Supplemental Filing

Response to Data Requests
1 through 52

In support of the

Petition for Amendment No. 1

for the

Russell City Energy Center

Hayward, California

(01-AFC-7)

Submitted to the:

California Energy Commission

Submitted by:

Russell City Energy Company, LLC

With Technical Assistance by:

CH2MHILL

Sacramento, California

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Contents

Contents iii
Introduction v
Air Quality (1-16) 7
Biology (17-20) 17
Cultural Resources (21-27) 29
Geology and Paleontology (28) 39
Land Use (29-37) 45
Soil and Water Resources (38-42) 59
Transmission System Engineering (43-51) 77
Waste Management (52) 83

Introduction

Attached are Russell City Energy Company, LLC's responses to California Energy Commission (CEC) Staff data requests numbers 1 through 52 for the Russell City Energy Center (RCEC) Petition for Amendment No. 1 (01-AFC-7). The CEC Staff served these data requests on December 22, 2006, as part of the discovery process for the RCEC amendment petition. The responses are grouped by individual discipline or topic area. Within each discipline area, the responses are presented in the same order as CEC Staff presented them and are keyed to the Data Request numbers (1 through 52). New or revised graphics or tables are numbered in reference to the Data Request number. For example, the first table used in response to Data Request 15 would be numbered Table DR15-1. The first figure used in response to Data Request 28 would be Figure DR28-1, and so on.

Additional tables, figures, or documents submitted in response to a data request (supporting data, stand-alone documents such as plans, folding graphics, etc.) are found at the end of a discipline-specific section and are not sequentially page-numbered consistently with the remainder of the document, though they may have their own internal page numbering system.

Air Quality

Data Responses 1-16

Air Quality (1-16)

Peak and Average Sulfur Content

1. *Please provide documentation from the proposed natural gas supplier of the guaranteed peak and average fuel sulfur content levels.*

Response: Pacific Gas & Electric Company (PG&E) will be the gas supplier for the RCEC. Per PG&E Rule 21, the gas delivered to PG&E's system shall contain no more than one grain of total sulfur per one hundred standard cubic feet (1 gr/100 scf). Based on historical data, the actual sulfur content of the natural gas supplied to the RCEC is expected to be significantly less than the 1 gr/100 scf maximum. Table DR1-1, which is reprinted from PG&E's Pipe Ranger website http://www.pge.com/pipeline/operations/sulfur/sulfur_info.shtml, lists recent average and maximum data.

TABLE DR1-1
Gas System Sulfur Survey Results

	Total Sulfur Average All Sites		Total Sulfur Maximum	
Date	**gr/100 scf**	**ppmv**	**gr/100 scf**	**ppmv**
Third Quarter 2006	0.241	4.05	0.466	7.88
Second Quarter 2006	0.160	2.70	0.408	6.90
First Quarter 2006	0.145	2.45	0.318	5.37

Source: http://www.pge.com/pipeline/operations/sulfur/sulfur_info.shtml

Fuel Sulfur Content

2. *Please provide the most recent six months of daily peak and average gas sulfur content values from the proposed natural gas supplier, collected at the nearest available location to the proposed facility gas tie-in. If daily values are not available, please provide either weekly or monthly sulfur content values, whichever is available, with an explanation as to why daily measurements are not available.*

Response: Sulfur data for the past six months, provided by PG&E's Mike O'Brien, is included in Attachment DR2-1. This data is from PG&E's Bixler sulfur analyzer. Mr. O'Brien noted that these are conservative numbers, but cautioned that they do not include the sulfur compound COS (approximately 0.40 ppmv), which is included in the Pipe Ranger values in Table DR1-1 above. The sulfur data in Attachment DR2-1 ranges between 2.77 and 4.96 ppmv with an average of 3.86 ppmv. If 0.40 ppmv is added to the data in Attachment DR2-1, the resulting data would range from 3.17 to 5.36 ppmv with an average of 4.26 ppmv.

Sulfur Limits for Natural Gas

3. *Please provide the steps and method the project owner will use to ensure continuous compliance with the sulfur content limits specified for the supplied natural gas fuel.*

Response: The project owner has used PG&E's maximum total sulfur value of 1 gr/100 scf for the purpose of evaluating the air quality impacts associated with the RCEC (i.e., hourly and daily emissions levels). A more typical total sulfur value of 0.25 gr/100 scf was used for the purpose of calculating annual sulfur dioxide emissions.

For the purpose of demonstrating compliance with Conditions of Certification AQ-11, AQ-20(g), and AQ-24(e), as proposed to be amended, the project owner suggests that CEC and Bay Area Air Quality Management District (BAAQMD) approved emissions factors, based on the maximum total sulfur content of 1 gr/100 scf, be applied to the actual heat input. Since the maximum total sulfur content is essentially limited by PG&E's Rule 21 to 1 gr/100 scf, and historical data shows actual values that are much less than 1 gr/100 scf, compliance with Conditions of Certification based on a this sulfur content should be assured.

For the purpose of demonstrating compliance with Condition of Certification AQ-25(e), the project owner suggests that CEC and BAAQMD-approved emissions factors, based on monthly sulfur data, be applied to the actual heat input during each month. The monthly sulfur data could be obtained either by monthly grab samples at the RCEC or by use of PG&E data if such data can be demonstrated to be representative of the gas delivered to the RCEC. In the event that monthly sulfur data is found to be greater than the assumed 0.25 gr/100 scf, compliance with AQ-25(e) may be assured through limiting the annual heat input accordingly.

Start-up and Shut-Down Events

4. *Please provide the maximum number of start-up and shut-down events on a daily and annual basis.*

Response: The short-term and annual emission rates include an assumed number of turbine startups/shutdowns. Table DR4-1 delineates the proposed total startups and shutdowns on a daily and annual basis.

TABLE DR4-1
Proposed Daily and Annual Startups and Shutdowns at RCEC

Scenario	Daily Startups	Daily Shutdowns	Annual Startups	Annual Shutdowns
Each Turbine	1 cold/1 hot	2	52 cold/260 hot	312
Both Turbines	2 cold/2 hot	2	104 cold/520 hot	614

In addition, Table 3.1-6 in the Amendment Petition presents data on the startup and shutdown emission rates, while Table 3.1-23 presents data on emissions rates as well as startup and shutdown durations.

The application is not seeking to limit the total number of startup/shutdown events. Rather, compliance with the annual limits will be monitored and based on total emissions rather than individual hours of operation, startup, or shutdown.

Estimated Facility Emissions

5. *Please provide actual calculations, assumptions, and methods used to estimate the facility daily and annual emissions provided in Tables 3.1-3 through 3.1-5.*

Response: The emissions calculations, assumptions, and methods are based on accepted and approved methodologies used in previous AFC submittals. The following table summarizes the calculations, assumptions, and methods.

TABLE DR5-1
Emission Calculations Assumptions and Methods

Pollutant	Reference Table	Comments (Assumptions, Methods, etc.)
Ammonia	3.1A-1	The emissions calculation is based on the proposed ammonia slip limit, exhaust flow rates and conditions, and proposed operational hours. The calculations match with those provided by Calpine in Table 3.1A-4.
NOx, CO, VOC, SOx, and $PM_{10/2.5}$ – Turbines/HRSGs	3.1A-4	The emissions calculations are based on a wide range of fuel input and analysis data, exhaust technical data, operating scenarios, control equipment operational parameters, etc. Exhaust data and conditions are accounted for in both inlet and outlet scenarios, and control efficiencies are factored into the calculations.
NOx, CO, VOC, SOx, and $PM_{10/2.5}$ – Turbines/HRSGs	3.1A-5	Startup and shutdown emissions values are based on detailed short and long term startup and shutdown test data for the specific turbines proposed.
HAPs – Turbines/HRSGs	3.1A-6	HAPs emissions values are based on accepted CARB CATEF emissions factors, fuel flow and heat rates, and operational hours.
HAPs – Cooling Tower	3.1A-9	HAPs emissions values are based on the proposed constituents of the cooling tower blowdown water, proposed BACT drift rate, and operational hours.
$PM_{10/2.5}$ – Cooling Tower	3.1A-7 and 3.1A-8	The emissions calculations are based on a wide range of cooling tower operational characteristics, blowdown chemistry, BACT drift rate, operational hours, and the standard cooling tower emissions equation.
NOx, CO, VOC, SOx, and $PM_{10/2.5}$ – FP Engine	3.1A-10	The emissions calculations are based on the engine type, engine horsepower, fuel type, fuel use rates, and engine specific emissions factors derived from the manufacturers' data sheets.
HAPs – FP Engine	3.1A-11	HAPs emissions values are based on accepted CARB CATEF emissions factors, fuel type, fuel flow rates, and operational hours.

Maximum Permitted VOC Emissions

6. *Table 3.1-3 lists the proposed maximum permitted VOC emissions for each turbine as 2.82 lbs/hour. Table 3.1A-4 (in the appendix) shows each turbine hourly VOC emissions as high as 5.6 lbs/hour. Please explain the differences between the two emission limits.*

Response: The 2.82 lbs/hr VOC emissions estimate is a controlled value based on the assumption that the proposed CO oxidation catalyst reduces VOCs by a minimum of 50 percent.

The VOC emission rate of 2.82 lbs/hr/turbine is equivalent to the proposed VOC BACT limit for VOC at 2.0 ppm (at 15% O_2).

Hourly VOC Emission Limit

7. *Please explain how Calpine would ensure compliance with the proposed hourly VOC emission limit.*

Response: Compliance will be established through the use of initial and annual source testing for VOC, as well as the use of natural gas as the only turbine fuel.

Maximum Permitted PM_{10} Emissions

8. *Table 3.1-3 lists the proposed maximum permitted PM10 emissions for each turbine as 9 lbs/hour. Table 3.1A-4 (in the appendix) shows each turbine hourly PM10 emissions as high as 29.2 lbs/hour. Please explain the differences of the two emission limits.*

Response: Table 3.1A-4 (page 4 of 4) of the Amendment Petition indicates that the final permitted PM_{10} emission rate per turbine as 9 lbs/hr. The 29.2 lb/hr value alluded to is an intermediary calculated value provided by the turbine manufacturer. The final value per the table is 9 lbs/hr/turbine. Source test data on similar turbines indicates that the 9 lb/hr proposed value is both reasonable and achievable.

PM_{10} Hourly Emission Limits

9. *Please explain how Calpine would ensure compliance with the proposed hourly PM10 emission limit.*

Response: Compliance will be established through the use of initial and annual source testing for PM_{10}, as well as the use of natural gas as the only turbine fuel.

SOx Emission Limits

10. *Please explain how Calpine would ensure compliance with the proposed annual SOx emission limits at the proposed hours of operation.*

Response: Please see the response to Data Request 3.

Emission Reduction Credits

11. *Please provide option contracts and/or evidence of acquisition of ERCs for the NOx, VOC, SOx and PM10/PM2.5 liability of the project.*

Response: The following table summarizes the offsets surrendered by RCEC. The emission reduction credits presented in this table exist as federally enforceable, banked emission reduction credits that have been reviewed for compliance with District Regulation 2, Rule 4, "Emissions Banking," and were subsequently issued as banking certificates by BAAQMD.

TABLE DR11-1
Emission Reduction Credits Surrendered for RCEC

Type	POC	NO_x
Valid Emission Reduction Credits	87.35[a]	95.25[b]
Permitted Source Emission Limits	28.5	134.6
Offsets Required per BAAQMD Calculations	28.5[c]	154.8[d]

[a] From Banking Certificate #855

[b] From Banking Certificate #815

[c] Reflects applicable offset ratio of 1.0:1.0 pursuant to Regulation 2-2-302

[d] Reflects applicable offset ratio of 1.15:1.0 pursuant to Regulation 2-2-302 with 95.25 tons of NO_x and 59.55 tons of POC.

