THE SIZE OF THE AVERAGE RIPRAP SIZE. THE MINIMUM THICKNESS OF THE RIPRAP APRON SHALL BE 1.5 TIMES THE MAXIMUM STONE DIAMETER AND NOT LESS THAN 6-INCHES. AN 8 oz. NON-WOVEN GEOTEXTILE SHALL BE PLACED BETWEEN THE RIPRAP APRON AND THE EXISTING GROUND.
7. EXISTING OIL AND WATER PIPES ARE ASSUMED TO BE STEEL OR CAST IRON PIPE WITH DIAMETERS OF 6-INCHES OR LESS.
8. BLIND FLANGES SHALL BE USED TO CAP EXISTING OIL AND WATER PIPES. IF ECONOMICALLY ADVANTAGEOUS, ALTERNATIVE METHODS CAN BE USED SUCH AS WELDING 2IN A STEEL CAP OR STEEL PLATE.
9. GRADE CAP TO AN ELEVATION NO MORE THAN 134.00
10. FOR EARTHEN SWALES ED-6 AND ED-11 PROVIDE A MINIMUM 6-INCH THICK AVERAGE-SIZE STONE BOTTOM WITH AN 8-OZ. GEOTEXTILE BETWEEN THE STONE AND THE EXISTING CHANNEL BOTTOM AS A SEPARATION LAYER.



DETAIL 3 (MULT/C27)
TYPICAL TRIANGULAR DITCH AND SCHEDULE

NOT TO SCALE

REV	DATE	DESCRIPTION	BY	APPROVED
C	12/18/07	ISSUED FOR PERMIT APPLICATION	TMH	RSH
B	09/07/07	WORKING DRAFT	TMH	RSH
A	03/07/07	PRELIMINARY DESIGN SUBMITTAL	TMH	RSH

REVISION SUMMARY

SCALE: AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY

PREPARED FOR: Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583

PREPARED BY: AVOCET ENVIRONMENTAL, INC.
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ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

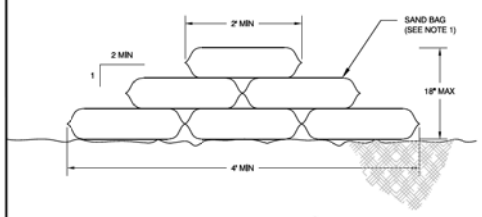
DESIGNER: T. HUNT
DRAWN BY: T. HUNT
CHECKED BY: R. VAN HYNING
APPROVED BY: R. VAN HYNING
DATE: 12/18/07

MISC. SECTIONS AND DETAILS

SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

PROJECT No. 1212,001 | FILE NAME: C27

SHEET No. C27
SHEET 38 OF 43
REVISION C



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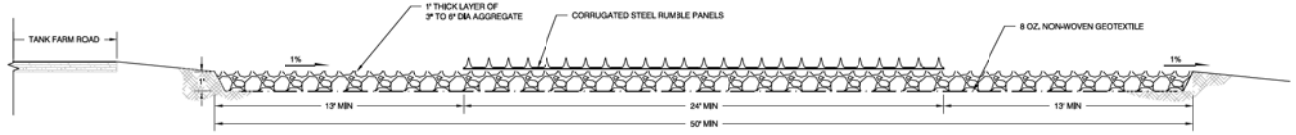
TYPICAL SANDBAG DETAIL

NOT TO SCALE



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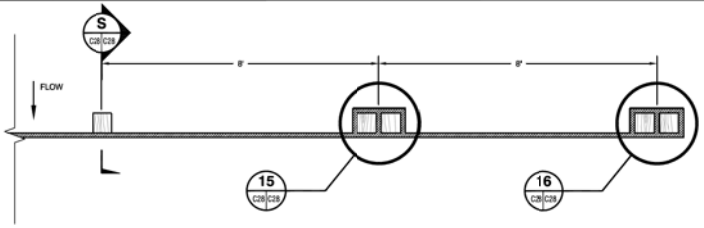
NOT TO SCALE



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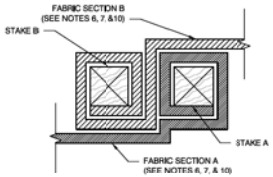
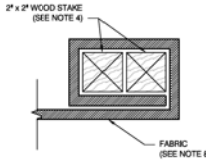
TYPICAL SILT FENCE PLAN

NOT TO SCALE



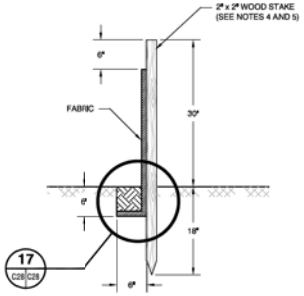
DETAIL 15 (C28|C28)
JOINING SECTION DETAIL (TOP VIEW)

NOT TO SCALE

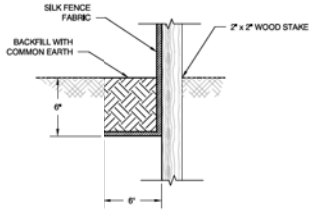


DETAIL 16 (C28|C28)
END STAKE DETAIL (TOP VIEW)

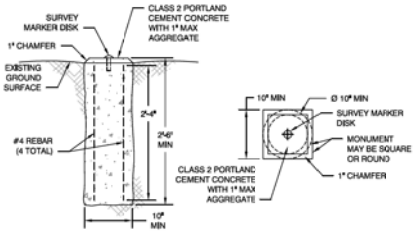
NOT TO SCALE



SECTION S (G06|C28)
TYPICAL SILT FENCE DETAIL



DETAIL 17 (C28|C28)
SILT FENCE TRENCH DETAIL



DETAIL 18 (M17|C28)
TYPICAL SURVEY MONUMENT

NOTES:

1. SANDBAGS SHALL BE WOVEN POLYPROPYLENE, POLYETHYLENE, OR POLYAMIDE FABRIC WITH A MULLEN BURST STRENGTH EXCEEDING 330 lb/in² AND AN ULTRAVIOLET STABILITY EXCEEDING 70%. EACH SANDBAG SHALL HAVE AN APPROXIMATE LENGTH OF 18-INCHES AND A WIDTH OF 12 INCHES. ALL SANDBAG MATERIAL SHOULD BE NON-COHESIVE, CLASS 1 OR CLASS 2 PERMEABLE MATERIAL FREE FROM CLAY OR DELETERIOUS MATERIAL. SANDBAGS SHALL BE PLACED ALONG LEVEL CONTOURS AND STACKED AT A MINIMUM OF THREE BAGS HIGH.
2. CONSTRUCT THE LENGTH OF EACH REACH SO THAT THE CHANGE IN BASE ELEVATION ALONG THE REACH DOES NOT EXCEED 1/3 THE HEIGHT OF THE LINEAR BARRIER, IN NO CASE SHALL THE REACH LENGTH EXCEED 50'.
3. THE LAST 8'-0" OF FENCE SHALL BE TURNED UP SLOPE.
4. STAKE DIMENSIONS ARE NOMINAL.
5. STAKES SHALL BE SPACED AT 8'-0" MAXIMUM AND SHALL BE POSITIONED ON DOWNSTREAM SIDE OF FENCE.
6. STAKES TO OVERLAP AND FENCE FABRIC TO FOLD AROUND EACH STAKE ONE FULL TURN. SECURE FABRIC WITH 4 STAPLES.
7. STAKES SHALL BE DRIVEN TIGHTLY TOGETHER TO PREVENT POTENTIAL FLOW-THROUGH OF SEDIMENT AT JOINT. THE TOPS OF THE STAKES SHALL BE SECURED WITH WIRE.
8. FOR END STAKE, FENCE FABRIC SHALL BE FOLDED AROUND TWO STAKES ONE FULL TURN AND SECURED WITH 4 STAPLES
9. MINIMUM 4 STAPLES PER STAKE.
10. JOINING SECTIONS SHALL NOT BE PLACED AT SUMP LOCATIONS.

REV	DATE	DESCRIPTION	BY	APPROVED
C	12/18/07	ISSUED FOR PERMIT APPLICATION	TMH	RVH
B	06/07/07	WORKING DRAFT	TMH	RVH
A	03/07/07	PRELIMINARY DESIGN SUBMITTAL	TMH	RVH

REVISION SUMMARY

SCALE: AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
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PREPARED FOR: Chevron
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padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

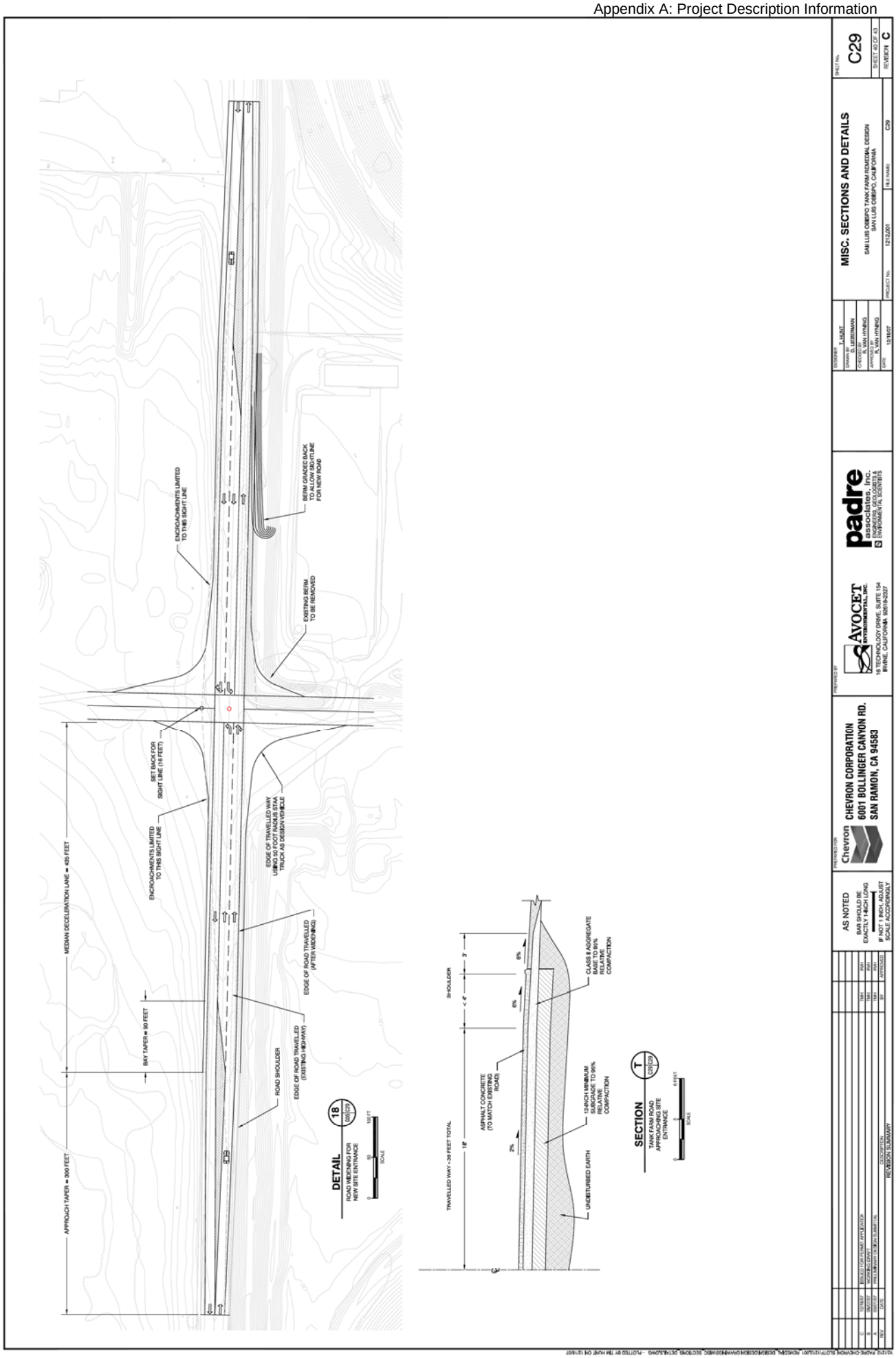
DESIGNER: T. HUNT
DRAWN BY: T. HUNT
CHECKED BY: R. VAN HYNING
APPROVED BY: R. VAN HYNING
DATE: 12/18/07

MISC. SECTIONS AND DETAILS

SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA

PROJECT No. 1212.001 | FILE NAME: C28

SHEET No. C28
SHEET 39 OF 43
REVISION C


APPROACH TAPER = 300 FEET
MEDIAN DECELERATION LANE = 435 FEET
BAY TAPER = 90 FEET
ROAD SHOULDER
EDGE OF ROAD TRAVELLED (EXISTING HIGHWAY)
EDGE OF ROAD TRAVELLED (AFTER WIDENING)
ENCROACHMENTS LIMITED TO THIS SIGHT LINE
SET BACK FOR SIGHT LINE (16 FEET)
EDGE OF TRAVELLED WAY USING 50 FOOT RADIUS STAA TRUCK AS DESIGN VEHICLE
EXISTING BERM TO BE REMOVED
BERM GRADED BACK TO ALLOW SIGHT LINE FOR NEW ROAD
DETAIL 18 C29/C29
ROAD WIDENING FOR NEW SITE ENTRANCE
SCALE
SHOULDER
TRAVELLED WAY - 36 FEET TOTAL
18'
ASPHALT CONCRETE (TO MATCH EXISTING ROAD)
2%
6%
CLASS II AGGREGATE BASE TO 95% RELATIVE COMPACTION
12-INCH MINIMUM SUBGRADE TO 95% RELATIVE COMPACTION
UNDISTURBED EARTH
SECTION T C29/C29
TANK FARM ROAD APPROACHING SITE ENTRANCE
SCALE
AS NOTED
BAR SHOULD BE EXACTLY 1-INCH LONG
IF NOT 1 INCH, ADJUST SCALE ACCORDINGLY
Chevron
CHEVRON CORPORATION
6001 BOLLINGER CANYON RD.
SAN RAMON, CA 94583
PREPARED BY
AVOCET ENVIRONMENTAL, INC.
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padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS
DESIGNER T. ASHBY
DRAWN BY D. GERSTMAN
CHECKED BY R. VAN HYNING
APPROVED BY R. VAN HYNING
DATE 12/18/07
MISC. SECTIONS AND DETAILS
SAN LUIS OBISPO TANK FARM REMEDIAL DESIGN
SAN LUIS OBISPO, CALIFORNIA
PROJECT No. 12112.001
FILE NAME C29
SHEET No. C29
SHEET 40 OF 43
REVISION C
REV DATE DESCRIPTION BY APPROVED
C 12/18/07 ISSUED FOR PERMIT APPLICATION TMH PSH
B 09/07/07 PRELIMINARY ISSUE TMH PSH
A 03/07/07 PRELIMINARY ISSUE TMH PSH
REVISION SUMMARY

Appendix D

Remedial Design Specifications

Appendix E

Earth Materials Specifications

Table E.1

Earth Material Specifications

Chevron San Luis Obispo Tank Farm
San Luis Obispo, California

Screen Size	For Common Earth and Structural Backfill (% Passing)	For Gravel (% Passing)
1"	100	- -
3/4"	75 - 100	100
1/2"	85 - 100	25 - 55
3/8"	68 - 95	22 - 45
#4	50 - 77	18 - 25
#10	40 - 63	12 - 20
#30	30 - 50	5 - 15
#70	15 - 35	0 - 10
#200	5 - 30	0 - 5

Note: Refer to Figures E-1 and E-2 for gradation curves.

V:\1212_Padre-Chevron_SLOTF\1212.001_Remedial_Design\037_1212.001_Gradation_Curve_Common_Earth\08/16/2007

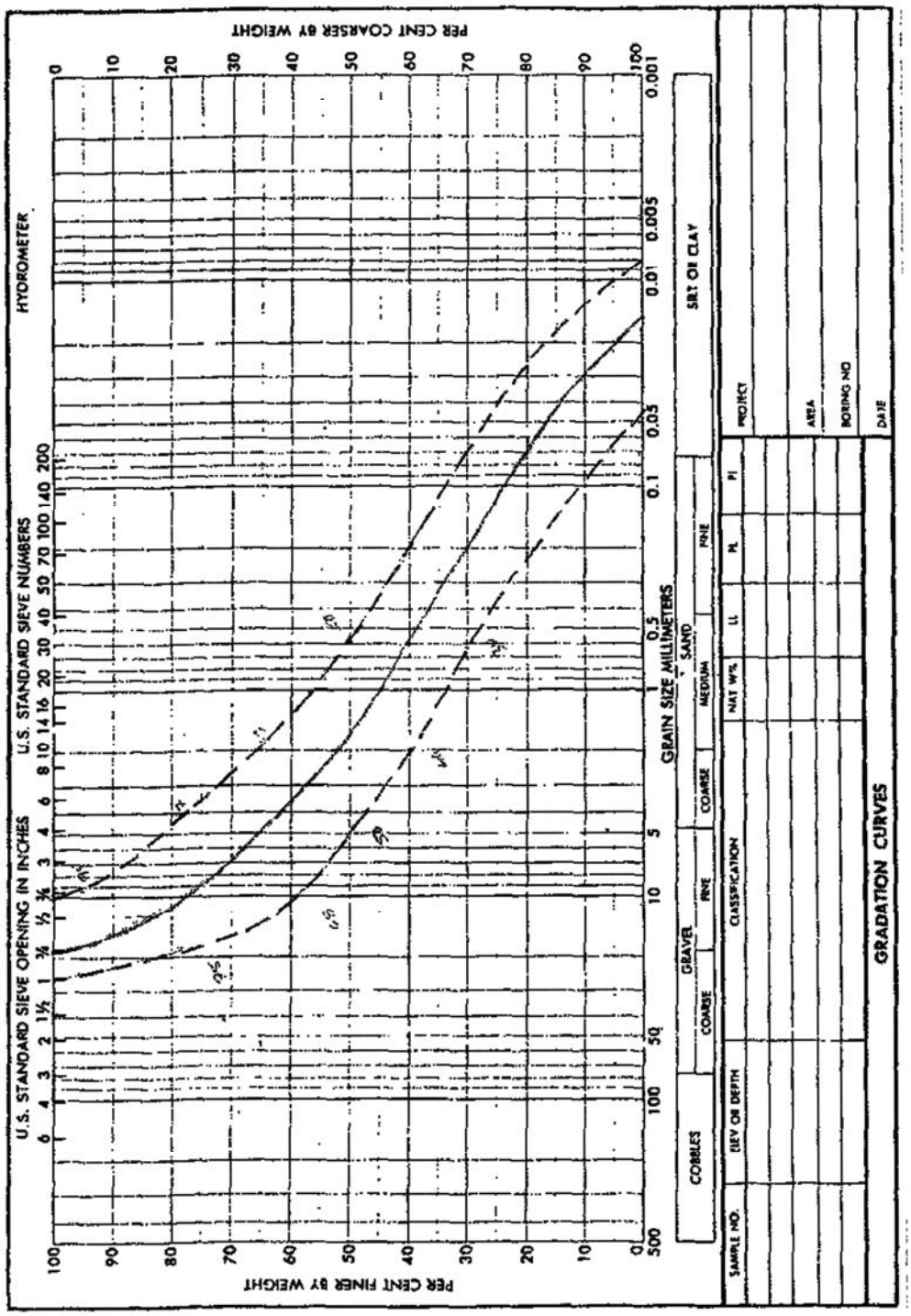


FIGURE E-1

GRADATION CURVE FOR COMMON EARTH AND STRUCTURAL BACKFILL

REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM

PREPARED FOR

CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA

AVOCET ENVIRONMENTAL, INC.

V:\1212_Padre-Chevron_SLOTF\1212.001_Remedial_Design\038_1212.001_Gradation_Curve_Gravel.ai\08/16/2007

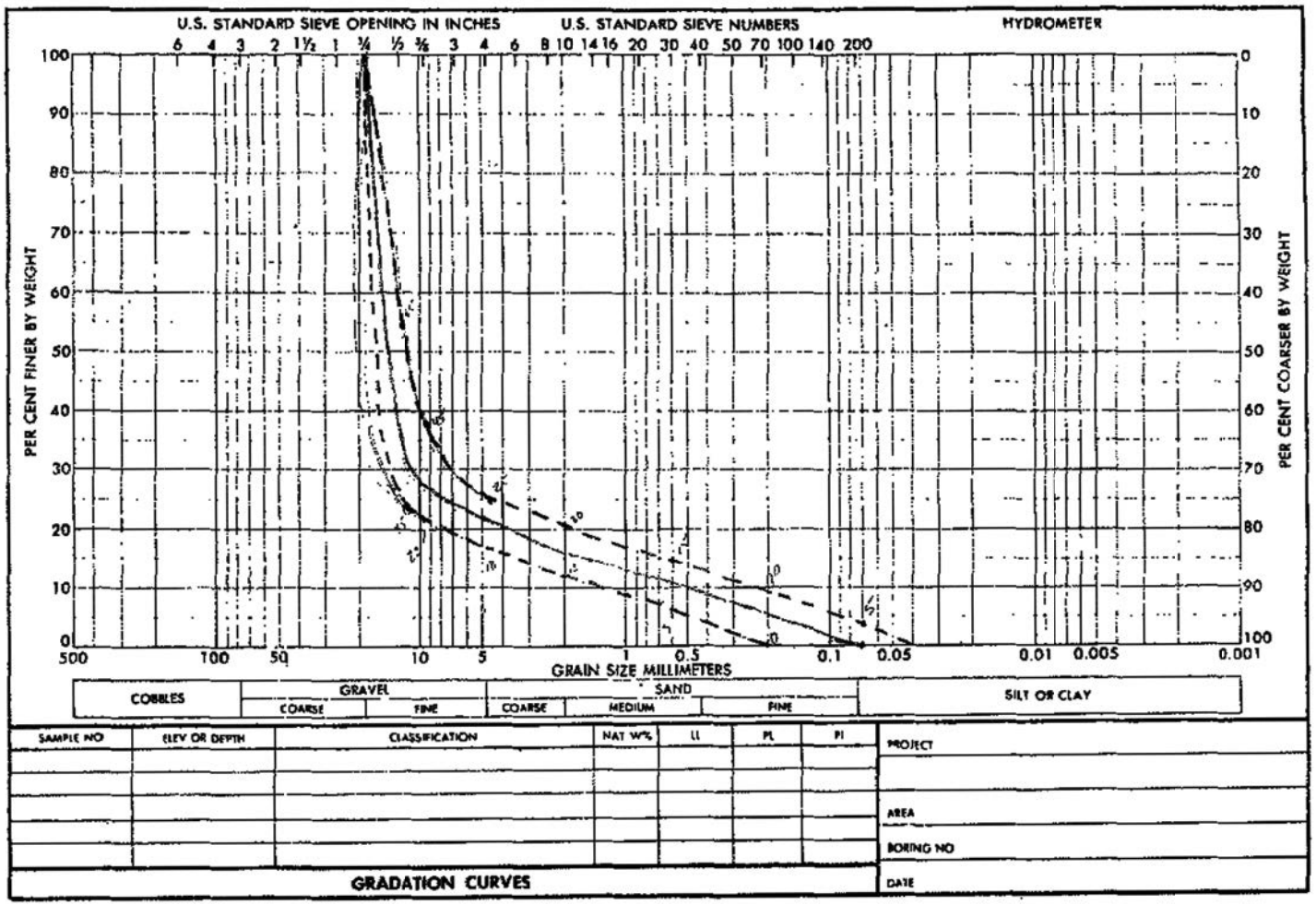


FIGURE E-2

GRADATION CURVE FOR GRAVEL

REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM

PREPARED FOR

CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA

AVOCET ENVIRONMENTAL, INC.

Appendix F

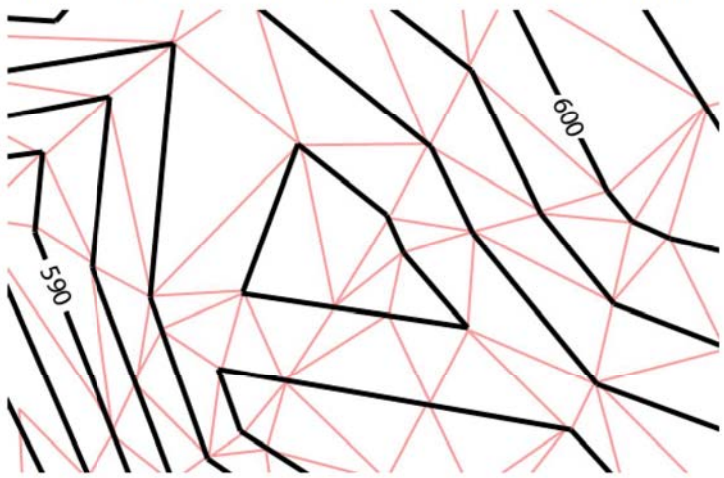
Quantity Calculations

APPENDIX F
QUANTITY CALCULATIONS

This appendix describes the basic assumptions and design parameters used to calculate the earthwork volumes and geosynthetic quantities for each excavation and capping area within the San Luis Obispo Tank Farm.

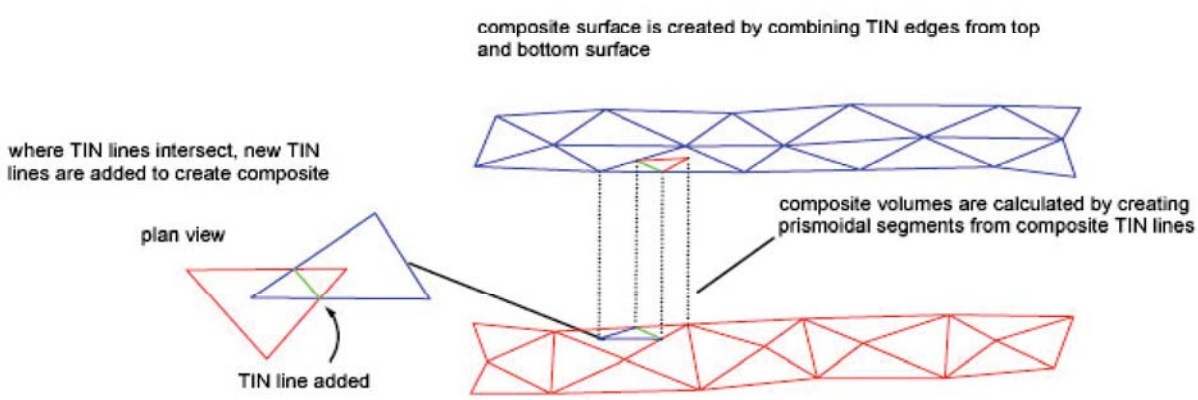
METHODOLOGY

Autodesk's AutoCAD Civil 3D 2008 was used to perform the complex surface area and volume calculations shown on the design drawings and throughout this report. AutoCAD Civil 3D uses a series of contours, as provided by a surveying company, with elevations to generate a Triangular Irregular Network (TIN) 3D surface. A TIN surface is the most common method of interpolating elevation data. The points contained within the contours are connected into triangles that are used to interpolate for intermediate contours, and to generate profiles and cross sections. These triangles are made up of TIN lines.



To create TIN lines, AutoCAD Civil 3D connects the surface points, in this case contour vertices, that are closest together. The elevation of any point in the surface is defined by interpolating the elevations of the vertices of the triangles that the point lies within.

In AutoCAD Civil 3D, volumes are calculated using the Composite Method, which triangulates a new surface based on points from two separate existing surfaces. This method uses the points from both surfaces, as well as any location where the triangle edges between the two surfaces cross. The new composite surface elevations are calculated based on the difference between the elevations of the two surfaces, as shown below:



The Composite Method is the most accurate method for determining earth volume between two surfaces. The accuracy of the Composite Method is limited only by the accuracy of the two TIN surfaces being compared.

SURFACES

Described below are the various surfaces that were generated in AutoCAD Civil 3D and subsequently used in calculating the earthwork volumes for excavations and capping.

Existing Conditions Surface

In order to perform composite volume calculations, it is necessary to create an existing conditions TIN surface. A topographic map, complete with contours assigned at 1-foot elevations, in AutoCAD DWG format was supplied by EDA Design Professionals (EDA) in July 2007 and is representative of conditions at the site on March 2, 2007. Using the contours contained within the topographic map and Autodesk's AutoCAD Civil 3D, an existing conditions TIN surface was created and named "Existing Surface 03022207".

As-Built Reservoir Concrete Floor/Wall Surfaces

Since no historical as-built plans exist for any of the reservoirs, surfaces for Reservoirs 3, 5, and 7 were generated using boring logs from wells and shallow soil borings within each reservoir and cross section details presented in the San Luis Obispo and Stewart Tank Farm Fires report (Prussing, et al., 1926).

Shallow soil borings R5-A through R5-E show concrete and wire debris in Reservoir 5 at approximately 2 feet below ground surface (bgs), with a thickness of approximately 6 inches. With an existing ground surface elevation in Reservoir 5 of around 117.5 to 118 feet, the concrete floor is estimated to be at an elevation of 115.5 feet. The concrete floor and side wall surface was generated using this elevation with a floor diameter of 215 feet and a wall slope of 1:1. According to the San Luis Obispo and Stewart Tank Farm Fires report (Prussing, et al., 1926), the walls extended to an elevation of approximately 23 feet above the concrete floor.

Shallow soil borings R7-A and R7-B show concrete and wire debris in Reservoir 7 at approximately 6 to 12 inches bgs, with a thickness of approximately 6 inches. The existing ground surface elevation within Reservoir 7 is approximately 118 to 118.5 feet. However, the ground elevation within Reservoir 7 has steadily increased over time with the rise and fall of groundwater. The seepage structure boring logs indicate that the concrete floor elevation is approximately 116.5 feet. The concrete floor and side wall surface was generated for Reservoir 7 using an elevation of 116.5 feet, with a floor diameter of 215 feet and a wall slope of 1.5:1. According to the San Luis Obispo and Stewart Tank Farm Fires report (Prussing, et al., 1926), the walls extended to an elevation of approximately 23 feet above the concrete floor.

Reservoir 3 Excavation Surface

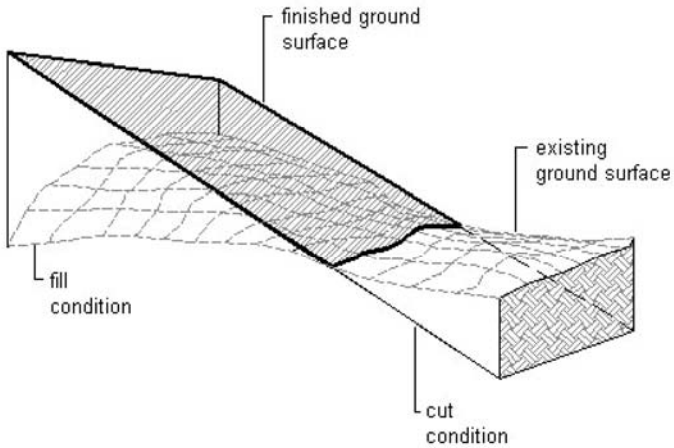
An excavation surface was created for Reservoir 3. The remedial design for Reservoir 3 consists of excavating approximately 2 feet of soil from within the entire reservoir. This excavation surface was created by lowering the existing surface by 2 feet with a diameter of 300 feet and center within the reservoir. The sides were then sloped at 2:1 until daylighting with the existing grade.

Gravel Surfaces

The design for Reservoirs 3, 5, and 7 contain a layer of gravel installed at a specific thickness. A separate top-of-gravel surface was created for each reservoir at an elevation of 133 feet for Reservoir 3, 119.2 feet for Reservoir 5, and 123.5 feet for Reservoir 7. The bottom surface of the gravel layer will be comprised of either an as-built concrete surface in Reservoirs 5 and 7 or an excavation surface in Reservoir 3.

Final Grade Surface

Final grade surfaces for the Northwest Operations Area and Reservoirs 3, 4, 5, and 7 were generated using final grade contours as shown in the design drawings and control lines such as ditches and daylight lines. The resulting surfaces are accurate 3D representations of the design grade.



CALCULATIONS

Described below are the steps taken to generate the required earthwork volumes and geosynthetic area calculations. A summary of the results of these calculations can be found in Tables F.1 and F.2. Supporting AutoCAD Civil 3D surface and volume reports for the Northwest Operations Area and Reservoir 3, 4, 5, and 7 can be found attached to this appendix.

Earthwork Volumes

Northwest Operations Area

The Northwest Operations Area consists of a 4- to 7-foot cap graded to drain into the existing drainage channel along the east side of the Northwest Operations Area. The entire cap will consist of suitable structural backfill material borrowed from other areas onsite or imported from an offsite location. Two surfaces were used in AutoCAD Civil 3D to estimate the total fill volume needed to establish the final design grade. The existing ground surface was used as a base surface and the final grade surface was used as a comparative surface. The resulting comparison of the two surfaces generates the total fill needed to establish the final grade. The surfaces used in this calculation are shown graphically in Figure F-1.

Appendix F
Quantity Calculations

Reservoirs 5 and 7

Reservoirs 5 and 7 consists of excavating down to the existing concrete floor, backfilling with gravel to an elevation of 119.2 feet in Reservoir 5 and 123.5 feet in Reservoir 7, applying a minimum 2-foot cap, and regrading the area to allow for proper drainage. Four surfaces for each reservoir were used in AutoCAD Civil 3D to estimate the total cut, fill, and gravel volumes needed to establish the final design grade. The existing surface was used as a base surface. The reservoir as-built surfaces were then compared against the base surface to establish the amount of soil excavated to reach the existing concrete floor in each reservoir. The top-of-gravel surface consists of a flat surface at an elevation of 119.2 feet for Reservoir 5 and 123.5 feet for Reservoir 7. These surfaces were compared with the reservoir as-built surfaces to establish the volume of gravel needed.

To find the remaining cut-and-fill volumes needed to establish the final grade in each reservoir, the final grade surfaces were compared against the existing surface. The resulting volumes from this comparison do not take into consideration the gravel layers. The difference in the volume of soil excavated to reach the concrete floor and the volume of gravel must be subtracted from the final grade fill volume. This is best illustrated in Figure F-2.

The final grade fill volumes calculated above include all common earth backfill and a 1-foot-thick layer of topsoil, as specified in the design drawings. The topsoil volume is calculated by multiplying the entire total grading area by a 1-foot thickness.

Reservoir 4 and Flower Mound Borrow Area

Reservoir 4 and the Flower Mound Borrow Area consists of regrading the area to provide an adequate rough grade of the Santa Fe Road extension and corresponding Collector Loop while providing a minimum 4-foot cap of clean soil above the Reservoir 4 floor. All roads and the Reservoir 4 cap will consist entirely of suitable structural backfill material. Two surfaces were used in AutoCAD Civil 3D to estimate the cut-and-fill volumes needed to establish the final grade of this area. The existing surface was used as a base surface while the final grade surface was used as a comparative surface. The resulting comparison of the two surfaces generates the total fill needed to establish the final grade. The surfaces used in this calculation are shown graphically in Figure F-3.

Borrow Area 2 Grade Restoration

Borrow Area 2 is located just south of Tank Farm Road on the eastern portion of the site. This borrow area will be used as a source of topsoil for various areas of the site. When borrow is complete the grade in this area will be restored to provide adequate drainage and to support future site development. Two surfaces were used in AutoCAD Civil 3D to estimate the cut-and-fill volumes needed to establish the final grade of this area. The existing surface was used as a base surface, while the final grade surface was used as a comparative surface. The resulting comparison of the two surfaces generates the total fill needed to establish the final grade. The surfaces used in this calculation are shown graphically in Figure F-4.

North Marsh Area

The North Marsh Area consists of excavating to a depth of 3.5 feet, as shown in the design drawings. The volume of soil excavated is calculated by multiplying the total grading area by a 3.5-foot thickness. The topsoil volume is calculated by multiplying the total grading area by a 1-foot thickness. The remaining volume to bring the excavation back to the original grade will be made up of common earth backfill. Figure F-5 shows a typical cross section for this calculation.

Reservoir 3

Reservoir 3 consists of excavating within Reservoir 3 to a depth of approximately 2 feet, backfilling with gravel to a thickness of 1 foot, and backfilling the remaining with common earth fill and a 1-foot thickness of topsoil. Three surfaces were used in AutoCAD Civil 3D to estimate the volume of topsoil, gravel, and soil excavated. The existing surface was used as a base surface. The Reservoir 3 excavation surface was compared in Civil 3D with the base surface to estimate the amount of contaminated soil excavated from within Reservoir 3. The gravel surface was compared with the excavation surface to estimate the volume of gravel needed to establish a 1-foot-thick layer. The topsoil volume is calculated by multiplying the excavation area by a 1-foot thickness. The common earth backfill volume is calculated by subtracting the gravel volume and topsoil volume from the excavation volume. This will bring the excavation back to the original grade. The surfaces used in this calculation are shown graphically in Figure F-6.

Remaining PPSH Areas

The remaining PPSH areas, as shown in Figure F-7, consist of excavating to a depth of 3 feet, as shown in the design drawings. The volume of soil excavated in each area is calculated by multiplying the grading area by a 3-foot thickness. The topsoil volume is calculated by multiplying the grading area by a 1-foot thickness. The remaining volume to bring the excavations back to their original grade will be made up of common earth backfill and can be calculated by subtracting the topsoil volume from the excavation volume for each area. Figure F-4 shows a typical cross section for these calculations.

Geosynthetic Areas

The design of the caps within the Northwest Operations Area and Reservoirs 3, 4, 5, and 7 require the installation of any number of geotextiles, geomembranes, and/or geogrids to achieve the remedial objectives. The geosynthetic material areas were estimated using AutoCAD by drawing the limit of each geosynthetic layer and performing an area command on that limit. The results of these procedures are summarized in Table F.2.

REFERENCES

Prussing, G. F., Hampton, L. C., and Lienesch, C. F., 1926, *San Luis Obispo and Stewart Tank Farm Fires, April 7 to 11, 1926: Union Oil Company of California,* Los Angeles, California, Engineering Department Report Dated November 1, 1926.

Tables

Table F.1
Summary of Earthwork Volumes
Chevron San Luis Obispo Tank Farm
San Luis Obispo, California

Area	Total Grading Area (sf)	Cut (cy)	Common Earth Fill (cy)	Gravel (cy)	Topsoil (cy)	Excess Cut (cy)	Common Earth Borrow Needed (cy)
OU #1 - Northwest Operations Area							
Final Grade	280,300	-	53,400	-	-	-	53,400
OU #2 - Reservoir 5							
Excavate to Existing Concrete Floor	-	15,300	-	-	-	-	-
Gravel Layer	-	-	-	20,100	-	-	-
Final Grade	340,239	38,800	12,500	-	12,600	26,300	-
OU #2 - Reservoir 7							
Excavate to Existing Concrete Floor	-	11,000	-	-	-	-	-
Gravel Layer	-	-	-	39,000	-	-	-
Final Grade	295,939	32,800	24,500	-	11,000	8,300	-
OU #3 - Reservoir 4 and Flower Mound Borrow Area							
Final Grade	2,290,570	401,900	262,800	-	-	139,100	-
Borrow Area 2							
Final Grade	527,389	4,850	57,900	-	-	-	53,050
OU #4 - North Marsh Area							
Final Grade	580,800	75,300	53,800	-	21,500	-	53,800
OU #4 - Reservoir 3							
Excavate to a depth of 2 feet	-	26,700	-	-	-	-	-
Gravel Layer	-	-	-	10,500	-	-	-
Restore Existing Grade	300,161	-	5,100	-	11,100	-	5,100
OU #4 - Remaining PPSH Areas							
Area 1	8,154	900	600	-	300	-	600
Area 2	2,349	300	200	-	100	-	200
Area 3	2,830	300	200	-	100	-	200
Area 4	17,894	2,000	1,300	-	700	-	1,300
Area 5	32,911	3,700	2,500	-	1,200	-	2,500
Area 6	6,005	700	500	-	200	-	500
Area 7	9,588	1,100	700	-	400	-	700
Area 8	29,262	3,300	2,200	-	1,100	-	2,200
Area 9	9,096	1,000	700	-	300	-	700
Area 10	39,831	4,400	2,900	-	1,500	-	2,900
Area 11	8,950	1,000	700	-	300	-	700
Area 12	90,003	10,000	6,700	-	3,300	-	6,700

Total Cut Volume:	635,350	cy
Total Contaminated Soil:	157,000	cy
Total Fill Volume:	489,200	cy
Total Topsoil Borrow Volume:	65,700	cy
Total Common Earth Borrow Volume:	10,850	cy

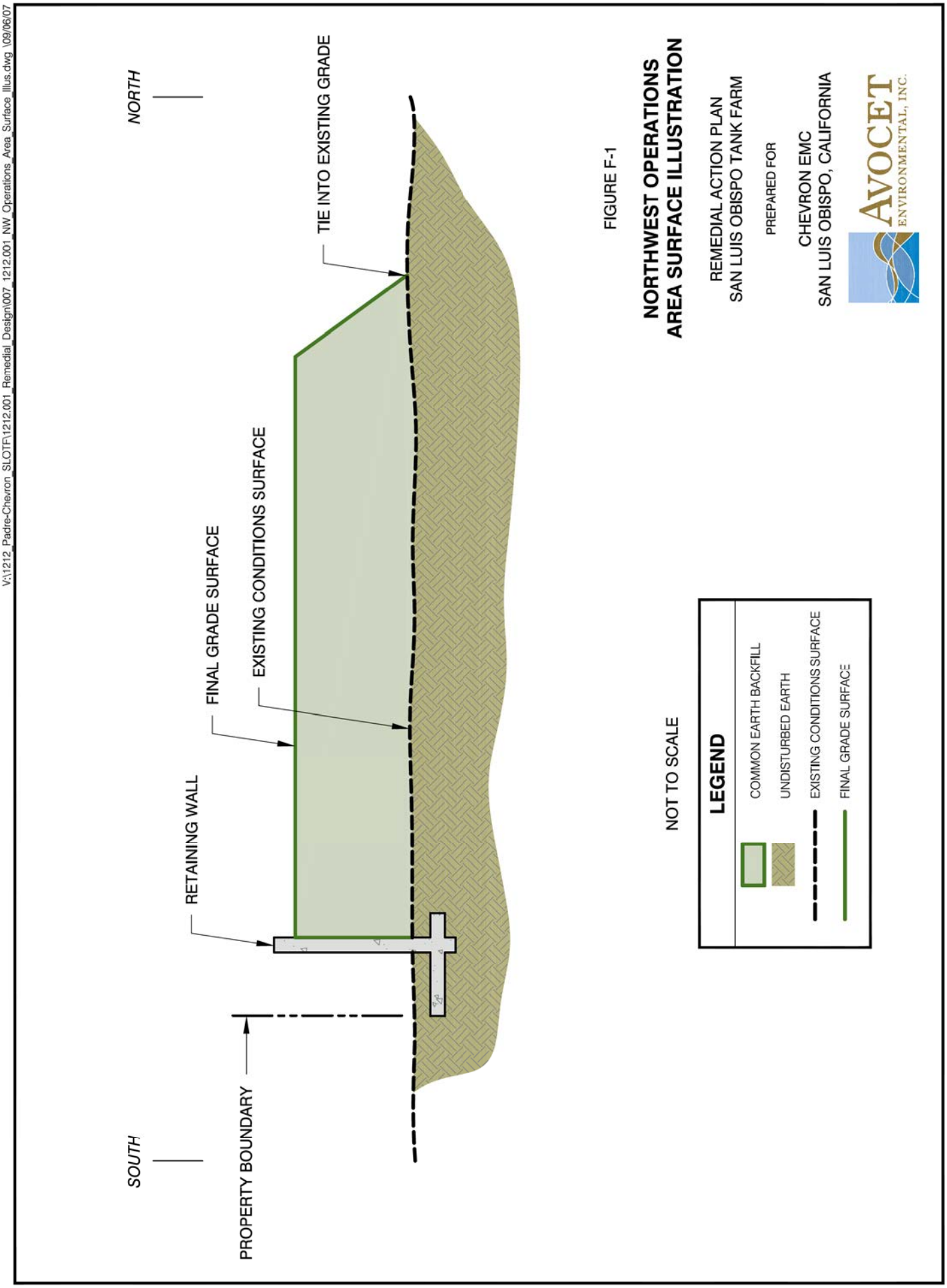
Notes:
(1) The North Marsh Area will be excavated to a depth of 3.5 feet and backfilled with clean soil to restore existing grade.
(2) All remaining PPSH areas will be excavated to a depth of 3 feet and backfilled with clean soil to restore existing grade.
(3) All soil removed from the North Marsh Area and the remaining PPSH Areas will be considered contaminated and disposed of.
(4) All soil removed from within Reservoirs 3, 5, and 7 will be considered contaminated and disposed of.
(5) All soil removed from berms surrounding Reservoirs 3, 5, and 7 is clean and can be used as fill material.
(6) Topsoil volumes are calculated by multiplying the affected grading area by 1 foot.

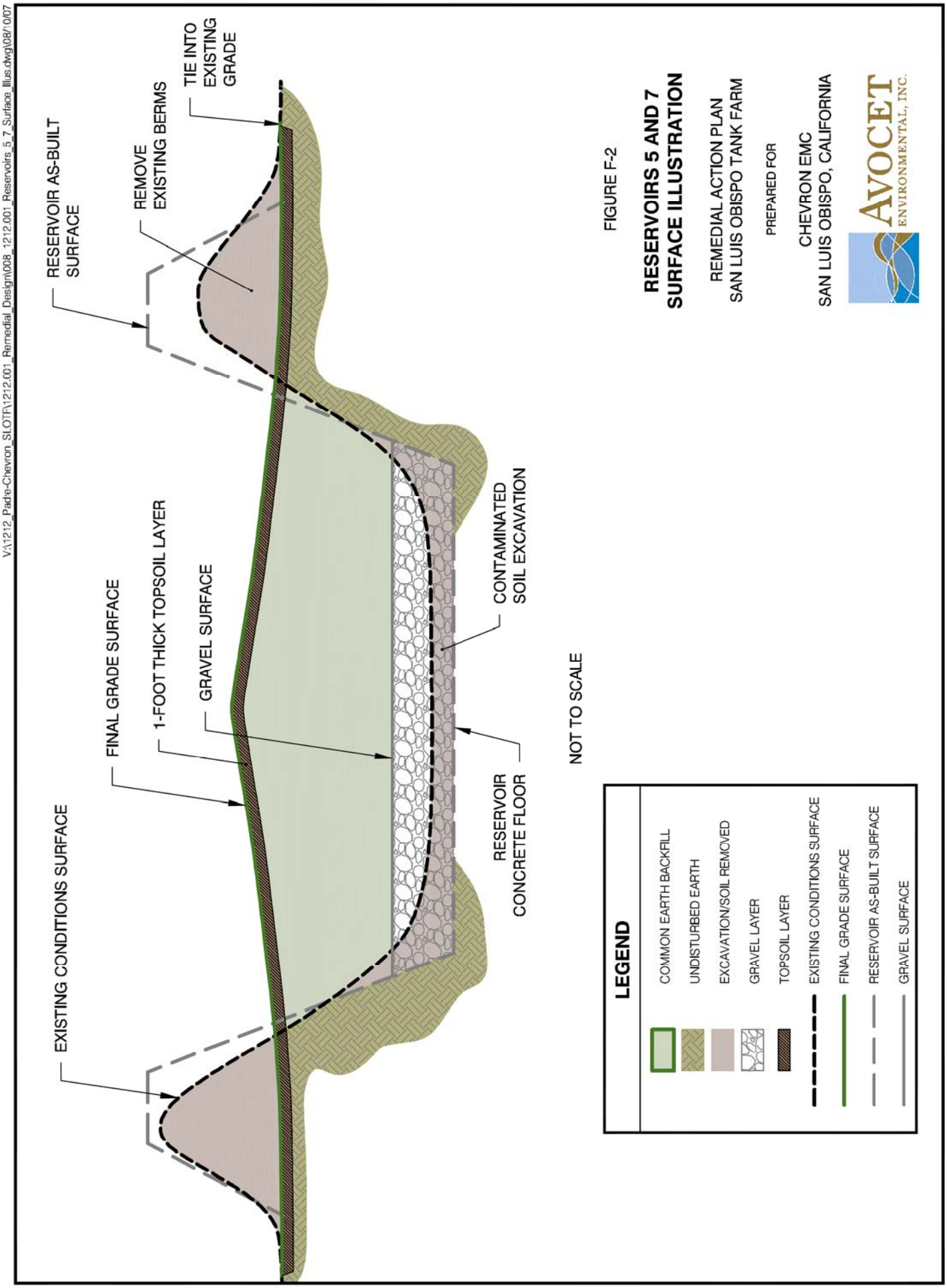
Table F.2
Summary of Geosynthetic Quantities
Chevron San Luis Obispo Tank Farm
San Luis Obispo, California

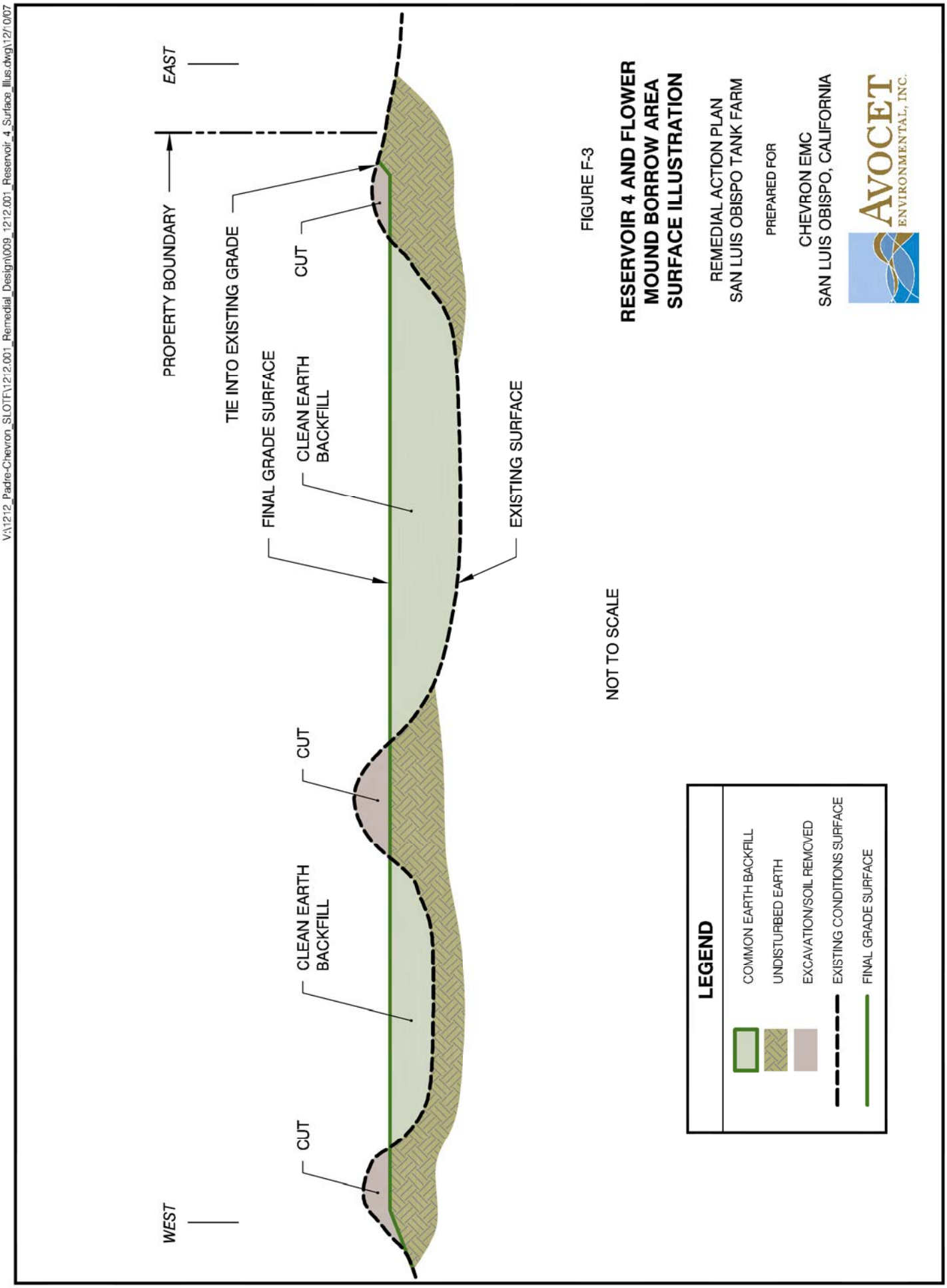
Area	Estimated Areas		Geosynthetics		
	Grading Area (sf)	Work Area[1] (sf)	Geotextile 12oz. (sf)	Geomembrane (sf)	Geogrid (sf)
Northwest Operations Area	-	280,300	280,300	-	-
Reservoir 5	54,100	453,190	54,100	-	-
Reservoir 7	43,800	349,815	160,460	-	-
Reservoir 4	2,290,570	2,290,570	342,886	-	-
North Marsh Area	75,300	678,988	-	-	-
Reservoir 3	26,700	581,436	871,002	290,334	290,334
Remaining PPSH	28,700	155,860	-	-	-
Total	2,519,170	4,790,159	1,708,748	290,334	290,334

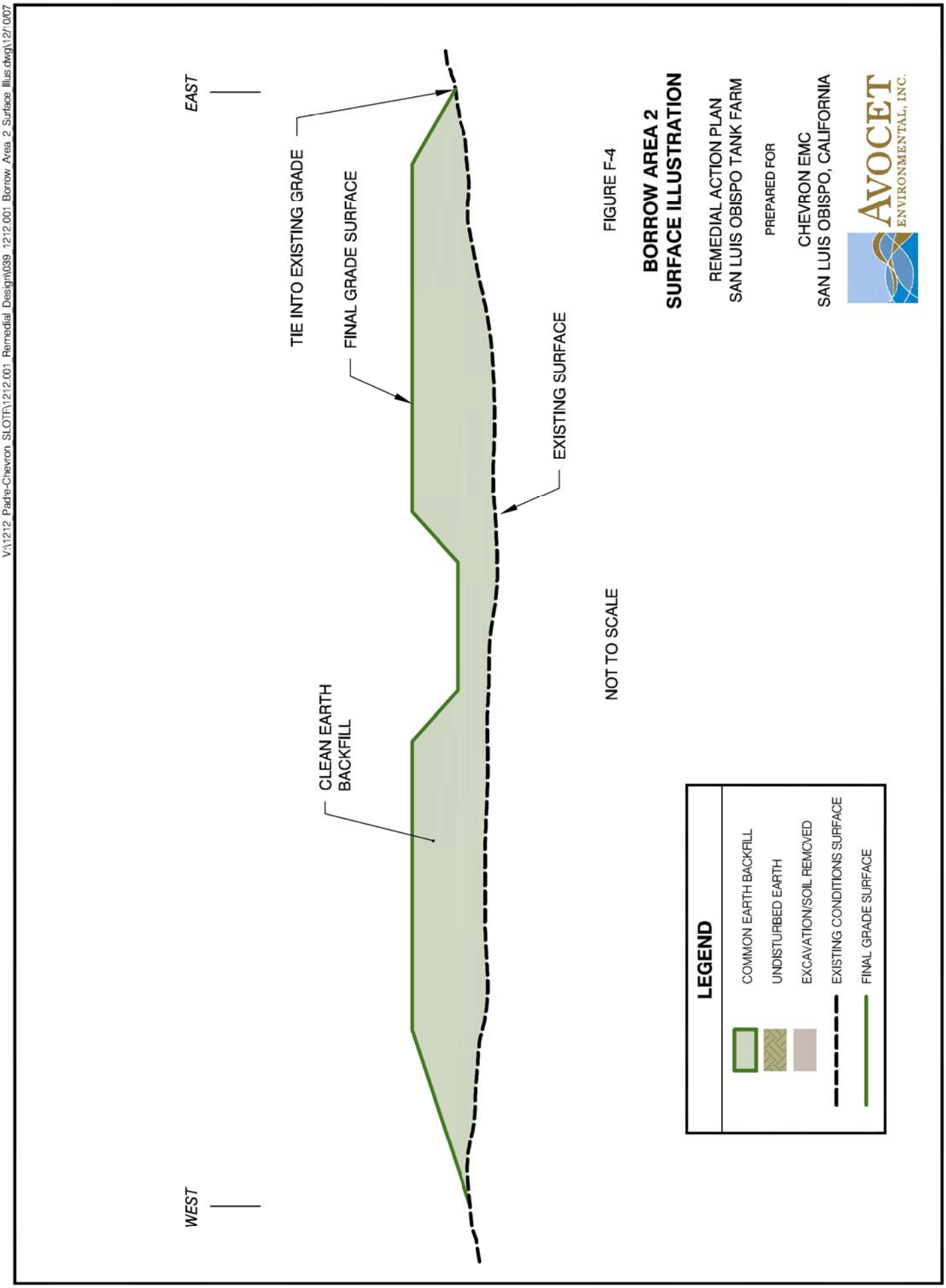
Notes:
(1) The work area includes all the area within the identified clear and grub line.
(2) Some of the work area for Remaining PPSH has already been accounted for in the work areas corresponding to Reservoirs 5, 7, and 3.

Figures

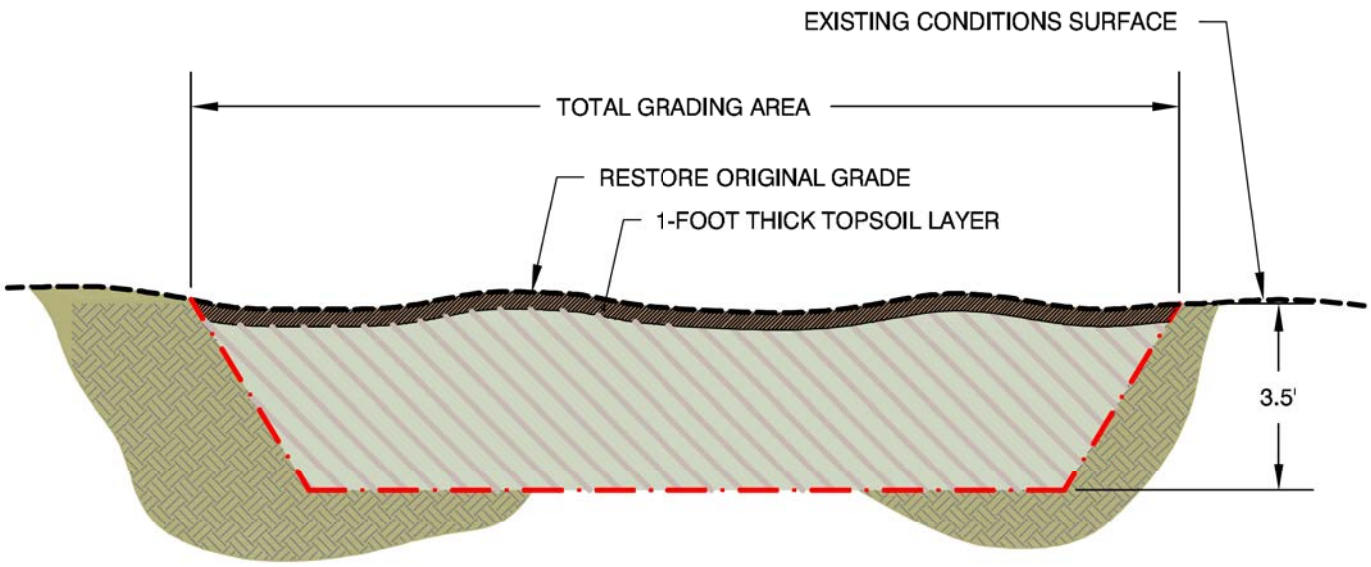

V:\1212_Padre-Chevron_SLOTF\1212.001_Remedial_Design\007_1212.001_NW_Operations_Area_Surface_Illus.dwg \09/06/07
NORTH
SOUTH
TIE INTO EXISTING GRADE
EXISTING CONDITIONS SURFACE
FINAL GRADE SURFACE
RETAINING WALL
PROPERTY BOUNDARY
NOT TO SCALE
LEGEND
COMMON EARTH BACKFILL
UNDISTURBED EARTH
EXISTING CONDITIONS SURFACE
FINAL GRADE SURFACE
FIGURE F-1
NORTHWEST OPERATIONS
AREA SURFACE ILLUSTRATION
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET
ENVIRONMENTAL, INC.


V:\1212_Padre-Chevron_SLOTF\1212.001_Remedial_Design\008_1212.001_Reservoirs_5_7_Surface_Illus.dwg\08/10/07
RESERVOIR AS-BUILT SURFACE
REMOVE EXISTING BERMS
TIE INTO EXISTING GRADE
EXISTING CONDITIONS SURFACE
FINAL GRADE SURFACE
1-FOOT THICK TOPSOIL LAYER
GRAVEL SURFACE
CONTAMINATED SOIL EXCAVATION
RESERVOIR CONCRETE FLOOR
NOT TO SCALE
LEGEND
COMMON EARTH BACKFILL
UNDISTURBED EARTH
EXCAVATION/SOIL REMOVED
GRAVEL LAYER
TOPSOIL LAYER
EXISTING CONDITIONS SURFACE
FINAL GRADE SURFACE
RESERVOIR AS-BUILT SURFACE
GRAVEL SURFACE
FIGURE F-2
RESERVOIRS 5 AND 7 SURFACE ILLUSTRATION
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET ENVIRONMENTAL, INC.


V:\1212_Padre-Chevron_SLOTF\12\2.001_Remedial_Design\009_1212.001_Reservoir_4_Surface_Illus.dwg\12/10/07
WEST
EAST
CUT
CLEAN EARTH BACKFILL
CUT
FINAL GRADE SURFACE
TIE INTO EXISTING GRADE
PROPERTY BOUNDARY
CUT
CLEAN EARTH BACKFILL
EXISTING SURFACE
NOT TO SCALE
LEGEND
COMMON EARTH BACKFILL
UNDISTURBED EARTH
EXCAVATION/SOIL REMOVED
EXISTING CONDITIONS SURFACE
FINAL GRADE SURFACE
FIGURE F-3
RESERVOIR 4 AND FLOWER MOUND BORROW AREA SURFACE ILLUSTRATION
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET
ENVIRONMENTAL, INC.

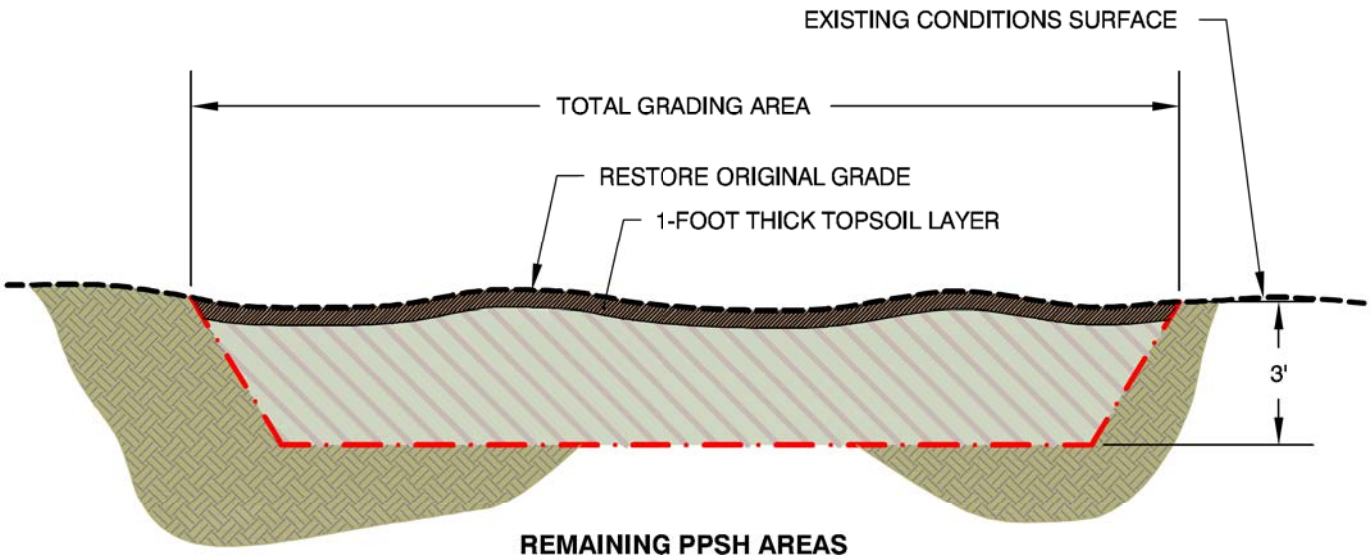

V:\1212_Padre-Chevron_SLOT\1212.001_Remedial_Design\039_1212.001_Borrow_Area_2_Surface_Illus.dwg\12/10/07
EAST
WEST
TIE INTO EXISTING GRADE
FINAL GRADE SURFACE
EXISTING SURFACE
CLEAN EARTH BACKFILL
NOT TO SCALE
LEGEND
COMMON EARTH BACKFILL
UNDISTURBED EARTH
EXCAVATION/SOIL REMOVED
EXISTING CONDITIONS SURFACE
FINAL GRADE SURFACE
FIGURE F-4
BORROW AREA 2
SURFACE ILLUSTRATION
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET
ENVIRONMENTAL, INC.

V:\1212_Padre-Chevron_SLOTF\1212.001_Remedial_Design\010_1212.001_North_Marsh_Remaining_PPSH.dwg\12/ 1/07



NORTH MARSH AREA

NOT TO SCALE



REMAINING PPSH AREAS

NOT TO SCALE

FIGURE F-5

NORTH MARSH AND REMAINING PPSH AREAS EXCAVATION ILLUSTRATION

REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM

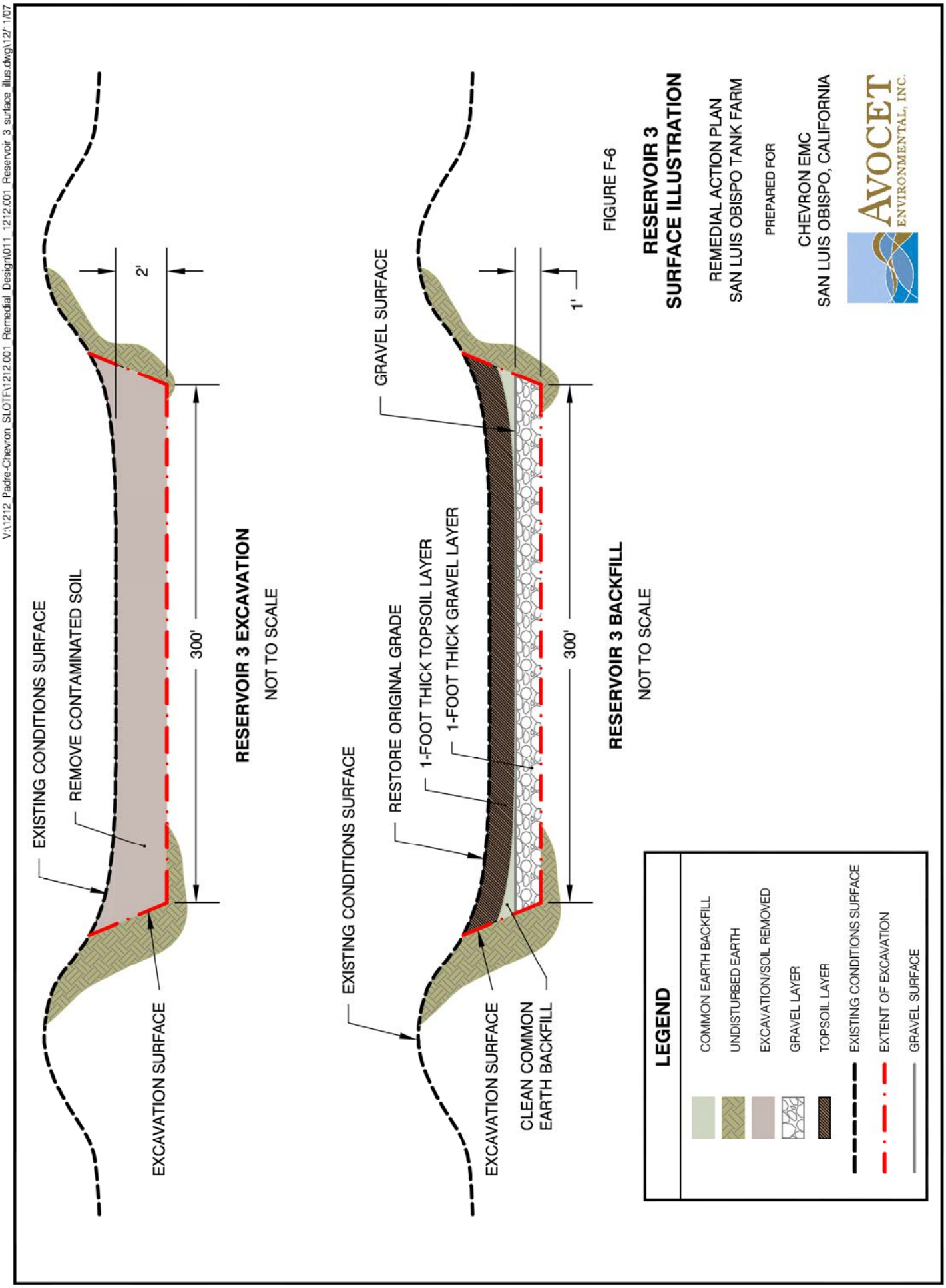
PREPARED FOR

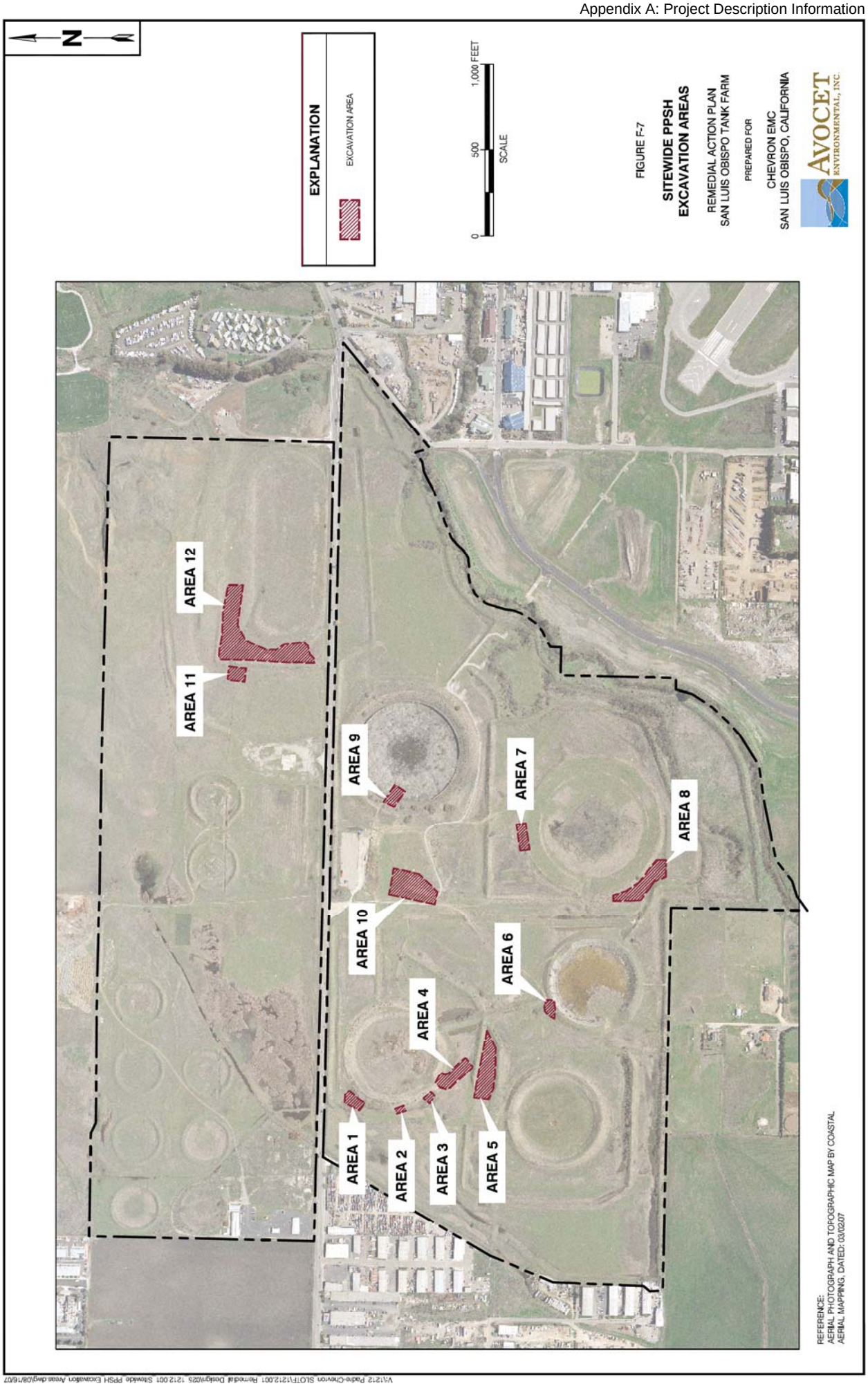
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA

LEGEND

- EXCAVATION AND COMMON EARTH BACKFILL
- UNDISTURBED EARTH
- TOPSOIL LAYER
- EXISTING CONDITIONS SURFACE
- EXTENT OF EXCAVATION

AVOCET ENVIRONMENTAL, INC.


V:\1212_Padre-Chevron_SLOTF\1212.001_Remedial_Design\011_1212.001_Reservoir_3_surface_illus.dwg\12/11/07
EXISTING CONDITIONS SURFACE
REMOVE CONTAMINATED SOIL
2'
300'
EXCAVATION SURFACE
RESERVOIR 3 EXCAVATION
NOT TO SCALE
GRAVEL SURFACE
1'
RESTORE ORIGINAL GRADE
1-FOOT THICK TOPSOIL LAYER
1-FOOT THICK GRAVEL LAYER
EXISTING CONDITIONS SURFACE
300'
EXCAVATION SURFACE
CLEAN COMMON EARTH BACKFILL
RESERVOIR 3 BACKFILL
NOT TO SCALE
LEGEND
COMMON EARTH BACKFILL
UNDISTURBED EARTH
EXCAVATION/SOIL REMOVED
GRAVEL LAYER
TOPSOIL LAYER
EXISTING CONDITIONS SURFACE
EXTENT OF EXCAVATION
GRAVEL SURFACE
FIGURE F-6
RESERVOIR 3
SURFACE ILLUSTRATION
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET
ENVIRONMENTAL, INC.


N
EXPLANATION
EXCAVATION AREA
0
500
1,000 FEET
SCALE
FIGURE F-7
SITEWIDE PPSH
EXCAVATION AREAS
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET
ENVIRONMENTAL, INC.
AREA 1
AREA 2
AREA 3
AREA 4
AREA 5
AREA 6
AREA 7
AREA 8
AREA 9
AREA 10
AREA 11
AREA 12
REFERENCE:
AERIAL PHOTOGRAPH AND TOPOGRAPHIC MAP BY COASTAL
AERIAL MAPPING, DATED: 03/02/07

Attachment 1

Supporting AutoCAD Civil 3D Surface and Volume Reports

Avocet Environmental, Inc.

16 Technology Drive

Suite 154

Irvine, California 92618

Surface Report

Client: Chevron

Project Name: V:\1212_Padre-Chevron_SLOTF\1212.001_Remedial_Design\Design Drawings\Design Calcs\NW-Operations-Volumes.dwg

Project Description:

Report Date: 09/06/07 11:35:35

Prepared by: Tim Hunt

Linear Units: foot	**Area Units:** squareFoot	**Volume Units:** cubicYard

Surface: Operations Area - Final Volume Surface - 07182007
Description: Northwest Operations Area final volume surface dated July 18, 2007.

Area 2D: 280300.6102031059	Area 3D: 281213.10760568734
Elevation Max: 7.643686504977	Elevation Min: -0.440320335244
Number of Points: 7774	Number of Triangles: 14919

Volume Surface: Operations Area - Final Volume Surface - 07182007
Description: Northwest Operations Area final volume surface dated July 18, 2007.

Volume Cut:	Volume Fill:	Volume Total:
0.000000000000	53390.077946314827	53390.077946314827

Compare Surface: Existing Surface - 03022007
Base Surface: Operations Area - Final Grade Surface - 07182007

Report generated by Autodesk LandXML Reporting 7.

Avocet Environmental, Inc.

16 Technology Drive

Suite 154

Irvine, California 92618

Surface Report

Project Name: V:\1212_Padre-Chevron_SLOTF\1212.001_Remedial_Design\Design Drawings\Design Calcs\Reservoir 5 - Volumes.dwg

Report Date: 07/18/07 09:27:27

Client: Chevron

Project Description:

Prepared by: Tim Hunt

Linear Units: foot	**Area Units:** squareFoot	**Volume Units:** cubicYard

Surface: Reservoir 5 - Contaminated Soil Excavation
Description: Excavation of soil within Reservoir 5 down to existing concrete floor.

Area 2D: 193934.54693402283	Area 3D: 203595.96187519847
Elevation Max: 19.825747861717	Elevation Min: -6.201991404459
Number of Points: 6488	Number of Triangles: 12360

Surface: Reservoir 5 - Finished Grade Volume
Description: Reservoir 5 - Remaining finished grade volume.

Area 2D: 340239.92701356544	Area 3D: 346534.70749656321
Elevation Max: 9.097660659431	Elevation Min: -15.107459418148
Number of Points: 29704	Number of Triangles: 58346

Surface: Reservoir 5 - Gravel Volume
Description: Gravel volume.

Area 2D: 148680.82907122048	Area 3D: 150408.79376728993
Elevation Max: 3.7	Elevation Min: 0.139497107859
Number of Points: 413	Number of Triangles: 722

Volume Surface: Reservoir 5 - Contaminated Soil Excavation
Description: Excavation of soil within Reservoir 5 down to existing concrete floor.

Volume Cut: 15341.869902708069	Volume Fill: 13927.03448266136	Volume Total: -1414.835420046672

Compare Surface: Existing Topo - 03022007
Base Surface: Reservoir 5 - Concrete As Built

Volume Surface: Reservoir 5 - Finished Grade Volume

Description: Reservoir 5 - Remaining finished grade volume.

Volume Cut:	Volume Fill:	Volume Total: -
38787.116487914849	29904.865120443148	8882.251367471805

Compare Surface: Existing Topo - 03022007
Base Surface: Reservoir 5 - Final Grade Surface

Volume Surface: Reservoir 5 - Gravel Volume
Description: Gravel volume.

Volume Cut: 0. Volume Fill: 20122.687758696298 Volume Total: 20122.687758696298

Compare Surface: Reservoir 5 - Concrete As Built
Base Surface: Reservoir 5 - Top of Gravel Surface

Report generated by Autodesk LandXML Reporting 7.

Avocet Environmental, Inc.

16 Technology Drive

Suite 154

Irvine, California 92618

Surface Report

Client: Chevron

Project Name: V:\1212_Padre-Chevron_SLOTF\1212.001_Remedial_Design\Design Drawings\Design Calcs\Reservoir 7 - Volumes.dwg

Project Description:

Report Date: 07/18/07 09:28:33

Prepared by: Tim Hunt

Linear Units: foot	**Area Units:** squareFoot	**Volume Units:** cubicYard

Surface: Reservoir 7 - Contaminated Soil Excavation
Description: Excavation of soil within Reservoir 7 down to concrete floor.

Area 2D: 198492.36974211686	Area 3D: 201665.83198307981
Elevation Max: 24.026949481708	Elevation Min: -9.65237145591
Number of Points: 10937	Number of Triangles: 21393

Surface: Reservoir 7 - Finished Grade Volume
Description: Reservoir 7 - Remaining finished grade volume.