The Banking Certificates referred to in Table DR11-1 originated from the following locations (Table DR11-2):

TABLE DR11-2
Banking Certificates

Certificate Number	Company	Location	Original Issue Date	Original Certification
#855	Pacific Gas & Electric	San Francisco	9/30/85	#14[a]
#815	Pacific Refining	Hercules	1/19/01	#558[b]

[a] Certificate #14 (#671) was generated by the shutdown of Potrero Units 1&2 (Boilers S-3, S-4, S-5; B&W 500,000 pounds per hour) at the Potrero Power Plant facility.

[b] Certificate #558 (#728) was generated by the closure of the Pacific Refining Company in Hercules. The credits resulted from the shutdown of process heaters (S-3,4,5,6,8,9,10,12,13) and a safety flare (S-76).

Table DR11-3 shows the quantities of emission reduction credits surrendered, per certificate. PM10/2.5 ERCs were not required under BAAQMD rules.

TABLE DR11-3
Emission Reduction Credits Surrendered

Certificate Number	NOx ERCs Surrendered, Tons	POC ERCs Surrendered, Tons
#855	53.11	87.35
#815	49.864	80.325
POC surrendered for NOx on #815	51.825	(80.325 – 51.825 = 28.5)
Total NOx	154.8	28.5

ERCs for NOx, VOC, SOx, and PM10

12. *If the project owner is unable to adequately respond to the Data Request above, please provide a status report starting February 1, 2007, and continuing monthly until the report identifies option contracts and/or evidence of acquisition of ERCs for the NOx, VOC, SOx, and PM10 liability of the project. The report should be specific to each pollutant and provide new information and update information from previous monthly status reports as appropriate. The reports should include for the ERCs:*

    a. *contact names and telephone numbers;*

    b. *company or source names;*

    c. *pollutant credit types and amounts in lbs/day;*

    d. *ERC certificate numbers;*

    e. *the methods of emission reductions (e.g., shutdown, reduction of hours of operation, emission controls, etc.);*

    f. *the status of ERC or option negotiations; and*

    g. *the location of the emission reduction credits.*

Response: The project owner has been able to respond adequately to Data Request 11. Please see the response to Data Request 11.

PM_{10} and PM2.5 ERCs

13. *Table 3.1-5 identifies that the project PM10/PM2.5 emissions would be limited to 86.8 tons/yr, and Calpine has proposed to only mitigate the project PM10, PM2.5 and SOx emissions during the fall and winter months. Thus the proposed revised condition AQ-58 only identifies 43.4 tons of PM10/PM2.5 liabilities (fall and winter, or half a year) to be mitigated. This proposed mitigation can only work if the operational profile of the source providing the emission reduction credits is known to emit emissions only during fall and winter. Therefore, early identification of the source providing offsets is needed to verify the source emission or operational profile. Please provide for the PM10 and PM2.5 ERCs:*

    a. *company or source names;*

    b. *pollutant credit types and amounts in lbs/day;*

    c. *ERC certificate numbers;*

    d. *the methods of emission reductions (e.g., shutdown, reduction of hours of operation, emission controls, etc.);*

    e. *the status of ERC or option negotiations; and*

    f. *the location of the emission reduction credits.*

    g. *Any pertinent information to show that the facility emits PM10/PM2.5 emissions only during fall and winter.*

Response 13: Facility PM_{10}/$PM_{2.5}$ emissions offsets are not required by the BAAQMD's Regulation 2 Rule 2. RCEC proposes to offset PM_{10}/$PM_{2.5}$ emissions during the fall/winter

period in which ambient PM concentrations are above the ambient air quality standards and the area is in non-attainment. During the other half of the year, the region is in attainment for these standards, so no offsets are required. The emissions will be offset on a 1:1 basis, or at an interpollutant trading ratio of 3:1 (SOx:PM_{10}). The justification for the 3:1 ratio is discussed in detail in Data Response 15. RCEC will work with the CEC to develop an acceptable mitigation plan that may include a combination of banked emission reduction credits (ERCs) of SOx and PM_{10}, as well as projects that reduce PM_{10}/$PM_{2.5}$ emissions, such as the proposed fireplace retrofit program. If PM_{10}/$PM_{2.5}$ emission reduction credits or SOx credits are required, they will be generated from the recently submitted banking application for the Los Medanos Energy Center.

SOx ERCs

14. *Similar to the Data Request above, if Russell City Energy Center SOx emissions are proposed to be mitigated during the fall and winter only, please provide for the SOx ERCs:*

    a. *company or source names;*

    b. *pollutant credit types and amounts in lbs/day;*

    c. *ERC certificate numbers;*

    d. *the methods of emission reductions (e.g., shutdown, reduction of hours of operation, emission controls, etc.);*

    e. *the status of ERC or option negotiations; and*

    f. *the location of the emission reduction credits.*

    g. *Any pertinent information to show that the facility emits SOx emissions only during fall and winter.*

Response: Please see the response to Data Request 13.

PM_{10} Trading Ratio

15. *Please provide an analysis demonstrating that the use of the proposed 3 to 1 SOx for PM10 trading ratio would mitigate the project's new PM10/PM2.5 emissions impacts.*

Response: RCEC's request to use SO_2 offsets in lieu of PM_{10} at an interpollutant trading ratio of 3:1 is consistent with BAAQMD Regulation 2-2-303-1. SO_2 is a precursor to the formation of PM_{10}/$PM_{2.5}$. Not all emitted SO_2 contributes to the formation of PM_{10}/$PM_{2.5}$. Traditionally, the BAAQMD has evaluated each proposed interpollutant trade to determine the ratio needed to provide a net air quality benefit as defined in BAAQMD Regulation 2-2-224. The RCEC project has a direct impact for PM_{10} that is not significant, as defined in BAAQMD Regulation 2-2-219 and 2-2-3030.1. As a result, the proposed offsets must result in a net air quality benefit for the entire region as a whole and need not be from sources near RCEC.

The amount of PM_{10} that forms as a result of SO_2 emissions is determined by measuring the amount of sulfate in collected ground-level particulates, and the amount of SO_2 known to have been emitted in the area. On recent BAAQMD projects, the District has determined that the ratio of SO_2 to PM_{10} is 3:1 and that this ratio has a significant benefit in the area

directly impacted by the offsetting source and a net air quality benefit in the general area impacted by the proposed project.

Recent air permit reviews before the BAAQMD and other air districts, and recent cases before the CEC support the use of a 3:1 SOx for PM_{10} interpollutant trading ratio. That is, in several recent siting cases, the BAAQMD has agreed to the 3:1 ratio (or less) and such a ratio has been reflected in the CEC's final decisions.

- February 2001—BAAQMD staff proposed a 3:1 SO_2/PM_{10} inter-pollutant offset ratio for the Potrero Unit 7 project. District staff indicated that the 3:1 offset ratio is consistent with their previous actions as well as the 1992 SAI report for Contra Costa County. In addition, BAAQMD staff clearly indicated that the ratio should be based on the winter PM episode data, not annual average data. Use of the winter period PM_{10} data is also supported by data presented in the CARB Almanac-2006, Chapter 2, which indicates for the San Francisco Bay Area, that there is "a strong seasonal variation in PM, with higher PM_{10} and $PM_{2.5}$ concentrations in the fall and winter months. In the winter, PM_{10} and $PM_{2.5}$ concentrations remain elevated for extended periods. These higher concentrations are caused by increased activity for some emission sources and meteorological conditions that are conducive to the build-up of PM." CARB presented data which indicates that for the Bay Area region, that the estimated secondary portion of $PM_{2.5}$ (from SOx and NOx) is approximately 40%, which results in an inter-pollutant offset ratio of 2.5:1. In addition, CARB presents values that clearly indicate that the peak PM_{10} and $PM_{2.5}$ periods occur during the winter.
- August 2002—BAAQMD staff analysis in the FDOC for the East Altamont Energy Center concluded that a ratio of 3:1 is sufficient to produce a net air quality benefit when using SO_2 emissions reductions or credits to mitigate PM_{10} emissions increases.

Based on the above summary, the proposed SO_2/PM_{10} offset ratio of 3:1 is more than sufficient to provide a net air quality benefit.

Cumulative Impacts Analysis

16. *Please provide the cumulative impacts analysis or identify the timeline for completion and submittal of the cumulative impacts analysis.*

Response: The Applicant has requested a list of other permitted but not yet operational sources in the vicinity of RCEC from the BAAQMD. As soon as this list is received, a cumulative modeling analysis will be prepared. The cumulative modeling analysis including the recently proposed Eastshore project will be provided by the end of January 2007.

Attachment DR2-1

PG&E Sulfur Data

Attachment DR2-1

PG&E sulfur gas data from the Bixler sulfur analyzer

Date	Total Sulfur*, PPMv	Date	Total Sulfur*, PPMv	Date	Total Sulfur*, PPMv	Date	Total Sulfur*, PPMv
07/01/06	4.29	08/16/06	4.19	10/01/06	4.66	11/16/06	2.78
07/02/06	4.25	08/17/06	4.22	10/02/06	4.44	11/17/06	2.81
07/03/06	4.31	08/18/06	4.04	10/03/06	4.27	11/18/06	3.33
07/04/06	4.25	08/19/06	4.48	10/04/06	4.36	11/19/06	3.34
07/05/06	4.10	08/20/06	4.68	10/05/06	4.23	11/20/06	3.49
07/06/06	4.04	08/21/06	4.66	10/06/06	4.10	11/21/06	3.56
07/07/06	4.20	08/22/06	4.60	10/07/06	4.19	11/22/06	3.24
07/08/06	4.26	08/23/06	4.44	10/08/06	4.13	11/23/06	3.31
07/09/06	4.39	08/24/06	4.38	10/09/06	4.13	11/24/06	3.46
07/10/06	4.27	08/25/06	4.21	10/10/06	3.69	11/25/06	3.23
07/11/06	4.29	08/26/06	4.52	10/11/06	3.44	11/26/06	3.24
07/12/06	4.91	08/27/06	4.52	10/12/06	3.86	11/27/06	3.54
07/13/06	4.04	08/28/06	4.37	10/13/06	4.12	11/28/06	3.23
07/14/06	3.69	08/29/06	4.35	10/14/06	3.86	11/29/06	3.42
07/15/06	4.37	08/30/06	4.34	10/15/06	4.00	11/30/06	3.56
07/16/06	4.35	08/31/06	4.01	10/16/06	3.99	12/01/06	3.20
07/17/06	3.29	09/01/06	4.27	10/17/06	3.92	12/02/06	3.05
07/18/06	3.43	09/02/06	4.23	10/18/06	4.30	12/03/06	3.49
07/19/06	3.33	09/03/06	4.21	10/19/06	4.03	12/04/06	3.50
07/20/06	3.25	09/04/06	4.38	10/20/06	3.96	12/05/06	3.12
07/21/06	3.24	09/05/06	4.56	10/21/06	4.21	12/06/06	3.07
07/22/06	3.18	09/06/06	4.38	10/22/06	4.29	12/07/06	3.41
07/23/06	3.21	09/07/06	4.32	10/23/06	4.05	12/08/06	3.38
07/24/06	3.37	09/08/06	4.42	10/24/06	2.77	12/09/06	3.26
07/25/06	3.64	09/09/06	4.34	10/25/06	3.16	12/10/06	3.42
07/26/06	3.25	09/10/06	4.48	10/26/06	3.49	12/11/06	3.45
07/27/06	3.32	09/11/06	4.41	10/27/06	3.38	12/12/06	3.55
07/28/06	3.62	09/12/06	4.37	10/28/06	3.44	12/13/06	3.59
07/29/06	4.40	09/13/06	4.23	10/29/06	3.99	12/14/06	3.32
07/30/06	4.29	09/14/06	4.25	10/30/06	4.27	12/15/06	3.81
07/31/06	3.97	09/15/06	4.23	10/31/06	4.09	12/16/06	3.56
08/01/06	3.68	09/16/06	4.17	11/01/06	3.41	12/17/06	3.50
08/02/06	4.03	09/17/06	4.21	11/02/06	3.70	12/18/06	3.38
08/03/06	3.99	09/18/06	4.18	11/03/06	3.46	12/19/06	3.45
08/04/06	4.19	09/19/06	4.13	11/04/06	3.32	12/20/06	3.42
08/05/06	4.11	09/20/06	4.05	11/05/06	3.40	12/21/06	3.32
08/06/06	4.08	09/21/06	4.28	11/06/06	3.63	12/22/06	3.36
08/07/06	3.95	09/22/06	4.35	11/07/06	3.68	12/23/06	3.51
08/08/06	3.97	09/23/06	4.30	11/08/06	3.64	12/24/06	3.45
08/09/06	3.62	09/24/06	4.59	11/09/06	3.44	12/25/06	3.28
08/10/06	3.42	09/25/06	4.56	11/10/06	3.43	12/26/06	3.42
08/11/06	4.12	09/26/06	4.81	11/11/06	3.40	12/27/06	3.28
08/12/06	4.36	09/27/06	4.17	11/12/06	3.41	12/28/06	3.46
08/13/06	4.09	09/28/06	4.39	11/13/06	3.34	12/29/06	3.37
08/14/06	4.08	09/29/06	4.54	11/14/06	2.89		
08/15/06	4.01	09/30/06	4.96	11/15/06	2.85		

* Total Sulfur includes injected odorant, H2S, and other naturally occuring odorants. This figure does not include COS.

Biology

Data Responses 17-20

Biology (17-20)

Biological Surveys along Transmission Lines

17. *Please provide the results of biological resource surveys conducted along the two alternative transmission line routes that are comparable in scope to the surveys done for the project site. If the surveys have not been completed, please provide a schedule of when they will be completed and submit the survey results to the CEC.*

Response: Biological surveys recently conducted to further characterize the biological habitats along the two alternate transmission lines and the Eastshore Substation are described in Attachment DR17-1.

Biological Surveys at Substation

18. *Please provide the results of biological resource surveys conducted at the Eastshore Substation that are comparable in scope to the surveys done for the project site. If the surveys have not been completed, please provide a schedule of when they will be completed and submit the survey results to the CEC.*

Response: Biological surveys recently conducted to further characterize the biological habitats within the Eastshore Substation are described in Attachment DR17-1.

Aerial Photo of Substation

19. *Please provide an aerial photograph or illustration of the Eastshore Substation at a scale of 1" equals 75' or larger that shows all existing transmission lines entering the substation as well as the lines proposed for the RCEC. On the photograph or illustration, please identify the current land uses and any wildlife habitat, including ruderal areas, immediately adjacent to the Eastshore Substation.*

Response: Figure DR17-1 is map of the Eastshore Substation on an aerial photographic base that shows all of the existing transmission lines entering the substation, the line proposed for the RCEC, and the current land uses and wildlife habitat areas surrounding the Eastshore Substation. This figure is also included in Attachment DR17-1.

Biological Assessments for Reconductoring Projects

20. *Please provide the Biological Resource assessments prepared for the two reconductoring projects (Eastshore to San Mateo and Eastshore to Dumbarton) related to transmission system improvements.*

Response: Attachment DR20-1 is a Biological Assessment of the Eastshore to Dumbarton Reconductoring that was prepared on behalf of the RCEC. The Amendment Petition, in Section 2.3.3.2, describes the Eastshore to Dumbarton reconductoring and discusses the biological assessment that PG&E has conducted in conjunction with the engineering assessment. This assessment determined that PG&E would be able to avoid impacting wetlands and sensitive species by helicopter construction of most of the reconductoring project. This assessment was based both on the Biological Assessment found in

Attachment DR20-1 and on the independent field assessments of the PG&E biologists. The PG&E design and assessment have not changed since the Amendment Petition was filed.

Biological resources impacts assessments were prepared as part of the Environmental Assessment prepared for the Eastshore to San Mateo reconductoring in May of 2002, and PG&E plans to rely on that document (Attachment DR20-2). PG&E biologists, however, have conducted an assessment of one minor modification to PG&E's reconductoring plan, which involves moving the pull and tensioning site at the west end of the Hayward-San Mateo Bridge. This is summarized in Amendment Petition Section 2.3.3.1. The PG&E design and assessment have not changed since the Amendment Petition was filed.

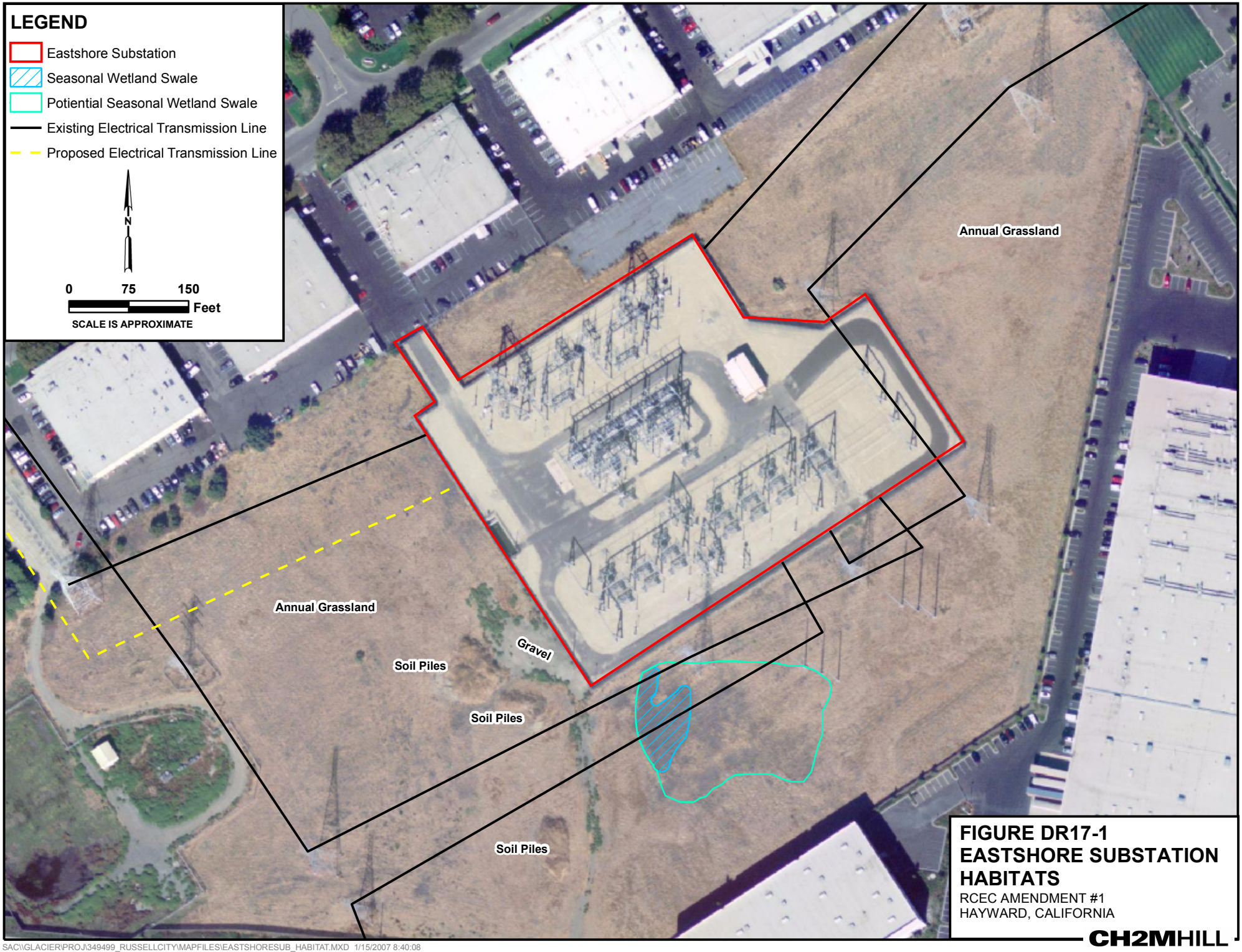

FIGURE DR17-1
EASTSHORE SUBSTATION HABITATS
RCEC AMENDMENT #1
HAYWARD, CALIFORNIA

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Attachment DR17-1

Biological Surveys

Transmission Line Routes and Eastshore Substation

Russell City Energy Center - Eastshore Substation and Transmission Line Route Biological Resource Surveys

PREPARED FOR: Doug Davy/CH2M HILL

PREPARED BY: Russell Huddleston/CH2M HILL

COPIES: Mike Hatfield/Calpine

DATE: January 11, 2007

Introduction

Calpine Corporation was granted a California Energy Commission Certificate for the construction of the Russell City Energy Center, a 600 MW power generation facility in Hayward, Alameda County, in September of 2002. The City of Hayward has recently made available a new site that is located on City property that has siting and permitting advantages, compared with the original site. The new site is partly located within the City's Water Pollution Control Facility. This memorandum presents the results of a biological survey and habitat characterization of the Pacific Gas and Electric Eastshore Substation and the proposed transmission line alternatives.

Methods

An initial investigation of the Eastshore Substation was conducted by Russell Huddleston a CH2M HILL biologist on May 24, 2006. The site was inaccessible at the time and general habitat descriptions and species composition was determined based on observations made along the perimeter fence line. Pedestrian surveys of the site were conducted by Russell Huddleston on January 10, 2007 in response to California Energy Commission Staff Data Request #18. Surveys of the proposed and alternate transmission line routes were also conducted by Russell Huddleston on January 10, 2007. The purpose of the surveys was to characterize the habitat, document wildlife sprtecies present, identify potential sensitive habitats, and describe the surrounding land use. Representative photographs are provided in Attachment A.

Results

Eastshore Substation

Natural habitat surrounding the Eastshore Substation is characterized by non-native annual grassland. Dominant species include rip-gut brome (*Bromus diandrus*), wild oat (*Avena fatua*), Italian ryegrass (*Lolium multiflorum*) and annual fescue (*Vulpia sp.*). Common ruderal forbs include mustard (*Brassica* sp.), wild radish (*Raphanus sativa*), Italian thistle (*Carduus pycnocephalus*), bristly ox-tongue (*Picris echioides*) and cut-leaf geranium (*Geranium*

dissectum). Native species such as slender tarweed (*Madia gracillis*), saltgrass (*Distichlis spicata*) and alkali heath (*Frankenia* sp.) are present in a few areas, but are generally sparse throughout the site. During the June 8, 2006 site visit the majority of the grassland habitat surrounding the sub-station had been disked, presumably for fire prevention.

A large seasonal wetland area was identified on the south side of the substation. This area is characterized by a well defined topographic depression with a distinct change in plant the community from the adjacent annual grassland. Vegetation in this area appears to be comprised of hydrophytic species including rabbitfoot grass (*Polypogon monspeliensis*), brass buttons (*Cotula coronopifolia*) and pickle grass (*Crypsis* sp.). On January 10, 2007 the soil in this area was moist, but no surface inundation was noted; likely due to the below-average rainfall to date. The location of the seasonal wetland area is shown on Figure DR17-1 (submitted separately within this Data Request Response package, also in response to CEC Staff Data Request #17). A small gravel area and overgrown roadway are located in the southwest corner of the substation. Several soil piles with dense mustard are also located immediately east of the substation.

The former Pacific Gas and Electric substation on the west side of the site is characterized by coyote brush (*Baccharis pilularis*), slender tarweed, and annual grasses and ruderal forbs similar to those observed elsewhere on site. The area to the west is characterized by landscaped trees and shrubs such as eucalyptus (*Eucalyptus globulus*), peppertree (*Schinus terebinthifolia*), ngaio tree (*Myoporum laetum*) and toyon (*Heteromeles arbutifolia*). Understory vegetation includes similar annual grassland species to those observed elsewhere as well as small patches of Himalayan blackberry (*Rubus discolor*).