Area 2D: 295938.71534802887	Area 3D: 309328.99476780836
Elevation Max: 15.	Elevation Min: -17.03905516446
Number of Points: 59858	Number of Triangles: 118611

Surface: Reservoir 7 - Gravel Volume
Description: Reservoir 7 gravel volume.

Area 2D: 157788.20305195707	Area 3D: 161452.55784327319
Elevation Max: 7.	Elevation Min: -0.979747951403
Number of Points: 342	Number of Triangles: 580

Volume Surface: Reservoir 7 - Contaminated Soil Excavation
Description: Excavation of soil within Reservoir 7 down to concrete floor.

Volume Cut: 10980.236190587395	Volume Fill: 4033.70990187313	Volume Total: -6946.526288714176

Compare Surface: Existing Surface - 03022007
Base Surface: Reservoir 7 - Concrete Surface 07182007

Volume Surface: Reservoir 7 - Finished Grade Volume

Description: Reservoir 7 - Remaining finished grade volume.

Volume Cut:	Volume Fill:	Volume Total:
32770.103039365102	63465.075513084215	30694.972473719103

Compare Surface: Existing Surface - 03022007
Base Surface: Reservoir 7 - Final Grade 07182007

Volume Surface: Reservoir 7 - Gravel Volume
Description: Reservoir 7 gravel volume.

Volume Cut:	Volume Fill:	Volume Total:
14.520043917126	39012.266571308595	38997.746527391464

Compare Surface: Reservoir 7 - Concrete Surface 07182007
Base Surface: Reservoir 7 - Gravel Surface 07182007

Report generated by Autodesk LandXML Reporting 7.

Avocet Environmental, Inc.

16 Technology Drive

Suite 154

Irvine, California 92618

Surface Report

Client: Chevron

Project Name: V:\1212_Padre-Chevron_SLOTF\1212.001_Remedial_Design\Design Drawings\Design Calcs\OU3 and Flower Mound Borrow - Final Grade Design 2 - 121007.dwg

Project Description:

Report Date: 12/14/07 11:15:36

Prepared by: Tim Hunt

Linear Units: foot	**Area Units:** squareFoot	**Volume Units:** cubicYard

Surface: OU #3 FINAL FILL VOLUME SURFACE
Description: Description

Area 2D: 2290570.2877687206	Area 3D: 2323610.4813980283
Elevation Max: 13.884581311551	Elevation Min: -52.376578856082
Number of Points: 242238	Number of Triangles: 480633

Volume Surface: OU #3 FINAL FILL VOLUME SURFACE
Description: Description

Volume Cut: 401904.92586515227	Volume Fill: 262802.93513555586	Volume Total: -139101.99072959385

Compare Surface: Existing Surface 032007
Base Surface: Final Fill Surface North 120407

Report generated by Autodesk LandXML Reporting 7.

Avocet Environmental, Inc.

16 Technology Drive

Suite 154

Irvine, California 92618

Surface Report

Client: Chevron

Project Name: V:\1212_Padre-Chevron_SLOTF\1212.001_Remedial_Design\Design Drawings\Design Calcs\OU3 and Flower Mound Borrow - Final Grade Design 2 - 121007.dwg

Project Description:

Report Date: 12/14/07 12:44:43

Prepared by: Tim Hunt

Linear Units: foot	**Area Units:** squareFoot	**Volume Units:** cubicYard

Surface: Borrow Area #2 - Final Graded Volume - 121407
Description: Description

Area 2D: 527389.3115409232	Area 3D: 534753.59398073517
Elevation Max: 15.258557356178	Elevation Min: -8.
Number of Points: 53920	Number of Triangles: 106334

Volume Surface: Borrow Area #2 - Final Graded Volume - 121407
Description: Description

Volume Cut:	Volume Fill:	Volume Total:
4850.671000244099	57892.249402369685	53041.578402125393

Compare Surface: Existing Surface 032007
Base Surface: Final Fill Surface South 121007

Report generated by Autodesk LandXML Reporting 7.

Avocet Environmental, Inc.

16 Technology Drive

Suite 154

Irvine, California 92618

Surface Report

Client: Chevron

Project Name: V:\1212_Padre-Chevron_SLOTF\1212.001_Remedial_Design\Design Drawings\Design Calcs\Reservoir 3 - Grade.dwg

Project Description:

Report Date: 07/18/07 12:23:39

Prepared by: Tim Hunt

Linear Units: foot	**Area Units:** squareFoot	**Volume Units:** cubicYard

Surface: Reservoir 3 - Contaminated Soil Excavation
Description: Excavation of contaminated soil within Reservoir 3 to a depth of approximately 2 feet.

Area 2D: 300161.88782019395
Area 3D: 301670.35370866081
Elevation Max: 0.128877593457
Elevation Min: -4.727263531242
Number of Points: 15086
Number of Triangles: 29482

Surface: Reservoir 3 - Gravel Volume 07182007
Description: Gravel volume.

Area 2D: 285749.45825121191
Area 3D: 286106.3780675265
Elevation Max: 1.
Elevation Min: -0.205007868991
Number of Points: 3140
Number of Triangles: 4857

Volume Surface: Reservoir 3 - Contaminated Soil Excavation
Description: Excavation of contaminated soil within Reservoir 3 to a depth of approximately 2 feet.

Volume Cut: 26692.926345938169
Volume Fill: 0.406441170979
Volume Total: -26692.519904767123

Compare Surface: Existing Surface 03022007
Base Surface: Reservoir 3 - Excavation Bottom 07182007

Volume Surface: Reservoir 3 - Gravel Volume 07182007
Description: Gravel volume.

Volume Cut: 0.08266511614 Volume Fill: 10536.768451121085 Volume Total: 10536.68578600494

Compare Surface: Reservoir 3 - Excavation Bottom 07182007
Base Surface: Reservoir 3 - Top of Gravel 07182007

Report generated by Autodesk LandXML Reporting 7.

Appendix G

Hydrology Calculations

APPENDIX G
HYDROLOGY CALCULATIONS

This appendix describes the basic assumptions and design parameters used to size the drainage channels for the estimated peak flows for each of the capping areas within the San Luis Obispo Tank Farm.

In general terms, Avocet's approach to drainage-related calculations was as follows:

- Lay out a series of perimeter drains designed to collect the runoff from the proposed covers and intercept runon where required.
- Select two or more design points on each channel and measure the drainage area reporting to each.
- Estimate design flows for each design point using the Rational Method and a 100-year storm event.
- Select an appropriately sized channel section for each design flow using Manning's Equation.

Each of these aspects of the design process is outlined in the following sections.

DESIGN METHODOLOGY

Drainage Control Channels

Drainage control channels for each of the capping areas were first laid out according to the final grading plan and desired flow path. Design points were identified on the drainage channel in order to delineate drainage areas.

Delineation of Drainage Areas

Drainage areas contributing flow to the proposed channels were delineated using the identified design points, final grading plan, and existing topography. Areas contributing flow to a particular channel included capped surfaces as well as the surrounding areas, if applicable.

Design Flows

Runoff from the various drainage areas was estimated using the Rational Method. The Rational Method is based on the formula:

$$Q = C \, x \, i \, x \, A$$

where:

Q = peak discharge in cubic feet per second (cfs)

C = runoff coefficient whose value depends on the characteristics of the drainage area

i = rainfall intensity in inches per hour

A = drainage area in acres

The value of i used in the formula is based on site-specific precipitation data and the time of concentration (t_c). The t_c is defined as the time required for runoff from the most remote part of the drainage area to reach the design point. The t_c consists of two parts:

- The time for overland flow to reach the drainage channel.
- Channel flow time from the point of entry into the channel to the design point.

Because channel flow is much faster, the overland flow time is usually the major portion of t_c. Channel flow times can often be ignored if they are very small compared to overland flow times. Overland flow time is a function of the length of the travel path (L), and the average slope (S). Overland flow times for each of the drainage subareas were estimated using a C value of 0.2, corresponding to a normal terrain with a slope of between 5 to 10 percent (California Department of Transportation, 2003); the L and S values in Table G.1; and using the Kirpich equation for overland flow (Viessman and Lewis, 1996).

$$t_c = 0.0078 \times L^{0.77} \times S^{-0.385}$$

The rainfall intensity is dependent on t_c. If two or more areas drain into the same channel, the higher t_c value is used for calculating i.

All channels are sized for a storm with a return period of 100 years. Accordingly, the 5-minute 100-year storm was used for the peak flow calculations.

Since short-duration precipitation data are not available for the Paso Robles area, the 5-minute 100-year storm intensity was calculated by applying the relevant storm ratio of 0.315 provided in the *Short Duration Rainfall Frequency Relations for California* publication (Frederick and Miller, 1979) to the 1-hour 100-year rainfall intensity value obtained from the National Oceanic & Atmospheric Administration (NOAA) Atlas 2 rainfall duration curves. Based on these NOAA curves, the 1-hour 100-year rainfall intensity for the Paso Robles is approximately 1.5 inches per hour (in/hr). This intensity value was divided by the 0.315 to obtain the respective 5-minute 100-year rainfall intensity values. This translates to an i value of 4.76 in/hr for the 5-minute storm.

The peak flows were estimated using the corresponding C, A, and i values from the Rational Method formula mentioned above.

Channel Sizing

This peak flow was then used to size the channel width and depth using Manning's formula.

$$Q = (1.49 \times A \times R^{2/3} \times S^{1/2}) / n$$

where:

Q = peak discharge in cfs
A = cross section of the channel in square feet
R = hydraulic radius = area/wetted perimeter
S = slope in feet per feet
n = Manning's Roughness Coefficient

The length of the channel and the corresponding slope were obtained from the corresponding final grading plan. Avocet assumed that all of the drainage control channels will have a shallow "V" section. Furthermore, Avocet assumed that the channels would feature a rough concrete lining. A Manning's roughness coefficient (n) of 0.025 was used for most of the channels classified under "bare earth, straight, uniform channel in fair condition" and 0.015. An n value of 0.015 was used when the channel proposed was an unfinished concrete channel (U.S. Department of Transportation, 2001). Since A and R are dependent on the width and depth, an iterative approach was then used to size a channel to handle a particular Q. The width and depth were varied until the required Q was obtained.

NORTHWEST OPERATIONS AREA

Proposed Drainage Control Channels

The principal drainage control structure for the capped northwest operations area will be the perimeter drain system shown in Figure G-1. The perimeter drain system will intercept runoff from the capped surface. Since the cap is raised over the existing ground surface, no runon is anticipated to enter the perimeter drain.

For drainage calculation purposes, the capped area was divided into ten drainage subareas, Subareas A through J. The locations of Subareas A through J are shown in Figure G-1. The boundaries of the subareas were selected based on topography and the locations of the design points on the proposed drainage channels. The areas occupied by the drainage subareas are summarized in Table G.1.

The perimeter drain system will consist of several segments:

- northwestern corner (NW-1) to intercept runoff from Subarea A
- northern side (NW-2) to intercept runoff from Subarea B
- north-northeastern side (NW-3) to intercept runoff from Subareas B and C
- eastern side (NW-4) to intercept runoff from Subarea D
- southeastern corner (NW-5) to intercept runoff from Subarea E
- southern side (NW-6) to intercept runoff from Subarea F
- southwestern corner (NW-7) to intercept runoff from Subarea G
- west-northwestern side (NW-8) to intercept runoff from Subarea H

- western side (NW-9) to intercept runoff from Subarea I
- west-southwestern side (NW-10) to intercept runoff from Subarea J
- Drain NW-11 to handle the combined flows from Subareas A and H
- Drain NW-12 to handle the combined flows from Subareas B, C, and D
- Drain NW-13 to handle the combined flows from Subareas E and F
- Drain NW-14 to handle the combined flows from Subareas G, I, and J

Drains NW-12 and NW-13 will discharge into the adjoining drainage channel. Drains NW-11 and NW-14 will discharge into the adjoining property to the west.

Design Flows

The areas and times of concentration corresponding to the drainage subareas are summarized in Table G.1. The overland flow times, summarized in Table G.1, range from 1.94 minutes for Subarea F to 4.41 minutes for Subareas B and C. Based on the calculated times of concentration, all of the channels were designed for estimated peak flows using a 5-min 100-year storm intensity value. The proposed widths and depths of the channels are summarized in Table G.2, along with a summary of the calculations.

DRAINAGE FOR RESERVOIR 5

Proposed Drainage Control Channels

The principal drainage control structure for capped Reservoir 5 will be the perimeter drain system shown in Figure G-2. The perimeter drain system will essentially be provided along the right half of the circular reservoir and will intercept runoff from the capped surface and runoff from adjoining areas with higher elevations.

For drainage calculation purposes, the capped area was divided into two drainage subareas, Subareas A and B, as shown in Figure G-2. The boundaries of the subareas were selected based on topography and the locations of the design points on the proposed drainage channels. The areas occupied by the two drainage subareas are summarized in Table G.1.

The perimeter drain system will consist of two segments along the:

- north-northeastern quadrant (R5-1) to intercept runoff from Subarea A
- south-southeastern quadrant (R5-2) to intercept runoff from Subarea B

Drain R5-1 will discharge into the adjoining natural drainage channel along the northwestern corner via an energy dissipator. R5-2 will discharge into the adjoining natural drainage channel along the southwest corner via an energy dissipator.

Design Flows

The areas and time of concentration corresponding to the drainage subareas are summarized in Table G.1. The overland flow times, summarized in Table G.1, range from 2.5 minutes for Subarea B to 4.6 minutes for Subarea A. Based on the calculated times of concentration, both channels were designed for estimated peak flows using a 5-min 100-year storm intensity value. The proposed widths and depths of the three channels are summarized in Table G.2, along with a summary of the calculations.

DRAINAGE FOR RESERVOIR 7

Proposed Drainage Control Channels

The principal drainage control structure for capped Reservoir 7 will be the perimeter drain system shown in Figure G-3. The perimeter drain system will essentially be provided along two-thirds of the circular reservoir and will intercept runoff from the capped surface and runoff from adjoining areas with higher elevations.

For drainage calculation purposes, the capped area was divided into two drainage subareas, Subareas A and B, as shown in Figure G-3. The boundaries of the subareas were selected based on topography and the locations of the design points on the proposed drainage channels. The areas occupied by the two drainage subareas are summarized in Table G.1.

The perimeter drain system will consist of two segments:

- drain along the northern third (R7-1) to intercept runoff from Subarea A
- drain along the eastern third (R7-2) to intercept runoff from Subarea B

Drain R7-1 will discharge into the adjoining natural drainage channel along the western side via an energy dissipator. R7-2 will discharge into the adjoining natural drainage channel along the southern side via an energy dissipator.

Design Flows

The areas and time of concentration corresponding to the drainage subareas are summarized in Table G.1. The overland flow times, summarized in Table G.1, range from 1.8 minutes for Subarea B to 2.4 minutes for Subarea A. Based on the calculated times of concentration, both channels were designed for estimated peak flows using a 5-min 100-year storm intensity value. The proposed widths and depths of the three channels are summarized in Table G.2, along with a summary of the calculations.

DRAINAGE FOR OU#3 AND FLOWER MOUND BORROW AREA

Proposed Drainage Control Channels

The principal drainage control structure for this area will be the drain system adjoining the proposed roads shown in Figure G-4. The drain system will intercept runoff from the capped surface and some runon from an elevated area to the northwest of the regraded area.

For drainage calculation purposes, the graded area was divided into 12 drainage subareas, Subareas A through L. The locations of Subareas A through L are shown in Figure G-4. The boundaries of the subareas were selected based on topography and the locations of the design points on the proposed drainage channels. In essence, each subarea drains to one of the design points. However, some design points receive runoff from two or more drainage subareas. The areas occupied by the 12 drainage subareas are summarized in Table G.1.

The drain system will consist of several segments:

- Drain ED-1 to intercept runoff from Subarea A
- Drain ED-2 to intercept runoff from Subarea B
- Drain ED-3 to intercept runoff from Subarea C
- Drain ED-4 to handle combined flow from Subareas A, B, C, and D
- Drain ED-5 to intercept flow from Subarea E
- Drain ED-6 to handle combined flow from Subareas A, B, C, D, E, and F
- Drain ED-7 to intercept flow from Subarea G
- Drain ED-8 to intercept flow from Subarea H
- Drain ED-9 to intercept flow from Subarea L
- Drain ED-10 to handle combined flows from Subareas I and L
- Drain ED-11 to handle combined flows from Subareas A, B, C, D, E, F, and J
- Drain ED-12 to handle combined flows from Subareas G, H, and K

Drains ED-1, ED-2, and ED-3 will combine to drain into ED-4. Drains ED-4 and ED-5 will discharge into Drain ED-6, which will flow along the northern edge of Tank Farm Road and discharge into Drain ED-11. Drains ED-7 and ED-8 will combine to discharge into Drain ED-12. Drain ED-9 will merge into Drain ED-10. Drains ED-10, ED-11, and ED-12 will all flow into a small basin prior to overflowing into the adjoining wetland areas (Figure G-4). The basin has been provided to reduce the flow velocity and help settle out any possible suspended sediment.

Design Flows

The areas and time of concentration corresponding to the drainage subareas are summarized in Table G.1. The overland flow times, summarized in Table G.1, range from 1.9 minutes for Subarea I to 11.2 minutes. Based on the calculated times of concentration, all of the channels were designed using a 5-min 100-year storm intensity value. In order to be conservative, the time associated with the flow within the channels was ignored. The channels were designed for

the estimated peak flows. The proposed widths and depths of the channels are summarized in Table G.2, along with a summary of the calculations.

Change in Hydrological Condition

As shown in Figure G-5, most of the runoff from OU#3 and the Flower Mound Borrow Area (approximately 43.9 acres) flowed towards the west and discharged into the existing wetland area. Based on the longest flow path and equations provided in the Waterway Management Plan, Drainage Design Manual (County of San Luis Obispo, 2003), peak flows of approximately 54, 60, and 67 cubic feet per second (cfs) were estimated for 25-year, 50-year, and 100-year storm events, respectively. Peak flow rates were also estimated for the proposed grading. Based on the longest flow path shown in Figure G-5, peak flows of approximately 42, 45, and 51 cfs were estimated for 25-year, 50-year and 100-year storm events, respectively (Tables G.3 and G.4). Hence, the proposed grading of this area causes a reduction in peak flows entering the wetland area to the west. The reduced flows are due to the longer flow path and time of concentration.

DRAINAGE FOR BORROW AREA NO. 2

Proposed Drainage Control Channels

The principal drainage control structure for Borrow Area No. 2, will be the drain system shown in Figure G-6. The drain system will intercept runoff from the graded surface and some runon from the southern half of Tank Farm Road.

For drainage calculation purposes, the graded area was divided into seven drainage subareas, Subareas A through G. The locations of Subareas A through G are shown in Figure G-6. The boundaries of the subareas were selected based on topography and the locations of the design points on the proposed drainage channels. In essence, each subarea drains to one of the design points. However, some design points receive runoff from two or more drainage subareas. The areas occupied by the seven drainage subareas are summarized in Table G.1.

The drain system will consist of several segments:

- Drain BA-1 to intercept runoff from Subarea A
- Drain BA-2 to intercept runoff from Subarea B
- Drain BA-3 to handle combined flows from Subareas B and C
- Drain BA-4 to intercept flow from Subarea D
- Drain BA-5 to intercept flow from Subarea E
- Drain BA-6 to handle combined flow from Subareas B, C, and D
- Drain BA-7 to intercept flow from Subarea F
- Drain BA-8 to handle combined flow from Subareas F and G

Drains BA-1 and BA-5 will intercept runoff from their corresponding subareas and discharge into adjoining natural channels. Drains BA-2, BA-3, and BA-4 will combine to drain into BA-6,

which will discharge into an existing natural channel to the south. Drain BA-7 will merge into BA-8, which will also discharge into an existing natural channel to the south.

Design Flows

The areas and time of concentration corresponding to the drainage subareas are summarized in Table G.1. The overland flow times, summarized in Table G.1, range from 0.2 minute for Subarea I to 2.2 minutes. Based on the calculated times of concentration, all of the channels were designed using a 5-min 100-year storm intensity value. In order to be conservative, the time associated with the flow within the channels was ignored. The channels were designed for the estimated peak flows. The proposed widths and depths of the channels are summarized in Table G.2, along with a summary of the calculations.

Change in Hydrological Condition

In its existing condition, runoff from Borrow Area No. 2 formed localized pools of water along the eastern half, whereas runoff from the western half flowed in the southwestern direction into a pool along the southern boundary. Since there is a berm along the southern boundary of the property, runoff never enters into the adjoining East Fork of the San Luis Obispo Creek. Based on the proposed grading plan, most of the eastern half of this area will drain into the Creek through Ditches BA-6 and BA-8 (Figure G-6). Although this area is not very large (2.9 acres), the combined peak flows from both ditches resulting from 25-year, 50-year, and 100-year storm events are estimated to be approximately 4.1, 4.7, and 5.1 cfs, respectively (Tables G.3 and G.4). These flows are considered insignificant in comparison to the capacity of the existing creek.

OFFSITE RUNON

Runon from the offsite area to the west of the Northwest Operations Area will flow into the drainage channel along the southern edge of the capped Northwest Operations Area. Approximately 34 acres of cultivated land to the west of the Northwest Operations Area would contribute flow to the onsite channel. Due to presence of an access road, this flow would be directed into the onsite channel via culvert pipes.

Design Flows

The areas and time of concentration corresponding to the offsite area is summarized in Table G.1. The overland flow time was calculated to be approximately 29 minutes. Accordingly, a 30-min 100-year storm intensity value was used. This was obtained using the same method described above but using a ratio of 0.729. To handle the peak runon flow, two 18-inch-diameter storm drains will be provided to direct the runon into the drainage channel. A summary of the calculations is provided in Table G.2

FLOOD VOLUME ANALYSIS

As discussed in Section 2.2 of the report, the Northwest Operations Area portion of the site is within the 100-year flood plain of Tank Farm Creek. The floodplain contour in this area is assumed to be 122 feet above mean sea level (amsl), as shown in Figure G-7). Since the lowest ground elevation in this area is approximately 120 feet amsl, construction of the pad is anticipated to locally remove approximately 12.4 acre-feet of flood storage capacity, corresponding to about 2 feet of cap over 6.2 acres. This displaced volume is highlighted in Figure G-7.

It is estimated, however, that further downstream (south of Tank Farm Road), there is some storage capacity available. As shown in Figure G-7, there is a berm along the southwest corner of the property. The top of this berm is at approximately 199 feet amsl. Although the floodplain is shown to encroach into this area within the property, it is obvious that the berms will prevent that from occurring, thereby providing additional storage capacity within the property. This additional storage capacity was estimated by calculating the volume between the 118 feet amsl contour (1 foot below the top of the berm) and the existing ground, as shown in Figure G-7. This translates to approximately 27.9 acre-feet of storage capacity available. Hence a sufficient capacity is available to accommodate the displaced volume due to the cap in the Northwest Operations Area.

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Tables

Table G.1
Drainage Subarea Summary
Chevron San Luis Obispo Tank Farm
San Luis Obispo, California

$$t_c = 0.0078\ L^{0.77}\ S^{-0.385}$$ **Kirpich Equation**

Drainage Subarea	Area (sf)	Area (acres)	Highest Elevation (feet MSL)	Lowest Elevation (feet MSL)	Elevation Difference (feet)	Maximum Slope Length (L) (feet)	Average Slope (S)	Maximum Overland Flow Time (t_c) (minutes)
Northwest Area								
A	3,280	0.08	127.0	126.1	0.9	130	0.0069	2.25
B	52,122	1.20	127.5	125.5	2.0	180	0.0111	2.40
C	37,256	0.86	127.0	123.7	3.3	360	0.0092	4.41
D	32,972	0.76	127.0	123.7	3.3	360	0.0092	4.41
E	15,304	0.35	127.0	124.0	3.0	310	0.0097	3.85
F	75,332	1.73	127.5	124.0	3.5	180	0.0194	1.94
G	9,310	0.21	127.0	125.2	1.8	180	0.0103	2.48
H	5,832	0.13	127.0	126.5	0.5	130	0.0042	2.73
I	11,144	0.26	127.5	126.0	1.5	140	0.0107	2.01
J	18,172	0.42	127.5	125.0	2.5	180	0.0139	2.21
Reservoir 5								
A	186,760	4.29	136.0	121.0	15.0	616	0.0244	4.58
B	77,900	1.79	129.0	125.5	3.5	222	0.0158	2.47
Reservoir 7								
A	98,354	2.26	133.0	124.0	9.0	290	0.0310	2.34
B	80,909	1.86	133.0	124.0	9.0	219	0.0411	1.69
OU#3 And Flower Mound Borrow Area								
A	35,090	0.81	164.0	160.0	4.0	860	0.0047	11.21
B	27,476	0.63	164.0	160.0	4.0	515	0.0078	6.20
C	83,424	1.92	171.0	161.0	10.0	600	0.0167	5.20
D	193,098	4.43	171.0	158.0	13.0	715	0.0182	5.75
E	152,012	3.49	160.0	148.0	12.0	600	0.0200	4.85
F	330,142	7.58	159.0	146.0	13.0	970	0.0134	8.18
G	517,026	11.87	160.0	145.0	15.0	890	0.0169	7.01
H	44,326	1.02	162.0	157.0	5.0	200	0.0250	1.91
I	329,410	7.56	164.0	135.0	29.0	560	0.0518	3.19
J	34,757	0.80	141.0	130.0	11.0	280	0.0393	2.08
K	118,570	2.72	144.0	136.0	8.0	650	0.0123	6.21
L	287,140	6.59	171.0		171.0	650	0.2631	1.91

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Table G.1
Drainage Subarea Summary
Chevron San Luis Obispo Tank Farm
San Luis Obispo, California

$$t_c = 0.0078\ L^{0.77}\ S^{-0.385}$$ **Kirpich Equation**

Drainage Subarea	Area (sf)	Area (acres)	Highest Elevation (feet MSL)	Lowest Elevation (feet MSL)	Elevation Difference (feet)	Maximum Slope Length (L) (feet)	Average Slope (S)	Maximum Overland Flow Time (t_c) (minutes)
Borrow Area 2								
A	40,535	0.93	149.0	147.0	2.0	100	0.0200	1.22
B	36,475	0.84	149.0	147.0	2.0	130	0.0154	1.65
C	67,391	1.55	149.0	145.5	3.5	200	0.0175	2.19
D	4,898	0.11	149.0	147.5	1.5	50	0.0300	0.61
E	26,222	0.60	149.0	146.0	3.0	175	0.0171	1.99
F	27,266	0.63	151.0	147.0	4.0	25	0.1600	0.19
G	32,596	0.75	151.0	145.0	6.0	30	0.2000	0.20
Offsite Runon								
A	1,466,404	33.66	129.5	121.5	8.0	2,376	0.0034	27.77

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Table G.2
Channel Size Selection
Chevron San Luis Obispo Tank Farm
San Luis Obispo, California

Channel Segment	Channel Length (feet)	Highest Elevation (feet)	Lowest Elevation (feet)	Average Channel Slope (*S*)	Contributing Drainage Subareas	Total Drainage Area (acres)	Time of Conc. (minutes)	Design Storm	Rainfall Intensity (*i*) (in/hr)	*C* Value	Peak Design Flow (cfs)	Proposed Channel							
												Width (feet)	Depth (feet)	Area (*A*)	Wetted Perimeter (*P*)	Hydraulic Radius (*R*)	Type	Flow Capacity (cfs)	Anticipated Flow Velocity[1] (fps)
Northwest Area																			
NW-1	50	126.2	126.1	0.0012	A	0.08	2.25	5 min/100 yr	4.76	0.20	0.07	2.00	0.50	0.50	1.41	0.35	Earthen	0.57	0.14
NW-2	390	126.2	125.0	0.0030	B	1.20	2.40	5 min/100 yr	4.76	0.20	1.14	2.00	0.50	0.50	1.41	0.35	Earthen	1.35	2.28
NW-3	135	125.0	123.7	0.0098	B, C	2.05	4.41	5 min/100 yr	4.76	0.20	1.95	4.00	0.50	1.00	2.24	0.45	Earthen	3.83	1.95
NW-4	194	124.3	123.7	0.0029	D	0.76	4.41	5 min/100 yr	4.76	0.20	0.72	2.00	0.50	0.50	1.41	0.35	Earthen	0.90	1.44
NW-5	90	124.3	124.0	0.0033	E	0.35	3.85	5 min/100 yr	4.76	0.20	0.33	2.00	0.50	0.50	1.41	0.35	Earthen	0.96	0.67
NW-6	435	125.3	124.0	0.0030	F	1.73	1.94	5 min/100 yr	4.76	0.20	1.65	4.00	0.50	1.00	2.24	0.45	Earthen	2.12	1.65
NW-7	100	125.3	125.0	0.0030	G	0.21	2.48	5 min/100 yr	4.76	0.20	0.20	2.00	0.50	0.50	1.41	0.35	Earthen	0.91	0.41
NW-8	120	126.5	126.1	0.0030	H	0.13	2.73	5 min/100 yr	4.76	0.20	0.13	2.00	0.50	0.50	1.41	0.35	Earthen	0.91	0.26
NW-9	120	126.5	126.0	0.0038	I	0.26	2.01	5 min/100 yr	4.76	0.20	0.24	2.00	0.50	0.50	1.41	0.35	Earthen	1.02	0.49
NW-10	202	126.0	125.0	0.0050	I, J	0.67	2.21	5 min/100 yr	4.76	0.20	0.64	2.00	0.50	0.50	1.41	0.35	Earthen	1.16	1.28
NW-11	18	126.1	122.2	0.2167	A, H	0.21	2.73	5 min/100 yr	4.76	0.20	0.20	2.00	0.50	0.50	1.41	0.35	Gunite	11.56	0.40
NW-12	26	123.7	120.0	0.1415	B, C, D	2.81	4.41	5 min/100 yr	4.76	0.20	2.68	2.00	0.50	0.50	1.41	0.35	Gunite	9.34	5.35
NW-13	26	124.0	119.0	0.1923	E, F	2.08	3.85	5 min/100 yr	4.76	0.20	1.98	2.00	0.50	0.50	1.41	0.35	Gunite	10.89	3.96
NW-14	18	125.0	121.0	0.2222	G, I, J	0.89	2.48	5 min/100 yr	4.76	0.20	0.84	2.00	0.50	0.50	1.41	0.35	Gunite	11.70	1.69
Reservoir 5																			
R5-1	520	125.0	118.5	0.0125	A	4.29	4.58	5 min/100 yr	4.76	0.20	4.08	4.00	0.50	1.00	2.24	0.45	Earthen	4.33	4.08
R5-2	540	125.8	118.5	0.0135	B	1.79	2.47	5 min/100 yr	4.76	0.20	1.70	4.00	0.50	1.00	2.24	0.45	Earthen	4.50	1.70
Reservoir 7																			
R7-1	480	130.6	124.0	0.0138	A	1.86	1.69	5 min/100 yr	4.76	0.20	1.77	4.00	0.50	1.00	2.24	0.45	Earthen	4.54	1.77
R7-2	320	130.6	125.0	0.0175	B	1.86	1.69	5 min/100 yr	4.76	0.20	1.77	4.00	0.50	1.00	2.24	0.45	Earthen	5.12	1.77
OU#3 And Flower Mound Borrow Area																			
ED-1	750	166.0	160.5	0.0073	A	0.81	11.21	5 min/100 yr	4.76	0.20	0.77	2.00	0.50	0.50	1.41	0.35	Earthen	1.42	1.53
ED-2	405	167.0	160.5	0.0160	B	0.63	6.20	5 min/100 yr	4.76	0.20	0.60	2.00	0.50	0.50	1.41	0.35	Earthen	2.10	1.20
ED-3	490	167.8	160.0	0.0159	C	4.43	5.75	5 min/100 yr	4.76	0.20	4.22	3.00	1.00	1.50	3.61	0.42	Earthen	6.98	2.81
ED-4	800	160.0	148.0	0.0150	A, B, C, D	7.78	11.21	5 min/100 yr	4.76	0.20	7.41	5.00	1.67	4.18	8.99	0.46	Earthen	20.30	1.78
ED-5	1170	165.0	148.0	0.0145	E	7.58	4.85	5 min/100 yr	4.76	0.20	7.22	4.00	1.00	2.00	4.47	0.45	Earthen	9.33	3.61
ED-6	1250	148.0	140.0	0.0064	A, B, C, D, E, F	15.36	11.21	5 min/100 yr	4.76	0.20	14.63	6.00	2.00	6.00	12.65	0.47	Earthen	19.33	2.44
ED-7	800	145.0	137.0	0.0100	G	11.87	7.01	5 min/100 yr	4.76	0.20	11.30	4.00	1.67	3.34	7.47	0.45	Earthen	12.93	3.38
ED-8	725	164.0	137.0	0.0372	H	1.02	1.91	5 min/100 yr	4.76	0.20	0.97	2.00	0.50	0.50	1.41	0.35	Earthen	3.19	1.94
ED-9	1375	168.0	136.0	0.0233	L	6.59	3.19	6 min/100 yr	4.76	0.20	6.28	4.00	1.00	2.00	4.47	0.45	Earthen	11.81	3.14
ED-10	570	136.0	125.0	0.0193	I, L	14.15	3.19	5 min/100 yr	4.76	0.20	13.48	4.00	1.50	3.00	6.71	0.45	Earthen	16.14	4.49
ED-11	1000	140.0	125.0	0.0150	A, B, C, D, E, F, J	19.65	2.08	5 min/100 yr	4.76	0.20	18.72	5.00	1.67	4.18	8.99	0.46	Earthen	20.30	4.48
ED-12	400	136.0	126.0	0.0250	G, H, K	15.61	7.01	5 min/100 yr	4.76	0.20	14.86	6.00	2.00	6.00	12.65	0.47	Earthen	38.20	2.48
Borrow Area 2																			
BA-1	700	147.0	143.7	0.0047	A	0.93	1.22	5 min/100 yr	4.76	0.20	0.89	2.00	0.50	0.50	1.41	0.35	Earthen	1.14	1.77
BA-2	325	147.0	145.8	0.0037	B	0.84	1.65	5 min/100 yr	4.76	0.20	0.80	2.00	0.50	0.50	1.41	0.35	Earthen	1.01	1.59
BA-3	280	145.8	143.2	0.0093	B, C	1.55	2.19	5 min/100 yr	4.76	0.20	1.47	2.00	0.50	0.50	1.41	0.35	Earthen	1.59	2.95
BA-4	156	148.4	143.2	0.0333	D	2.38	0.61	5 min/100 yr	4.76	0.20	2.27	2.00	0.50	0.50	1.41	0.35	Earthen	3.02	4.54
BA-5	470	148.4	144.0	0.0094	E	0.60	1.99	5 min/100 yr	4.76	0.20	0.57	2.00	0.50	0.50	1.41	0.35	Earthen	1.60	1.15
BA-6	125	143.2	142.0	0.0096	B,C,D	2.50	2.19	5 min/100 yr	4.76	0.20	2.38	2.00	0.50	0.50	1.41	0.35	Earthen	2.43	4.76
BA-7	315	149.0	146.0	0.0095	F	0.63	0.19	5 min/100 yr	4.76	0.20	0.60	2.00	0.50	0.50	1.41	0.35	Earthen	1.62	1.19
BA-8	380	146.0	142.0	0.0105	F, G	1.37	0.20	5 min/100 yr	4.76	0.20	1.31	2.00	0.50	0.50	1.41	0.35	Earthen	1.70	2.62

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Table G.2
Channel Size Selection
Chevron San Luis Obispo Tank Farm
San Luis Obispo, California

Channel Segment	Channel Length (feet)	Highest Elevation (feet)	Lowest Elevation (feet)	Average Channel Slope (*S*)	Contributing Drainage Subareas	Total Drainage Area (acres)	Time of Conc. (minutes)	Design Storm	Rainfall Intensity (*i*) (in/hr)	*C* Value	Peak Design Flow (cfs)	Proposed Channel							
												Width (feet)	Depth (feet)	Area (*A*)	Wetted Perimeter (*P*)	Hydraulic Radius (*R*)	Type	Flow Capacity (cfs)	Anticipated Flow Velocity[1] (fps)
Offsite Runon Culvert																			
C-1	50	120.5	120.0	0.0100	A	33.66	27.77	30 min/100 yr	2.06	0.20	13.85	-	-	4.81	11.00	0.44	-	17.19	2.88

Notes:

(1) Anticipated flow velocity calculated using the proposed channel dimensions and peak design flows.

(2) The 5-min and 10-min 100-year storm intensity values obtained by using the 1-hr 100-year value from the NOAA Atlas 2 Rainfall Duration Contours and ratios provided in the Frederick and Miller paper titled "Short Duration Rainfall Frequency Relations for California," 1979.

(3) Coefficient of roughness used is 0.0225, corresponding to a bare, straight, uniform earth channel in 'Fair' condition (Caltrans, 2003).

(4) Coefficient of roughness used is 0.015, corresponding to a gunite-lined channel (Federal Highway Institute, 2001).

(5) Channel elevations considered as surface elevation.

(6) Offsite runoff culvert size based on 30-min 100-yr storm. The storm intensity values obtained by using the 1-hr 100-year value from the NOAA Atlas 2 Rainfall Duration Contours and ratio of 0.729 recommended in the Frederick and Miller paper titled "Short Duration Rainfall Frequency Relations for California," 1979. Pipe C-1 designed using a coefficient of roughness of 0.024.

(7) Time of travel within channels is ignored for conservatism.