Wildlife species observed around the substation included several western meadowlarks (*Sturnella neglecta*), American Crows (*Corvus brachyrhynchos*) and Mourning Doves (*Zenaida macroura*). Two Fox sparrows (*Passerella iliaca*) were also observed. The only mammal species was a single black tailed jackrabbit (*Lepus californicus*).

The substation and annual grassland habitat are entirely surrounded by urban development comprised of office buildings, warehouses and light industrial facilities with landscaped vegetation along streets, buildings and parking lots. Salt evaporation ponds are located approximately 700 feet south of the substation and pickleweed marsh is located approximately 3,700 feet to the west on the north side of Highway 92.

Transmission Line

With the exception of the annual grassland habitat surrounding the Eastshore Substation described above, the proposed transmission line route would be located entirely within urban, industrial, and landscaped areas. No sensitive habitats or wildlife species were observed along the proposed route. The alternate route would be located between the existing waste water treatment facility and other industrial land use areas such as equipment storage yards and auto salvage businesses. The parcel immediately east of the existing water treatment plant is currently under development as part of the water treatment plant expansion.

Eastshore Substation – looking north from Arden Road - Annual grassland habitat, predominantly rip-gut brome and wild mustard; May 24, 2006

Eastshore Substation – looking east along the south side of the substation; disked annual grassland and seasonal wetland; June 8, 2006.

Eastshore Substation – looking southeast at the seasonal wetland located south of the substation; rabbitfoot grass and brass buttons around the perimeter; June 8, 2006

Former Eastshore Substation – looking southwest; coyote brush, slender tarweed and annual grasses; January 10, 2007

West of the Eastshore Substation – wooded landscaped area; eucalyptus, pepper tree and ngaio tree with annual grassland understory; January 10, 2007

Proposed Transmission Line Route – looking north at landscaped area immediately south of Highway 92; Italian ryegrass, ice plant, ngaio tree and cypress; January 10, 2007

Proposed Transmission Line Route –landscaped parking area and adjacent office/industrial buildings north of Breakwater Ave; January 10, 2007

Proposed Transmission Line Route – Industrial area south of Enterprise Ave; January 10, 2007

Proposed Transmission Line Route –Expansion site for the water treatment facility north of Enterprise Ave; January 10, 2007

Alternate Transmission Line Route - looking west, route is located between the existing water treatment facility and industrial/auto salvage areas; January 10, 2007

Attachment DR20-1

Biological Assessment

Eastshore to Dumbarton Reconductoring

Biological Resources of the Eastshore to Dumbarton 115 kV Transmission Line

PREPARED FOR: Doug Davy/CH2M HILL

PREPARED BY: Russell Huddleston/CH2M HILL

COPIES: Mike Hatfield/Calpine

DATE: June 13, 2006

Introduction

Pacific Gas & Electric Company (PG&E) proposes to reconductor approximately 6.7 miles of 115 kV electric transmission line between the Eastshore and Dumbarton substations in western Alameda County, California. The reconductoring would be necessary to reinforce the local transmission system to accommodate power generated at the proposed Russell City Energy Center.

Field surveys were completed to identify significant biological resources along the alignment and to evaluate access and develop appropriate avoidance or mitigation measures for sensitive habitats and special-status species. This memorandum documents the results of the biological resources evaluation and field survey.

Project Location

The project includes approximately 6.7 miles of 115 kV transmission line between the Eastshore Substation, located between Investment Boulevard, Arden Road, and Corporate Avenue in Hayward, and the Dumbarton Substation at the intersection of Commerce Drive and Tupelo Street in Fremont (Figure 1). The line is supported on steel lattice towers and crosses an industrial park, salt evaporation ponds, a wastewater treatment plant, open space, agricultural fields, and a public park.

Environmental Setting

Regionally, the project is located within the California Central Coast Ecological Region, which encompasses the mountains, hills, and coastal plains around the San Fransisco Bay where the climate is significantly modified by marine influence from the Pacific Ocean. Locally the project is found in the Bay Flats ecological subsection which includes the coastal plains along the southern end of the San Francisco Bay. This subsection occurs on Quaternary alluvial sediments of the bay margins, comprised primarily of silt and clay. The project area is nearly level, with elevations typically less than 10 feet above sea level. Average annual precipitation ranges between 12 and 15 inches with averages temperatures 58° to 60° F. In general, the western part of the subsection is comprised of natural saltmarshes and salt evaporation ponds, and the eastern part consists of developed urban and industrial areas, including the Cities of Hayward, Union City and Fremont. Eight

general habitat types were identified in the project area. General descriptions of these areas are provided in the following sections.

Pickleweed Marsh

Pickleweed marsh is characterized by dense cover of pickleweed (*Salicornia virginica*) and other salt tolerant species such as saltgrass (*Distichilis spicata*), alkali heath (*Frankenia salina*, arrow-grass (*Triglochin maritima*), annual beard grass (*Polypogon monsplenisis*) and perennial ryegrass (*Lolium perenne*). Pickelweed marsh typically occurs along the more sheltered, inland margins of the bay in areas that are subject to regular or periodic inundation.

Brackish Marsh

Brackish marsh habitat is dominated by perennial emergent species such as cattails (*Typha spp.*), hardstem bull rush (*Schenoplectis acutus*), California bulrush (*S. californicus*), Common three-square (*S. americanus*), saltmarsh bulrush (*S. maritimus*), and flatsedge (*Cyperus erqagrostis*). Brackish marsh occurs where fresh water mixes with salt water. The salinity of brackish marshes may be highly variable as a result of tidal influences. Within the project area, brackish marsh habitat primarily occurs along the edges of Alameda Creek, Coyote Hills Slough, and in the demonstration urban storm water treatment wetlands in the north east corner of the Coyote Hills Regional Park.

Salt Evaporation Ponds

Numerous salt evaporation ponds have been constructed around the San Francisco Bay in areas that historically supported pickleweed marsh and/or brackish marsh habitats. Active salt evaporation ponds generally lack vegetation, but sparse marsh species may occur around the edges of some ponds or scattered within inactive pond areas. The hydrology in these areas is actively managed to move water from one pond to the next, increasingly concentrating the salt content to the point at which the water can be drained and salt harvested.

Grassland/Ruderal

Grassland ruderal habitat is characterized largely by non-native grasses and weedy forbs such as wild oats (*Avena fatua*), rip-gut brome (*Bromus diandrus*), mustard (*Brassica* spp.), wild radish (*Raphanus sativa*), Italian thistle (*Carduus pycnocephalus*), bristly ox-tongue (*Picris echioides*) and fennel *(Foeniculum vulgare*). This habitat is found along roadsides, on levees, hill slopes, upland areas adjacent to marsh habitats, and open spaces. Quack grass (*Elytrigia repens*), a non-native perennial bunchgrass, has been widely introduced in sections of the Coyote Hills Regional Park in an effort to enhance wildlife habitat.

Agricultural

Agricultural habitat in the project area includes irrigated pastures, hay/alfalfa fields, and dry land wheat fields. Within the project area, the irrigated pasture is located in what appears to have historically been pickleweed marsh and is largely characterized by annual beard grass. At the time of the survey, the hay field had been recently harvested and the wheat field had been recently disked.

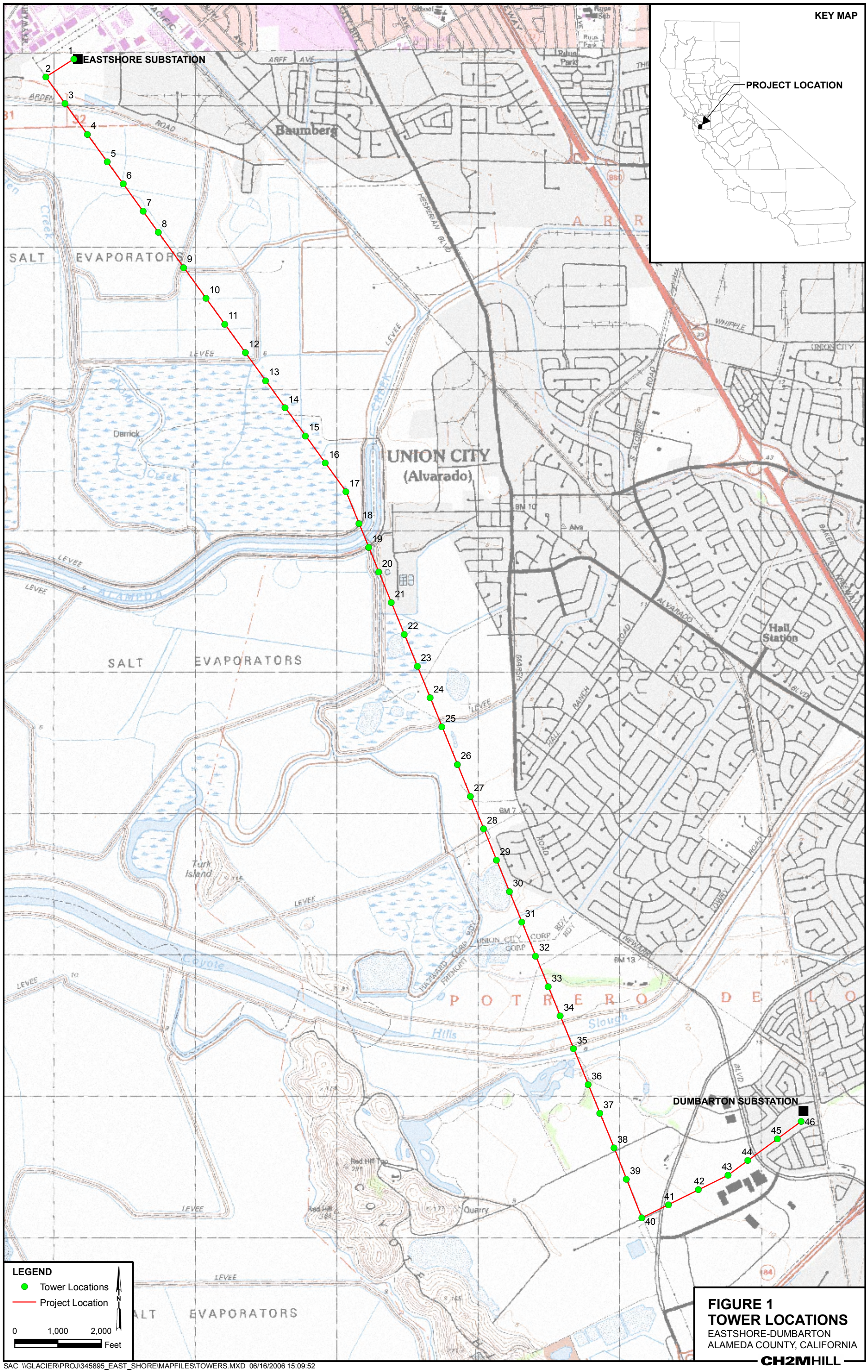

FIGURE 1
TOWER LOCATIONS
EASTSHORE-DUMBARTON
ALAMEDA COUNTY, CALIFORNIA

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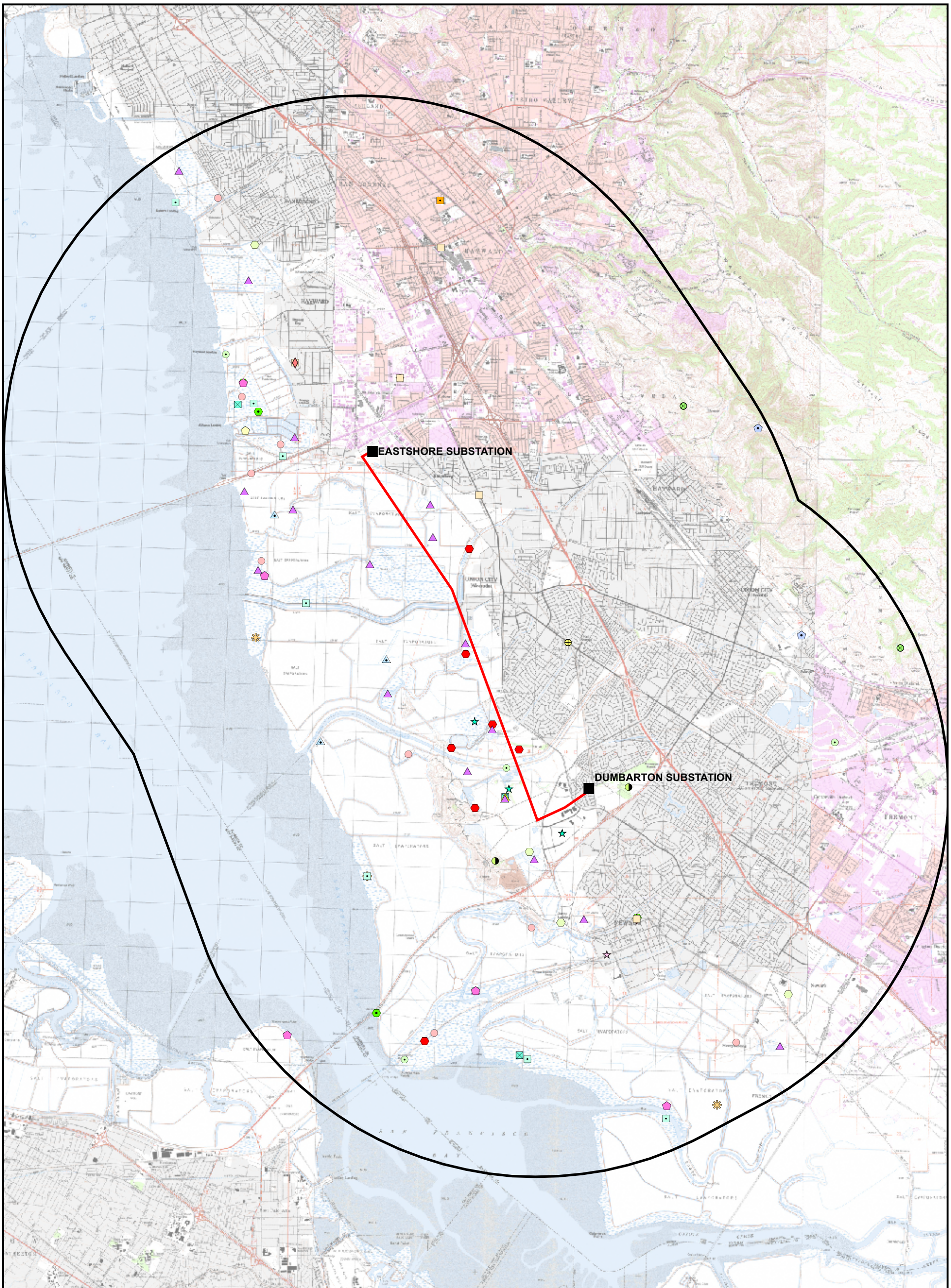

LEGEND

CNDDB, 2006

- Alameda song sparrow
- Alkali milk-vetch
- Bank swallow
- Black skimmer
- Burrowing owl
- California black rail
- California clapper rail
- California least tern
- California red-legged frog
- Congdon's tarplant
- Contra Costa goldfields
- Great blue heron
- Northern Coastal Salt Marsh
- Hairless popcorn-flower
- Monarch butterfly
- Most beautiful jewel-flower
- Northern harrier
- Salt-marsh harvest mouse
- Salt-marsh wandering shrew
- Saltmarsh common yellowthroat
- Santa Cruz tarplant
- Tricolored blackbird
- Western snowy plover
- White-tailed kite

- Substation Locations
- Project Location
- 5-Mile Buffer of Project Location

N

0 3,500 7,000 Feet

FIGURE 2
CNDDB OCCURRENCES WITHIN 5 MILES OF THE PROJECT LOCATION
EASTSHORE-DUMBARTON
ALAMEDA COUNTY, CALIFORNIA

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Parkland

Parkland habitats are landscaped and maintained areas adjacent to or within the urban areas. These areas are typically characterized by lawns and/or landscaped tress and shrubs. Recreational amenities such as ball fields, tennis courts, playgrounds, and bike trails are often associated with these areas. The Eastshore to Dumbarton transmission line passes along one edge of Coyote Hills Regional Park and crosses through Karl Nordvik Park in Fremont.

Urban/Industrial

Urban and industrial areas include developed, paved areas such as the Atlas Van Lines warehouse facility and the Union Sanitary District waste water treatment facility. The line also passes between industrial areas where it runs through a narrow parkland walkway southwest of Karl Nordvik Park in Fremont.

Methods

Evaluation of biological resources included a database search for special-status species that are either known to occur, or have the potential to occur in the project area. For the purposes of this evaluation, a special status-species is defined as (1) any federal- or state-listed threatened or endangered species, (2) any federal or state species that are proposed or candidates for listings as threatened or endangered, (3) any federal or state species of concern, (4) any state of California fully-protected or rare species, (5) any plant species considered rare, threatened or endangered by the California Native Plant Society. Special-status species that are known to occur in either the Newark or Hayward United State Geologic Survey (USGS) 7.5-minute topographic quadrangles were determined based on lists provided by the United States Fish and Wildlife Service and from the California Department of Fish and Game Natural Diversity Data Base (Rarefind V. 3.0.5). The results of the data base search are presented in Appendix A, Table A-1. Known locations of special-status species in a 5-mile radius of the project are shown in Figure 2.

A field reconnaissance of the tower locations and access routes was conducted by CH2M HILL biologist Russell Huddleston on May 24 and June 5, 2006. The purpose of the surveys was to identify sensitive habitat areas and evaluate access to the tower locations for the reconductoring project and to recommend methods for avoiding sensitive species and habitats to PG&E. Representative photos of the towers are included in Attachment B. Due to limited access, none of the towers within the Cargill Salt Ponds of north of Alameda Creek were included in the field survey, but this area is included in the biological evaluation.

Results and Recommendations

The following sections describe the habitats, biological resources and access issues associated with each tower or group of towers. Additional general mitigation measures and are discussed at the end of this section. The tower numbers are indicated in Figure 2. The tower numbers start at the Eastshore Substation (north end) and end at the Dumbarton Substation. The first part of the tower number is the mile from Eastshore. The second

number is the sequential tower number from Eastshore. For example, tower 5/40 is tower number 40, in the fifth mile from the Eastshore Substation.

Towers 0/1 and 0/2

Towers 0/1 and 0/2 are located in the outer perimeter fenced area of the Eastshore Substation. They are outside of the fence that encloses the substation equipment, but inside of the fence that separates the substation area from surrounding streets and businesses. This outer substation area is an open field. The fenceline of the abandoned former Eastshore Substation (all substation equipment has been removed) is located in the western portion of this property. The habitat in this area is predominantly annual grasses and mustard. The majority of the area had been disked at the time of the survey. A seasonal wetland is present on the south side of the substation, just west of tower 0/1 and this area had not been disked. This large, shallow basin has sparse vegetative cover comprised of non-native species such as brass buttons (*Cotula coronopifolia*) and annual beard grass, but much of it is unvegetated mudflat. This seasonal wetland area may provide suitable habitat for federally listed vernal pool invertebrates and should be avoided during the reconductoring activities in this area. A burrowing owl (*Athene cunicularia*) was seen several years ago at the substation, however was not seen during this survey.No other significant biological resources or access constrains were noted in this area.

Tower 0/3

Tower 0/3 is located in the Atlas Van Lines parking and loading area immediately south of the Eastshore Substation. A small unpaved area at the base of the tower supports weedy, non native plants such as mustard, bristly ox-tongue, wild oat, annual beard grass, and sour clover (*Melilotus indica*). There are no access constraints or biological issues associated with this tower location.

Towers 0/4 through 2/18

Towers 0/4 to 2/18 are all located within Cargill salt evaporation ponds north of Alameda Creek. Due to limited access, surveys were not conducted at each tower in this area. From aerial photographs, it is apparent that the tower bases are installed in the salt evaporation ponds. Within the salt ponds, natural vegetation is sparse or absent in most areas, although the ponds support a variety of fish and wildlife species. Fish such as topsmelt, goby, killifish and perch occur in the low to moderately salty ponds, but are absent from ponds with high salt content which typically support only brine shrimp. These fish and invertebrates provide foraging habitat for a variety of shore birds and migratory water fowl, including several sensitive species.

Special-status species such as the California least tern, black skimmer, and western snowy plover forage in the salt ponds and may nest on the open sandy dikes and roadways between the ponds. Preconstruction surveys should be completed prior to work activity during the nesting season and appropriate avoidance measures should be implemented to prevent abandonment or clutch failure if nests are found in the project vicinity.

The salt marsh harvest mouse has been observed in the pickleweed habitat associated with private hunting clubs east of the alignment, but suitable habitat is not found for this species in the salt evaporation ponds due to the lack of vegetation and managed flooding regimes.

In addition to the potential sensitive resources associated with this area, access to the towers is limited when ponds are flooded or saturated. Vehicle and equipment access to these towers would need to be scheduled to coincide with Cargill's salt collection operations.

Tower 2/19

Tower 2/19 is located near the levee road along the south bank of Alameda Creek just west of the Union Sanitation District's Alvarado Pump Station. Vegetation at the base of the tower consists largely of ruderal species such as wild oat, mustard, and bristly ox-tongue, along with a few large shrubs on the north side of the tower. Gravel access roads are present on both the north and west side of the tower.

Brackish marsh habitat is present about 200 feet north of the tower throughout the Alameda Creek channel. This area may provide suitable habitat for special-status species such as the California clapper rail and the salt marsh common yellowthroat and should be avoided during work activities in this area.

Towers 2/20 and 2/21

Towers 20 and 21 are both located within the developed areas of the Union Sanitation District's waste water treatment facility. There are no biological constraints associated with either of these towers.

Towers 3/22 though 3/24

Towers 3/22 to 3/24 are located within high quality pickleweed marsh where both the salt marsh harvest mouse and the saltmarsh common yellowthroat have been observed. Gravel access roads are present around the perimeter and through the center of the marsh, but none of the towers are accessible from these existing roads. Vehicle access in this area would result in temporary habitat impacts and would likely require more involved agency corrdination and permitting requirements as well as site-specific avoidance and mitigation measures such as exclusion fencing, trapping/relocation and habitat restoration. Helicopter construction is recommended

Towers 3/25 and 3/26

Towers 25 and 26 are located within an upland ruderal habitat with brackish marsh and open water along the north and east sides of the towers. The area west of the towers is characterized by ruderal species such as quack grass, poison hemlock, mustard, perennial ryegrass, curly dock and Italian thistle.

The access road to these tower locations has not been maintained and is currently overgrown with quack grass, perennial ryegrass and wild oat. Vehicle access to these towers would require upland vegetation clearing (e.g. mowing) and minor access road maintenance. Assuming vehicle access would be limited to the existing access road and the ruderal upland areas impacts to wetlands can be avoided at these tower locations.

The adjacent marsh and open water provides suitable habitat for sensitive species such as the California clapper rail and salt marsh common yellowthroat. Predisturbance surveys should be conducted prior to any vegetation clearing and/or roadway maintenance as well as for any activities during the breeding season of these species.

Towers 3/27 and 3/28

Towers 3/27 and 3/28 are located in ruderal grassland habitats with existing access roads immediately adjacent to the towers. No wetlands or aquatic resources are present in the vicinity of tower 3/27 but pickleweed marsh occurs south of Tower 3/28. Sufficient work area appears to be present in these areas avoid impacts to wetlands and other biological resources at both of these locations.

Towers 4/29 and 4/30

Towers 4/29 and 4/30 are located in pickleweed marsh habitat where the salt marsh harvest mouse is know to occur. The pickleweed marsh in this area is comprised of a mosaic of dense pickleweed and slightly elevated areas characterized by perennial ryegrass and alkali heath. A few upland ruderal species such as mustard and wild oat are present along constructed berms. There are no existing access roads to these towers and any vehicle access in this area would result in temporal habitat loss and require more involved agency consulation and permitting requirements as well as implementation of avoidance and mitigation measures. Helicopter construction is recommended for this area so that these habitats can be avoided.