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Table G.3
Hydrological Conditions in OU#3 and Flower Mound Area, and Borrow Area No. 2
Chevron San Luis Obispo Tank Farm
San Luis Obispo, California

Flow Path	Type of Flow	Highest Elevation (feet MSL)	Lowest Elevation (feet MSL)	Elevation Difference (feet)	Maximum Slope Length (L) (feet)	Average Slope (S)	Time of Concentration (t_c) (minutes)
OU#3 and Flower Mound Borrow Area - Existing Condition							
1	Sheet	219	200	19	300	0.063	1.82
2	Natural Channel	200	138	62	950	0.065	4.38
3	Natural channel	138	125	13	760	0.017	6.18
OU#3 and Flower Mound Borrow Area - Regraded Condition							
1	Sheet	171	167.8	3.2	400	0.008	5.05
2	Ditch ED-3	167.8	160	7.8	490	0.016	2.92
3	Ditch ED-4	160	148	12	800	0.015	7.41
4	Ditch ED-6	148	140	8	1250	0.006	9.92
5	Ditch ED-11	140	125	15	1000	0.015	5.34
Borrow Area No. 2 - Subareas B & C							
1	Sheet	149	147	2	130	0.015	1.65
2	Ditch BA-2	147	145.8	1.2	325	0.004	1.93
3	Ditch BA-3	145.8	143.2	2.6	280	0.009	2.59
4	Ditch BA-6	143.2	142	1.2	125	0.010	1.16
Borrow Area No. 2 - Subareas F & G							
1	Sheet	151	147	4	25	0.160	0.19
2	Ditch BA-7	149	146	3	315	0.010	1.88
3	Ditch BA-8	146	142	4	380	0.011	3.52

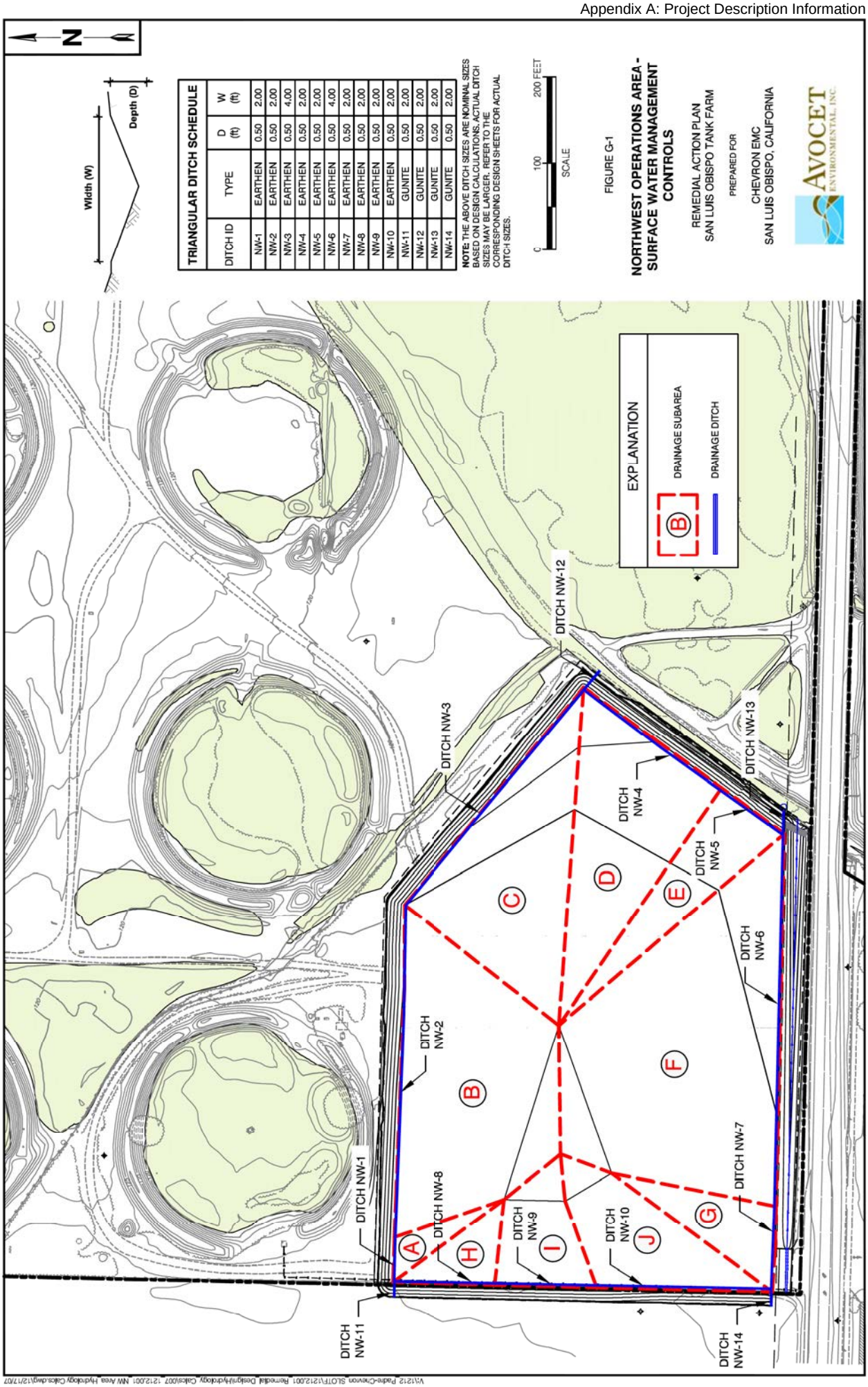
Note:
Equations for time of concentration obtained from County of San Luis Obispo's "Waterway Management Plan, Drainage Design Manual", Volume III, February 2003.

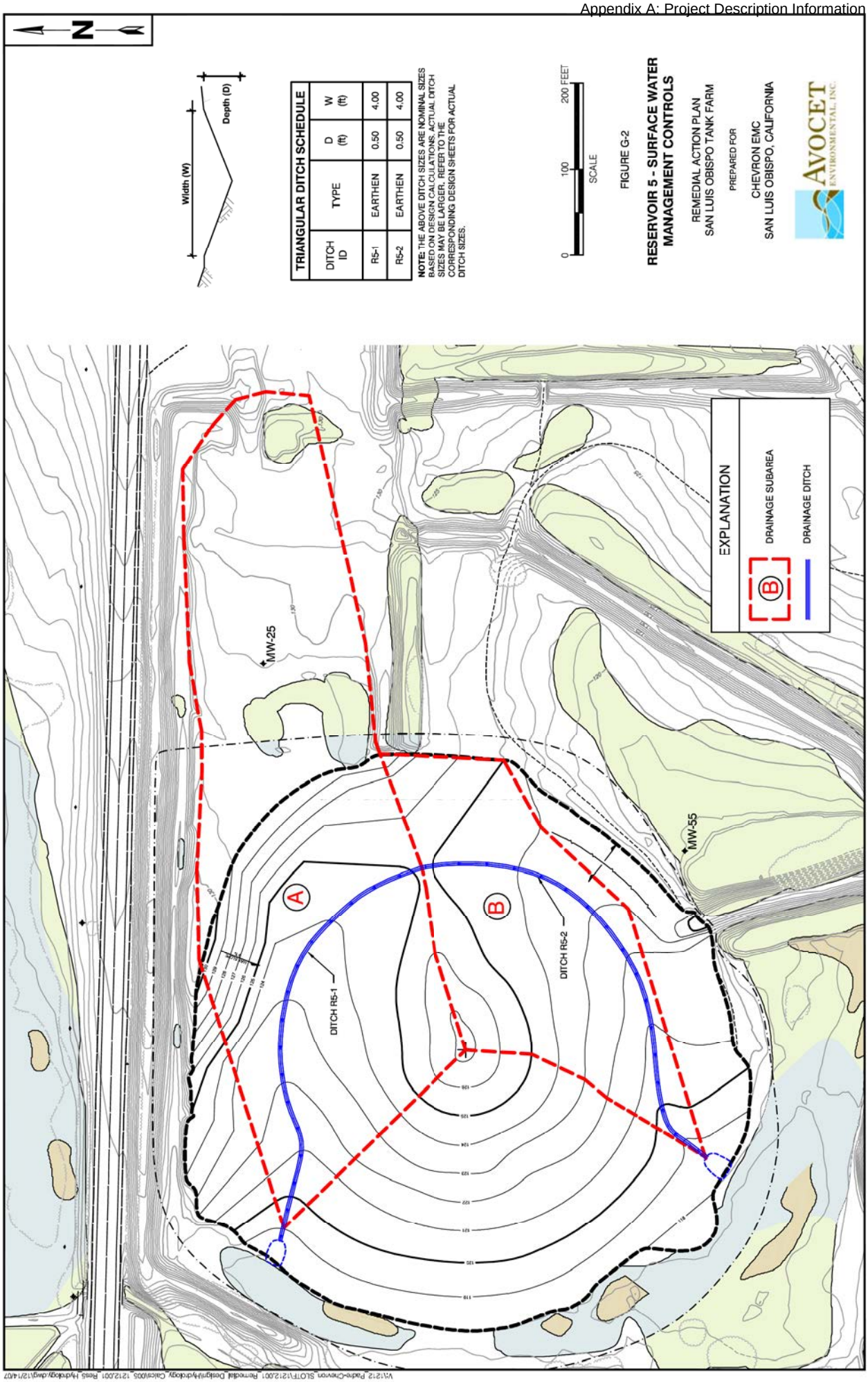
Table G.4
Summary of Peak Flowrates in OU#3 and Flower Mound Area, and Borrow Area No. 2
Chevron San Luis Obispo Tank Farm
San Luis Obispo, California

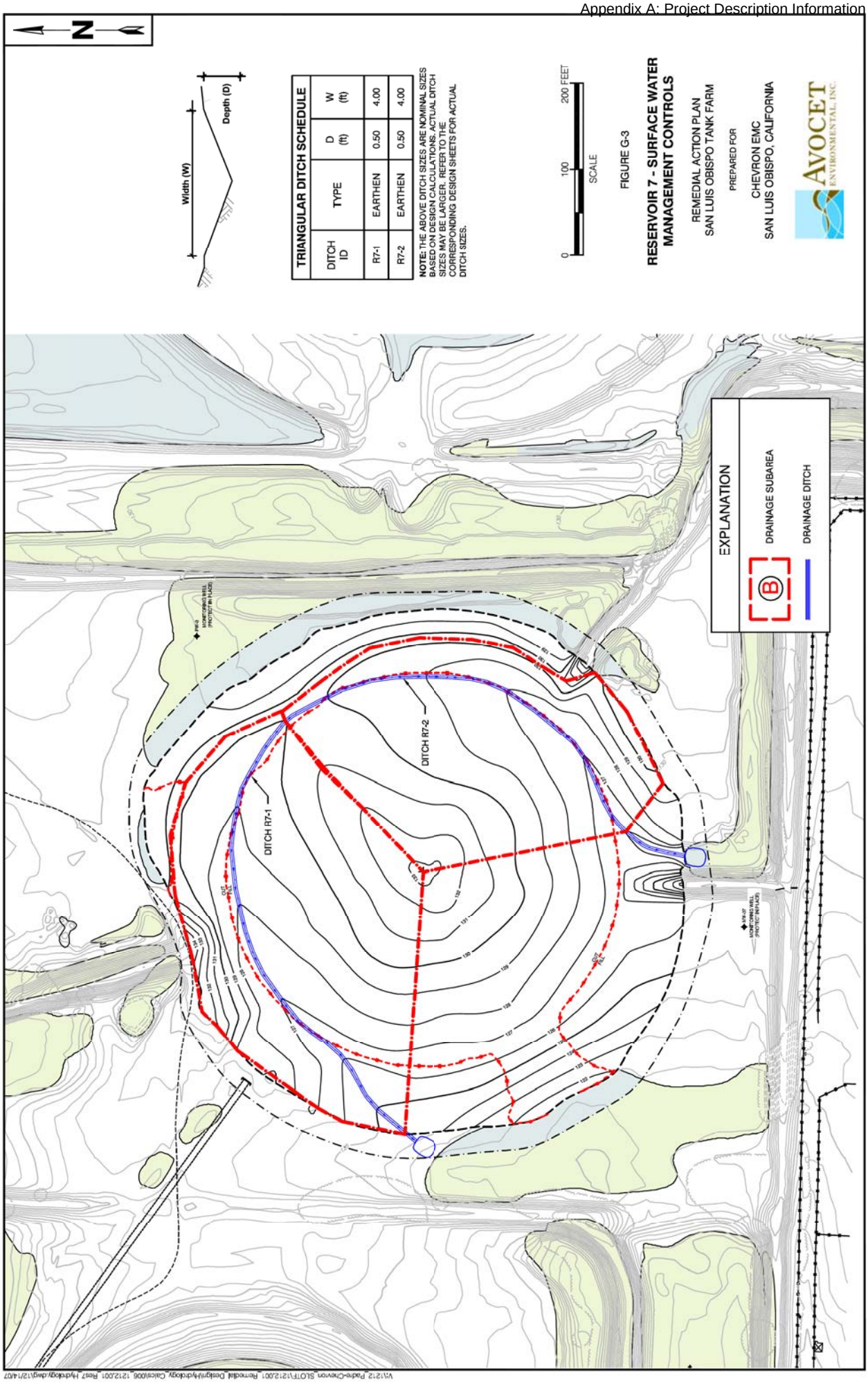
Condition	Area (acres)	Runoff Coefficient[1] (*C*)	Time of Concentration (minutes)	Rainfall Intensity[2] (inches/hour)			Peak Flowrate (cfs)		
				25-Year	50-Year	100-Year	25-Year	50-Year	100-Year
OU#3 and Flower Mound Borrow Area									
Existing Condition	43.9	0.35	12.4	3.5	3.9	4.3	54.26	60.46	66.66
Proposed Condition	49.4	0.35	30.6	2.4	2.6	2.9	41.84	45.33	50.56
Borrow Area No. 2									
From Subareas B & C	1.5	0.35	6.18	4.0	4.6	5.0	2.18	2.51	2.73
From Subareas F & G	1.4	0.35	5.58	4.0	4.6	5.0	1.94	2.23	2.42

Notes:
(1) Obtained from Table 4-1 of County of San Luis Obispo's "Waterway Management Plan, Drainage Design Manual", Volume III, February 2003.
(2) Obtained from Table 4-6 of County of San Luis Obispo's "Waterway Management Plan, Drainage Design Manual", Volume III, February 2003.

Figures


N
Width (W)
Depth (D)
TRIANGULAR DITCH SCHEDULE
DITCH ID | TYPE | D (ft) | W (ft)
NW-1 | EARTHEN | 0.50 | 2.00
NW-2 | EARTHEN | 0.50 | 2.00
NW-3 | EARTHEN | 0.50 | 4.00
NW-4 | EARTHEN | 0.50 | 2.00
NW-5 | EARTHEN | 0.50 | 2.00
NW-6 | EARTHEN | 0.50 | 4.00
NW-7 | EARTHEN | 0.50 | 2.00
NW-8 | EARTHEN | 0.50 | 2.00
NW-9 | EARTHEN | 0.50 | 2.00
NW-10 | EARTHEN | 0.50 | 2.00
NW-11 | GUNITE | 0.50 | 2.00
NW-12 | GUNITE | 0.50 | 2.00
NW-13 | GUNITE | 0.50 | 2.00
NW-14 | GUNITE | 0.50 | 2.00
NOTE: THE ABOVE DITCH SIZES ARE NOMINAL SIZES BASED ON DESIGN CALCULATIONS. ACTUAL DITCH SIZES MAY BE LARGER. REFER TO THE CORRESPONDING DESIGN SHEETS FOR ACTUAL DITCH SIZES.
0 100 200 FEET
SCALE
FIGURE G-1
NORTHWEST OPERATIONS AREA - SURFACE WATER MANAGEMENT CONTROLS
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET ENVIRONMENTAL, INC.
EXPLANATION
DRAINAGE SUBAREA
DRAINAGE DITCH
DITCH NW-1
DITCH NW-2
DITCH NW-3
DITCH NW-4
DITCH NW-5
DITCH NW-6
DITCH NW-7
DITCH NW-8
DITCH NW-9
DITCH NW-10
DITCH NW-11
DITCH NW-12
DITCH NW-13
DITCH NW-14
A
B
C
D
E
F
G
H
I
J


N
Width (W)
Depth (D)
TRIANGULAR DITCH SCHEDULE
DITCH ID | TYPE | D (ft) | W (ft)
R5-1 | EARTHEN | 0.50 | 4.00
R5-2 | EARTHEN | 0.50 | 4.00
NOTE: THE ABOVE DITCH SIZES ARE NOMINAL SIZES BASED ON DESIGN CALCULATIONS. ACTUAL DITCH SIZES MAY BE LARGER. REFER TO THE CORRESPONDING DESIGN SHEETS FOR ACTUAL DITCH SIZES.
0 100 200 FEET
SCALE
FIGURE G-2
RESERVOIR 5 - SURFACE WATER MANAGEMENT CONTROLS
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET ENVIRONMENTAL, INC.
EXPLANATION
B DRAINAGE SUBAREA
DRAINAGE DITCH
MW-25
MW-55
DITCH R5-1
DITCH R5-2
A
B


N
Width (W)
Depth (D)
TRIANGULAR DITCH SCHEDULE
DITCH ID | TYPE | D (ft) | W (ft)
R7-1 | EARTHEN | 0.50 | 4.00
R7-2 | EARTHEN | 0.50 | 4.00
NOTE: THE ABOVE DITCH SIZES ARE NOMINAL SIZES BASED ON DESIGN CALCULATIONS. ACTUAL DITCH SIZES MAY BE LARGER. REFER TO THE CORRESPONDING DESIGN SHEETS FOR ACTUAL DITCH SIZES.
0
100
200 FEET
SCALE
FIGURE G-3
RESERVOIR 7 - SURFACE WATER MANAGEMENT CONTROLS
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET ENVIRONMENTAL, INC.
EXPLANATION
DRAINAGE SUBAREA
DRAINAGE DITCH
DITCH R7-1
DITCH R7-2
MONITORING WELL (PROTECTIVE IN PLACE)
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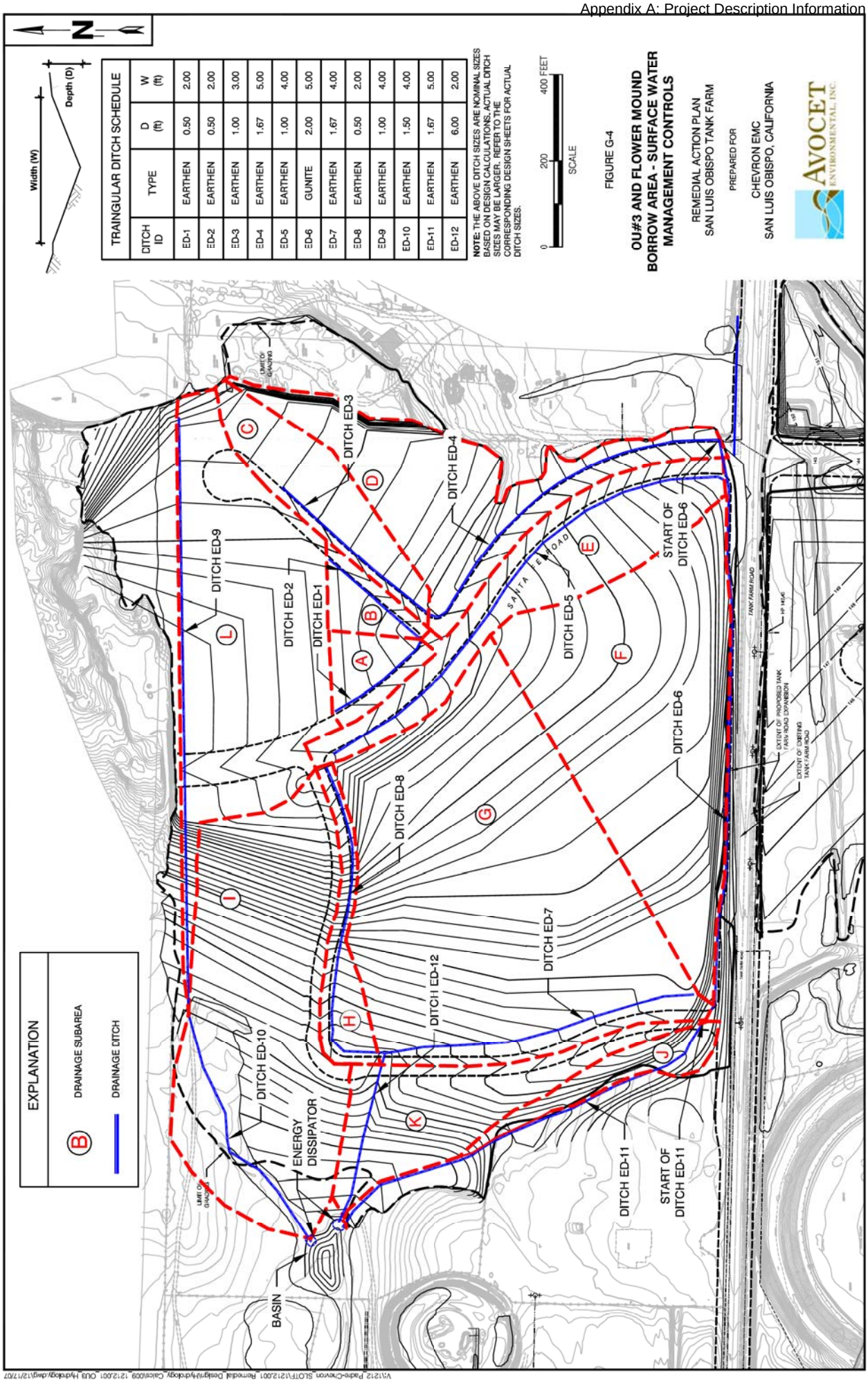


TRAINGULAR DITCH SCHEDULE			
DITCH ID	TYPE	D (ft)	W (ft)
ED-1	EARTHEN	0.50	2.00
ED-2	EARTHEN	0.50	2.00
ED-3	EARTHEN	1.00	3.00
ED-4	EARTHEN	1.67	5.00
ED-5	EARTHEN	1.00	4.00
ED-6	GUNITE	2.00	5.00
ED-7	EARTHEN	1.67	4.00
ED-8	EARTHEN	0.50	2.00
ED-9	EARTHEN	1.00	4.00
ED-10	EARTHEN	1.50	4.00
ED-11	EARTHEN	1.67	5.00
ED-12	EARTHEN	6.00	2.00

NOTE: THE ABOVE DITCH SIZES ARE NOMINAL SIZES BASED ON DESIGN CALCULATIONS. ACTUAL DITCH SIZES MAY BE LARGER. REFER TO THE CORRESPONDING DESIGN SHEETS FOR ACTUAL DITCH SIZES.

FIGURE G-4

OU#3 AND FLOWER MOUND BORROW AREA - SURFACE WATER MANAGEMENT CONTROLS

REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM

PREPARED FOR

CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA

AVOCET ENVIRONMENTAL, INC.

V:\1212 Parke-Chevron SLOTF\1212.001 Remedial Design\Hydrology Calcs\009 1212.001 OU3 Hydrology.dwg\12/17/07

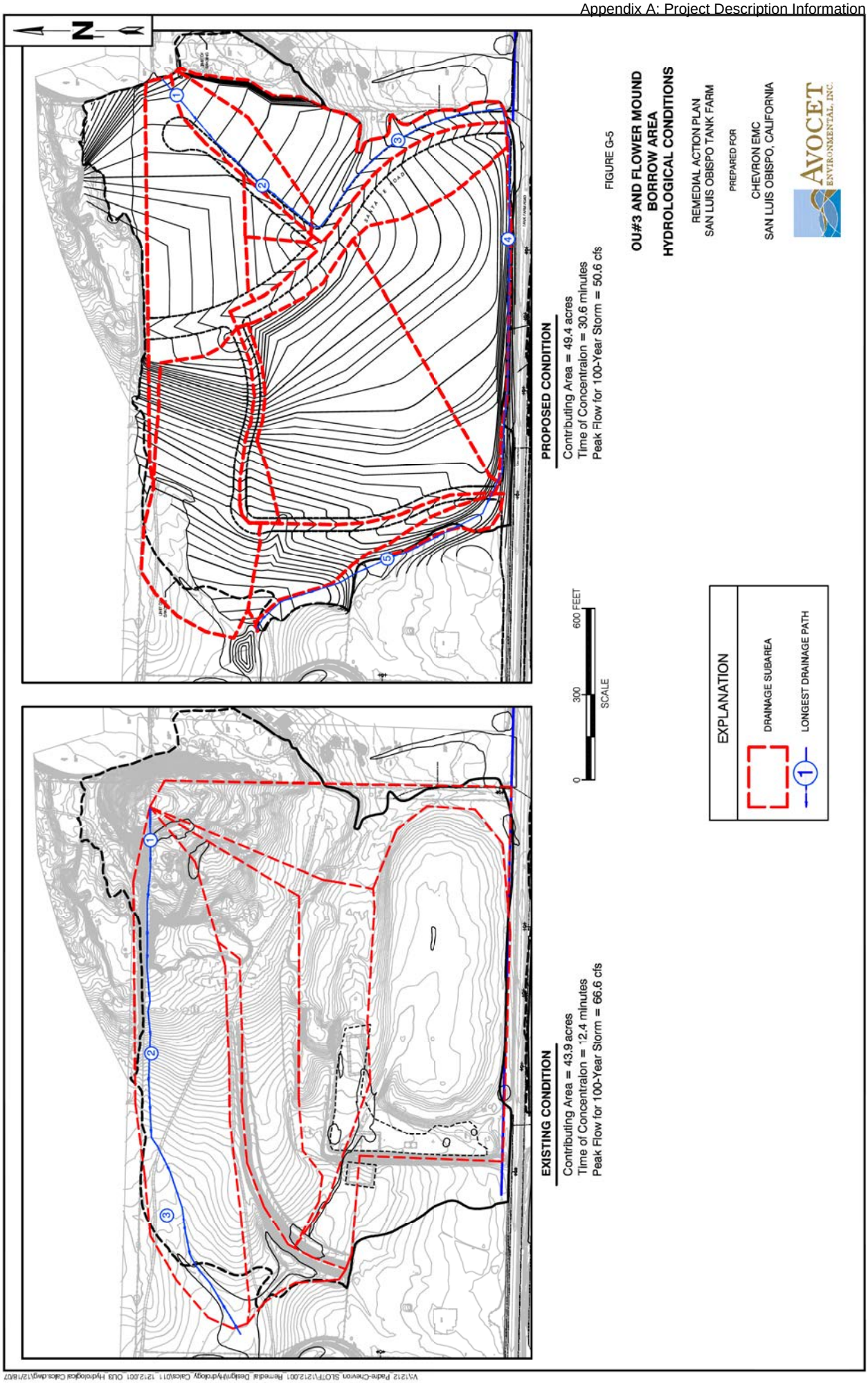
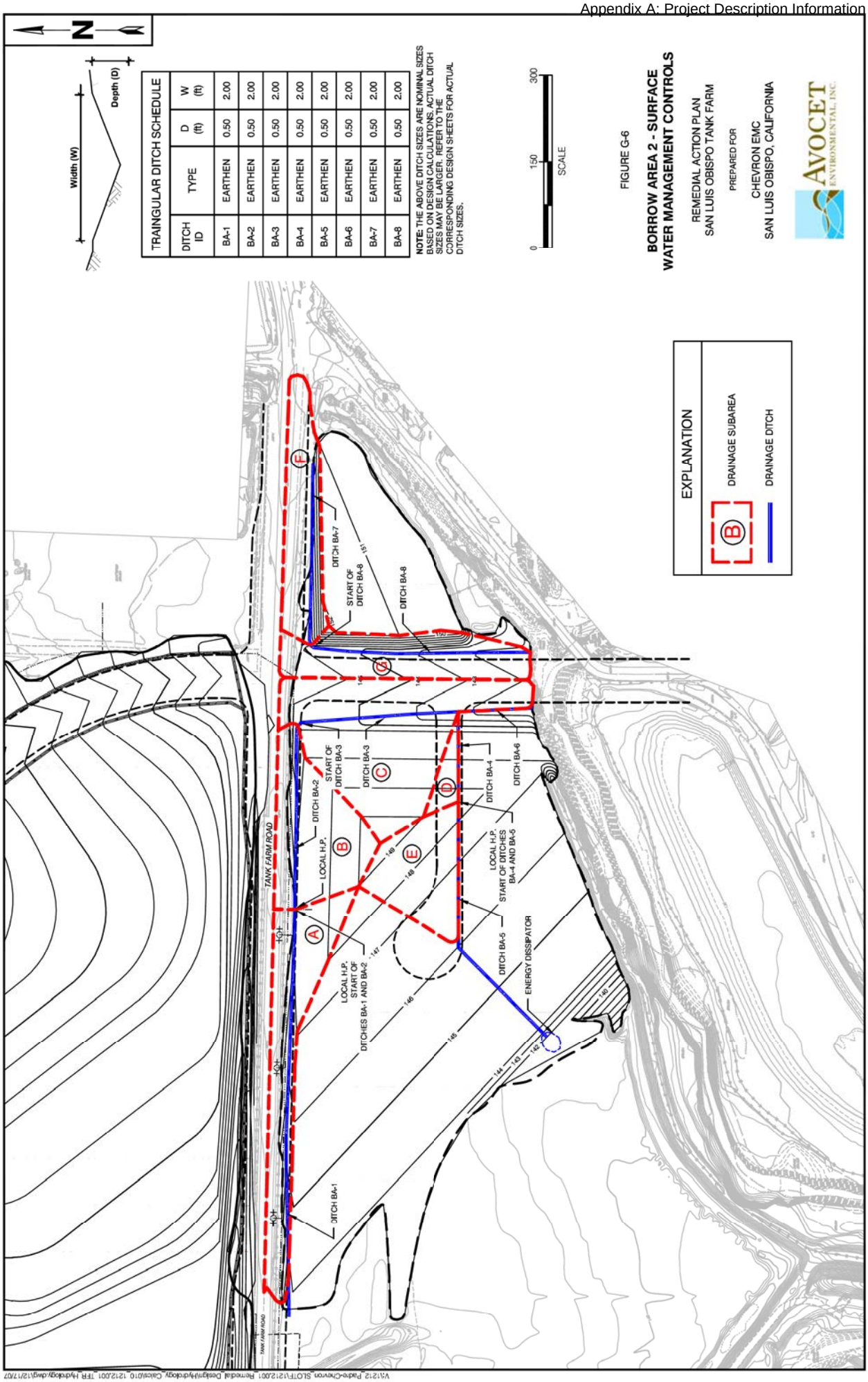
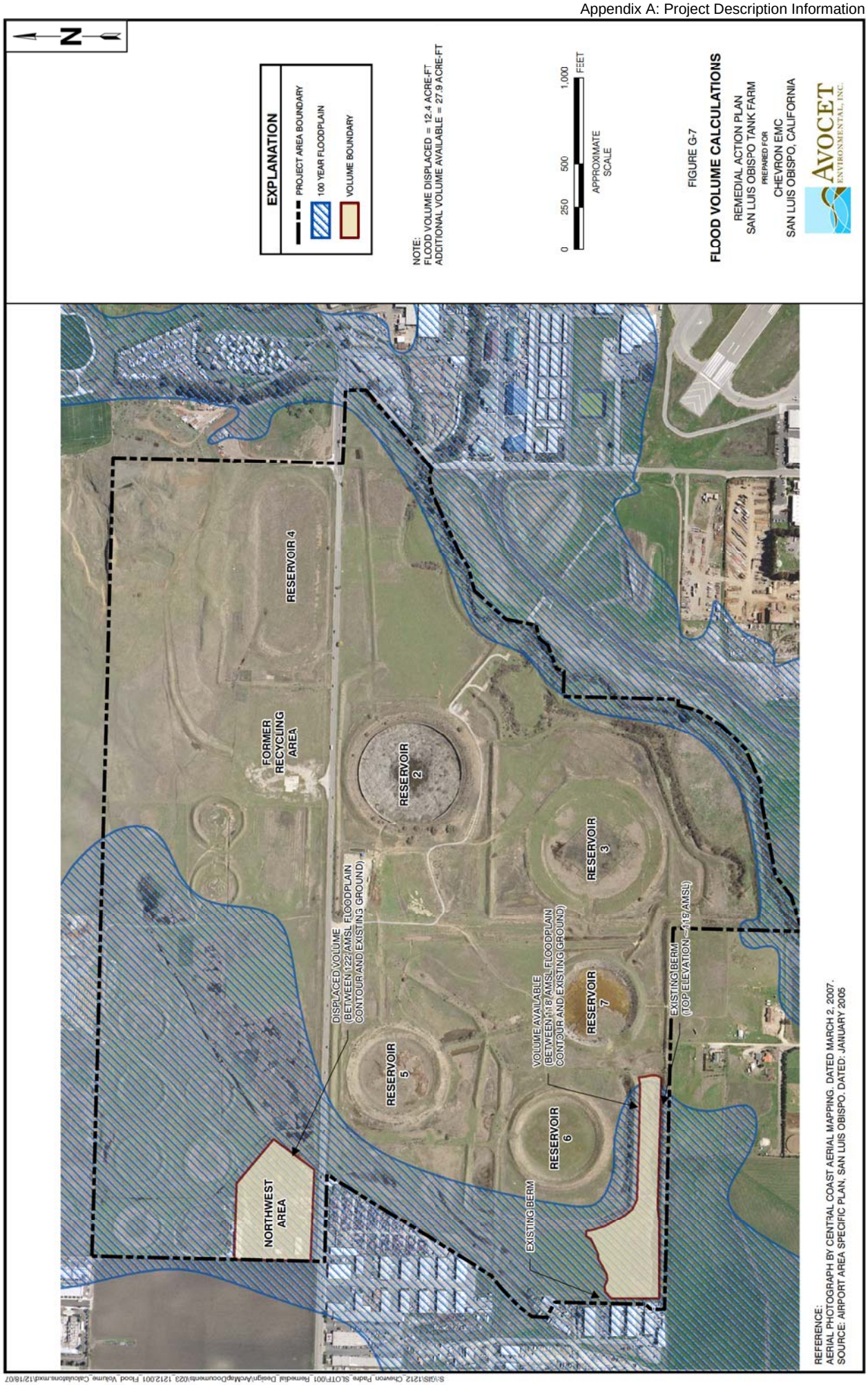

N
PROPOSED CONDITION
Contributing Area = 49.4 acres
Time of Concentraion = 30.6 minutes
Peak Flow for 100-Year Storm = 50.6 cfs
EXISTING CONDITION
Contributing Area = 43.9 acres
Time of Concentraion = 12.4 minutes
Peak Flow for 100-Year Storm = 66.6 cfs
0
300
600 FEET
SCALE
EXPLANATION
DRAINAGE SUBAREA
LONGEST DRAINAGE PATH
OU#3 AND FLOWER MOUND
BORROW AREA
HYDROLOGICAL CONDITIONS
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET
ENVIRONMENTAL, INC.

FIGURE G-5


N
Width (W)
Depth (D)
TRAINGULAR DITCH SCHEDULE
DITCH ID | TYPE | D (ft) | W (ft)
BA-1 | EARTHEN | 0.50 | 2.00
BA-2 | EARTHEN | 0.50 | 2.00
BA-3 | EARTHEN | 0.50 | 2.00
BA-4 | EARTHEN | 0.50 | 2.00
BA-5 | EARTHEN | 0.50 | 2.00
BA-6 | EARTHEN | 0.50 | 2.00
BA-7 | EARTHEN | 0.50 | 2.00
BA-8 | EARTHEN | 0.50 | 2.00
NOTE: THE ABOVE DITCH SIZES ARE NOMINAL SIZES BASED ON DESIGN CALCULATIONS. ACTUAL DITCH SIZES MAY BE LARGER. REFER TO THE CORRESPONDING DESIGN SHEETS FOR ACTUAL DITCH SIZES.
0
150
300
SCALE
FIGURE G-6
BORROW AREA 2 - SURFACE WATER MANAGEMENT CONTROLS
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET ENVIRONMENTAL, INC.
EXPLANATION
DRAINAGE SUBAREA
DRAINAGE DITCH
DITCH BA-7
START OF DITCH BA-8
DITCH BA-8
DITCH BA-2
START OF DITCH BA-3
DITCH BA-3
DITCH BA-4
DITCH BA-6
TANK FARM ROAD
LOCAL H.P.
LOCAL H.P. START OF DITCHES BA-1 AND BA-2
LOCAL H.P. START OF DITCHES BA-4 AND BA-5
DITCH BA-5
ENERGY DISSIPATOR
DITCH BA-1
A
B
C
D
E
F
G
V:\1212_Padre-Chevron_SLOT\F1212001_Remedial_Design\Hydrology\Calcs\010_1212001_TFR_Hydrology.dwg\12/17/07



S:\GIS\1212_Chevron_Parks_SLOTF\001_Remedial_Design\ArcMapDocuments\023_1212001_Flood_Volume_Calculations.mxd\12/18/07

Attachment 1

Supporting Information

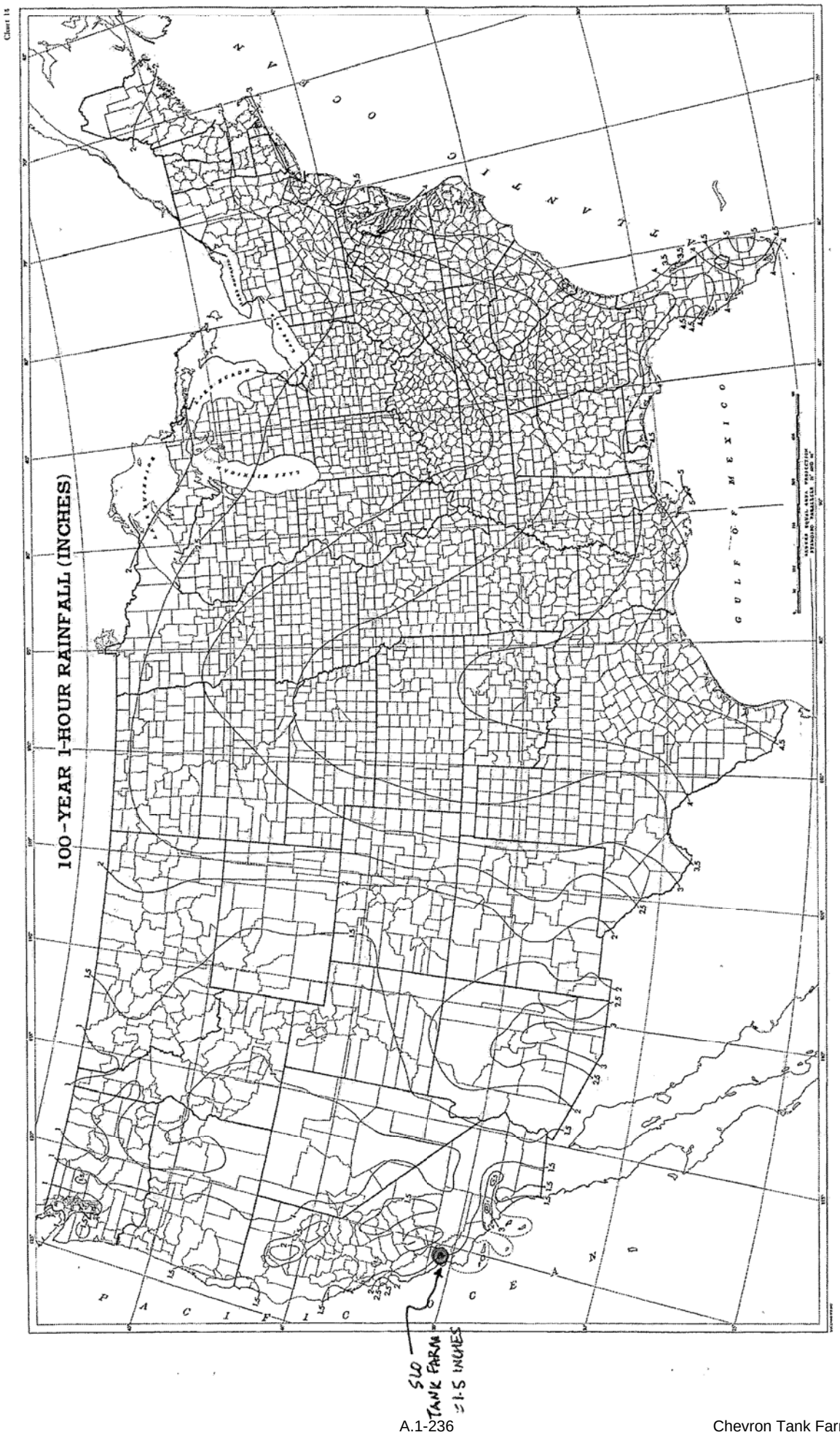


Chart 14
100-YEAR 1-HOUR RAINFALL (INCHES)
21
N E V A D A
U T A H
A R I Z O N A
G U L F O F M E X I C O
P A C I F I C O C E A N
SLO TANK FARM
≈1.5 INCHES

Table 8-3: Runoff Coefficients for Undeveloped Areas Watershed Types

	Extreme	High	Normal	Low
Relief	0.28 -0.35 Steep, rugged terrain with average slopes above 30%	0.20 - 0.28 Hilly, with average slopes of 10 to 30%	0.14 -0.20 Rolling, with average slopes of 5 to 10%	0.08 - 0.14 Relatively flat land, with average slopes of 0 to 5%
Soil Infiltration	0.12 - 0.16 No effective soil cover, either rock or thin soil mantle of negligible infiltration capacity	0.08 - 0.12 Slow to take up water, clay or shallow loam soils of low infiltration capacity, imperfectly or poorly drained	0.06 - 0.08 Normal; well drained light or medium textured soils, sandy loams, silt and silt loams	0.04 - 0.06 High; deep sand or other soil that takes up water readily, very light well drained soils
Vegetal Cover	0.12 - 0.16 No effective plant cover, bare or very sparse cover	0.08 - 0.12 Poor to fair; clean cultivation crops, or poor natural cover, less than 20% of drainage area over good cover	0.06 - 0.08 Fair to good; about 50% of area in good grassland or woodland, not more than 50% of area in cultivated crops	0.04 - 0.06 Good to excellent; about 90% of drainage area in good grassland, woodland or equivalent cover
Surface Storage	0.10 - 0.12 Negligible surface depression few and shallow; drainage-ways steep and small, no marshes	0.08 - 0.10 Low; well defined system of small drainageways; no ponds or marshes	0.06 - 0.08 Normal; considerable surface depression storage; lakes and basin marshes	0.04 - 0.06 High; surface storage, high; drainage system not sharply defined; large flood plain storage or large number of ponds or marshes

Reference: Caltrans Highway Design Manual, Section 819.2, Figure 819.2A, November 1, 2001

Example Determination of Runoff Coefficient for a watershed:

Given: An undeveloped watershed consisting of:
1) rolling terrain with average slopes of 5%,
2) clay type soils,
3) good grassland area, and
4) normal surface depressions.