Tower 4/31

Tower 4/31 is located at the northern end of an irrigated pasture that appears to have previously been a more natural pickleweed marsh. The hydrology and natural vegetation in this area appear to have been historically altered due to agricultural conversion, but the area has not been recently cultivated and is currently used for cattle grazing. Existing vegetation around the tower includes a mixture of pickleweed and annual beard grass. Relatively undisturbed pickleweed habitat is present to the north and west of this tower where the salt marsh harvest mouse is known to occur.

The existing access road terminates approximately 400 feet south of the tower. Vehicle access would need to occur at a time when soils are dry and may require addiditonal agency consultation and permiting, as well as avoidance and mitigation measures. Helicopter construction is recommended for this area so that these habitats can be avoided.

Towers 4/32 to 4/34

Towers 4/32 to 4/34 are all located within agricultural/ruderal areas and are generally all accessible by existing roads or throught actively cultivated fields. Tower 4/32 is within an irrigated, grazed pasture dominated by annual beard grass with an existing access road approximately 50 feet east of the tower. Tower 4/33 is located in a hay/alfalfa field and tower 4/34 is located approximately 60 feet south of an access road in a weedy upland area characterized by poison hemlock, Italian thistle, and coyote brush (*Baccharis pilularis*). No significant biological constraints were identified at any of these tower locations.

Tower 4/35

Tower 4/35 is located on the south side of Coyote Hills Slough near the access road to the Coyote Hills Regional Park demonstration urban storm water wetland. Vegetation surrounding the tower base is comprised predominantly of quack grass and bristly ox-

tongue. Brackish marsh habitat is present in the drainage south of the tower and the treatment wetland to the southwest.

The brackish marsh habitat associated with Coyote Hills Slough, the treatment wetland and the small drainage to the south all provide suitable habitat for several special-status species including the California clapper rail, salt marsh common yellowthroat, saltmarsh harvest mouse, northern harrier and white-tailed kite.

Vehicle access to this tower may require minimal vegetation clearing (e.g. mowing) of quack grass and ruderal species, but wetland areas and other sensitive habitats can be avoided. Work activities would require implementation of best management practices to avoid adverse impacts to wetlands and water quality. Given the proximity to sensitive habitats and potential for special-status species to occur in the vicinity of this tower preconstruction surveys and a biological monitor on site during work activities are also recommended.

Tower 5/36

Tower 5/36 is located within the Coyote Hills Regional Park east of the treatment wetland. Dense vegetation consisting of quack grass and poison oak (*Toxicodendron diversilobum*) is present at the base of the tower. An existing access road is located approximately 30 feet west of the tower. Minimal vegetation clearing (mowing) of quack grass and poison oak may be required for vehicle access to this location. Impacts to wetlands or other sensitive habitat areas can be avoided. Given the proximity to sensitive habitats and potential for special-status species to occur in the vicinity of this tower preconstruction surveys and a biological monitor on site during work activities are recommended.

Tower 5/37

Tower 5/37 is located on the eastern edge of Coyote Hills Regional Park in an area of dense quack grass. There is no existing access road to this tower; however, access may be possible from the wheat field approximately 30 feet east of the tower. Vehicle access to this location would require temporary removal of a section of a 3-strand barb-wire fence and may involve minimal clearing (mowing) of quack grass. No significant biological constraints were noted in this area, but given the proximity to sensitive resources preconstructions survceys are recommended prior to any vegetation clearing in this area.

Towers 5/38 through 5/40

Towers 5/38 to 5/40 are all located within a cultivated wheat field that was disked at the time of the survey. While there are no existing access roads to Towers 5/38 and 5/59, vehicle access is possible through the field. There is an existing access road on the south side of tower 5/40. The only significant biological resource associated with these towers is a drainage channel supporting brackish marsh habitat on the south side of tower 5/40. All activities in this area can be accomplished from the existing access road and from within the field and impacts to this wetland area can be avoided.

Towers 6/41 through 6/45

Towers 6/41 to 6/45 are located within parkland habitat comprised of an open space parkway with a paved trail and an urban park. Vehicle access to these locations may be

possible by the paved (approximately 12-foot wide) trail and across the mowed grass of the park. No significant biological resources were identified at these tower locations.

Tower 6/46

Tower 6/46 is located in a ruderal/grassland area south of the Dumbarton substation. Scattered trees and shrubs are present in the vicinity of the towers. At the time of the survey the grassland area had recently been mowed. Vehicle access is possible to these towers with minimal vegetation disturbance other than mowing.

A seasonal wetland is present just outside the southwest corner of the Dumbarton substation and is spanned by the conductors. No work activities would occur in or immediately adjacent to the wetland area. No other significant biological resources were identified in this area.

General Mitigation Measures

PG&E has indicated that it intends to use helicopter-assisted construction for the reconductoring project as much as possible and that, in this way, PG&E will avoid impacts to wetlands or sensitive species that may be located near the tower bases. Due to the potential for special-status species to occur in several areas along the project, the following general mitigation measures are recommended to minimize adverse affects to both habitat and species during construction.

- Where project activities will occur within or in close proximity to California clapper rail habitat, PG&E will avoid working during the species' breeding season which is February 1 to August 31.
- In other sensitive habitats including salt evaporation ponds, preconstruction surveys should be completed by a qualified biologist to determine if any active nests or sensitive species are present that may be affected by the project. Seasonal restrictions, limited work periods, monitoring and other mitigation measures may be required if active nest are identified.
- Provide worker environmental awareness training to field crews. Training should include a discussion of the special-status species and sensitive habitats in the project area and clearly defined avoidance and mitigation measures.
- A biological monitor should be on site when work occurs on the ground in or immediately adjacent to any sensitive habitats.
- Implement best management practices to prevent erosion and other impacts to water quality. Such practices may include working when soils are dry, installation of silt fences, and/or the use of straw wattles when working adjacent to wetland areas.

Attachment A

Special-Status Species

TABLE A-1.
Special-status known to occur or potentially occurring in the project area.

Species	Status	Habitat	Potential to Occur in Project Area	
Invertebrates				
Lum's micro-blind harvestman *Microcina lumi*	None	Serpentine grasslands in coastal foothills	No	No suitable habitat in project area
Monarch butterfly *Danaus plexippus*	None	Winter roost sites located in well protected tree groves near water and nectar sources	Yes	Limited suitable habitat towards south end of the project; mostly near Dumbarton substation
Vernal pool fairy shrimp *Branchinecta lynchi*	FT	Vernal pools and other freshwater seasonal wetlands	Yes	Limited potential to occur in the project area; seasonal wetlands present around both the Eastshore and Dumbarton Substations.
Vernal pool tadpole shrimp *Lepidurus packardi*	FE	Vernal pools and other freshwater seasonal wetlands	Yes	Limited potential to occur in the project area; seasonal wetlands present around both the Eastshore and Dumbarton Substations.
Fish (Non-Salmonid)				
Delta smelt *Hypomesus transpacificus*	FT	Sacramento and San Joaquin Delta; most often in water with salinity less than 2 PPT	No	Species is not reported from Alameda County although potentially could occur in Alameda Creek and Coyote Hills Slough
Amphibians				
California red-legged frog *Rana aurora draytonii*	FT	Found in areas with either permanent or long ;lasting ponding with patches of dense shrubby or emergent vegetation	Yes	Wetland area at Coyote Hills Regional Park may provide suitable habitat.
California tiger salamander (Ambystoma californiense)	FT	Vernal pools and other freshwater seasonal wetlands required for breeding; adults require underground refuges such as ground squirrel burrows	Yes	Very limited potential to occur due to lack of suitable breeding habitat; few seasonal wetlands present near substations only. This species has not been reported in the vicinity of the project area.
Reptiles				
Alameda whipsnake *Masticophis lateralis euryxanthus*	FT	Found on south facing slopes within the coastal foothills in mixed tree, shrub and grassland habitat	No	No suitable habitat in the project area

TABLE A-1.
Special-status known to occur or potentially occurring in the project area.

Species	Status	Habitat		Potential to Occur in Project Area
Birds				
Bald Eagle *Haliaeetus leucocephalus*	FT CE	Nest in large trees with open branches near lakes, reservoirs or large rivers	No	One nest location reported for Alameda County on the west side of Del Valle Reservoir. No suitable nesting habitat in the project vicinity.
California Brown pelican *Pelecanus occidentalis californicus*	FE CE	Nest sites located on coastal islands	No	No nest locations reported in the project vicinity – salt evaporation ponds may provide foraging habitat
California clapper rail *Rallus longirostris obsoletus*	FE	Saltwater and brackish marshes	Yes	Suitable habitat present in the project area; known to occur in the brackish marsh habitat along Alameda Creek and other marsh habitats in the vicinity.
Northern Harrier *Circus cyaneus*	CFP	Ground nesting species – nest located in salt marshes, brackish and fresh water marshes. Forages in wetlands, wet meadows, fields and grasslands	Yes	Suitable nesting and foraging habitat occurs throughout the project area. Known to nest in the wetlands at the Coyote Hills Regional Park
Saltmarsh common yellowthroat *Geothlypis trichas sinuosa*	CSC	Densely vegetated marshes with continuous cover down to water for foraging	Yes	Several known occurrences in both pickelweed and brackish marshes along the alignment as well as along Alameda Creek and Coyote Hills Slough.
Sharp-shinned hawk *Accipter striatus*	CSC	Prefers to nest riparian trees or near water; plucking perches on south facing slopes important habitat component	No	No suitable habitat within project area.
Tri-color blackbird *Agelaius tricolor*	CSC	Nest typically found in dense emergent vegetation, willows or shrubs near open water	Yes	Known to nest in wetland area in Coyote Hills Regional Park
Western snowy plover *Charadrius alexandrinus nivosus*	FT	Open sandy beaches or gravelly/ friable soils along large alkali lakes or salt evaporation ponds	Yes	Two historic nest observations (1971 and 1975) reported from this area. No recent nest observations reported in the database; however, salt pond dikes may provide suitable nesting habitat for this species.
White-tailed kite *Elanus leucurus*	CFP	Nest located in trees near foraging habitats, wetlands, wet meadows, grasslands, fields and pastures	Yes	Nest location have been reported within one mile of the alignment , including within the Coyote Hills Regional Park.
Yellow warbler *Dendroica petechia brewsteri*	CSC	Nests in riparian woodlands and forests	No	No suitable nesting habitat in the project area

TABLE A-1.
Special-status known to occur or potentially occurring in the project area.

Species	Status	Habitat	Potential to Occur in Project Area	
Mammals				
Saltmarsh harvest mouse *Reithrodontomys raviventris*	FE	Saltmarsh habitats dominated by pickleweed	Yes	Several known occurrences in the project vicinity; suitable habitat is present around some of the tower locations
Saltmarsh wandering shrew *Sorex vagrans halicoetes*	CSC	Tidally influenced saltmarsh habitats with abundant driftwood scattered throughout	No	Pickleweed habitat present in the project area, but all known occurrences in the project area are restricted to saltmarshes in close proximity to the Bay
Plants				
Alkali milk-vetch *Astragalus tener* var. *tener*	1B	Alkali playas and vernal pools	No	Known from only four historic occurrences in areas that are all now developed, Few degraded seasonal wetlands only within project area
Big-scale balsamroot *Balsamorhiza macrolepis* var. *macrolepis*	1B	Found in the coastal foothills in chaparral, woodland and grassland habitats	No	No suitable habitat in the project area
Congdon's tarplant *Centromadia parryi* ssp. *congdonii*	1B	Grasslands	Yes	Low potential to occur in ruderal disturbed grassland areas throughout project
Contra Costa goldfields *Lasthenia congugens*	FE	Vernal pools, swales and low depressions within grasslands	No	Historic record of this species only; presumed to have been extirpated; limited poor quality habitat only within project area
Diablo helianthella *Helianthella castanea*	1B	Woodlands, chaparral, scrub and grasslands in the coastal foothills	No	No suitable habitat in the project area
Fragrant fritillary *Fritillaria liliacea*	1B	Coastal prairie, grassland and chaparral; sometimes on serpentine soil	Yes	Potential habitat present, but no known occurrences in the vicinity of the project
Hairless popcorn flower *Plagiobothrys glaber*	1B	Salt marshes and alkaline vernal pools	No	Historic records of this species only; presumed to have been extirpated; limited poor quality habitat only within project area
Most beautiful jewel-flower *Streptanthus albidus* ssp. *peramoenus*	1B	Serpentine outcrops on ridges and slopes in coastal foothills	No	No suitable habitat in project area

TABLE A-1.
Special-status known to occur or potentially occurring in the project area.

Species	Status	Habitat	Potential to Occur in Project Area	
Robust monardella *Monardella villosa* ssp. *globosa*	1B	Forest, chaparral, woodland and grassland in the coastal foothills	No	No suitable habitat in the project area
Santa Cruz tarplant (Holocarpha castanea)	FT CE	Coastal prairie and annual grassland	No	Historic record of this species only; presumed to have been extirpated
Santa Cruz tarplant *Holocarpha macradenia*	FT CE	Coastal prairies and grasslands	No	Historic record of this species only – population possibly extirpated. Not known to occur in the project area.

Notes:

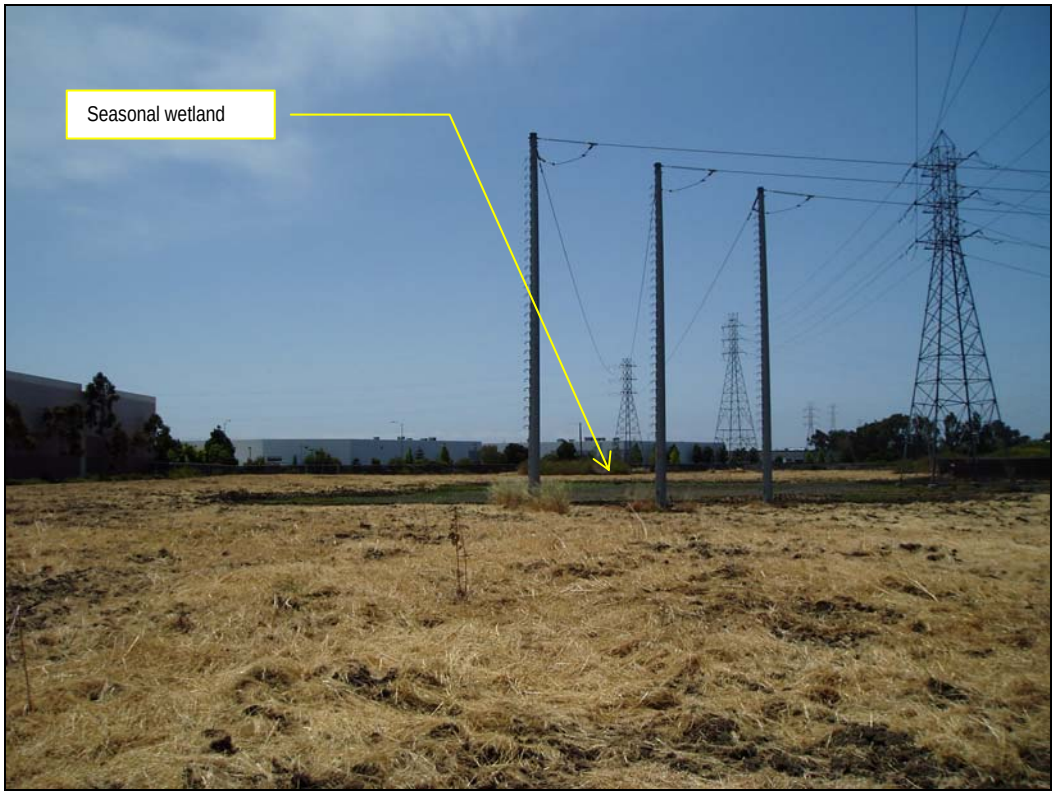
Species list compiled from the U.S. Fish and Wildlife Service Sacramento Field Office http://www.fws.gov/sacramento/es/spp_list.htm ; and the California Department of Fish and Game's Natural Diversity Data Base (RareFind V 3.0.5) for the for the Newark and Hayward 7.5 Minute U.S. Geological Survey Quadrangles.

Status Codes
FE – Federal listed endangered
FT – Federal listed threatened
CE – California listed endangered
CT – California listed threatened
CSC – California species of concern
CFP – California fully protected species
1B – California Native Plant Society rare, threatened or endangered plant species

Attachment B

Representative Photographs

Eastshore Substation view east; disked ruderal/grassland



Tower 0/1 Eastshore Substation view west-southwest; disked ruderal/grassland with a seasonal wetland located west of the towers

Tower 0/2 Eastshore Substation view south; disked ruderal/grassland

Tower 0/3 view north; Industrial; Atlas Van Lines

Towers 0/4 through 2/18 view southeast; Cargill salt evaporation ponds

Tower 2/19 view north; dirt access roads adjacent to tower, ruderal/grassland

Tower 3/22 view southwest; pickleweed marsh; no vehicle access to tower

Tower 3/23 view northwest; pickleweed marsh; no vehicle access to tower

Tower 3/24 view northwest; pickleweed marsh; no vehicle access to tower

Tower 3/25 view north; ruderal vegetation with scattered pickleweed, open water and brackish marsh to the north and west of the tower

View south from Tower 3/25; along the overgrown access road between towers 3/25 and 3/28 with adjacent wetlands to the east

Tower 3/26 view north; ruderal/grassland around tower; wetlands to the north and east

Tower 3/28 view north; dirt access roads and ruderal and planted landscape vegetation around tower

Tower 4/29 view south; open water, ruderal and pickleweed marsh habitat; no vehicle access to this location

Tower 2/29 view north; ruderal vegetation under tower, pickleweed and open water to south and west, residential area to the east

Tower 4/30 view north; upper marsh habitat with a mosaic of pickleweed - ryegrass/alkali heath – ruderal vegetation; no vehicle access to this tower

Tower 4/31 view north; irrigated pasture dominated by pickleweed and annual beard grass, brackish marsh habitat along drainage area to the north; no existing roads to this tower

Tower 4/32 view north; irrigated pasture, dirt access road present to the west

Tower 4/33 view north; cultivated hay/alfalfa field

Tower 4/34 view southeast; mowed ruderal area dominated by poison hemlock

Tower 4/35 view southeast; partial access along gravel road, area surrounding tower mostly introduced quack grass and ruderal forbs, wetland area immediately south of the tower

Tower 5/36 view north; access road west of tower, introduced quack grass and dense poison oak surround the tower base; wetland habitat present west of the road

Tower 5/37 view north; dense quack grass around tower, cultivated field approximately 50 feet to the east of tower, barb-wire fence along edge of field

Tower 5/38 view northeast; cultivated wheat field north of Patterson Ranch Road

Tower 5/39 view south; cultivated wheat field south of Patterson Ranch Road

Tower 5/40 view west; cultivated wheat field, wetland drainage present south of the tower

Tower 6/41 view west; parkland (green space) with paved trail south of tower

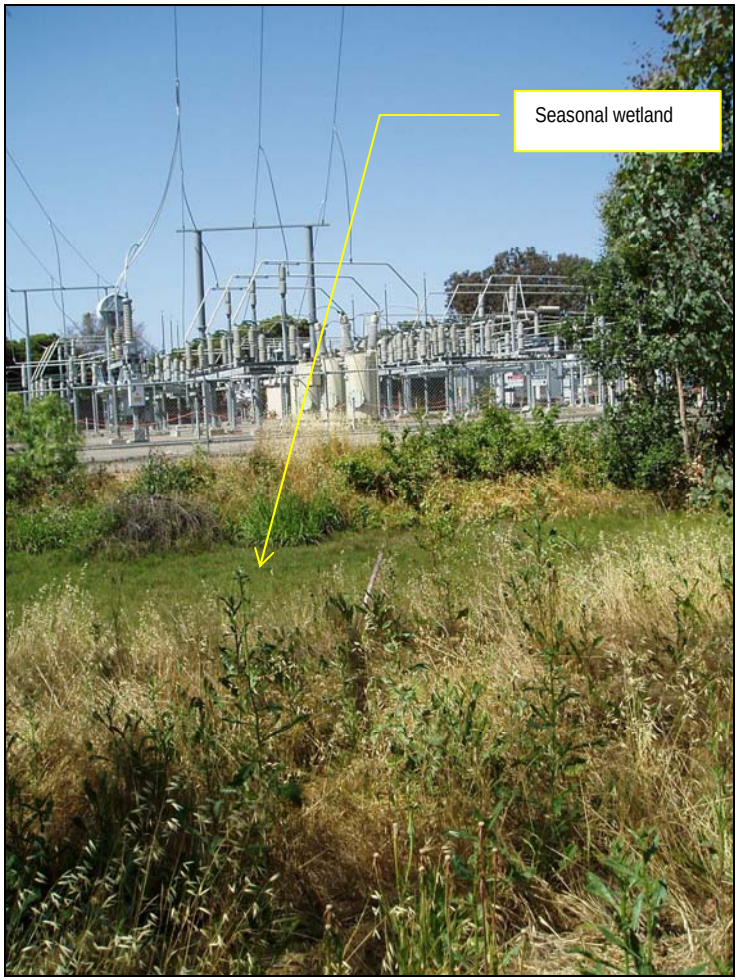
Tower 6/42 view west; parkland (green space) with paved trail south of tower

Tower 6/43 view west; parkland (green space) with paved trail south of tower

Tower 6/44 view west; parkland (green space) with paved trail south of tower

Tower 6/45 view west; parkland with mowed lawn

Tower 6/46 view east; mowed ruderal/grassland



Dumbarton substation view north; seasonal wetland area just south of the substation

Attachment DR20-2

2002 Environmental Assessment
Eastshore to San Mateo Reconductoring

Environmental Assessment of Reconductoring the East Shore to San Mateo 230 kV Transmission Line

RUSSELL CITY ENERGY CENTER

(01-AFC-07)
Hayward, California

CALPINE CORPORATION

Repowering America

May 2002

CONTENTS

Page

CONTENTS ii
TABLES vi
FIGURES vii
EXECUTIVE SUMMARY viii

1.0 INTRODUCTION 1-1
1.1 LEVEL OF ANALYSIS 1-2
1.2 THE EAST SHORE TO SAN MATEO TRANSMISSION LINE 1-2
1.3 PULL AND TENSIONING SITES 1-8

2.0 PROJECT DESCRIPTION 2-1
2.1 GENERAL INSTALLATION METHODS AND PROCEDURES 2-1
2.1.1 Temporary Staging Areas 2-1
2.1.2 Pull/Tensioning sites 2-1
2.1.3 Pre-Marking / Environmental Survey of Right of Way 2-2
2.1.4 Access 2-2
2.1.5 Installation and Tension Stringing 2-2
2.1.6 Typical Equipment 2-6
2.1.7 Fences, Other Improvements, and Existing Land Uses 2-6
2.1.8 Work Force 2-7
2.2 TYPICAL MITIGATION MEASURES 2-7
2.3 REFERENCES CITED 2-9

3.0 ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES 3-1
3.1 AIR QUALITY 3-1
3.2 BIOLOGICAL RESOURCES 3-2
3.2.1 Affected Environment 3-2
3.2.2 Environmental Consequences 3-12
3.2.3 Mitigation Measures 3-14
3.2.4 References 3-15
3.3 CULTURAL RESOURCES 3-26
3.3.1 Affected Environment 3-16
3.3.2 Environmental Consequences 3-23
3.3.3 Mitigation Measures 3-25
3.3.4 References 3-28
3.4 GEOLOGIC RESOURCES AND HAZARDS 3-30
3.4.1 Affected Environment 3-30