Solution:

Relief	0.14
Soil Infiltration	0.08
Vegetal Cover	0.04
Surface Storage	0.06
C =	0.32

Find: The runoff coefficient, C, for the above watershed

Table 8-4: Runoff Coefficients for Developed Areas

Type of Drainage Area	Runoff Coefficient
Business:	
Downtown areas	0.70 - 0.95
Neighborhood areas	0.50 - 0.70
Residential:	
Single-family areas	0.30 - 0.50
Multi-units, detached	0.40 - 0.60
Multi-units, attached	0.60 - 0.75
Suburban	0.25 - 0.40
Apartment dwelling areas	0.50 - 0.70
Industrial:	
Light areas	0.50 - 0.80
Heavy areas	0.60 - 0.90
Parks, Cemeteries:	0.10 - 0.25
Playgrounds:	0.20 - 0.40
Railroad yard areas:	0.20 - 0.40
Unimproved areas:	0.10 - 0.30
Lawns:	
Sandy soil, flat, 2%	0.05 - 0.10
Sandy soil, average, 2-7%	0.10 - 0.15
Sandy soil, steep, 7%	0.15 - 0.20
Heavy soil, flat, 2%	0.13 - 0.17
Heavy soil, average, 2-7%	0.18 - 0.25
Heavy soil, steep, 7%	0.25 - 0.35
Streets:	
Asphaltic	0.70 - 0.95
Concrete	0.80 - 0.95
Brick	0.70 - 0.85
Drives and walks	0.75 - 0.85
Roofs:	0.75 - 0.95

Reference: Caltrans Highway Design Manual, Section 819.2, Table 819.2B, November 1, 2001

8.1.9 Other Information

Include any other information that would explain the decisions or rationale behind the selection and deployment of both permanent and Construction Site BMPs chosen by the designer. Examples include the designer's estimated staging of the project and estimated time of year for those stages; any scheduling modifications included in the Order of Work specifications that were included to enhance water pollution control; and any specific BMP deployments that are considered to be critical to the success of the contractor's SWPPP/WPCP. The designer should verify that all requirements listed herein would be reflective of the contract special provisions.

Other Plans/Permits: Other agencies may have issued permits or have plan requirements for the construction of the project or imposed certain conditions. If so, a written description of the permit conditions and a copy of the permit must be provided for inclusion in an appendix to the SWPPP. For example, hazardous materials must be handled in accordance with specific laws and regulations and disposed of properly. If during the preparation of the PS&E, it is known that special permits for hazardous waste disposal are required, a written explanation must be provided

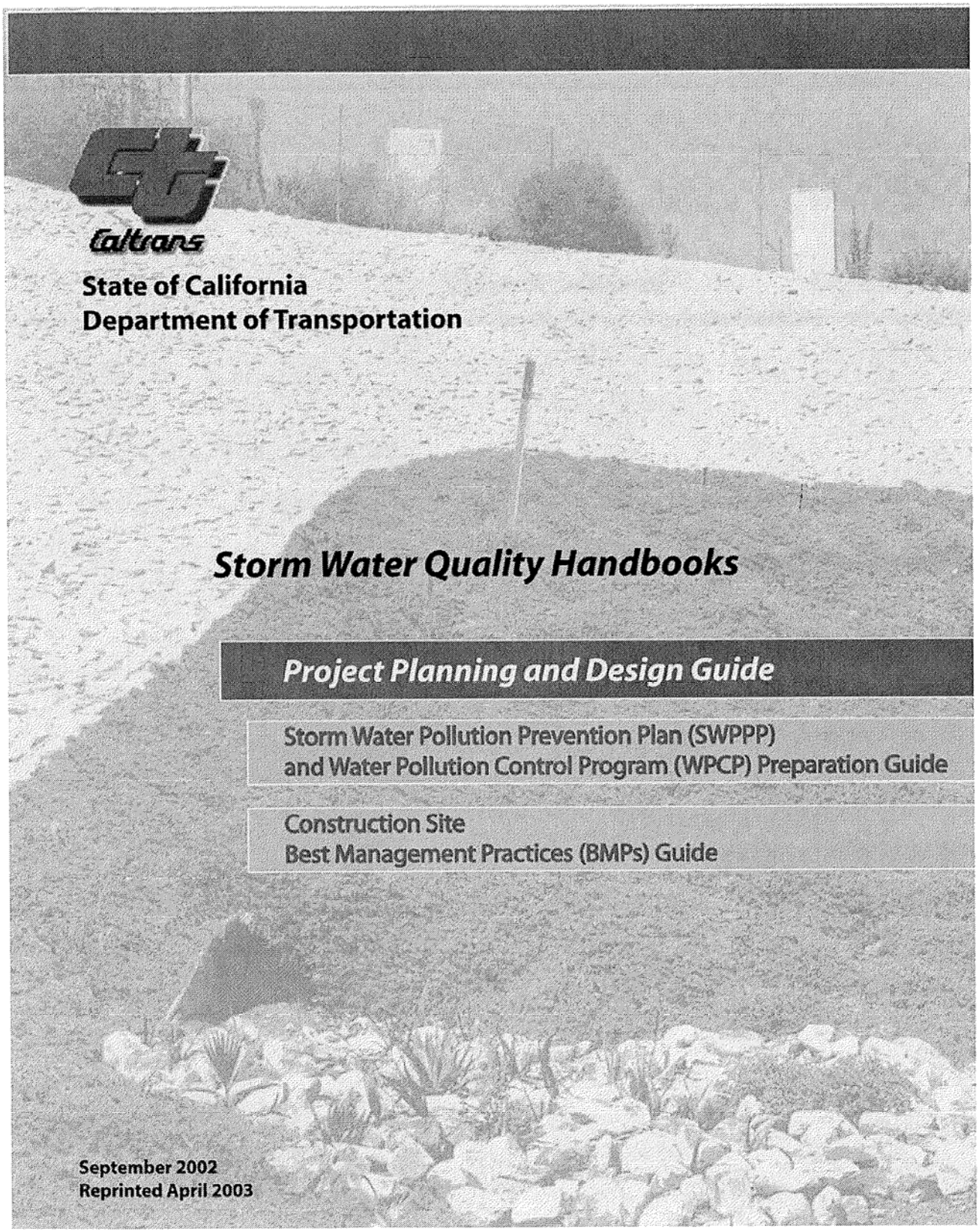

Caltrans
State of California
Department of Transportation
Storm Water Quality Handbooks
Project Planning and Design Guide
Storm Water Pollution Prevention Plan (SWPPP)
and Water Pollution Control Program (WPCP) Preparation Guide
Construction Site
Best Management Practices (BMPs) Guide
September 2002
Reprinted April 2003

Table 3-4. Values of Manning's Coefficient (n) for Channels and Pipes[15].

Conduit Material	Manning's n*
Closed Conduits	
Asbestos-cement pipe	0.011 0.015
Brick	0.013 - 0.017
Cast iron pipe	
Cement-lined and seal coated	0.011 - 0.015
Concrete (monolithic)	0.012 - 0.014
Concrete pipe	0.011 - 0.015
Corrugated-metal pipe - 13 mm by 64 mm (½ inch by 2 ½ inch) corrugations	
Plain	0.022 - 0.026
Paved invert	0.018 - 0.022
Spun asphalt lines	0.011 - 0.015
Plastic pipe (smooth)	0.011 - 0.015
Vitrified clay	
Pipes	0.011 - 0.015
Liner plates	0.013 - 0.017
Open Channels	
Lined channels	
Asphalt	0.013 - 0.017
Brick	0.012 - 0.018
Concrete	0.011 - 0.020
Rubble or riprap	0.020 - 0.035
Vegetal	0.030 - 0.400
Excavated or dredged	
Earth, straight and uniform	0.020 - 0.030
Earth, winding, fairly uniform	0.025 - 0.040
Rock	0.030 - 0.045
Unmaintained	0.050 - 0.140
Natural channels (minor streams, top width at flood stage <30 m (100 ft))	
Fairly regular section	0.030 - 0.070
Irregular section with pools	0.040 - 0.100

*Lower values are usually for well-constructed and maintained (smoother) pipes and channels.

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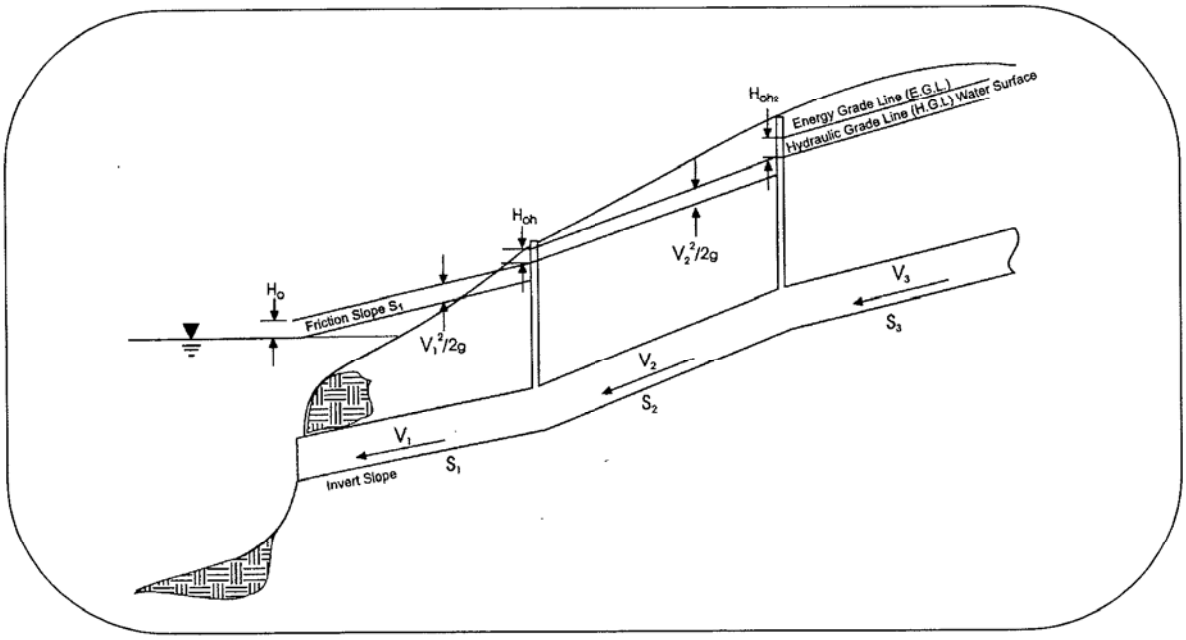
U.S. Department
of Transportation

Federal Highway Administration

Hydraulic Engineering Circular No. 22, Second Edition

URBAN DRAINAGE DESIGN MANUAL



NATIONAL HIGHWAY INSTITUTE

Training Solutions for Transportation Excellence

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SHORT DURATION RAINFALL FREQUENCY RELATIONS FOR CALIFORNIA

Ralph H. Frederick and John F. Miller

Office of Hydrology
National Weather Service, NOAA
Silver Spring, Maryland

The need for precipitation-frequency values for durations under 1 hour has increased greatly during the recent past. Drainage design for shopping center parking lots, cattle feed lots, storm sewer systems for urban developments, and other small drainage areas with their short periods of concentration require precipitation-frequency values for these durations. To partially meet this need NOAA Technical Memorandum NWS HYDRO-35, "Five- to 60-Minute Precipitation Frequency for the Eastern and Central United States," [Frederick et al. 1977] was published. This publication, unlike its predecessors, defines the geographic and frequency variation in short-duration rainfall over the relatively uncomplicated terrain of the Eastern and Central United States. Another common procedure is to develop ratios of the short-duration value to 1-hr (60-min) value derived from more abundant data. This procedure is used in the 11 Western conterminous United States where short-duration rainfall frequency values are still obtainable only as fixed ratios of the 1-hr values from NOAA Atlas 2 [Miller et al. 1973]. These ratios are based upon a nationwide average relationship developed from data for 200 National Weather Service stations and do not vary with region nor with return period.

For durations from 1 to 24 hours, NOAA Atlas 2 incorporates elevational, geographical and frequency differences in relations between the various durations. For durations less than 1 hour, there are few stations having N-min data extracted from their records. This has made a study of such relations difficult. There is, however, one data set that can be used to investigate such relations. The Resources Agency, Department of Water Resources of California, has abstracted annual maximum values for short (less than 1 hour) duration rainfall from recording raingages distributed throughout that State. These raingages are operated by a variety of federal, state, and local organizations and private utility companies. The data have been published in "Rainfall Analysis for Drainage Design, Volume 1, Short-Duration Precipitation Frequency Data," Bulletin 195, Department of Water Resources State of California [Goodridge 1976]. The data are also available on magnetic tape.

The annual maximum amount for 5-, 10-, 15-, 30-, and 60-min durations were extracted for each station in the data set which had at least 15 years of record. Only those years were used where data were available for each of the 5 durations. The data were used to form N-min (N=5, 10, 15, 30) to 60-min ratios.

There were 250 such stations distributed throughout the State. Elevations of these stations range from 30 feet below sea level to over 8,000 ft mean sea level. Figure 1 shows the geographical distribution of these stations. Stations at elevations above 4,000 ft are indicated by an X. Although the stations are reasonably evenly distributed, there is more concentration in the San Francisco and Los Angeles metropolitan areas, and a lack of data for the lee slopes of the Sierra Nevada, Death Valley, and Northeastern Desert areas of eastern California.

California is a State with a wide diversity of topographical and climatological regimes. Thus, state-wide averaging was not considered to be the best method. We, therefore, divided the State into 14 reasonably meteorologically and topographically homogeneous regions, figure 2. One of the defined regions, Death Valley and the northern part of the Desert, could not be analyzed since there were no recording raingage stations with data for durations of less than 1 hour for 15 or more years of record. The region east of the crest of the Sierra Nevada was analyzed in less detail than the remaining regions since there were a total of only seven stations in this region and the northern stations showed distinct differences from those south of approximately 39°N. These two regions are indicated in figure 2 as regions of no data and limited data, respectively. During the investigation comparison of station ratios indicated the three regions along the Sierras could be combined into one region, and those of the coastal mountains south of San Francisco Bay could be combined into another region. The preliminary boundaries are shown as dashed lines on figure 2 and the final regional boundaries by solid lines. Table 1 shows the number of stations (grouped by length of record) within each of the final regions. The average record length for the stations used was slightly over 25 years. The longest average record lengths were in the Central Valley, slightly over 30 years, North Pacific Coast, nearly 30 years, and the Sierra Nevada, slightly over 25 years. The shortest average record lengths, just over 20 years, were in the San Jacinto Basin and Southeast Desert.

The three regions with the most topographic variations are the Sierra Nevada, North Pacific Coast, and South Pacific Coast. Figure 3 shows by 1,000-ft elevation bands the percentage of stations for these three regions and for the entire state. Although a majority of the stations within these orographic regions are at the lower elevation, there is a reasonable percentage of

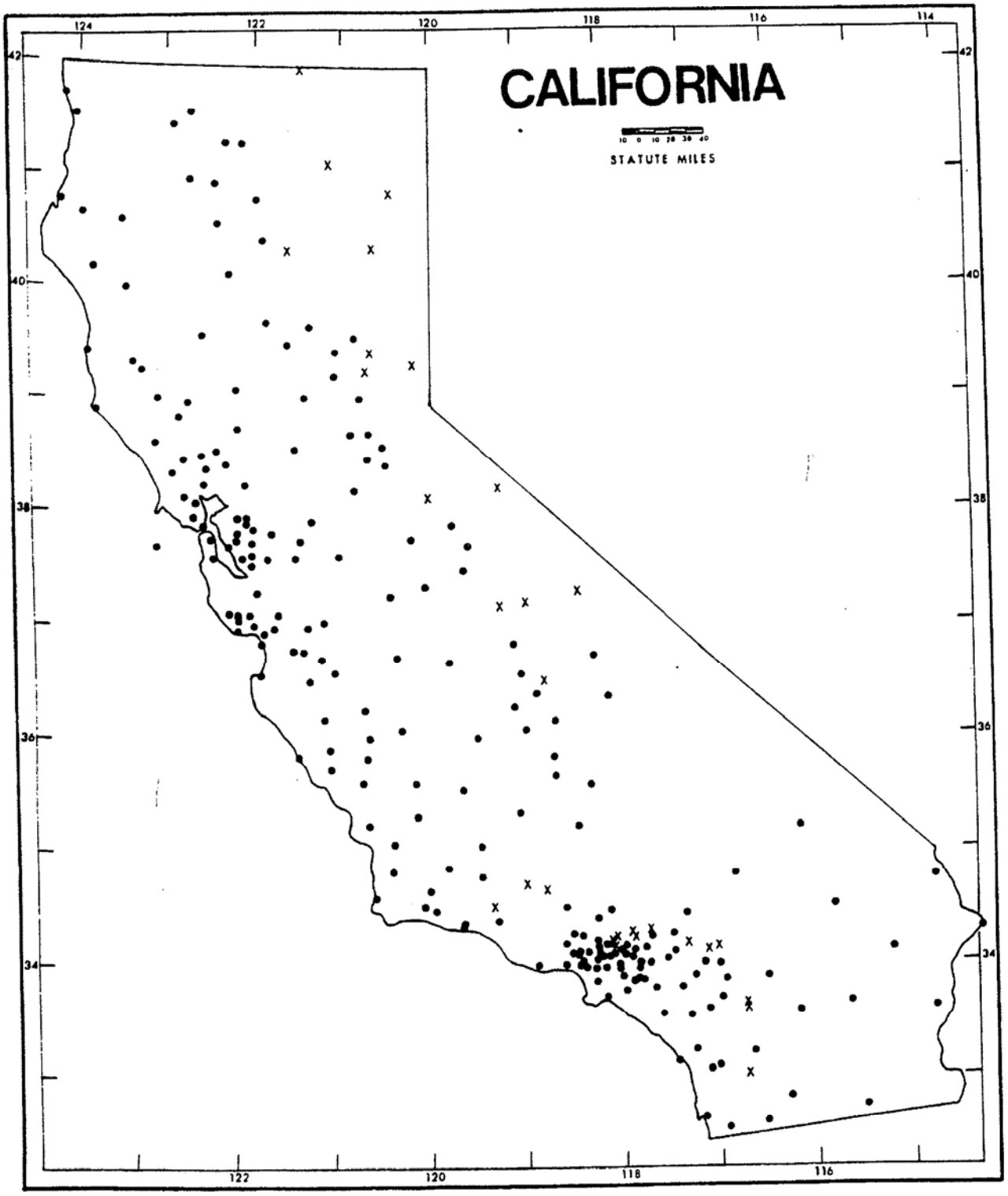

Figure 1.--Geographic distributions of stations used in this study.

Table 1.—Distribution of stations within each of the major geographic regions grouped by length of record.

Region \ Length of Record (yrs)	15-19	20-24	25-29	30-34	35-39	40-44	45-49	>50	Total No. of Stations
Sierra Nevada	3	12	8	16	1				40
Central Valley	2	1	2	9	2			3	19
North Pacific Coast	3	1	4	7				1	16
South Pacific Coast	26	15	20	14	13	13	3	2	106
Lee of Coastal Ranges	4	1	1	3					9
Southeast Desert	1	7	2						10
San Francisco Bay	13	9	5	3	1			2	33
San Jacinto Basin	2	2	1	1					6
Other	1	3	3	4					11
Total	55	51	46	57	17	13	3	8	250

stations at the higher elevations. For example, within the Sierra Nevada over 20% of the stations are above 4,000 feet.

For each of the 250 stations having at least 15 years of annual maximum 5- to 60-min amounts, frequency values were determined by fitting the Fisher-Tippett Type I Distribution to the series of annual maxima. The fitting method used was that developed by the late E. J. Gumbel [1958]. All subsequent analysis was done using ratios of 5-, 10-, 15-, and 30-min values to the 60-min value determined by the station-frequency analysis for return periods of 2, 5, 10, 25, 50, and 100 years. No attempt has been made to draw isopluvials of the N-min frequency values. We are instead seeking dimensionless relations between the N-min and 60-min values which can then be used in conjunction with the 1-hr (actually 60-min) values in NOAA Atlas 2, Volume XI: California.

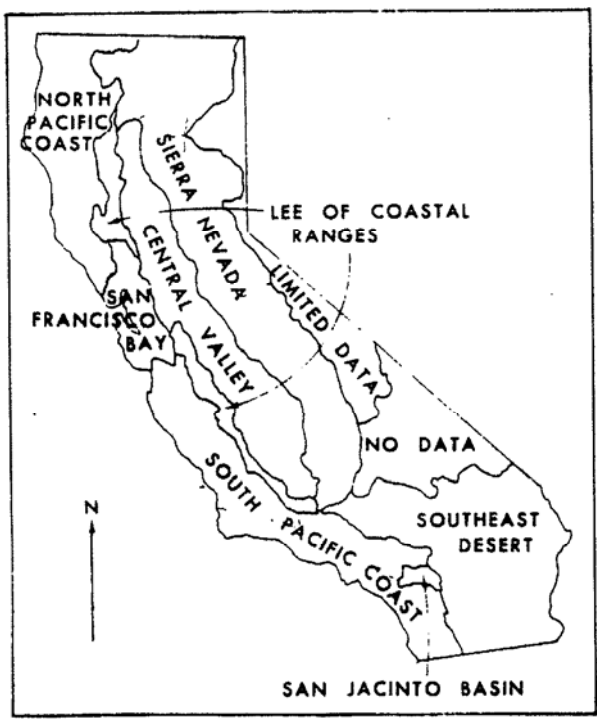

Figure 2.--Major geographic regions in California used to study short duration precipitation-frequency ratios.

For each of the physiographic regions originally outlined, an average of the station N-min to 60-min ratios for each duration for each return period was computed. At the same time a standard deviation (not shown) was computed to have a check on the internal consistency of the ratios within each region. This was done not only with equal weight for each station, but also with stations weighted by length of record. Results were so close between the weighted and unweighted values that it was concluded that no differences were involved. The results presented are for unweighted averages. Weighted standard deviations are, of course, smaller because of the apparently larger sample size.

The unweighted average ratios and standard deviations were compared for each of the 12 regions originally selected for which values could be determined. These comparisons showed that the three preliminary regions within the Sierra Nevada and the three preliminary regions of the South Pacific Coast had only negligible differences for the four ratios and six recurrence intervals considered. For this reason, the three regions of the Sierra Nevada and the three parts of the South Pacific Coast were each combined. Figure 4 is a plot of the average 5-

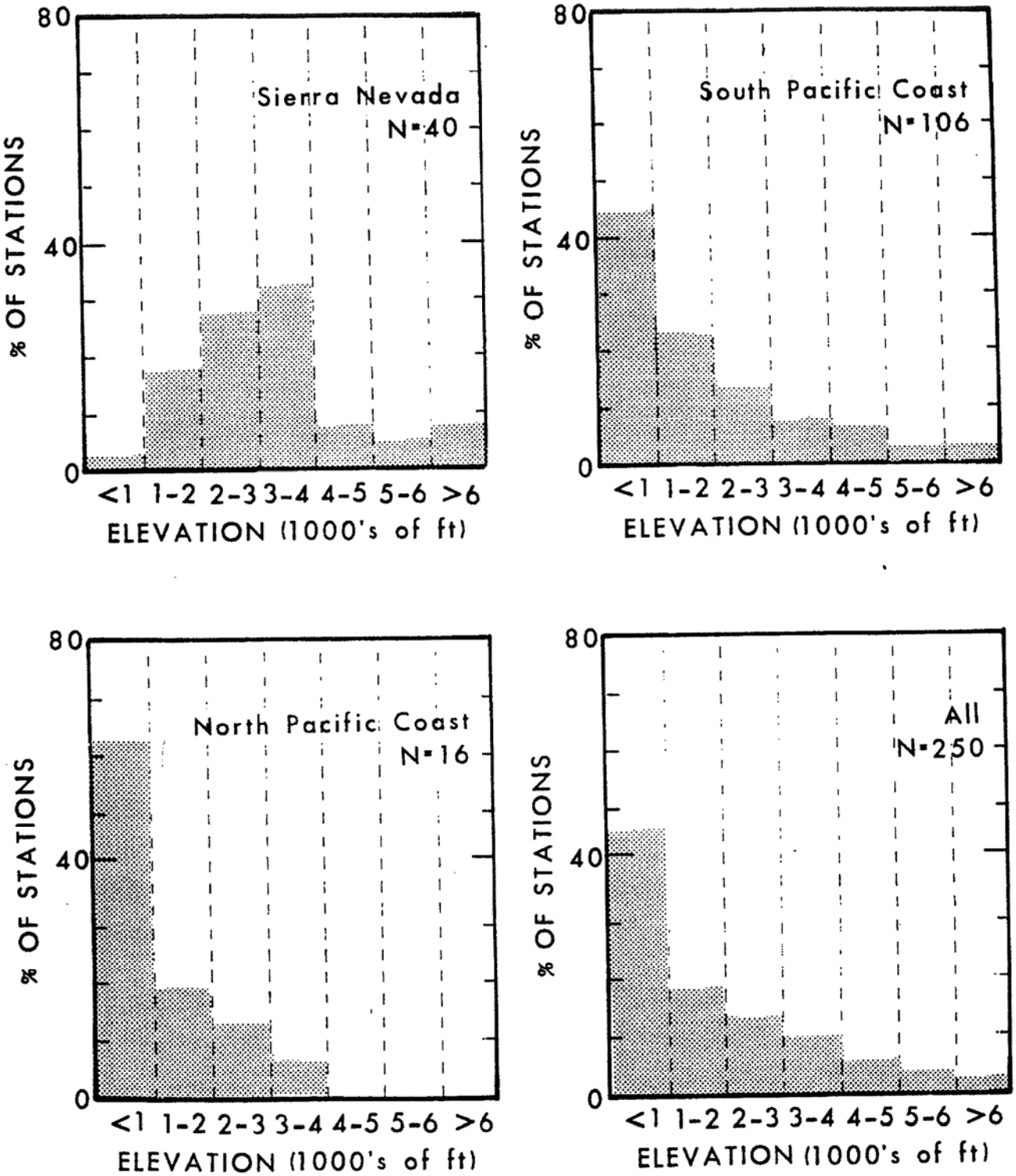

Figure 3.--Distribution of station elevation by 1,000-ft bands in major orographic regions of California and for all stations.

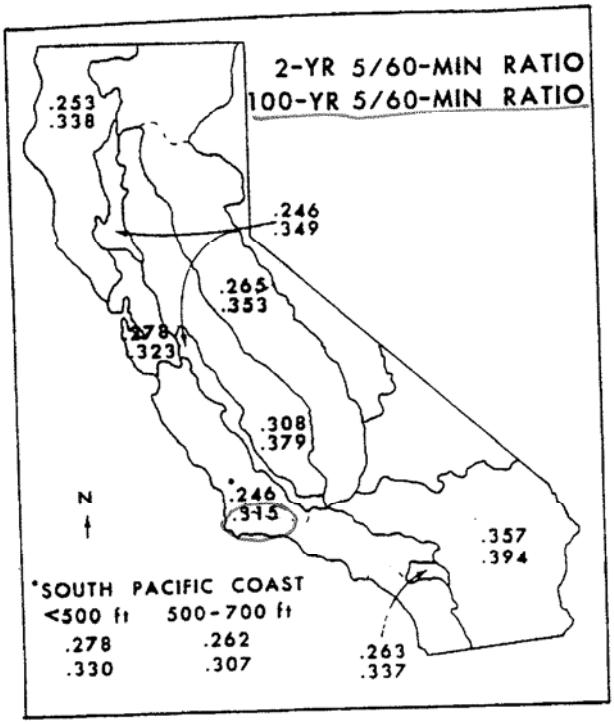

Figure 4.-- 5- to 60-min ratios for the 2- and 100-yr return periods for major geographic regions of California. Values for South Pacific Coast Region are for stations at elevations >700 ft.

to 60-min ratio for the 2- and 100-yr recurrence interval for the various regions. The lowest ratios are in the orographic and coastal areas. The highest ratios are in the Central Valley and the Southeastern Desert. These higher ratios are indicative of the more convective and short lived nature of the precipitation in these latter two regions.

In orographic and coastal regions, there is a continued vertical air motion resulting from topographic features that is relatively independent of atmospheric process. In mountainous regions during storm situations the prevailing winds blow against the mountains causing a forced ascent and vertical motion. In coastal regions, the prevailing winds move from a relatively frictionless surface to one with greater friction. This results in a horizontal convergence and some vertical motion. This is combined, even in the San Francisco Bay region, with ascent over coastal hills. These continued vertical motions in the atmosphere tend to prolong the precipitation and thus reduce the ratios between values for short durations. In addition, in the coastal regions and the Sierra Nevada the 5- and 60-min values nearly always come from general cyclonic storms during the colder portion of the year. In the Desert and Central Valley, in addition to having precipitation values from the general cyclonic storms during the cooler season, there are convective showers and thunderstorms that occur during the warmer months.

In precipitation-frequency studies it has been hypothesized that as the duration decreases, the N- to 60-min ratios are less dependent on elevation. The relation of N- to 60-min ratios to elevation was examined by correlating the station ratios with elevation within each region. The result confirms this hypothesis. In a few areas and for some return periods, the correlation coefficients did reach values in the 0.30 to 0.50 range and in most cases there was a negative correlation. However, it was not stable and not persistent. For example, in the preliminary north Sierra Region at the 2-yr return period correlations were -0.50 to -0.60. Correlation fell off rapidly as the return period increased, and at the 25-, 50-, and 100-yr return periods the coefficients were small with two positive and two negative ones. In the South Pacific Coastal Region, the correlations for the 5- to 60-min ratio with elevation varied between -0.31 for the 2-yr return period to 0.04 at the 100-yr return period.

Another method of examining the variation of ratios by elevation is to group stations by elevation bands. Figure 4 shows average 5- to 60-min ratios for the South Pacific Coastal Region by such elevation bands. Examination of these ratios shows a progression up the coastal ranges. For the area below 500 feet the ratio is 0.278. It decreases as one goes into the mountains and is 0.262 for 500-700 ft and 0.246 for the region above 700 ft. The ratio for all stations within the South Pacific Coastal Region for the 2-yr return period is 0.254 (not shown on fig. 4). When the data for the 100-yr recurrence interval is examined, however, one sees an interruption in the progression of the 5- to 60-min ratios the values being 0.330 (<500 ft) lowering to 0.307 (500-700 ft), then rising to 0.315 (>700 ft), and 0.394 (Desert), respectively, and for the region as a whole it is 0.317. The lowest ratio is now in the 500-700 ft elevation band. Scatter plots and plotting of the ratios on maps failed to reveal any factor which could produce a significant improvement over the average ratio shown.

Figure 5 shows the 30- to 60-min ratios for the 2- and 100-yr recurrence intervals. The geographic pattern is similar to that shown for the 5- to 60-min ratios. The lowest ratios again are in the coastal and orographic regions with the highest ratios in the Central Valley and Desert areas. If one again examines the ratios preceding eastward across the southern California coastal mountains, we see a decrease in ratios from the lowest elevation band, stations near the coast, into the lower foothills, elevation band 500 to 700 feet, and onto the slopes of the San Gabriel and San Bernardino Mountains and then an increase into the desert areas. Although the changes are consistent in both the 2- and 100-yr recurrence interval, the differences between the ratios are small. The 30- to 60-min ratio for the entire South Pacific Coastal Region is 0.679 for the 2-yr return period and 0.731 for the 100-yr return period. None of the differences between similar regions, e.g., the North Pacific Coastal and the South Pacific Coastal Regions, are meaningful at the 2-yr recurrence intervals. However, the differences between regions are larger and are greater than one standard deviation at the 100-yr return period.

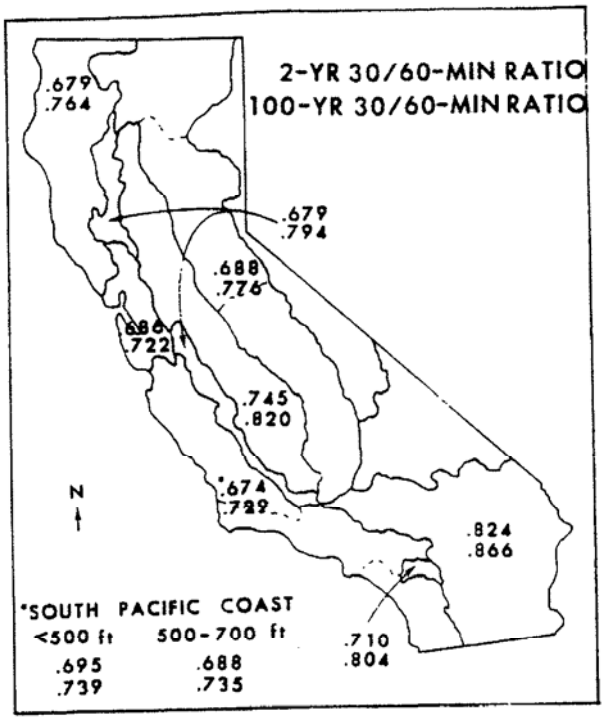

Figure 5.-- 30- to 60-min ratios for the 2- and 100-yr return periods for major geographic regions in California. Values for South Pacific Coast Region are for stations at elevations >700 ft.

The San Jacinto Basin in southern California is a relatively arid region. Moisture bearing winds must enter from the south-southwest or south across the Coastal Plain or across the barrier of the Santa Ana Mountains on the west that averages approximately 3,000 feet in elevation. These sheltering effects are evident when a comparison is made of ratios for stations in this basin with ratios from stations on nearby exposed coastal mountains. As expected, ratios for the sheltered valley stations are higher. They are slightly lower than the ratios for stations in the Central Valley. Ratios for this basin are probably indicative of those that would be found in other reasonably large sheltered valleys along mountain ranges. Valleys of more limited extent and those with a direct flow of moisture bearing winds would not show this difference in 30- to 60-min or 5- to 60-min ratios.

In the Eastern and Central United States, the N-min to 60-min ratios decrease with increasing return periods, i.e., 5- to 60-min ratio at the 100-yr return period was smaller than at the 2-yr return period. In the California sample, the reverse is true. For example, in the San Francisco area the 5- to 60-min ratio at the 100-yr return period is 116% of the same ratio at the 2-yr return period. Figure 6 shows the variation of ratio of 10- to 60-min values with return period for four of the regions of California. The variation for the other regions and durations is similar: the ratio increases as the recurrence interval increases. The increase is not linear and has some tendency to become asymptotic at some point. The short record does not permit any conclusions on when this point is reached. The important thing is that the ratio increases for all regions. Of the 250 stations, only 18 had each of the 5-, 10-, 15-, and 30-min to 60-min ratios that decreased with increasing return period. Forty other stations had one or more N-min ratio that decreased with increasing return period. The other 192 stations had N-min to 60-min ratios that all increased as the return period increased for all durations.

Another duration investigated in this study was the 15-min period. Table 2 shows the 15- to 60-min ratios for the eight geographic regions investigated. The same feature evident in the data for the other durations is evident here. The highest ratios are in the Central Valley and the Southeast Desert with the San Jacinto Basin being somewhat intermediate between those and the orographic and coastal regions. The lowest ratios are in the coastal areas with the Sierra Nevada being just slightly higher. The ratios increase with increasing return period.

There are seven stations in the region to the lee of the Sierra Nevada crest between 36° 30'N and nearly 41°N, a distance of about 350 miles. The stations range in elevation from approximately 3,800 feet to slightly over 6,500 feet. The four southern stations, which include the lowest and highest elevations, have ratios

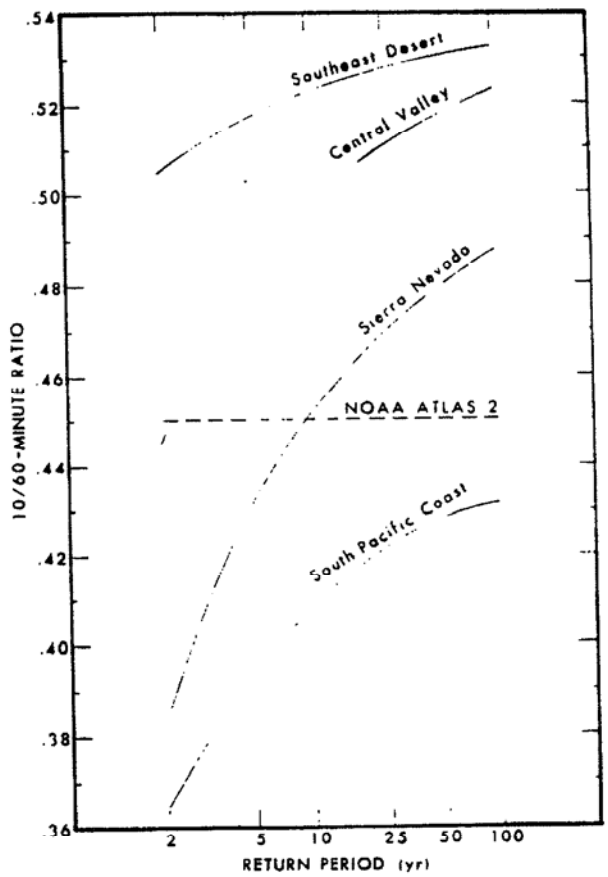

Figure 6.--Variation of 10- to 60-min ratio with return period for the South Pacific Coastal, Sierra Nevada, Central Valley and Southeast Desert Regions of California.

Table 2.-- 15- to 60-min ratios for major geographic regions of California

Region \ Return Period (yrs)	2	5	10	25	50	100	Number of Stations
Sierra Nevada	.485	.534	.554	.571	.581	.589	40
Central Valley	.551	.598	.616	.632	.641	.648	19
North Pacific Coast	.467	.514	.534	.554	.565	.574	16
South Pacific Coast - >700 ft	.461	.492	.505	.516	.522	.527	77
South Pacific Coast - 500-700 ft	.481	.499	.507	.514	.518	.521	9
South Pacific Coast - <500 ft	.495	.521	.531	.541	.546	.550	20
South Pacific Coast - Entire Reg.	.469	.498	.510	.521	.526	.531	106
Lee of Coastal Range	.470	.529	.552	.572	.583	.592	9
Southeast Desert	.633	.653	.661	.668	.671	.674	10
San Francisco Bay	.481	.502	.512	.520	.525	.529	33
San Jacinto Basin	.504	.555	.575	.593	.603	.611	6

which are similar to those in the lee of the coastal mountains. The three northern stations, all north of 39°N, have ratios that are approximately the same as those in the Southeastern Desert. It is impossible, therefore, to draw any conclusions. It will require considerably more data or the ability to relate these variations to some other physiographical factor before reliable ratios can be used in the lee of the Sierra Nevada.

It was the initial aim of this investigation to develop meaningful relations that could be extended by use of index relations to other parts of the west. We have been able to define variations between geographical regions in California. The Central Valley, a wide flat agricultural valley, is different from the Southeastern Desert Region of California. These two regions have different 5- to 60-min, 10- to 60-min, etc., ratios than the slopes of the Sierra Nevada or the coastal mountains. It would be misleading to take a limited sample of stations with short-duration precipitation that are located primarily on valley floors and to extend these ratios into the surrounding mountainous regions. If the (primary) interest, however, is in peak rates of runoff use of valley ratios and thus concentrating precipitation into shorter time increments would produce a higher peak. This use of ratios determined from valley floor stations would then tend to be conservative. Investigations are continuing with the intent of developing a methodology which would permit the use of a limited sample of stations to develop meaningful geographic variations in the relations of extreme short duration precipitation to 1-hr values.

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Appendix H

Settlement Calculations

APPENDIX H
SETTLEMENT CALCULATIONS

This appendix describes the basic assumptions and methodology of estimating the settlement that could occur in each of the capped areas within the San Luis Obispo Tank Farm.

METHODOLOGY

Reservoirs 3, 5, and 7 will be excavated and capped as indicated in the remedial design. The depths of excavation and final grade after backfilling and compaction vary with each area. The Northwest Operations Area and Reservoir 4 will not be excavated. However, both of these areas will be capped, the Northwest Operations Area with a cap with an maximum thickness of 7 feet and Reservoir 4 with a cap having a maximum thickness of 14 feet. Placement and compaction of the capping soil over the existing soil could result in surcharge loads. This additional surcharge could result in compaction and densification of the underlying soil, thereby causing compression settlement. Any geotextile placed between the base soil and backfill soil could experience tensile stresses and undergo elongation due to the settlement. Estimation of settlement becomes necessary to ensure that the allowable tensile stress and strain in the geotextile are not exceeded. It also helps ensure that excessive settlement does not occur, especially if the capped area is to be developed in the future.

SETTLEMENT DUE TO PRIMARY COMPRESSION

The amount of settlement by primary compression may be estimated using the following, widely used equation:

$$S_c = C_c/(1+e_0) \times H_0 \times \log \{(P_i + \Delta P)/P_i\}$$

where:

S_c = magnitude of settlement by primary compression (ft)
H_o = mid-point thickness of existing soil (ft)
C_c = compression index
e_o = initial void ratio of waste
P_i = vertical stress before loading
ΔP = increment in stress after loading

The compression index (C_c) is often expressed as:

$$C_c = (e_0 - e_1)/(\log P_1 - \log P_i)$$

where:

e_1 = final void ratio of waste
P_1 = vertical stress after loading

Initial void ratio is, in turn, often expressed in terms of porosity (n). Based on historical boring logs, the soil in Reservoir 7 is silty clay, Reservoir 3 is a silty sand, and soil in the Northwest Operations Area is sandy clay (CL) down to approximately 5 feet below ground surface. Literature values of "n" for moderately compacted silty clays (CH), sandy clay (CL), and silty sands (SM) are typically between 0.4 to 0.5 (Schroeder, 1994). Since the existing soil in all the areas has been in place for several years, for the purpose of this calculation, Avocet has assumed initial porosity values corresponding to moderately compacted soils in Reservoir 4 and well-compacted soils in Reservoir 3 and the Northwest Operations Area. The final porosity values were assumed to be slightly lower to account for the possible compaction. Table H.1 summarizes the values used in the settlement calculations.

Using the widely used formula:

$$e_o = n/(1-n)$$

the corresponding value of e_o and e_1 values were calculated. Assuming the weight of fill soil as 120 pounds per cubic foot (pcf), the proposed backfill depths were used to estimate corresponding C_c for each of the areas. This weight included additional weight due to moving machinery and compaction equipment.

This value was substituted in the S_c formula to estimate the settlement.

Northwest Operations Area

The Northwest Operations Area will not be excavated. A cap with a maximum thickness of 7 feet (average thickness of 5.5 feet) will be constructed over the existing ground after demolition and clearing activities. A geotextile will be placed over the existing ground, primarily as a separation layer. Using the above equation, assuming 5 feet of the existing soil undergoing deformation, a maximum settlement of 6.5 inches is estimated for this capped area.

To calculate the deformation in the geotextile, the cross section with the highest backfill soil depth and shortest span of affected liner was used. Assuming that the maximum settlement of 6.5 inches occurs at the point of maximum thickness (7 feet), the total deformation is estimated to be approximately 0.007 inches with a negligible strain induced (Table H.2).

Reservoir 3

Reservoir 3 has a concrete bottom with existing soil up to 11 feet deep. During capping of Reservoir 3, approximately 2 feet of soil will be excavated and backfilled with 1 foot of gravel and o1 foot of topsoil. A geotextile will be provided over the subgrade to act as a separation layer between the existing base and overlying gravel layer. A geogrid will be provided midway within the gravel layer. A geomembrane sandwiched between two geotextiles will be provided between the common earth fill and gravel. Using the above equation, a maximum settlement of 4 inches is estimated for this capped area.

To calculate the deformation in the geotextile, the cross section with the highest backfill soil depth and shortest span of affected liner was used. Assuming that the maximum settlement of 4 inches occurs at the point of maximum thickness (3.5 feet), the total deformation is estimated to be approximately 0.002 inch with a negligible strain induced (Table H.2).

Due to the importance of this cap, an additional strain was also calculated assuming that the underlying soil settles by 2 feet (very conservative). Possible strain induced in the geosynthetics due this 2 feet of settlement was also found to be negligible in comparison to the strength of the different geosynthetic materials.

Reservoir 4

Reservoir 4 has a concrete bottom with existing soil up to 5 feet deep. Soil in Reservoir 4 will not be excavated. A geotextile will be placed on the existing soil, followed by a cap with a maximum height of 14 feet over the geotextile. Placement and compaction of the capping soil may result in settlement of the underlying soil. Using the above equation, a maximum settlement of 4.6 inches is estimated for this capped area.

To calculate the deformation in the geotextile, the cross section with the highest backfill soil depth and shortest span of affected liner was used. Assuming that the maximum settlement of 4.6 inches occurs at the point of maximum thickness (14 feet), the total deformation is estimated to be approximately 0.004 inch with a negligible strain induced (Table H.2).

Reservoir 5

Reservoir 5 has a concrete bottom. During capping, the reservoir will be excavated down to the bottom. Approximately 4 feet of gravel will be provided over the concrete base, followed by a maximum of 8 feet of structural fill. A geotextile will be placed between the gravel layer and the structural fill. Since the reservoir has a concrete bottom and the gravel is not expected to undergo any significant compaction, settlement in the gravel layer is not anticipated. Hence, settlement calculations for Reservoir 5 have not been carried out.

Reservoir 7

Reservoir 7 also has a concrete bottom. During capping, the reservoir will be excavated down to the bottom. Approximately 8 to 10 feet of gravel will be provided over the concrete base, followed by a maximum of 10 feet of structural fill. A geotextile will be placed between the gravel layer and the structural fill. Since the reservoir has a concrete bottom and the gravel is not expected to undergo any significant compaction, settlement in the gravel layer is not anticipated. Hence, settlement calculations for Reservoir 7 have not been carried out.

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Tables

Table H.1
Summary of Settlement Calculations
Chevron San Luis Obispo Tank Farm
San Luis Obispo, California

Area	Depth of Existing Soil[1]	γ_A (pcf)	P_i (psf)	Height of Cap (feet)	γ_B (pcf)	P_1 (psf)	n_o	e_0	n_1	e_1	C_c	S_c	
												(feet)	(inches)
NW Area	5	100	500	7	120	840	0.465	0.87	0.4	0.67	0.47	0.54	6.50
Reservoir 3	6.5	100	650	3.5	120	420	0.45	0.82	0.42	0.72	0.43	0.34	4.03
Reservoir 4	2.5	100	250	14	120	1680	0.45	0.82	0.35	0.54	0.32	0.38	4.62

Notes:
(1) Depth corresponds to mid-point of the existing soil column.
(2) Value of initial porosity for Reservoir 4 used corresponds to moderately compacted soil.
(3) Value of initial porosity for Reservoir 3 and the Northwest Area used correspond to well compacted soils.

Table H.2
Estimate of Elongation in Geosynthetic Material
Chevron San Luis Obispo Tank Farm
San Luis Obispo, California

Area	Estimated Settlement (feet)	Settlement Length (feet)	Angle of Settlement δ	Change in Length (feet)	Geotextile Elongation (inches)	Strain (%)
NW Area	0.54	240	0.13	240.00061	0.007	2.55E-04
Reservoir 3	0.34	280	0.07	280.00020	0.002	7.21E-05
	2.00	280	0.41	280.00714	0.086	2.55E-03
Reservoir 4	0.38	200	0.11	200.00037	0.004	1.85E-04

Note:
A theoretical settlement of 2 feet in Reservoir 3 has been used to estimate the strain in the geosynthetics, in addition to those caused by the settlement calculated in Table H.1.

Appendix I

Geosynthetic Calculations

APPENDIX I
GEOSYNTHETIC CALCULATIONS

This appendix describes the basic assumptions and methodology of estimating the tensile stresses in the geotextiles due to settlement of the underlying soil, and the design calculations for geotextile anchor trenches at all the capped areas within the San Luis Obispo Tank Farm.

METHODOLOGY

Tensile Stress in Geosynthetics

Tensile stresses in the geosynthetics are primarily due to their self weight on slopes, temperature fluctuations, and settlement of the underlying soil. After ensuring that these stresses do not exceed the allowable strength of the geosynthetic material, anchor trenches are designed to resist these tensile stresses.

Since all the geosynthetic will be constructed over relatively flat surfaces (a maximum slope of 0.5 percent in Reservoir 3), stresses due to self weight will be negligible. Stresses due to temperature fluctuations should also be minimal as long as they are covered immediately after installation. The major stresses would primarily occur due to settlement of the underlying soil.

Estimation of settlement of the existing soil due to surcharge loads introduced during placement and compaction of capping soil, and corresponding strain in the geosynthetic materials above, have been calculated in Appendix H. Settlement of the underlying soil causes a strain in the geosynthetic material, thereby introducing tensile stresses in it.

To calculate the tensile stress in the geosynthetic material, the Modulus (E) is first calculated using the following formula, as provided in "Designing with Geosynthetics":

$$E = T_{ultimate} / \text{Ultimate Strain}$$

where:

$T_{ultimate}$ = Ultimate tensile force in geotextile (lb/ft)

Typically, an intermediate point on the Tensile Stress versus Strain curve for a particular geosynthetic is used to calculate E. However, lacking product-specific data, the ultimate stress and strain values are used, which provides a more conservative E value. The $T_{ultimate}$ values for an 8-ounce (oz) and 12-oz geotextile were obtained from the product specifications supplied by Polyfelt, Inc. (Koerner, 1990). The $T_{ultimate}$ value for 40-mil geomembrane was obtained from the product specifications supplied by Polyflex, Inc. (Koerner, 1990) by multiplying the ultimate stress by the thickness of the geomembrane.

The actual tensile stress developed in the geotextile due to settlement was then calculated as:

$$T_{actual} = E \text{ x Calculated Strain}$$

Appendix I
Geosynthetic Calculations

T_{actual} is compared with the allowable tensile stress ($T_{allowable}$) in the proposed geotextile. The selected geotextile was accepted if T_{actual} was less than $T_{allowable}$. $T_{allowable}$ is calculated as:

$$T_{allowable} = T_{ultimate}/\text{FS}$$

where:

FS = Factor of Safety = 2 for geotextile, 3 for geomembrane

A summary of the calculations for the relevant capped areas is provided in Table I.1.

Anchor Trench Design

All anchor trenches will be 3 feet deep by 1 foot wide. The geosynthetic material will be laid inside the trench, as shown in Figure I-1.

Force resisting capacity of this anchor trench design was estimated using the method suggested in "Designing with Geosynthetics" by Koerner (1990). In order to establish static equilibrium, the system is conceptualized as being a system of frictionless pulleys, thereby allowing the geotextile to be considered in its continuous form (Figure I-1).

Accordingly, the available force is given by:

$$T_{available} = F_{U1} + F_{L1} + (2 \text{ x } F_{AT1}) + F_{U2} + F_{L2} + (2 \text{ x } F_{AT2})$$

where:

$T_{available}$ = Available force capacity of trench design (lb/ft)
F_{U1} = friction force above geosynthetic = 0 (due to potential soil movement with geosynthetic)
$F_{L1} = q_1 \text{ x } \tan\delta \text{ x } L_{RO1}$ (lb/ft)
q_1 = surcharge pressure = $d_{cs} \text{ x } \gamma_{cs}$ (psf)
d_{cs} = height of fill above geotextile above trench (ft)
γ_{cs} = weight of soil (pcf)
L_{RO1} = runout length (psf)
$F_{AT1} = (\sigma_h)_{avg} \text{ x } \tan\delta \text{ x } d_{AT1}$
σ_h = average horizontal stress in anchor trench = $K_o \text{ x } \sigma_v$
$\sigma_v = \gamma_{cs} \text{ x } H_{avg}$
H_{avg} = average depth of anchor trench (ft)
$K_o = 1 - \sin\varphi$
φ = angle of shearing resistance of backfill soil
d_{AT1} = depth of anchor trench (ft)

Appendix I
Geosynthetic Calculations

Forces F_{U2}, F_{L2}, F_{AT2} are similar to the ones described above with the corresponding depths, as shown in Figure I-1.

A summary of the calculations for the Northwest Operations Area, Reservoir 4, and Reservoir 3 is provided in Tables I.1 through I.4, respectively. Based on the calculations, it is evident that the pullout resistance offered by the proposed anchor trench design is more than adequate to handle the possible tensile forces that may arise in the geosynthetic material due to settlement. In addition, the pullout resistance offered by the anchor trench is lower than the ultimate tensile yield strength of the geosynthetic materials. This means that the geosynthetic will pull out of the trench before it tears, which is what is typically desired. However, due to the negligible tensile stresses, the pullout forces are not expected to be mobilized and pull-out of the geosynthetic materials is not expected to occur.

Anchor trench calculations for Reservoirs 5 and 7 have not been included because no appreciable settlement is anticipated in these reservoirs due to their proposed configuration.

REFERENCES

Koerner, R.M., 1990, Designing with Geosynthetics, Prentice Hall, New Jersey.

Schroeder, P.R., T.S. Dozier, P.A. Zappi, B.M. McEnroe, J.W. Sjostrom, and R.L. Peyton, September 1994, *The Hydrologic Evaluation of Landfill Performance (HELP) Model: Engineering documentation for Version 3*, EPA/600/9-94, U.S. Environmental Protection Agency Risk Reduction Engineering Laboratory, Cincinnati, Ohio.

Tables

Table I.1
Anchor Trench Design - Northwest Operations Area
Chevron San Luis Obispo Tank Farm
San Luis Obispo, California

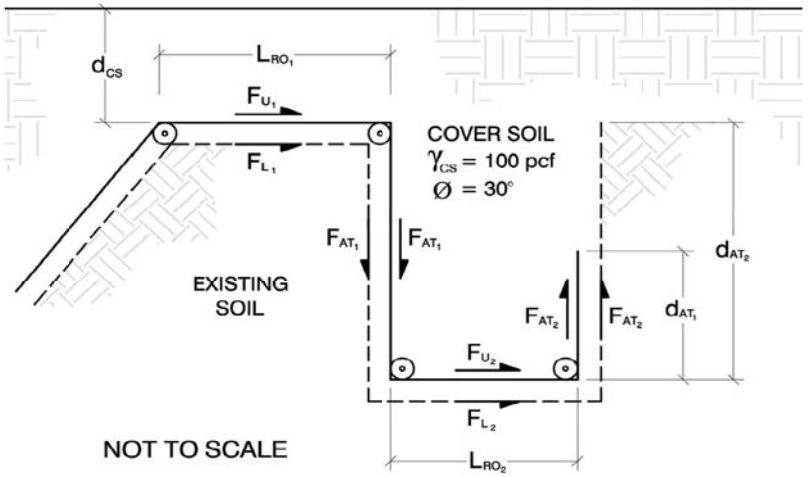
NORTHWEST OPERATIONS AREA

Estimated Tension in Geotextile due to Settlement

Ultimate Tensile Strength	$T_{ultimate}$	1260.0	lb/ft	Using data corresponding to a typical 8oz. Geotextile (Polyfelt, Inc.)
Strain	ε	0.95		
Modulus	E	1326.3	lb/ft	
Strain due to Settlement		2.55E-06		
Tensile Force on Geotextile	T_{actual}	3.38E-03	lb/ft	

Estimated Capacity of Anchor Trench

Depth of Cover	d_{cs}	2.0	ft	
Weight of soil	γ_{cs}	100.0	pcf	
Upper Surcharge Pressure	q_u	200.0	psf	
Lower Surcharge Pressure	q_L	200.0	psf	
Friction angle between geotextile & soil	δ_L	25.0	degrees	
Average Depth of Trench	H_{avg1}	5.0	ft	
Average horizontal stress	σ_{v1}	500.0	psf	
Depth of anchor trench	d_{AT1}	3.0	ft	
Average Depth of Trench	H_{avg2}	1.0	ft	
Average horizontal stress	σ_{v2}	100.0	psf	
Depth of geotextile on other side	d_{AT2}	1.0	ft	
Runout length	L_{RO1}	1.0	ft	
Trench width	L_{RO2}	1.0	ft	
Angle of shearing resistance of soil	φ	30.0	degrees	
Equal to 1-Sinφ	K_o	0.5		
Geotextile Tensile Strength	$T_{ultimate}$	105	lb/in	Typical value for a 8oz. Non-woven geotextile



F_{U1} lb/ft	F_{L1} lb/ft	$2*F_{AT1}$ lb/ft	F_{U2} lb/ft	F_{L2} lb/ft	$2*F_{AT2}$ lb/ft	$F_{available}$ lb/ft	$T_{allowable}$ lb/ft	FS	$T_{ultimate}$ lb/ft
0	0	699	233	233	47	1,212	630	2	1,260

T_{actual} < $T_{allowable}$ O.K.

$F_{available}$ > $T_{ultimate}$ Hence geotextile will pullout before it tears.

Table I.2
Anchor Trench Design - Reservoir 4
Chevron San Luis Obispo Tank Farm
San Luis Obispo, California

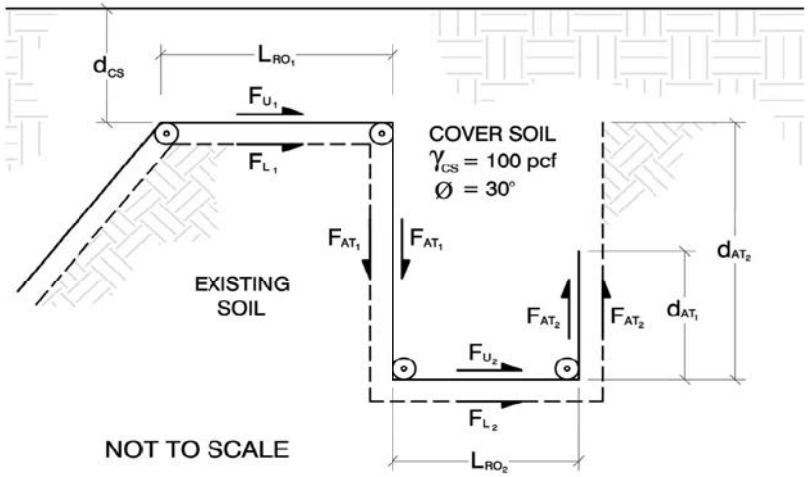
RESERVOIR 4

Estimated Tension in Geotextile due to Settlement

Ultimate Tensile Strength	$T_{ultimate}$	1620.0	lb/ft	Using data corresponding to a typical 12oz. Geotextile (Polyfelt, Inc.)
Strain	ε	0.95		
Modulus	E	1705.3	lb/ft	
Strain due to Settlement		1.85E-06		
Tensile Force on Geotextile	T_{actual}	3.15E-03	lb/ft	

Estimated Capacity of Anchor Trench

Depth of Cover	d_{cs}	2.5	ft	
Weight of soil	γ_{cs}	100.0	pcf	
Upper Surcharge Pressure	q_u	250.0	psf	
Lower Surcharge Pressure	q_L	250.0	psf	
Friction angle between geotextile & soil	δ_L	25.0	degrees	
Average Depth of Trench	H_{avg1}	5.5	ft	
Average horizontal stress	σ_{v1}	550.0	psf	
Depth of anchor trench	d_{AT1}	3.0	ft	
Average Depth of Trench	H_{avg2}	1.0	ft	
Average horizontal stress	σ_{v2}	100.0	psf	
Depth of geotextile on other side	d_{AT2}	1.0	ft	
Runout length	L_{RO1}	1.0	ft	
Trench width	L_{RO2}	1.0	ft	
Angle of shearing resistance of soil	φ	30.0	degrees	
Equal to 1-Sinφ	K_o	0.5		
Geotextile Tensile Strength	$T_{ultimate}$	135	lb/in	Typical value for a 12oz. Non-woven geotextile



F_{U1} lb/ft	F_{L1} lb/ft	$2*F_{AT1}$ lb/ft	F_{U2} lb/ft	F_{L2} lb/ft	$2*F_{AT2}$ lb/ft	$F_{available}$ lb/ft	$T_{allowable}$ lb/ft	FS	$T_{ultimate}$ lb/ft
0	0	769	256	256	47	1,329	810	2	1,620

T_{actual} < $T_{allowable}$ O.K.

$F_{available}$ > $T_{ultimate}$ Hence geotextile will pullout before it tears.

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Table I.3
Anchor Trench Design-Reservoir 3
Chevron San Luis Obispo Tank Farm
San Luis Obispo, California

RESERVOIR 3

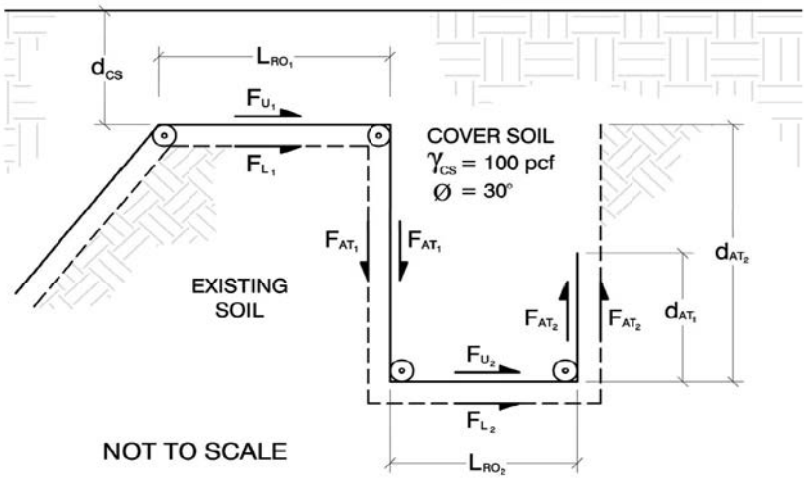
Estimated Tension in Geotextile due to Settlement

Ultimate Tensile Strength	$T_{ultimate}$	1,620	lb/ft	Using data corresponding to a typical 12oz. Geotextile (Polyfelt, Inc.)
Strain	ε	0.95		
Modulus	E	1,705	lb/ft	
Strain due to Settlement		2.55E-05		
Tensile Force on Geotextile	T_{actual}	4.35E-02	lb/ft	

Estimated Capacity of Anchor Trench

Depth of Cover	d_{cs}	1.0	ft
Weight of soil	γ_{cs}	100.0	pcf
Upper Surcharge Pressure	q_u	100.0	psf
Lower Surcharge Pressure	q_L	100.0	psf
Friction angle between geotextile & soil	δ_L	25.0	degrees
Average Depth of Trench	H_{avg1}	4.0	ft
Average horizontal stress	σ_{v1}	400.0	psf
Depth of anchor trench	d_{AT1}	3.0	ft
Average Depth of Trench	H_{avg2}	1.0	ft
Average horizontal stress	σ_{v2}	100.0	psf
Length of geotextile on other side	d_{AT2}	1.0	ft
Runout length	L_{RO1}	1.0	ft
Trench width	L_{RO2}	1.0	ft
Angle of shearing resistance of soil	φ	30.0	degrees
Equal to 1-Sinφ	K_o	0.5	
Geotextile Tensile Strength	$T_{ultimate}$	135	lb/in

Typical value for a 12oz. Non-woven geotextile



F_{U1} lb/ft	F_{L1} lb/ft	$2*F_{AT1}$ lb/ft	F_{U2} lb/ft	F_{L2} lb/ft	$2*F_{AT2}$ lb/ft	$F_{available}$ lb/ft	$T_{allowable}$ lb/ft	FS	$T_{ultimate}$ lb/ft
0	47	560	187	187	47	1,026	810	2	1,620

T_{actual} < $T_{allowable}$ O.K.

$F_{available}$ > $T_{ultimate}$ Hence geotextile will pullout before it tears.

Table I.4
Anchor Trench Design-Reservoir 3
Chevron San Luis Obispo Tank Farm
San Luis Obispo, California

RESERVOIR 3

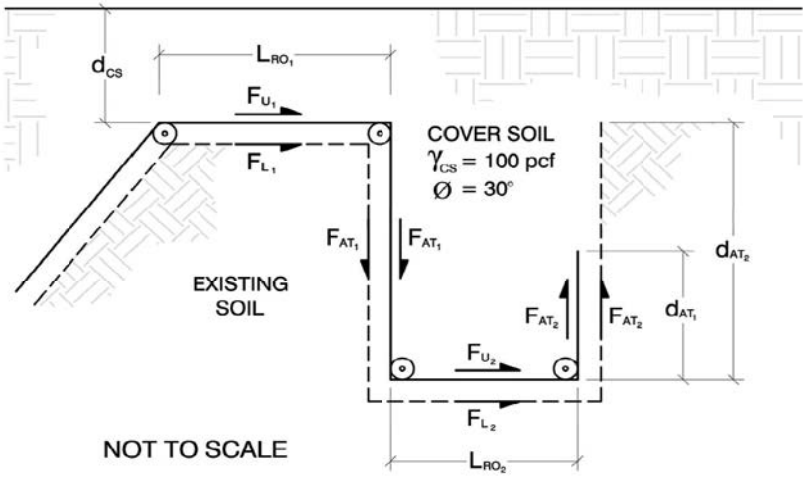
Estimated Tension in Geomembrane due to Settlement

Ultimate Tensile Strength	$T_{ultimate}$	1,536	lb/ft	Using data corresponding to a typical HDPE geomembrane (at yield).
Strain	ε	0.11		
Modulus	E	13,964	lb/ft	
Strain due to Settlement		2.55E-05		
Tensile Force on Geotextile	T_{actual}	0.36	lb/ft	

Estimated Capacity of Anchor Trench

Depth of Cover	d_{cs}	1.0	ft
Weight of soil	γ_{cs}	100.0	pcf
Upper Surcharge Pressure	q_u	100.0	psf
Lower Surcharge Pressure	q_L	100.0	psf
Friction angle between GM & geotextile	δ_L	8.0	degrees
Average Depth of Trench	H_{avg1}	4.0	ft
Average horizontal stress	σ_{v1}	400.0	psf
Depth of anchor trench	d_{AT1}	3.0	ft
Average Depth of Trench	H_{avg2}	1.0	ft
Average horizontal stress	σ_{v2}	100.0	psf
Length of geotextile on other side	d_{AT2}	1.0	ft
Runout length	L_{RO1}	1.0	ft
Trench width	L_{RO2}	1.0	ft
Angle of shearing resistance of soil	φ	30.0	degrees
Equal to 1-Sinφ	K_o	0.5	
Geomembrane Yield Tensile Stress	$\sigma_{ultimate}$	3,200	lb/in^2

Typical value for a HDPE geomembrane (Koerner, 1990).



F_{U1} lb/ft	F_{L1} lb/ft	$2*F_{AT1}$ lb/ft	F_{U2} lb/ft	F_{L2} lb/ft	$2*F_{AT2}$ lb/ft	$F_{available}$ lb/ft	$T_{allowable}$ lb/ft	FS	$\sigma_{ultimate}$ lb/in^2
0	14	169	56	56	14	309	512	3	3,200

T_{actual} < $T_{allowable}$ O.K.

$F_{available}$ > $T_{ultimate}$ Hence geomembrane will pullout before it tears.

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Figures

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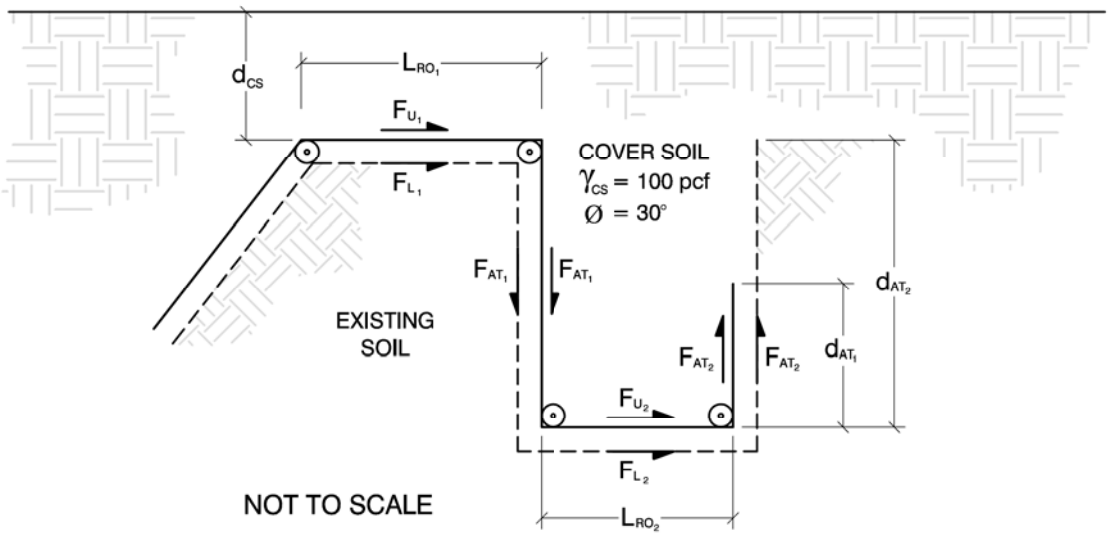
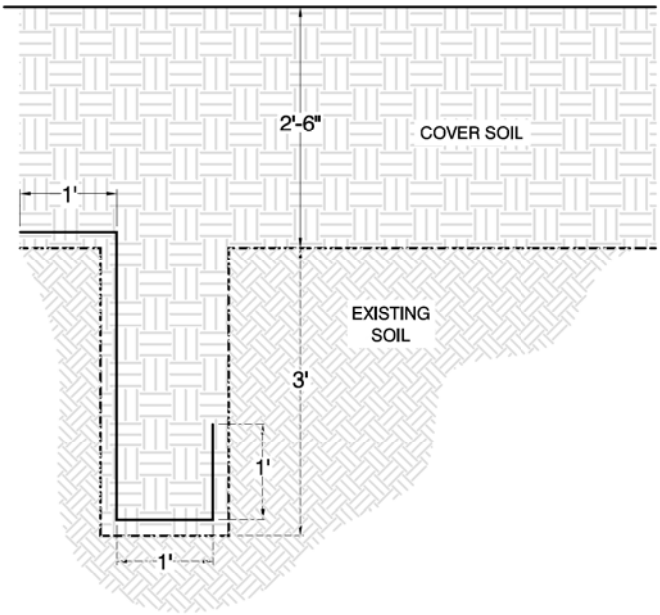


TYPICAL SECTION

ANCHOR TRENCH CALCULATIONS



TYPICAL SECTION

ANCHOR TRENCH DIMENSIONS

0 2 4 FEET

SCALE

FIGURE I-1

TRENCH DESIGN

REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM

PREPARED FOR

CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA

AVOCET ENVIRONMENTAL, INC.

Attachment 1

Supporting Information

GEOTEXTILE PRODUCT DIRECTORY

	Product Name	Structure Woven/ Nonwoven	Polymer [1]	Dimensional Properties: Roll Width/Length m (ft)	Thickness ASTM D1777-64 [2] mm (mils)	Mass Per Unit Area ASTM D3776-84 g/m² (oz/yd²)	Permeability/Filtration Properties: Nonwoven Porosity (calculated) or woven percent open area CWO-02215-86 %	Apparent Opening Size ASTM D4751-87 mm (U.S. Standard Sieve Size)	Permittivity ASTM D4491-85 sec⁻¹
Polyfelt Inc.	TS210	nonwoven	polypropylene	4.6/244 (15/800)	1.1 (43)	92 (2.7)	>85	.30–.70 (50–25)	4.6
	TS220	nonwoven	polypropylene	4.6/244 (15/800)	1.2 (47)	112 (3.3)	>85	.21–.60 (70–30)	4.2
	TS420	nonwoven	polypropylene	4.6/110 (15/360)	1.4 (55)	129 (3.8)	>85	.21–.50 (70–35)	3.6
	TS500	nonwoven	polypropylene	4.6/110 (15/360)	1.5 (60)	153 (4.5)	>85	.18–.43 (80–40)	3.3
	TS550	nonwoven	polypropylene	4.6/110 (15/360)	1.8 (70)	186 (5.5)	>85	.18–.35 (80–45)	2.8
	TS600	nonwoven	polypropylene	4.6/110 (15/360)	2.0 (80)	203 (6.0)	>85	.15–.25 (100–60)	2.4
	TS650	nonwoven	polypropylene	4.6/110 (15/360)	2.2 (90)	237 (7.0)	>85	.15–.21 (100–70)	2.2
	TS700	nonwoven	polypropylene	4.6/110 (15/360)	2.6 (105)	281 (8.3)	>85	.125–.18 (120–80)	1.9
	TS750	nonwoven	polypropylene	4.3/92 (14/300)	3.0 (120)	349 (10.3)	>85	.105–.15 (140–100)	1.3
	TS800	nonwoven	polypropylene	4/92 (13/300)	3.3 (130)	407 (12.0)	>80	.105–.15 (140–100)	1.2
	TS900	nonwoven	polypropylene	3/92 (10/300)	3.8 (150)	475 (14.0)	>80	<.075 (>200)	1.1
	TS1000	nonwoven	polypropylene	3/92 (10/300)	4.3 (170)	543 (16.0)	>80	<.075 (>200)	0.8
	PGM13	nonwoven	polypropylene	3.8/110 (12.5/360)	1.4 (55)	129 (3.8)	N/A	N/A	N/A
	PGM15	nonwoven	polypropylene	3.8/110 (12.5/360)	1.5 (60)	153 (4.5)	N/A	N/A	N/A
	PGM20	nonwoven	polypropylene	3.8/110 (12.5/360)	2.0 (80)	203 (6.0)	N/A	N/A	N/A
Reemay, Inc.	T-3601	spunbonded nonwoven	polypropylene	(151", 187"/300')	—	(5.8)	~50	0.08(170/200)	0.3
	T-3401	spunbonded nonwoven	polypropylene	(151", 197"/300")	—	(3.9)	~60	0.17(70/100)	0.8
	T-3341	spunbonded nonwoven	polypropylene	(151", 197"/300')	—	(3.3)	~60	0.23(60/70)	1.1

[1] Material
[2] 2 kPa loading
[3] Probe type, eg. flat tip probe, bevelled
[4] Wide width is a design test recommended for reinforcement applications only.
[5] 500 hrs.
N/A = not applicable
(—) = not available

GEOTEXTILE PRODUCT DIRECTORY (continued)

	Mechanical Properties: Puncture [3] ASTM D3787 kN (lbs)	Mullen Burst ASTM D3786 kPa (psi)	Trapezoid Tear Strength ASTM D4533-85 kN (lbs)	Grab Tensile/ Elongation ASTM D4632-86 kN (lbs)/%	Wide Width [4] Strip Tensile/Elongation ASTM D4595-86: MD kN/m (lb/in)/%	XD kN/m (lb/in)/%	Endurance: UV Resistance ASTM D4355-84 [5] % strength retained	Appropriate Applications
Polyfelt Inc.	.16 (35)	585 (85)	.16 (35)	.27 (60)/50	6.1 (35)/80	5.2 (30)/50	>70	multi-purpose dependent on functional design consideration
	.18 (40)	760 (110)	.18 (40)	.34 (75)/50	7.0 (40)/80	6.1 (35)/50	>70	multi-purpose dependent on functional design consideration
	.20 (45)	895 (130)	.20 (45)	.40 (90)/50	8.2 (47)/80	7.0 (40)/50	>70	multi-purpose dependent on functional design consideration
	.22 (50)	1035 (160)	.22 (50)	.49 (110)/50	9.6 (55)/80	8.8 (50)/50	>70	separation, filtration, drainage, reinforcement, protection, sealing
	.27 (60)	1380 (200)	.27 (60)	.58 (130)/50	11.4 (65)/90	9.6 (55)/50	>70	separation, filtration, drainage, reinforcement, protection, sealing
	.34 (75)	1515 (220)	.31 (70)	.65 (145)/50	13.1 (75)/95	11.4 (65)/50	>70	separation, filtration, drainage, reinforcement, protection, sealing
	.38 (85)	1795 (260)	.36 (80)	.75 (170)/50	14.9 (85)/95	13.1 (75)/50	>80	separation, filtration, drainage, reinforcement, protection, sealing
	.45 (100)	2070 (300)	.42 (95)	.90 (203)/50	18.4 (105)	16.6 (95)/50	>80	separation, filtration, drainage, reinforcement, protection, sealing
	.51 (115)	2655 (385)	.49 (110)	1.16 (260)/50	21.0 (120)/95	19.2 (110)/55	>90	separation, filtration, drainage, reinforcement, protection, sealing
	.58 (130)	2760 (400)	.53 (120)	1.33 (300)/60	23.6 (135)/95	21.0 (120)/55	>90	separation, filtration, drainage, reinforcement, protection, sealing
	.60 (135)	2895 (420)	.58 (130)	1.38 (310)/85	24.5 (140)/95	21.9 (125)/55	>90	separation, filtration, drainage, reinforcement, protection, sealing
	.62 (140)	3100 (450)	.62 (140)	1.42 (320)/85	24.5 (140)/95	21.9 (125)/55	>90	separation, filtration, drainage, reinforcement, protection, sealing
	.20 (45)	N/A	.20 (45)	.40 (90)/50	N/A	N/A	>70	paving fabric
	.22 (50)	N/A	.22 (50)	.45 (100)/50	N/A	N/A	>70	paving fabric
	.33 (75)	N/A	.31 (70)	.62 (140)/50	N/A	N/A	>70	paving fabric
Reemay, Inc.	(60)	(210)	(75)	(200)/60	(70)/60	(60)/50	90	erosion control, protection, separation, drainage, filtration, stabilization
	(40)	(140)	(60)	(130)/60	(35)/45	(40)/50	80	erosion control, protection, separation, drainage, filtration, stabilization, composite cover
	(30)	(90)	(40)	(120)/60	(30)/60	(40)/60	70	erosion control, protection, separation, drainage, filtration, stabilization, pipe wrap, composite cover

All values were requested to be minimum average roll values. Specifications and all claims are the responsibility of the manufacturer.
All product data are intended as a guide. Geotechnical Fabrics Report recommends you contact manufacturers before making any specifying/purchasing decisions.

Appendix J

Soil Loss Calculations

APPENDIX J
SOIL LOSS CALCULATIONS

This appendix describes the basic assumptions and methodology of estimating the soil loss for each of the capped or regraded areas within the San Luis Obispo Tank Farm.

METHODOLOGY

Soil loss from the ground surface due to water erosion is most commonly estimated using the Universal Soil Loss Equation (USLE) developed by the U.S. Department of Agriculture (USDA). The general form of the USLE is as follows:

$$A = R \times K \times LS \times C \times P$$

where:

A = average soil loss (tons/acre/year)
R = rainfall erosion index
K = soil erodibility factor
LS = slope length and steepness factor
C = vegetation cover factor
K = erosion control factor

Rainfall Erosion Index (*R*)

The rainfall erosion index (R) is the measure of the erosive force and intensity of rain in a normal year. The value of R is typically obtained from an "isoerodent" map, several of which are available. Based on the isoerodent map of California provided in the USDA Handbook (Renard, 1997), an R value of 60 was obtained for the San Luis Obispo Tank Farm site.

Soil Erodibility Factor (*K*)

The soil erodibility factor (K) is a measure of the susceptibility of soil particles to detachment and transport by rainfall and runoff. Texture is the principle factor affecting K, but structure, organic matter content, and permeability also contribute. K values typically range from 0.02 to 0.69. A K value of 0.41 was used in the calculations, assuming that the cover soil is a Sand Loam, thereby providing a relatively conservative estimate.

Slope Length-Steepness Factor (*LS*)

The slope length-steepness factor (LS) describes the combined effect of slope length and slope gradient. It is the ratio of soil loss per unit area on a site to the corresponding loss from a 72.6-foot-long experimental plot with a 9 percent slope. The value of LS may be calculated but is most often obtained from a table of values derived from Wischmeier's empirical equation (Goldman, et al., 1986).

The slope lengths and gradients for each of the capping areas at the San Luis Obispo Tank Farm vary. The slope lengths range from 200 to 1,000 feet, whereas the gradients vary from 0.3 to 6.0 percent. The slope lengths and gradients for each of the capping areas are summarized in Table J.1.

Vegetative Cover Factor (*C*)

The vegetative cover factor (*C*) is defined as the ratio of the soil loss from an area with specified cover to that from the same area but under bare soil conditions. In the USLE, the *C* factor reduces the soil loss estimate according to the effectiveness of the vegetative cover in preventing the detachment and transport of soil particles when the soil surface is bare (*C*=1.0). Undisturbed native vegetation is typically assigned a value of 0.01; two orders of magnitude lower.

For the proposed development area corresponding to the Northwest Operations Area, a *C* value of 0.1 was used. This value corresponds to an area provided with hydraulic mulch at a rate of 4.5 tons/hectare. This is a reasonable assumption considering that the area will be developed eventually, until which time appropriate erosion and sediment control measures will be implemented.

On the contrary, Reservoirs 3, 5, and 7, the OU#3 and Flower Mound Area (including Reservoir 4), and Borrow Area No. 2 will be converted into open vegetative areas. A *C* value of 0.06 was used for these areas, assuming that the planting of grass seeds has occurred prior to the temporary application of hay or dry straw mulch over the entire area at a rate of 4.5 tons/hectare.

Erosion Control Practice Factor (*P*)

The erosion control practice factor (*P*) is defined as the ratio of soil loss with a given surface condition to soil loss from a hill where plowing is perpendicular to the contours. Practices that reduce runoff velocities, and the tendency of runoff to flow directly downslope, reduce the *P* factor. For construction sites, where significant surface disturbance is common, *P* values range from 0.8 for loose soil to 1.3 for smooth, compact surfaces.

In the subject estimate of soil loss, Avocet anticipates that the surface of the capped areas will be "trackwalked" up and down the slope to roughen the surface and provide indentations where seeds, soil, and water will be trapped, providing ideal conditions for germination. For a trackwalked surface, a *P* value of 0.9 is appropriate (Goldman, et al., 1986).

Estimated Soil Loss (*A*)

A summary of the soil loss estimated using the USLE is provided in Table J.1. The estimated soil losses for the capped and/or regraded areas range from 0.09 to 1.38 tons per acre per year (tons/acre/year). These values are far lower than a soil loss of 3 tons/acre/year, which is classified as very low (tolerable).

REFERENCES

Fifield, J.S., 2004, Designing for Effective Sediment and Erosion Control on Construction Sites, Forester Communications, Inc., Santa Barbara.

Goldman, S.J., K. Jackson, and T.A. Bursztynysky, 1986, Erosion and Sediment Control Handbook, McGraw-Hill, New York.

Renard, K.G., 1997, *Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Soil Loss Equation (RUSLE)*, USDA Agricultural Handbook No. 703. U.S. Department of Agriculture, Washington, DC.

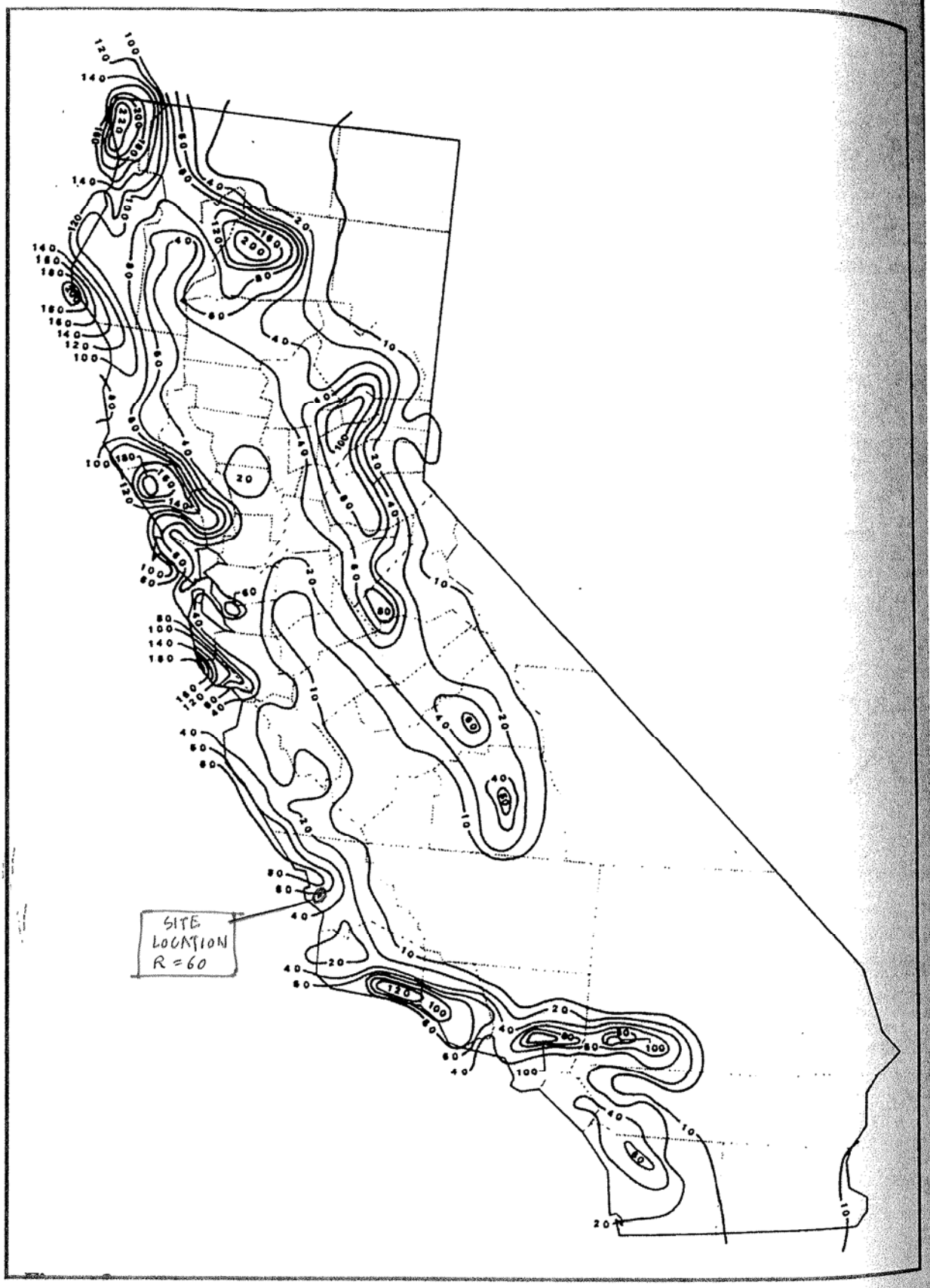
Tables

Table J.1
Summary fo Soil Loss Calculations
Chevron San Luis Obispo Tank Farm
San Luis Obispo, California

Area	Area (acres)	Maximum Length (feet)	Average Slope (%)	Rainfall Erosion Index *R*	Soil Erodibility Factor *K*	Slope Length Factor *LS*	Vegetation Cover Factor *C*	Erosion Control Factor *P*	Annual Soil Loss (tons/acre/year)
Northwest Area	6.4	500	1.00	60	0.41	0.16	0.1	0.9	0.35
Reservoir 5	7.8	218	2.75	60	0.41	0.40	0.06	0.9	0.53
Reservoir 7	6.8	222	4.00	60	0.41	0.58	0.06	0.9	0.77
Reservoir 4 - South Half	23.4	1000	1.80	60	0.41	0.35	0.06	0.9	0.46
Reservoir 4 - NW Portion	8.8	800	5.00	60	0.41	1.04	0.06	0.9	1.38
Reservoir 4 - NE Portion	15.2	675	2.00	60	0.41	0.34	0.06	0.9	0.45
Borrow Area No. 2	12.4	440	1.50	60	0.41	0.25	0.06	0.9	0.33
Reservoir 3	6.9	600	0.33	60	0.41	0.07	0.06	0.9	0.09

Attachment 1

Supporting Information



Isoerodent Map of California

Table 1: Values for topographic factor, LS, for rangeland and other consolidated soil conditions with cover (low rill to interrill erosion—applicable to thawing soil) where interrill and rill erosion are significant

Percent Slope	Slope Length (feet) <3.	6.	9.	12.	15.	25.	50.	75.	100.	150.	200.	250.	300.	400.	600.	800.	1000.
0.2	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
0.5	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
1.0	0.12	0.12	0.12	0.12	0.12	0.13	0.13	0.14	0.14	0.15	0.15	0.15	0.15	0.16	0.16	0.17	0.17
2.0	0.20	0.20	0.20	0.20	0.20	0.21	0.23	0.25	0.26	0.27	0.28	0.29	0.30	0.31	0.33	0.34	0.35
3.0	0.26	0.26	0.26	0.26	0.26	0.29	0.33	0.36	0.38	0.40	0.43	0.44	0.46	0.48	0.52	0.55	0.57
4.0	0.33	0.33	0.33	0.33	0.33	0.36	0.43	0.46	0.50	0.54	0.58	0.61	0.63	0.67	0.74	0.78	0.82
5.0	0.38	0.38	0.38	0.38	0.38	0.44	0.52	0.57	0.62	0.68	0.73	0.78	0.81	0.87	0.97	1.04	1.10
6.0	0.44	0.44	0.44	0.44	0.44	0.50	0.61	0.68	0.74	0.83	0.90	0.95	1.00	1.08	1.21	1.31	1.40
8.0	0.54	0.54	0.54	0.54	0.54	0.64	0.79	0.90	0.99	1.12	1.23	1.32	1.40	1.53	1.74	1.91	2.05
10.0	0.60	0.63	0.65	0.66	0.68	0.81	1.03	1.19	1.31	1.51	1.67	1.80	1.92	2.13	2.45	2.71	2.93
12.0	0.61	0.70	0.75	0.80	0.83	1.01	1.31	1.52	1.69	1.97	2.20	2.39	2.56	2.85	3.32	3.70	4.02
14.0	0.63	0.76	0.85	0.92	0.98	1.20	1.58	1.85	2.08	2.44	2.73	2.99	3.21	3.60	4.23	4.74	5.18
16.0	0.65	0.82	0.94	1.04	1.12	1.38	1.85	2.18	2.46	2.91	3.28	3.60	3.88	4.37	5.17	5.82	6.39
20.0	0.68	0.93	1.11	1.26	1.39	1.74	2.37	2.84	3.22	3.85	4.38	4.83	5.24	5.95	7.13	8.10	8.94
25.0	0.73	1.05	1.30	1.51	1.70	2.17	3.00	3.63	4.16	5.03	5.76	6.39	6.96	7.97	9.65	11.04	12.26
30.0	0.77	1.16	1.48	1.75	2.00	2.57	3.60	4.40	5.06	6.18	7.11	7.94	8.68	9.99	12.19	14.04	15.66
40.0	0.85	1.36	1.79	2.17	2.53	3.30	4.73	5.84	6.78	8.37	9.71	10.91	11.99	13.92	17.19	19.96	22.41
50.0	0.91	1.52	2.06	2.54	3.00	3.95	5.74	7.14	8.33	10.37	12.11	13.65	15.06	17.59	21.88	25.55	28.82
60.0	0.97	1.67	2.29	2.86	3.41	4.52	6.63	8.29	9.72	12.16	14.26	16.13	17.84	20.92	26.17	30.68	34.71

Table 2: Values for topographic factors, LS, for row-cropped agricultural and other moderately consolidated soil conditions with little to moderate cover (moderate rill to interril erosion—not applicable to thawing soil)

Percent Slope	Slope Length (feet) <3.	6.	9.	12.	15.	25.	50.	75.	100.	150.	200.	250.	300.	400.	600.	800.	1000.
0.2	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06
0.5	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.09	0.10	0.10	0.10	0.10
1.0	0.11	0.11	0.11	0.11	0.11	0.12	0.13	0.14	0.14	0.15	0.16	0.17	0.17	0.18	0.19	0.20	0.20
2.0	0.17	0.17	0.17	0.17	0.17	0.19	0.22	0.25	0.27	0.29	0.31	0.33	0.35	0.37	0.41	.44	0.47
3.0	0.22	0.22	0.22	0.22	0.22	0.25	0.32	0.36	0.39	0.44	0.48	0.52	0.55	0.60	0.68	0.75	0.80
4.0	0.26	0.26	0.26	0.26	0.26	0.31	0.40	0.47	0.52	0.60	0.67	0.72	0.77	0.86	0.99	1.10	1.19
5.0	0.30	0.30	0.30	0.30	0.30	0.37	0.49	0.58	0.65	0.76	0.85	0.93	1.01	1.13	1.33	1.49	1.63
6.0	0.34	0.34	0.34	0.34	0.34	0.43	0.58	0.69	0.78	0.93	1.05	1.16	1.25	1.42	1.69	1.91	2.11
8.0	0.42	0.42	0.42	0.42	0.42	0.53	0.74	0.91	1.04	1.26	1.45	1.62	1.77	2.03	2.47	2.83	3.15
10.0	0.46	0.48	0.50	0.51	0.52	0.67	0.97	1.19	1.38	1.71	1.98	2.22	2.44	2.84	3.50	4.06	4.56
12.0	0.47	0.53	0.58	0.61	0.64	0.84	1.23	1.53	1.79	2.23	2.61	2.95	3.26	3.81	4.75	5.56	6.28
14.0	0.48	0.58	0.65	0.70	0.75	1.00	1.48	1.86	2.19	2.76	3.25	3.69	4.09	4.82	6.07	7.15	8.11
16.0	0.49	0.63	0.72	0.79	0.85	1.15	1.73	2.20	2.60	3.30	3.90	4.45	4.95	5.86	7.43	8.79	10.02
20.0	0.52	0.71	0.85	0.96	1.06	1.45	2.22	2.85	3.40	4.36	5.21	5.97	6.68	7.97	10.23	12.20	13.99
25.0	0.56	0.80	1.00	1.16	1.30	1.81	2.82	3.65	4.39	5.69	6.83	7.88	8.86	10.65	13.80	16.58	19.13
30.0	0.59	0.89	1.13	1.34	1.53	2.15	3.39	4.42	5.34	6.98	8.43	9.76	11.01	13.30	17.37	20.99	24.31
40.0	0.65	1.05	1.38	1.68	1.95	2.77	4.45	5.87	7.14	9.43	11.47	13.37	15.14	18.43	24.32	29.60	34.48
50.0	0.71	1.18	1.59	1.97	2.32	3.32	5.40	7.17	8.78	11.66	14.26	16.67	18.94	23.17	30.78	37.65	44.02
60.0	0.76	1.30	1.78	2.23	2.65	3.81	6.24	8.33	10.23	13.65	16.76	19.64	22.36	27.45	36.63	44.96	52.70

TABLE 4-4. C-FACTOR AND P-FACTOR VALUES FOR CONSTRUCTION-SITE RAINFALL BMPS (ISRAELSEN ET AL., 1980; HDI, 1987; SCS, 1978; AND WISCHMEIER AND SMITH, 1978)

TREATMENT	C-FACTOR	P-FACTOR
Bare Soil		
Packed and smooth	1.00	1.00
Freshly disked or rough, irregular surface	1.00	0.90
Sediment Containment Systems (a.k.a. Sediment Trap/Basin)	1.00	0.10-0.90[A]
Bale or Sandbag Barriers	1.00	0.90
Rock (Diameter = 25-50 mm) Barriers at Sump Location	1.00	0.80
Silt-Fence Barrier	1.00	0.60
Asphalt/Concrete Pavement	0.01	1.00
Gravel (Diameter = 60-400 mm) at 300 tonnes/ha	0.05	1.00
Established Vegetation	Figs. 4-3, 4-4	1.00
Sod Grass	0.01	1.00
Temporary Vegetation/Cover Crop	0.45[B]	1.00
Hydraulic Mulch at 4.5 tonnes/ha	0.10[C]	1.00
Soil Sealant	0.10 - 0.60[D]	1.00
Rolled Erosion Control Products	0.10 - 0.30[D]	1.00
Hay or Straw Dry Mulch Applied at 4.5 tonnes/ha and anchored *Assumes planting of grass seed has occurred before application, otherwise C-factor = 1.00.*		
Slope (%)		
1 to 10	0.06	1.00
11 to 15	0.07	1.00
16 to 20	0.11	1.00
21 to 25	0.14	1.00
26 to 33	0.17	1.00
> 33	0.20	1.00
Contour Furrowed Surface *Must be maintained throughout construction activities, otherwise P-factor = 1.00. Maximum length refers to downslope length.*		
Slope (%) / Max. Length (m)		
1 to 2 / 120	1.00	0.60
3 to 5 / 90	1.00	0.50
6 to 8 / 60	1.00	0.50
9 to 12 / 40	1.00	0.60
13 to 16 / 25	1.00	0.70
17 to 20 / 20	1.00	0.80
> 20 / 15	1.00	0.80

[A] Should be constructed as the first step in over-lot grading.
[B] Assumes planting occurs within optimal climatic conditions.
[C] Some limitation on use in arid and semiarid climates.
[D] Value used must be substantiated by documentation.

Clay Loam	0.30	0.33	0.28
Coarse Sandy Loam	0.07	--	0.07
Fine Sand	0.08	0.09	0.06
Fine Sandy Loam	0.18	0.22	0.17
Heavy Clay	0.17	0.19	0.15
Loam	0.30	0.34	0.26
Loamy Fine Sand	0.11	0.15	0.09
Loamy Sand	0.04	0.05	0.04
Loamy Very Fine Sand	0.39	0.44	0.25
Sand	0.02	0.03	0.01
Sandy Clay Loam	0.20	--	0.20
Sandy Loam	0.13	0.14	0.12
Silt Loam	0.38	0.41	0.37
Silty Clay	0.26	0.27	0.26
Silty Clay Loam	0.32	0.35	0.30
Very Fine Sand	0.43	0.46	0.37
Very Fine Sandy Loam	0.35	0.41	0.33

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Table 3A. LS Factor Calculation

Slope Length ft (m)	Slope (%)	LS Factor
100 ft (31 m)	10	1.3800
	8	0.9964
	6	0.6742
	5	0.5362
	4	0.4004
	3	0.2965
	2	0.2008
	1	0.1290
	0	0.0693
200 ft (61 m)	10	1.9517
	8	1.4092
	6	0.9535
	5	0.7582
	4	0.5283
	3	0.3912
	2	0.2473
	1	0.1588
	0	0.0796
400 ft (122 m)	10	2.7602
	8	1.9928
	6	1.3484
	5	1.0723
	4	0.6971
	3	0.5162
	2	0.3044
	1	0.1955
	0	0.0915
	10	3.9035
	8	2.8183
	6	1.9070
	5	1.5165

Table 4B. Tillage Method Factor

Tillage Method	Factor
Fall Plow	1.0
Spring Plow	0.90
Mulch Tillage	0.60
Ridge Tillage	0.35
Zone Tillage	0.25
No-Till	0.25

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Table 5. P Factor Data

Support Practice	P Factor
Up & Down Slope	1.0
Cross Slope	0.75
Contour farming	0.50
Strip cropping, cross slope	0.37
Strip cropping, contour	0.25

Table 6. Soil Loss Tolerance Rates

Soil Erosion Class	Potential Soil Loss (tons/acre/year)
Very Low (tolerable)	<3
Low	3 - 5
Moderate	5 - 10
High	10 - 15
Severe	>15

Table 7. Management Strategies to Reduce Soil Losses

Factor	Management Strategies	Example
R	The R Factor for a field cannot be altered.	--
K	The K Factor for a field cannot be altered.	--
LS	Terraces may be constructed to reduce the slope length resulting in lower soil losses.	Terracing requires additional investment and will cause some inconvenience in farming. Investigate other soil conservation practices first.
C	The selection of crop types and tillage methods that result in the lowest possible C factor will result in less soil erosion.	Consider cropping systems that will provide maximum protection for the soil. Use minimum tillage systems where possible.
P	The selection of a support practice that has the lowest possible factor associated with it will result in lower soil losses.	Use support practices such as cross slope farming that will cause deposition of sediment to occur close to the source.

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Example: Calculation of Soil Erosion Using USLE

A =R x K x LS x C x P

Rainfall and Runoff Factor (R)

The sample field is in Middlesex County. Therefore the R Factor is obtained in Table 1 from the London

Appendix K

Retaining Wall Evaluation

APPENDIX K
RETAINING WALL CALCULATIONS

This appendix describes the basic assumptions and design parameters used to size the retaining wall bordering the south edge of the final cap for the Northwest Operations Area remedial design at San Luis Obispo Tank Farm.

ASSUMPTIONS

In preparing these calculations, Avocet has made the following conservative assumptions regarding soil characteristics and general retaining wall design:

- Backfill above the footings will be horizontal and there will be no surcharge over the footings.
- The retaining wall will have 2-inch-diameter weep holes along the base located at 5-foot intervals to allow for proper drainage from behind the retaining wall.
- Actual unit weight of soil backfill shall be equal to 125 pounds per cubic foot (pcf) with an equivalent fluid unit weight of 45 pcf.
- Actual unit weight of soil in front of the retaining wall key shall be equal to 125 pcf with a cohesion intercept of 100 pounds per square foot (psf) and a friction angle of 30 degrees.
- The 28-day compressive strength of concrete used for the retaining wall shall be 3,000 pounds per square inch (psi).
- The yield strength of the reinforcing steel used for the retaining wall shall be 60,000 psi.
- A base friction coefficient of 0.45 shall be used for silty granular material.
- The retaining wall foundation is assumed to be a cohesive soil with an undrained shear strength of 2,000 psf.

DESIGN METHODOLOGY

Earth Pressure Loads

The earth pressures that result from the weight of the backfill and surcharge load on the surface of the backfill act on the vertical plane extending from the heel of the wall to the surface of the backfill. The freebody used to calculate the forces on the base of the footing, and the factors of safety with respect to sliding and bearing capacity, includes the reinforced concrete retaining wall and the trapezoidal zone of backfill above the rear portion of the footing (behind the stem), as shown in Figure K-1.

Appendix K
Retaining Wall Calculations

The earth pressure due to the weight of the backfill is defined using the equivalent fluid pressure method. The earth pressure due to the weight of the soil increases linearly with depth, according to the following formula:

$$\sigma_{hb} = \gamma_{eq} z$$

where:

σ_{hb} = horizontal earth pressure due to weight of backfill (psf)
γ_{eq} = unit weight of the "equivalent fluid" (pcf)
z = depth below the surface of the backfill (ft)

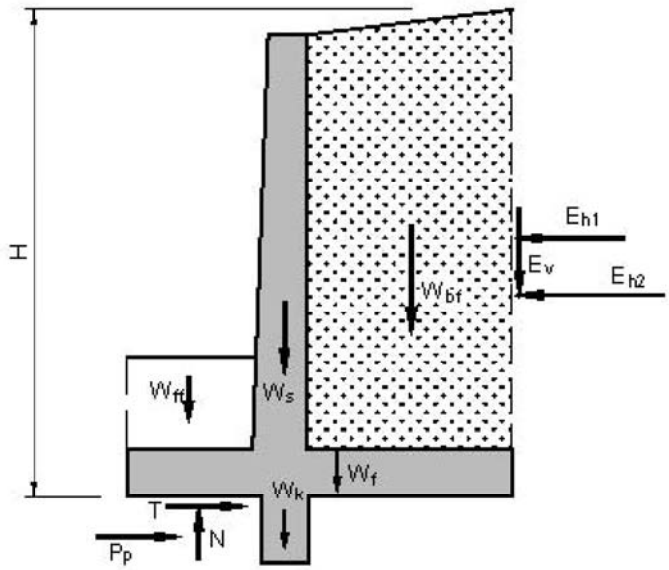


Figure K-1

The position of the resultant force (E_{h2}) due to σ_{hb} is specified by y/H, where y = height of E_{h2} above the base of the footing and H = height of the vertical plane from the heel of the wall to the surface of the backfill.

In the designed retaining wall, there is no surcharge, thus no surcharge earth pressure calculations were performed.

Bearing Pressures

Distribution of Bearing Pressure for Bearing Capacity

To account for the effect of eccentric loading on the footing, a reduced effective footing width is used, as suggested by Meyerhof (Duncan, 2002). The effective footing width used in computing bearing pressure is $2x$, where x is the distance from the toe of the footing to the point of application of the normal load N, as shown in Figure K-2. For a footing width of $2x$, the footing is centrally loaded and the bearing pressure is uniform. The bearing pressure for a reduced footing width of $2x$ is given by:

$$q = \frac{N}{2x}$$

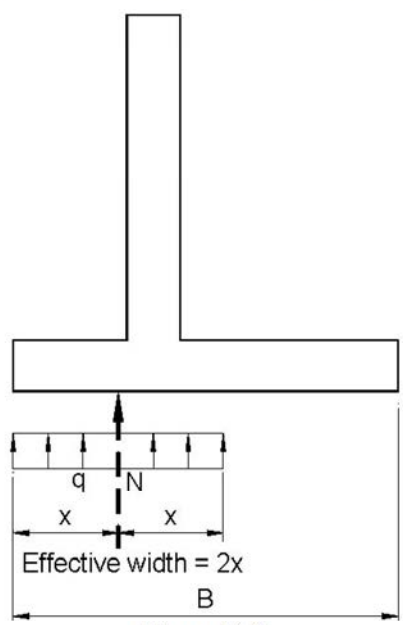


Figure K-2

Using an effective footing width smaller than the actual width is conservative.

Appendix K
Retaining Wall Calculations

Distribution of Bearing Pressure for Determining the Footing Thickness

Nonuniform bearing pressure is adopted for the purpose of computing the minimum footing thickness, in keeping with conventional structural engineering practice. The maximum and minimum bearing pressures are given by:

$$q_{\max} = \begin{cases} \frac{N}{B}(1+\frac{6e}{B}) & if \quad e \le \frac{B}{6} \\ \frac{2N}{3x} & if \quad e \ge \frac{B}{6} \end{cases}$$

and

$$q_{\min} = \begin{cases} \frac{N}{B}(1-\frac{6e}{B}) & if \quad e \le \frac{B}{6} \\ 0 & if \quad e \ge \frac{B}{6} \end{cases}$$

where:

e = the distance between the normal force and the center of the footing
B = the width of the footing

Bearing Capacity of Cohesive Soil Foundations

It is assumed, for the purpose of these calculations, that the foundations for each retaining wall will be comprised of cohesive soils. The bearing capacity of cohesive soil is computed using the simplified equations developed by Brinch Hansen (Duncan, 2002) for *φ = 0 soils*. Brinch Hansen's equation is expressed as follows:

$$q_{ult} = N_c S_u + \gamma D_f$$

where:

q_{ult} = ultimate bearing capacity (psf)
N_c = bearing capacity factor (dimensionless)
S_u = undrained shear strength of soil (which has φ = 0)
γ = unit weight of soil (pcf), the smaller of the unit weights of the backfill and foundation
D_f = depth from ground surface in front of wall to the bottom of the footing (ft)

The value of N_c is expressed as follows:

$$N_c = 5\left(1 + 0.2\frac{D_f}{2x}\right)\left(1 - 1.3\frac{T}{N}\right)$$

where:

$2x$ = effective footing width (ft)
x = distance from the edge of the footing to the point of application of the normal load (ft)
T = shear load on the footing (lb/ft)
N = normal load on the footing (lb/ft)

The value of T is expressed as follows:

$$T = E_h$$

$$E_h = 0.5\gamma_{eq}H^2 + Hq_sK_s$$

where:

γ_{eq} = equivalent fluid weight (pcf)
H = height of backfill plus footing thickness (ft)
q_s = surcharge (psf)
K_s = surcharge coefficient

The factor of safety against bearing capacity failure is calculated as:

$$F_{bc} = q_{ult} / q$$

where:

F_{bc} = bearing capacity factor of safety (dimensionless)
$qult$ = ultimate bearing capacity (psf)
q = bearing pressure (psf)

A typical factor of safety against bearing capacity failure is widely accepted as 2.5 or greater.

Factor of Safety Against Sliding

In computing the factor of safety against sliding, it is assumed that the concrete footing is cast on a layer of granular material. The factor of safety against sliding is computed using the following equation:

$$F_s = \frac{\mu N + P_p}{T}$$

where:

F_s = factor of safety against sliding (dimensionless)

μ = coefficient of friction between the wall footing and the granular material beneath (dimensionless)

N = resultant normal force on the base due to weight of wall plus the weight of backfill and the vertical earth pressure loads (lb/ft)

P_p = passive earth pressure force on the front of the key (lb/ft)

T = mobilized horizontal shear load on the bottom of the footing (lb/ft)

Resistance to sliding due to passive earth pressure on the front of the footing is ignored because the soil above the bottom of the footing may be weak and compressible. The passive earth pressure resisting sliding acting on the key is calculated using the Rankine earth pressure theory by the following formula:

$$P_p = D_k\left[2c\tan\left(45° + \frac{\emptyset}{2}\right) + \gamma Z_p \tan^2(45° + \frac{\emptyset}{2}\right]$$

where:

D_k = depth of key below bottom of footing (ft)

c = cohesion intercept of soil in front of key (psf)

φ = friction angle of soil in front of key (degrees)

Z_p = the depth from the ground surface in front of the wall to mid-height of the key (ft)

Retaining walls shall be designed to resist sliding with a factor of safety of at least 1.5 times the lateral force (ICBO, 1994; UBC, Section 1609.2).

Factor of Safety Against Overturning

In calculating the factor of safety against overturning, it is assumed that there will be no surcharge over the footing. The following equation is used in calculating the factor of safety against overturning:

$$F_{om} = \frac{W_f B/2 + W_s x_1 + W_{bf} x_2 + W_k x_3 + W_{ff} b_t/2 + E_v B}{0.5 K_s q_s H^2 + 0.5\gamma_{eq} H^2 y}$$

where:

F_{om} = factor of safety against overturning (dimensionless)

W_f = weight of footing (lb/ft)

B = width of footing (ft)

W_s = weight of stem (lb/ft)
x_1 = length from front of footing to center of stem (ft)
W_{bf} = weight of soil behind the stem and above the footing (lb/ft)
x_2 = length from front of footing to Wbf resulting location (ft)
W_k = weight of key (lb/ft)
x_3 = length from front of footing to center of key (ft)
W_{ff} = weight of soil in front of the stem and above the footing (lb/ft)
b_t = length from front of footing to beginning of stem (ft)
E_v = vertical component of earth pressure (lb/ft)
K_s = surcharge coefficient
q_s = surcharge (psf)
H = height of backfill plus footing thickness (ft)
γ_{eq} = equivalent fluid weight (pcf)
y = height above bottom of footing of resulting earth pressure caused by backfill weight (ft)

Retaining walls shall be designed to resist overturning with a factor of safety of at least 1.5 times the overturning moment (ICBO, 1994; UBC, Section 1609.2).

CALCULATION SUMMARY

The calculations for the retaining wall located along the southern edge of the Northwest Operations Area cap are summarized below and can be found in Tables K-1 though K-2.

The retaining wall will be approximately 6 feet 5 inches tall from the top of the footing to the top of the stem at its highest point. This height will leave a 6-inch lip at the top. The wall will have a thickness of 8 inches along the length of the stem and an 8-inch-thick footing and key. The key will extend to a depth of 9 inches below the bottom of the retaining wall footing and will be located directly beneath the retaining wall stem. The stem and key will be located 2 feet 2 inches from the backfill end of the footing. The retaining wall footing will be approximately 3 feet 6 inches wide.

Given the soil characterization and retaining wall assumptions stated previously, the factor of safety against sliding is calculated to be 1.90, while the factor of safety against overturning is calculated to be 2.11. The calculated bearing capacity factor of safety for the retaining wall foundation is 4.19.

REFERENCES

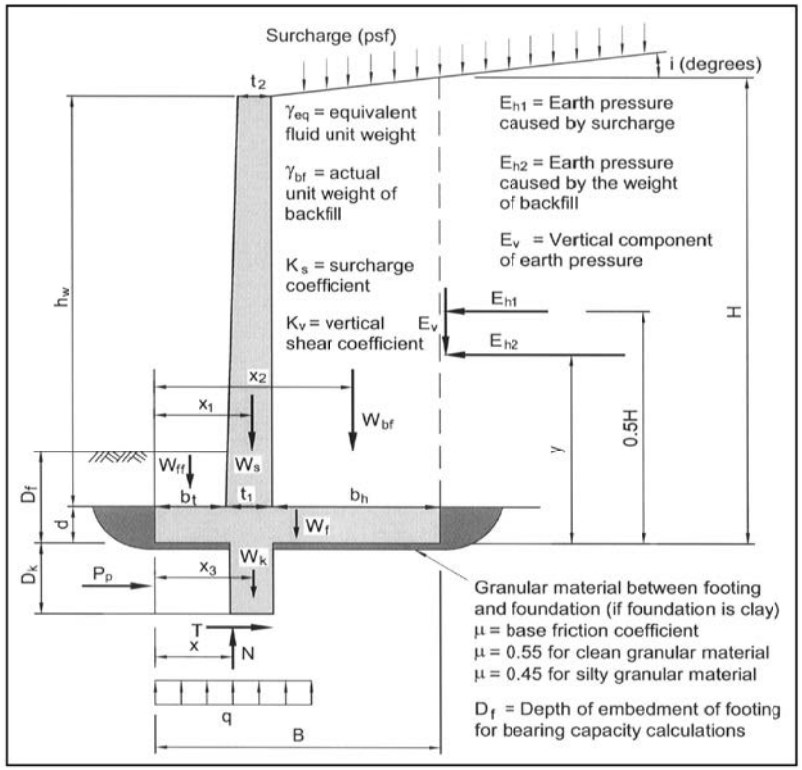
Duncan, J. Michael, and Bingzhi Yang, 2002, Retaining Wall Stability Workbook Documentation, Department of Civil and Environmental Engineering, Virginia Polytechnic Institute and State University

ICBO, 1994, *Uniform Building Code Volume 2,* International Conference of Building Officials

Tables

Table K.1
Retaining Wall Stability Analysis
6'5" High Retaining Wall South of Operations Area
Chevron San Luis Obispo Tank Farm
San Luis Obispo, California

Retaining Wall Stability
(South Side of Northwest Operations Area)



Notes: 1. P_p = passive pressure resisting force. Passive resistance is only included for the soil in front of a key, that is, only over the depth D_k.
2. f_c' = 28-day compressive strength of concrete (psi).
3. f_y = yield strength of reinforcing steel (psi).
4. r = Steel ratio = Area of steel/Area of concrete.
5. r_b = Balanced steel ratio - corresponds to equal concrete and steel strength in flexure.
6. The computed stem and footing thicknesses are based on required shear and moment capacity, which depend on fc', fy and r. These values are advisory. They are not automatically inserted as wall dimensions.

Project: 1212.001 - SLOTF Remedial Design
Calculated by: TMH
Date: 9/6/2007

Given: No existing soil data. Height of retaining wall will be approximately 6'5" on back end with 1' fill on front end. Backfill will be horizontal. Retaining wall will have 2-inch weep holes along the base at 5-foot intervals to allow for drainage.

Assumed: Actual Unit Weight of soil backfill equal to 125 pcf with an equivalent fluid unit weight of 45 pcf. These are conservative values. Assumed values of properties of soil in front of key. Actual values to be confirmed in the field.

Input

For wall dimensions, loads, and properties

Include surcharge over b_h?	No	
D_f =	1.7	ft
h_w =	6.4	ft
i =	0	deg.
Backfill g_{eq} =	45	pcf
Backfill g_{bf} =	125	pcf
Surcharge q_s =	0	psf
K_s =	0.35	
m =	0.45	
y/H =	0.33	
K_v =	0.00	
B =	3.50	ft
b_t =	0.67	ft
t_1 =	0.67	ft
t_2 =	0.67	ft
d =	0.67	ft
Properties of soil in front of key		
g =	125	pcf
c' =	100	psf
f' =	30	deg
Depth of key below footing		
D_k =	0.75	ft

For stem and footing thickness

f_c' =	3,000	psi
f_y =	60,000	psi
r/r_b =	0.45	

Calculated

b_h =	2.16	ft
H =	7.07	ft
E_{h1} =	0	lbs/ft
E_{h2} =	1,125	lbs/ft
E_h =	1,125	lbs/ft
E_v =	0	lbs/ft
W_{bf} =	1,728	lbs/ft
W_f =	352	lbs/ft
W_s =	643	lbs/ft
W_k =	75	lbs/ft
W_{ff} =	84	lbs/ft
y =	2.33	ft
x_1 =	1.01	ft
x_2 =	2.42	ft
x_3 =	1.01	ft
N =	2,882	lbs/ft
T =	1,125	lbs/ft
x =	1.01	ft
q =	1,421	psf
Pp =	835	lb/ft

Calculated

Sliding on granular layer F_s =	1.90	Should be 1.5 or greater
Position of Resultant x/B =	0.29	
Overturning F_{om} =	2.11	Should be 1.5 to 2.0 or greater
Volume of Concrete =	0.26	Cubic yds per ft of wall
Stem and footing thickness based on shear and moment capacity		
Approximate stem thickness (t1) =	0.67	(ft) Advisory - see note 6 at left
Approximate footing thickness (d) =	1.00	(ft) Advisory - see note 6 at left

AVOCET ENVIRONMENTAL, INC.

Table K.2
Bearing Capacity Computation
6'5" High Wall South of Operations Area
Chevron San Luis Obispo Tank Farm
San Luis Obispo, California

Bearing Capacity Computation Sheet for Cohesive Soils

Project: 1212.001 - SLOTF Remedial Design
Calculated by: TMH
Date: 9/6/2007

Data transferred from Wall Stability Computation Sheet are shown in green

N =	2,882	lbs
H =	1,125	lbs
x =	1.01	ft
D_f =	1.67	ft
B =	3.50	ft
q =	1,421	psf
g =	125	pcf

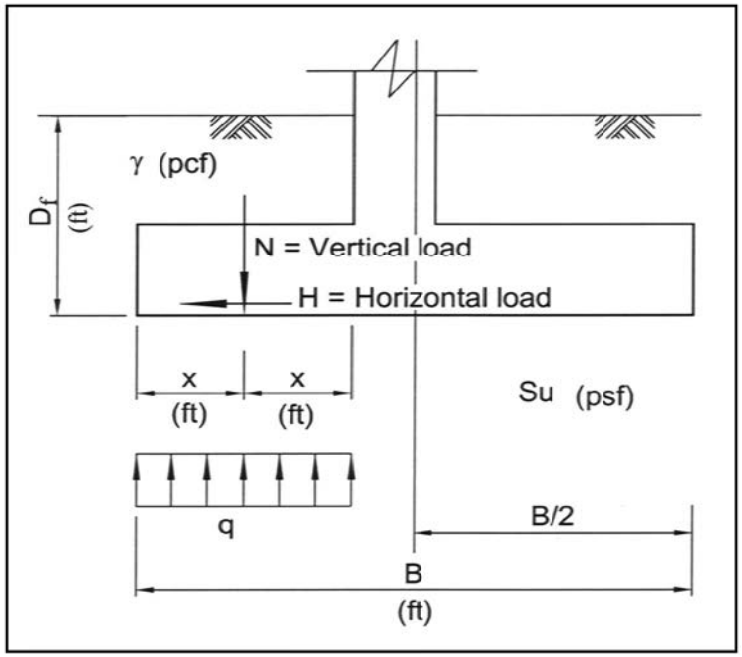
Input

Su = 2,000 psf

Calculated

Bearing capacity factor of safety

F_{bc} = 4.19 Should be 2.5 or greater



Notes: 1. Su = Undrained shear strength of cohesive soil.
2. D_f= Depth of embedment of footing for bearing capacity calculations.
3. m = Base friction coefficient

Appendix L

Pipeline Quantity Estimate

APPENDIX L
PIPELINE QUANTITY ESTIMATES

This appendix describes the basic assumptions used to estimate the quantity of existing pipelines at the San Luis Obispo Tank Farm and the volume associated with them.

ASSUMPTIONS

In preparing these calculations Avocet has made the following conservative assumptions:

- Pipeline alignment and lengths are as shown in Figures L-1 and L-2.
- It is assumed that all the pipelines shown in Figures L-1 and L-2 currently exist.
- Nominal diameter of all water lines is assumed to be 4 inches.
- Nominal diameter of all drain lines is assumed to be 4 inches.
- Nominal diameter of all leach lines is assumed to be 4 inches.
- Nominal diameter of all crude oil and gasoline lines is assumed to be 8 inches.
- Nominal diameter of all foamite lines is assumed to be 4 inches.

ESTIMATED QUANTITIES

A summary of the estimated pipeline quantities is provided in Table L.1. The quantities have been estimated for all the pipelines existing over the entire site, as well as the ones existing exclusively in the Northwest Operations Area.

Northwest Operations Area

Water Line

Approximately 4,898 linear feet of water lines are estimated to exist in the Northwest Operations Area. Assuming that all existing water lines have a 4-inch diameter, this corresponds to a volume of approximately 12,789 gallons.

Drain Line

Approximately 914 linear feet of drain lines are estimated to exist in the Northwest Operations Area. Assuming that all existing water lines have a 4-inch diameter, this corresponds to a volume of approximately 2,386 gallons.

Leach Line

Approximately 258 linear feet of water lines are estimated to exist in the Northwest Operations Area. Assuming that all existing water lines have a 4-inch diameter, this corresponds to a volume of approximately 674 gallons.

Crude oil and Gasoline Line

Approximately 4,327 linear feet of water lines are estimated to exist in the Northwest Operations Area. Assuming that all existing water lines have an 8-inch diameter, this corresponds to a volume of approximately 45,191 gallons.

Appendix L
Pipeline Quantity Estimates

Foamite Line

Approximately 1,121 linear feet of foamite lines are estimated to exist in the Northwest Operations Area. Assuming that all existing water lines have a 4-inch diameter, this corresponds to a volume of approximately 2,927 gallons.

Entire Site

These quantities also include the pipelines associated with the Northwest Operations Area.

Water Line

Approximately 38,263 linear feet of water lines are estimated to exist in the Northwest Operations Area. Assuming that all existing water lines have a 4-inch diameter, this corresponds to a volume of approximately 99,905 gallons.

Drain Line

Approximately 914 linear feet of drain lines are estimated to exist in the Northwest Operations Area. Assuming that all existing water lines have a 4-inch diameter, this corresponds to a volume of approximately 2,386 gallons.

Leach Line

Approximately 258 linear feet of water lines are estimated to exist in the Northwest Operations Area. Assuming that all existing water lines have a 4-inch diameter, this corresponds to a volume of approximately 674 gallons.

Crude oil and Gasoline Line

Approximately 25,125 linear feet of water lines are estimated to exist in the Northwest Operations Area. Assuming that all existing water lines have an 8-inch diameter, this corresponds to a volume of approximately 262,407 gallons.

Foamite Line

Approximately 9,177 linear feet of foamite lines are estimated to exist in the Northwest Operations Area. Assuming that all existing water lines have a 4-inch diameter, this corresponds to a volume of approximately 23,961 gallons.

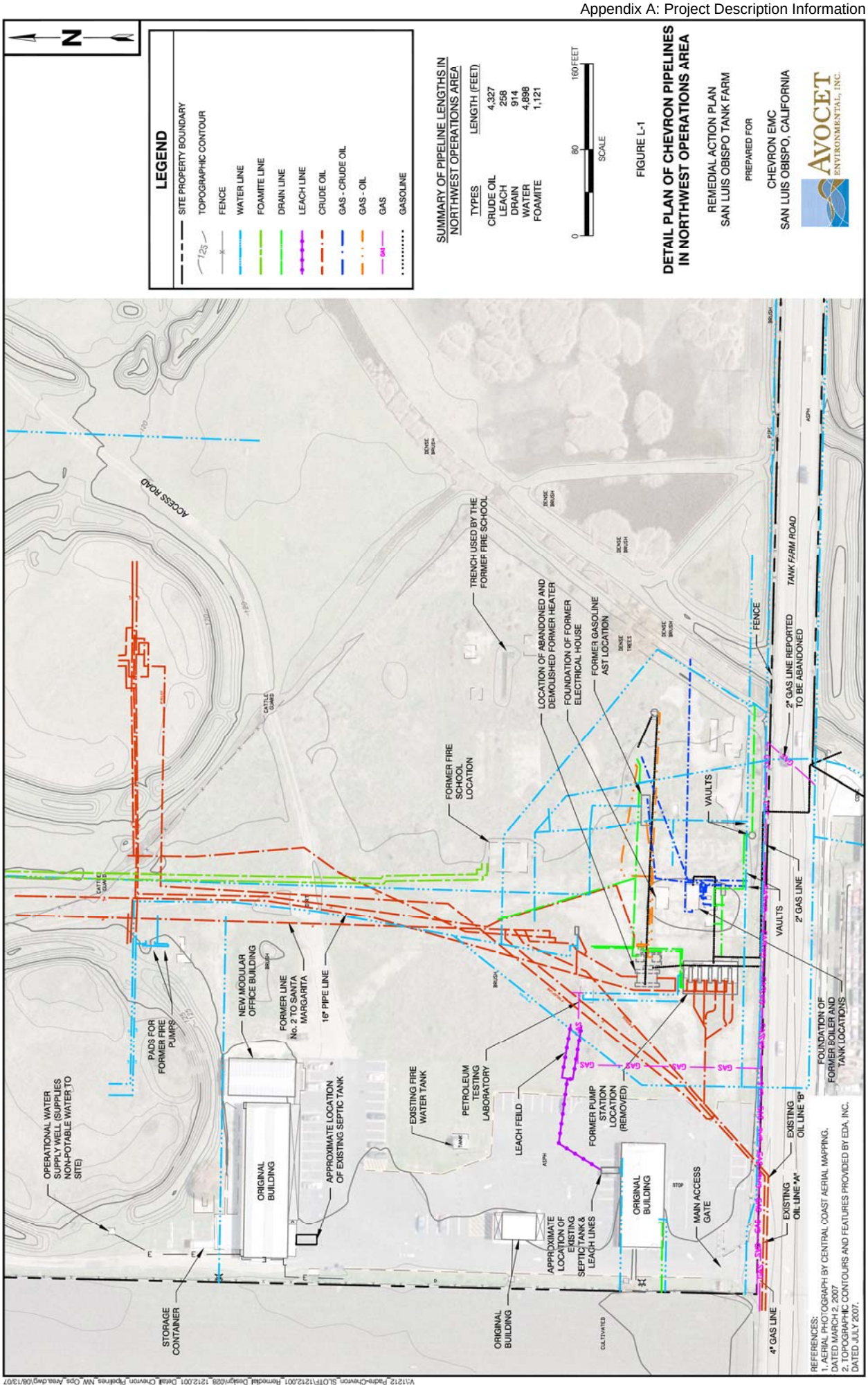
Tables

Table L.1
Pipeline Quantity Estimate
Chevron San Luis Obispo Tank Farm
San Luis Obispo, California

Pipeline	Northwest Operations Area		Entire Site	
	(linear feet)	(Volume in gallons)	(linear feet)	(Volume in gallons)
Water line	4,898	12,789	38,263	99,905
Drain line	914	2,386	914	2,386
Leach line	258	674	258	674
Crude oil and gasoline lines	4,327	45,191	25,125	262,407
Foamite lines	1,121	2,927	9,177	23,961

Notes:
1. Northwest Operations Area pipelines included in quantities corresponding to the entire site.
2. To calculate the volume associated with the pipelines, the following nominal pipe diameters were assumed:
   Water line - 4" dia.
   Drain line - 4" dia.
   Leach line - 4" dia.
   Crude oil and gasoline line - 8" dia.
   Foamite line - 4" dia.

Figures


N
LEGEND
SITE PROPERTY BOUNDARY
TOPOGRAPHIC CONTOUR
FENCE
WATER LINE
FOAMITE LINE
DRAIN LINE
LEACH LINE
CRUDE OIL
GAS - CRUDE OIL
GAS - OIL
GAS
GASOLINE
SUMMARY OF PIPELINE LENGTHS IN NORTHWEST OPERATIONS AREA
TYPES LENGTH (FEET)
CRUDE OIL 4,327
LEACH 258
DRAIN 914
WATER 4,898
FOAMITE 1,121
0 80 160 FEET
SCALE
FIGURE L-1
DETAIL PLAN OF CHEVRON PIPELINES IN NORTHWEST OPERATIONS AREA
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET ENVIRONMENTAL, INC.
ACCESS ROAD
TANK FARM ROAD
TRENCH USED BY THE FORMER FIRE SCHOOL
LOCATION OF ABANDONED AND DEMOLISHED FORMER HEATER
FOUNDATION OF FORMER ELECTRICAL HOUSE
FORMER GASOLINE AST LOCATION
FORMER FIRE SCHOOL LOCATION
FENCE
2" GAS LINE REPORTED TO BE ABANDONED
VAULTS
2" GAS LINE
FOUNDATION OF FORMER BOILER AND TANK LOCATIONS
NEW MODULAR OFFICE BUILDING
FORMER LINE No. 2 TO SANTA MARGARITA
16" PIPE LINE
PADS FOR FORMER FIRE PUMPS
OPERATIONAL WATER SUPPLY WELL (SUPPLIES NON-POTABLE WATER TO SITE)
ORIGINAL BUILDING
APPROXIMATE LOCATION OF EXISTING SEPTIC TANK
EXISTING FIRE WATER TANK
PETROLEUM TESTING LABORATORY
LEACH FEILD
FORMER PUMP STATION LOCATION (REMOVED)
GAS
EXISTING OIL LINE "B"
EXISTING OIL LINE "A"
MAIN ACCESS GATE
APPROXIMATE LOCATION OF EXISTING SEPTIC TANK & LEACH LINES
STORAGE CONTAINER
4" GAS LINE
REFERENCES:
1. AERIAL PHOTOGRAPH BY CENTRAL COAST AERIAL MAPPING, DATED MARCH 2, 2007
2. TOPOGRAPHIC CONTOURS AND FEATURES PROVIDED BY EDA, INC. DATED JULY 2007.

N
NOTE:
LEACH LINES AND DRAIN LINES ARE SHOWN AS CRUDE OIL LINES ON THIS FIGURE FOR CLARITY. SIMILIARLY FOAMITE LINES ARE SHOWN AS WATER LINES DUE TO THEIR SIMILIAR FUNCTIONS DURING OPERATIONS.
EXPLANATION
PROJECT AREA BOUNDARY
CRUDE OIL PIPELINES
OTHER UNDERGROUND PIPELINES
SUMMARY OF PIPELINE LENGTHS
TYPES LENGTH (FEET)
CRUDE OIL 25,125
LEACH LINE (SANITATION) 258
DRAIN LINES 914
WATER LINE 38,263
FOAMITE 9,177
0 250 500 1,000 FEET
APPROXIMATE SCALE
FIGURE L-2
CHEVRON PIPELINES
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM
PREPARED FOR
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA
AVOCET ENVIRONMENTAL, INC.
RESERVOIR 4
FORMER RECYCLING AREA
RESERVOIR 2
TANK FARM ROAD
RESERVOIR 3
RESERVOIR 7
RESERVOIR 5
RESERVOIR 6
NORTH MARSH
FORMER FIRE SCHOOL LOCATION
NORTHWEST AREA
SEE FIGURE 6 FOR DETAIL
OCCUPIED OFFICE STUCTURES
REFERENCES:
1. AERIAL PHOTOGRAPH BY COASTAL AERIAL MAPPING, DATED: 03/02/2007
2. GENERAL ARRANGEMENT SAN LUIS OBISPO TANK FARM, PRODUCERS PIPELINE, UNION OIL COMPANY OF CALIFORNIA, DRAWING No. UNKNOWN, DATED APRIL 3, 1950.
GENERAL ARRANGEMENT SAN LUIS OBISPO TANK FARM NORTHERN DIVISION PIPELINE, UNION OIL COMPANY OF CALIFORNIA, DRAWING No. D2A180, DATED JULY 30, 1961.
S:\GIS\1212_Chevron_Parks_SLOTF\001_Remedial_Design\ArcMapDocuments\012_1212.001_Chevron_Pipelines.mxd\08/13/07

Appendix M

Vapor Barrier Engineering Guidelines

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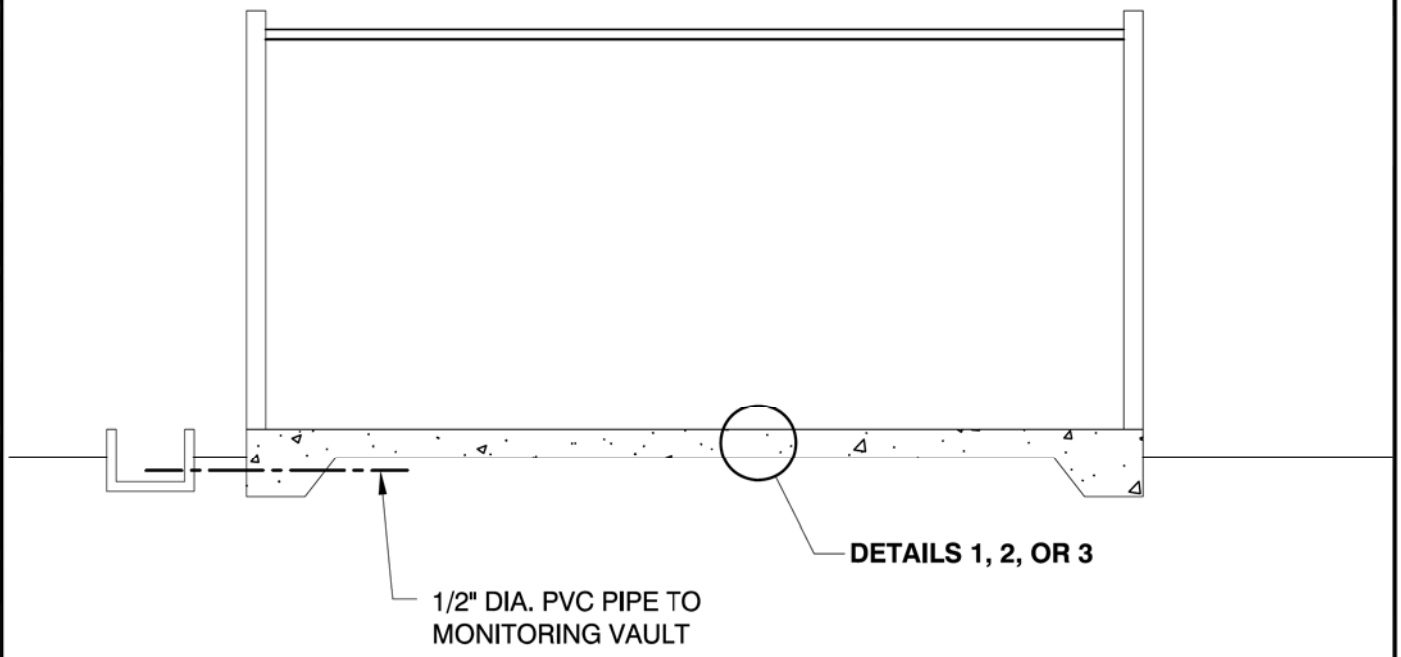
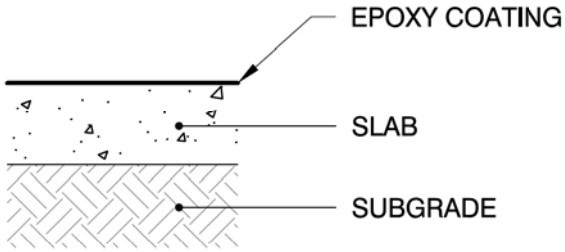
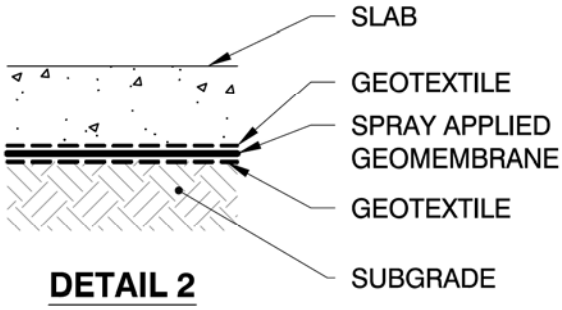
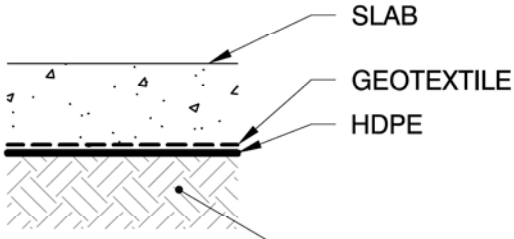




DETAIL 1



DETAIL 2



DETAIL 3

NOT TO SCALE

FIGURE M-1

GAS CONTROL SYSTEM WITH GAS BARRIERS

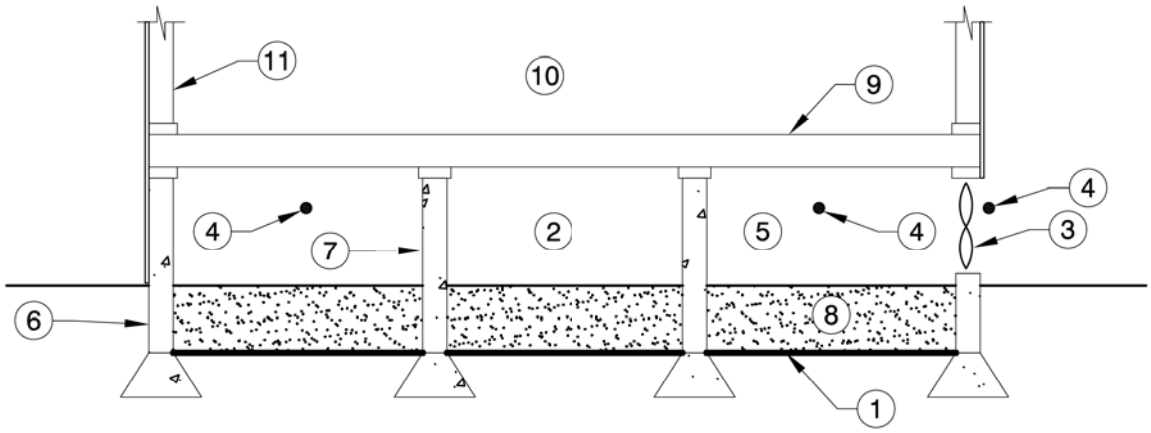
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM

PREPARED FOR

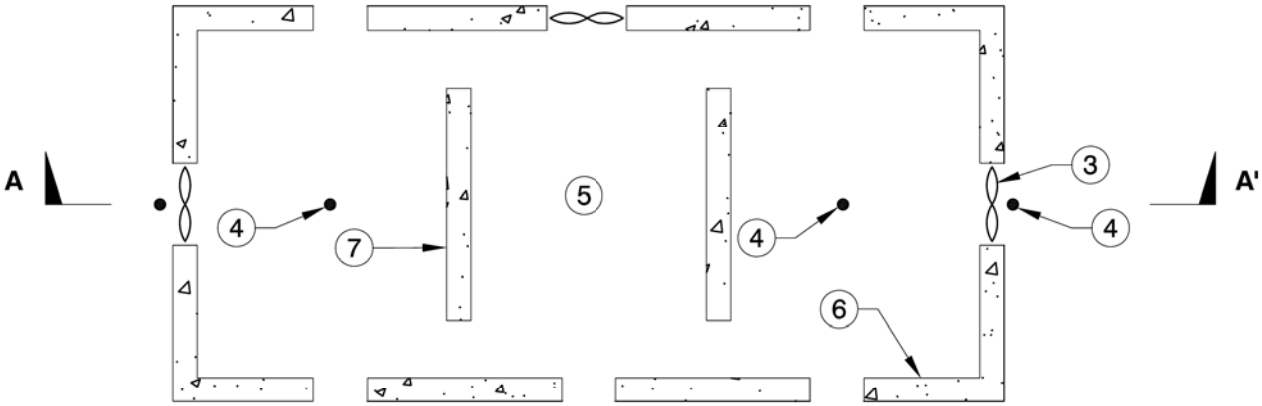
CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA

AVOCET ENVIRONMENTAL, INC.

V:\1212_Padre-Chevron_SLOTF\1212.001_Remedial_Design\048_1212.001_Crawl_Space_Open_Air_Gas_Extraction.dwg\12/19/07



SECTION A-A'



PLAN OF CRAWL SPACE

GAS CONTROL SYSTEM

1. GAS BARRIER - GEOMEMBRANE
2. GAS EXTRACTION - CRAWL SPACE
3. GAS EXTRACTION - FAN
4. MONITORING - INSTRUMENTS AND ALARMS

HOUSE AND STRUCTURE

5. CRAWL SPACE
6. PERIMETER STEM WALLS
7. INTERIOR STEM WALLS (OR ISOLATED FOOTINGS)
8. SOIL - GEOMEMBRANE PROTECTION
9. FLOOR SYSTEM AND FLOORING
10. INDOOR AIR SPACE
11. HOUSE STRUCTURE FRAMING

NOT TO SCALE

FIGURE M-2

CRAWL SPACE OPEN AIR GAS EXTRACTION

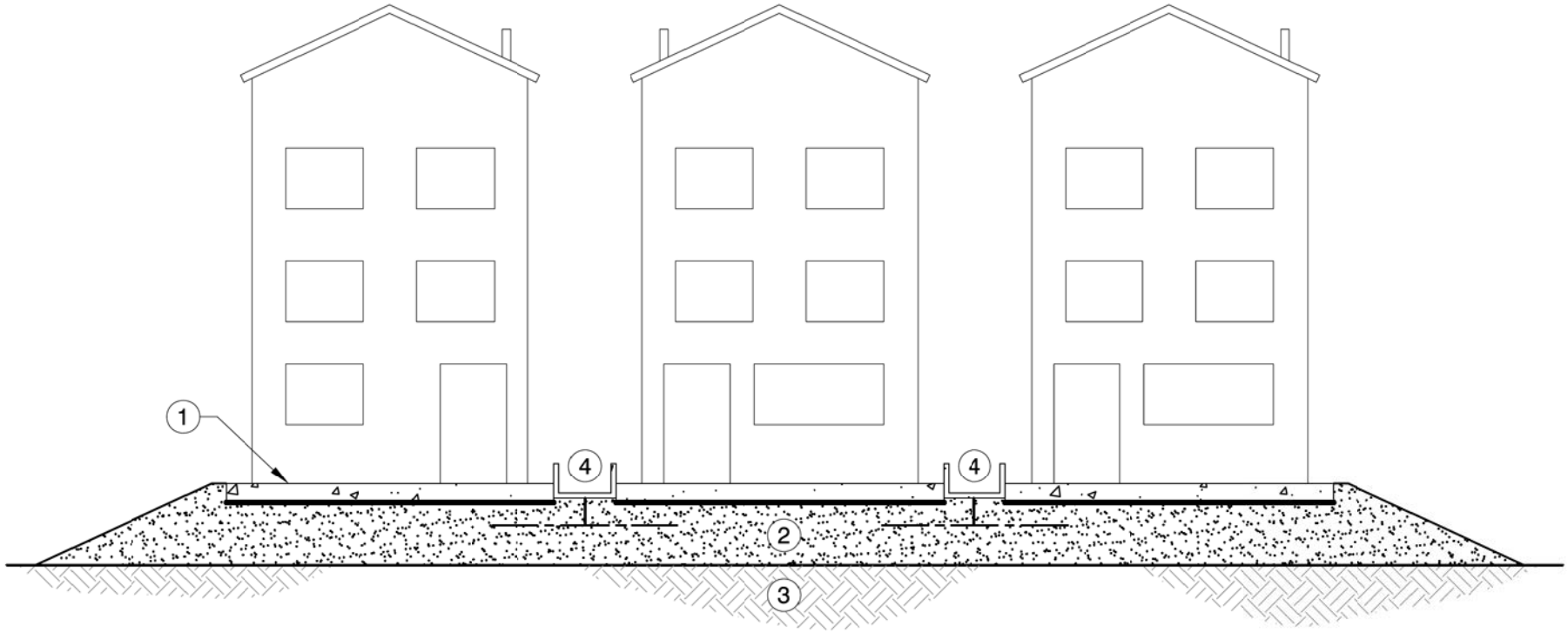
REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM

PREPARED FOR

CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA

AVOCET ENVIRONMENTAL, INC.

V:\1212_Padre-Chevron_SLOTF\1212.001_Remedial_Design\049_1212.001_Passive_Gas_Control_Sand.dwg\12/19/07



NOT TO SCALE

FIGURE M-3

PASSIVE GAS CONTROL SYSTEM ON SAND PLATFORM

REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM

PREPARED FOR

CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA

AVOCET ENVIRONMENTAL, INC.

GAS BARRIER SYSTEM

1. GAS BARRIER - SLAB AND GEOMEMBRANE
2. PASSIVE GAS EXTRACTION - COMPACTED SAND PLATFORM

OTHER

3. NATURAL GRADE - NATIVE SITE SOIL
4. 1/2" DIA. PVC PIPE TO MONITORING VAULT

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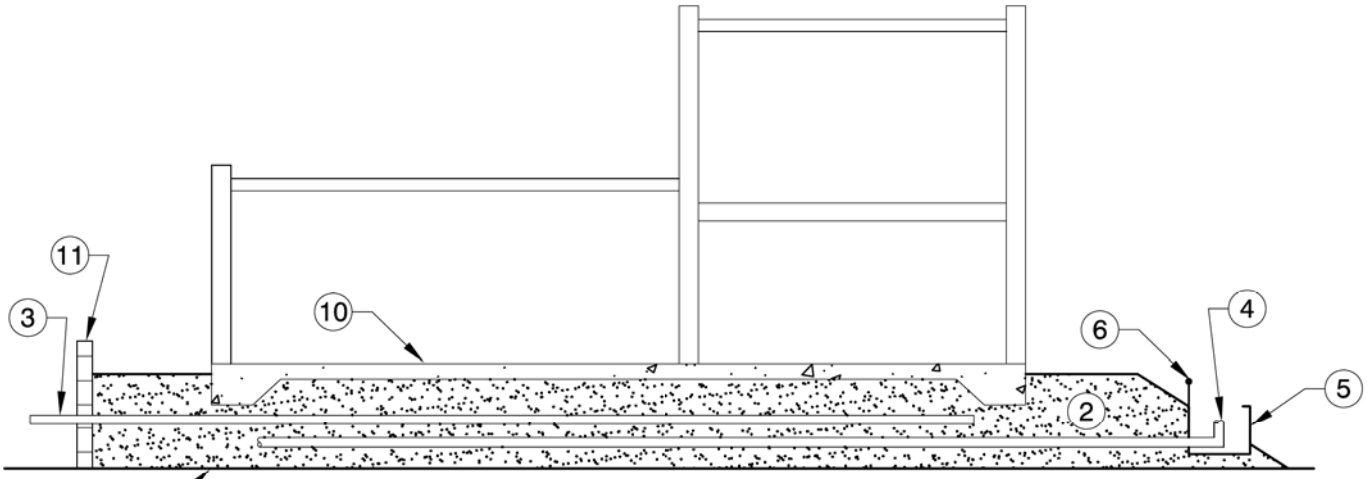
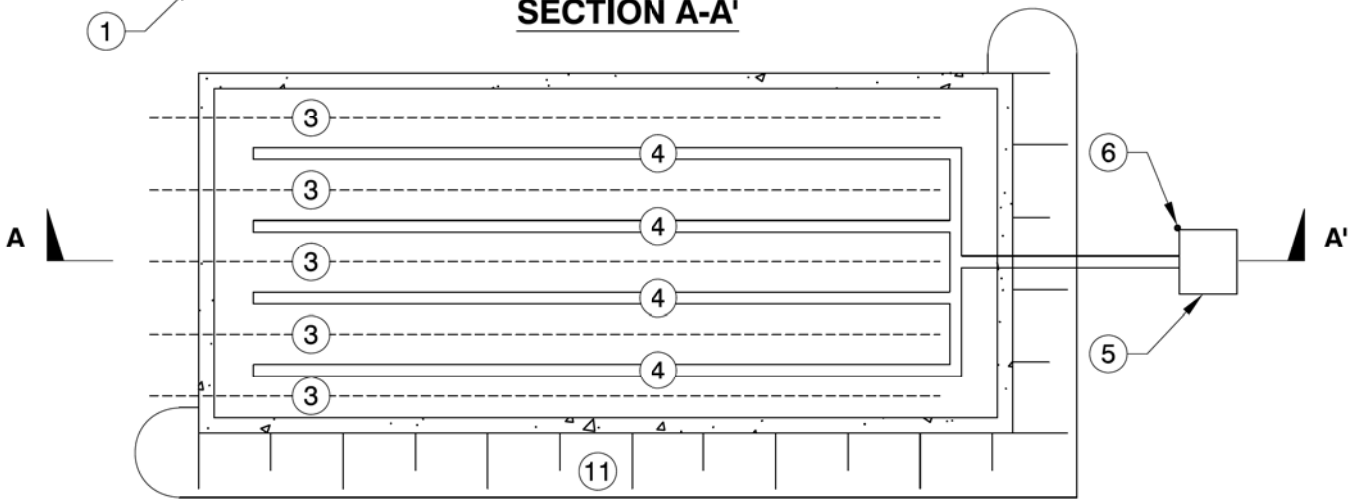


SECTION A-A'



PLAN OF SOIL PLATFORM

GAS CONTROL SYSTEM

1. GAS BARRIER - GEOMEMBRANE BENEATH GEOTEXTILE
2. GAS COLLECTION - SAND PLATFORM
3. GAS EXTRACTION - AIR INLET PIPES
4. GAS EXTRACTION - AIR REMOVAL PIPES
5. GAS EXTRACTION - PUMP AND EXIT PORT BOX
6. MONITORING - INSTRUMENTS AND ALARMS

STRUCTURE

10. OPEN SPACE FLOOR SLAB
11. PERIMETER WALL OR SLOPE

NOT TO SCALE

FIGURE M-4

STRUCTURE ON SAND PLATFORM WITH ACTIVE GAS EXTRACTION COMPONENTS

REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM

PREPARED FOR

CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA

AVOCET ENVIRONMENTAL, INC.

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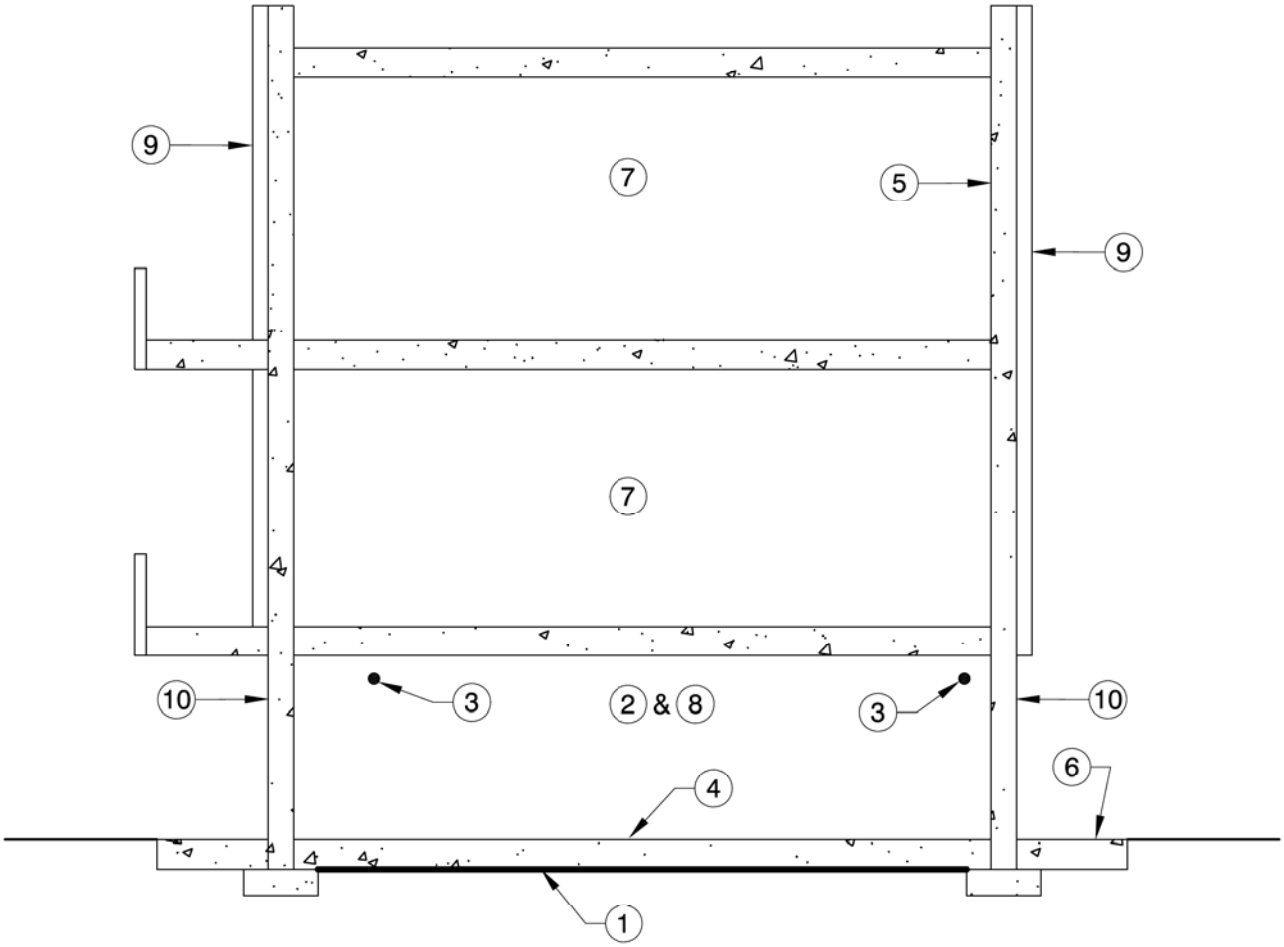

GAS CONTROL SYSTEM

1. GAS BARRIER - GEOMEMBRANE
2. GAS EXTRACTION - OPEN FIRST FLOOR
3. MONITORING - INSTRUMENTS AND ALARMS

STRUCTURE

4. OPEN SPACE FLOOR SLAB
5. 3-STORY STRUCTURE
6. FLATWORK
7. LIVING SPACE
8. OPEN SPACE (PARKING)
9. WALLS AND WINDOWS
10. COLUMNS

NOT TO SCALE

FIGURE M-5

MULTI-STORY RESIDENCE WITH OPEN SPACE FLOOR AND PASSIVE GAS EXTRACTION

REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM

PREPARED FOR

CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA

AVOCET ENVIRONMENTAL, INC.

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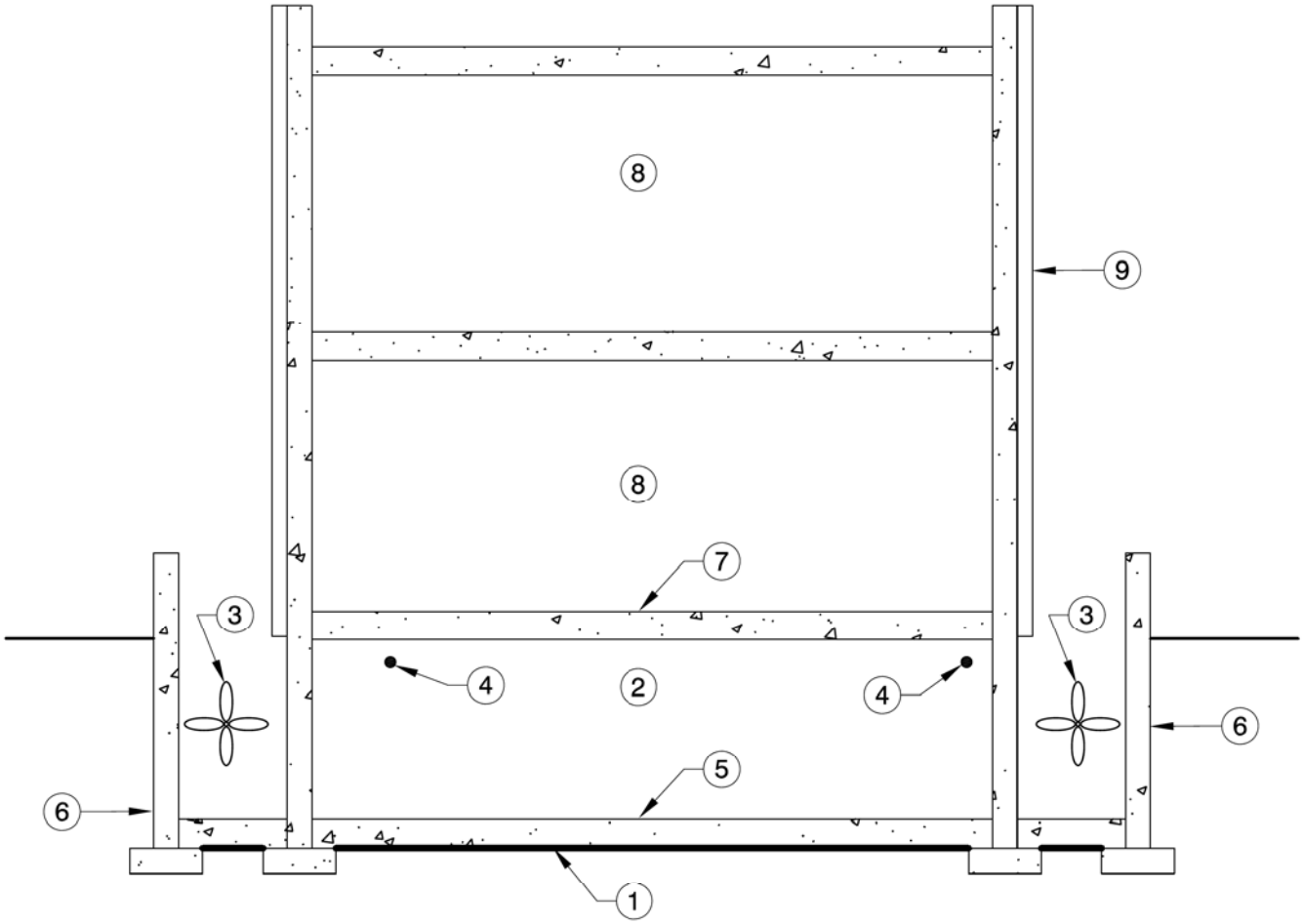

GAS CONTROL SYSTEM

1. GAS BARRIER - GEOMEMBRANE
2. GAS EXTRACTION - CRAWL SPACE
3. GAS EXTRACTION - FAN
4. MONITORING - INSTRUMENTS AND ALARMS

STRUCTURE

5. FLOOR SLAB
6. RETAINING WALL (ALTERNATIVELY - SLOPE EXCAVATION)
7. MAIN LIVING SPACE STRUCTURE ON COLUMNS
8. LIVING SPACE
9. WALLS AND WINDOWS

NOT TO SCALE

FIGURE M-6

MULTI-STORY RESIDENCE WITH OPEN BASEMENT AND ACTIVE GAS EXTRACTION

REMEDIAL ACTION PLAN
SAN LUIS OBISPO TANK FARM

PREPARED FOR

CHEVRON EMC
SAN LUIS OBISPO, CALIFORNIA

AVOCET ENVIRONMENTAL, INC.