Page

3.4.2 Environmental Consequences 3-37
3.4.3 Cumulative Impacts 3-38
3.4.4 Proposed Mitigation Measures 3-38
3.4.5 References 3-38
3.5 HAZARDOUS MATERIALS HANDLING 3-40
3.5.1 Affected Environment 3-40
3.5.2 Environmental Consequences 3-40
3.5.3 Mitigation Measures 3-40
3.6 LAND USE 3-44
3.6.1 Affected Environment 3-44
3.6.2 Environmental Consequences 3-44
3.6.3 Mitigation Measures 3-46
3.7 NOISE 3-47
3.7.1 Affected Environment 3-47
3.7.2 Environmental Impacts 3-48
3.7.3 Mitigation Measures 3-49
3.7.4 Cumulative Impacts 3-51
3.7.5 References 3-51
3.8 PALEONTOLOGICAL RESOURCES 3-52
3.8.1 Affected Environment 3-52
3.8.2 Environmental Consequences 3-54
3.8.3 Proposed Mitigation Measures 3-55
3.8.4 References 3-55
3.9 PUBLIC HEALTH 3-58
3.9.1 Affected Environment 3-58
3.9.2 Mitigation Measures 3-60
3.10 SOCIOECONOMICS 3-61
3.10.1 Affected Environment 3-61
3.10.2 Environmental Consequences 3-61
3.10.3 Mitigation Measures 3-63
3.11 SOILS AND AGRICULTURE 3-64
3.11.1 Affected Environment 3-64
3.11.2 Environmental Consequences 3-64
3.11.3 Soil Resources 3-66
3.11.4 Mitigation Measures 3-67
3.11.5 References 3-68
3.12 TRAFFIC AND TRANSPORTATION 3-69

Page

3.12.1 Affected Environment....3-69
3.12.2 Environmental Consequences....3-69
3.12.3 Mitigation Measures....3-70
3.12.4 References....3-70
3.13 VISUAL RESOURCES....3-72
3.13.1 Affected Environment....3-72
3.13.2 Environmental Consequences....3-73
3.13.3 Mitigation Measures....3-73
3.14 WASTE MANAGEMENT....3-74
3.14.1 Affected Environment....3-74
3.14.2 Project Waste Generation....3-74
3.14.3 Waste Disposal Sites....3-75
3.15 WATER RESOURCES....3-76
3.15.1 Affected Environment....3-76
3.15.2 Environmental Consequences....3-78
3.15.3 Mitigation Measures....3-78
3.16 WORKER HEALTH AND SAFETY....3-79
3.16.1 Construction Health and Safety Programs....3-79

FIGURES

Page

1.1-1 East Shore to San Mateo transmission line location 1-3
1.2-1 East Shore to San Mateo transmission line 1-4
1.3-1 Angle tower 1, looking west 1-10
1.3-2 Angle tower 2, (middle) looking northwest 1-10
2.1-1 Typical equipment layout for pulling and tensioning 2-3
3.2-1 Biological Resources in the East Shore to San Mateo transmission corridor 3-6
3.4-1 Earthquake faults 3-32
3.7-1 Noise complaint resolution form 3-50
3.12-1 Regional transportation setting 3-71

TABLES

		Page
1.3-1	Angle towers	1-9
2.2-1	Typical reconductoring environmental mitigation measures.	2-7
3.2-1	Special status species potentially occurring in the transmission line corridor	3-4
3.2-2	Wildlife species observed during 2002 wildlife surveys	3-11
3.2-3	Plant species observed during surveys of the transmission corridor	3-12
3.2-4	Habitat types, potential impacts, and avoidance measures at the angle towers	3-14
3.3-1	Archaeological survey reports within 0.25 miles of the project route	3-20
3.3-2	Recorded archaeological sites within 0.25 miles of the project route	3-21
3.3-3	Recorded archaeological sites within the project APE	3-22
3.7-1	Sensitive receptors within one mile of the transmission line	3-47
3.7-2	Construction equipment and composite site noise levels	3-49
3.9-1	Sensitive receptors within one mile of the transmission line	3-58
3.10-1	Transmission line reconductoring workforce	3-62
3.11-1	Soil mapping unit identified by county	3-64
3.12-1	Soil mapping unit descriptions	3-65
3.15-1	Average monthly rainfall amounts at Station 62 Hayward, CA (inches)	3-77
3.15-2	Storm duration-recurrence intervals at Station 62, Hayward Corporation Yard	3-77

Environmental Assessment

of

Reconductoring the East Shore to San Mateo 230 kV Transmission Line

Additional Information in Support of the

Application for Certification

for the

Russell City Energy Center

Hayward, California

01-AFC-07

Submitted to the
California Energy Commission

Submitted by
Russell City Energy Center LLC

May 6, 2002

EXECUTIVE SUMMARY

This document presents a general assessment of the potential environmental effects of reconductoring the East Shore to San Mateo 230 kV transmission lines. The East Shore to San Mateo transmission line extends from the East Shore Substation westward and southwestward across the Hayward-San Mateo Bridge and then turns to the northwest, extending to the San Mateo Substation in San Mateo, San Mateo County, a distance of 12.52 miles. This analysis was prepared to assist the California Energy Commission (CEC) Staff in their independent analysis of the potential effects of the Russell City Energy Center (RCEC) project (01-AFC-07). The CEC Staff has indicated that the reconductoring of the East Shore to San Mateo transmission line is a reasonably foreseeable indirect consequence of constructing the RCEC. Therefore, the Staff has prepared an environmental analysis as part of the Staff's Assessment of the RCEC, to satisfy the requirements of the California Environmental Quality Act (CEQA).

The Applicant believes that the addition of RCEC generation through the East Shore Substation does not, in itself, result in a need to reconductor the East Shore to San Mateo line because the RCEC would not trigger an overload of the line under normal conditions. Extensive transmission system modeling has shown, however, that this line could currently overload (pre-RCEC) under certain circumstances. Because of these potential overloads, PG&E may need to reconductor the line, changing to a higher capacity wire to prevent line failure and power outages.

The level of analysis presented in this document is more generalized and programmatic than found in an AFC or Environmental Impact Statement—similar to the level of CEQA analysis done to consider potential effects of project alternatives. This analysis is intended to apprise the decision-maker of the nature and scope of the probable impacts of the East Shore to San Mateo reconductoring, should it occur, and the currently anticipated measures for mitigating these effects.

This analysis describes the process of reconductoring and the types of environmental impacts that might occur as a result of reconductoring. This study also discusses some specific aspects of the East Shore to San Mateo transmission line, such as its location and some likely places for conductor pull and tensioning sites and marshalling yards. Project-specific details regarding the locations of the pull and tensioning sites and marshalling yards and the specific techniques that will be used for each span, however, will not available until a project to reconductor is determined necessary and is designed. The East Shore to San Mateo Transmission line reconductoring project, if it takes place, could be accomplished with no significant environmental impacts, as long as certain mitigation measures are followed.

1.0 INTRODUCTION

This document presents a general assessment of the potential environmental effects of reconductoring the East Shore to San Mateo 230 kV transmission lines, consisting of two circuits on a single set of towers[1]. It has been prepared in support of the Application for Certification (AFC) for the Russell City Energy Center (RCEC) (01-AFC-07) before the California Energy Commission (CEC). The AFC for the RCEC analyzed the potential environmental effects of the project up to the first point of interconnection with the electrical transmission system, at the Pacific Gas & Electric Company (PG&E) East Shore Substation in Hayward, California. The scope of the AFC analysis was consistent the CEC's licensing jurisdiction extending, under the Public Resource Code Section 25107, to the first point of interconnection between an electrical generating project and the electrical transmission system. The East Shore to San Mateo transmission line extends from the East Shore Substation westward and southwestward across the Hayward-San Mateo Bridge and then turns to the northwest, extending to the San Mateo Substation in San Mateo, San Mateo County, a distance of 12.52 miles (Figure 1.1-1).

The CEC Staff has indicated in their independent analysis of the RCEC's potential environmental effects that the reconductoring of the East Shore to San Mateo transmission line is a reasonably foreseeable indirect consequence of constructing the RCEC. Therefore, the Staff has prepared an environmental analysis as part of the Staff's Assessment of the RCEC, to satisfy the requirements of the California Environmental Quality Act (CEQA).

The Applicant believes that the addition of RCEC generation through the East Shore Substation does not, in itself, result in a need to reconductor the East Shore to San Mateo line because the RCEC would not trigger an overload of the line under normal conditions. Extensive transmission system modeling has shown, however, that this line could currently overload (pre-RCEC) under certain circumstances. Because of these potential overloads, PG&E may need to reconductor the East Shore to San Mateo line, changing to a higher capacity wire to prevent line failure and power outages.

The RCEC has proposed implementing a Special Protection System (SPS), also called a Remedial Action Scheme (RAS), to prevent RCEC from causing these kinds of overloads on the East Shore to San Mateo line. This system would essentially involve halting RCEC generation under the rare conditions that might otherwise cause overload. The California Independent System Operator (CAISO) on October 3, 2001 recommended that Calpine implement a RAS "to

[1] Currently only one of these lines terminates at the East Shore Substation. As part of the reconductoring program the second line, which currently bypasses the substation, would be reconfigured to terminate at the substation as well.

enable full output of 620 MW from the RCEC Project during all of the conditions studied." The CAISO also concurred with the conclusion of Calpine's System Impact Study that Calpine's proposed SPS would avoid overloads on the East Shore to San Mateo lines.

1.1 LEVEL OF ANALYSIS

The level of analysis presented in this document is more generalized and programmatic than found in an AFC or Environmental Impact Statement—similar to the level of CEQA analysis done to consider potential effects of project alternatives. This analysis is intended to apprise the decision-maker of the nature and scope of the probable impacts of the East Shore to San Mateo reconductoring, should it occur, and the currently anticipated measures for mitigating these effects. This analysis describes in detail the process of reconductoring and the types of environmental impacts that might occur as a result of reconductoring. This study also discusses some specific aspects of the East Shore to San Mateo transmission line, such as its location and some likely places for conductor pull and tensioning sites and marshalling yards. Project-specific details regarding the locations of the pull and tensioning sites and marshalling yards and the specific techniques that will be used for each span, however, will not be available until a project to reconductor is determined necessary and is designed.

1.2 THE EAST SHORE TO SAN MATEO TRANSMISSION LINE

The East Shore to San Mateo transmission line carries two 230 kV electrical circuits between the East Shore Substation, located in Hayward, Alameda County and the San Mateo Substation, located in San Mateo, San Mateo County, California, a distance of 12.52 miles (Figure 1-1). This line begins at the newly constructed East Shore Substation (though one circuit bypasses the substation), and runs west through a business park for a short distance, before crossing abandoned salt evaporation ponds. The line continues west on the south side of the approach to the Hayward-San Mateo Bridge (State Route 92) for 2.0 miles. It continues to parallel the bridge, heading west and then southwest, with tower bases in the San Francisco Bay for 7.0 miles, to the western footing of the bridge in Foster City. From there, the line turns west-northwest, crosses State Route 92 and extends through a commercial and industrial area. Along this portion of the route, the towers are located mostly in parking lots and paved storage yards.

The East Shore to San Mateo line joins three other transmission lines within the Foster City industrial/commercial area at milepost 10.0, near angle tower 7. These four lines parallel one another, running west-northwest and then northwest the final 2.5 miles to the San Mateo Substation. The East Shore to San Mateo line is the easternmost of the four lines where it joins the others. At milepost 10.7, the line crosses into the City of San Mateo, crosses a levee to San Francisco Bay, spans a small salt marsh, and crosses a small embayment in the water (one tower). Heading northwest, the line runs to the west of a closed landfill and through an open

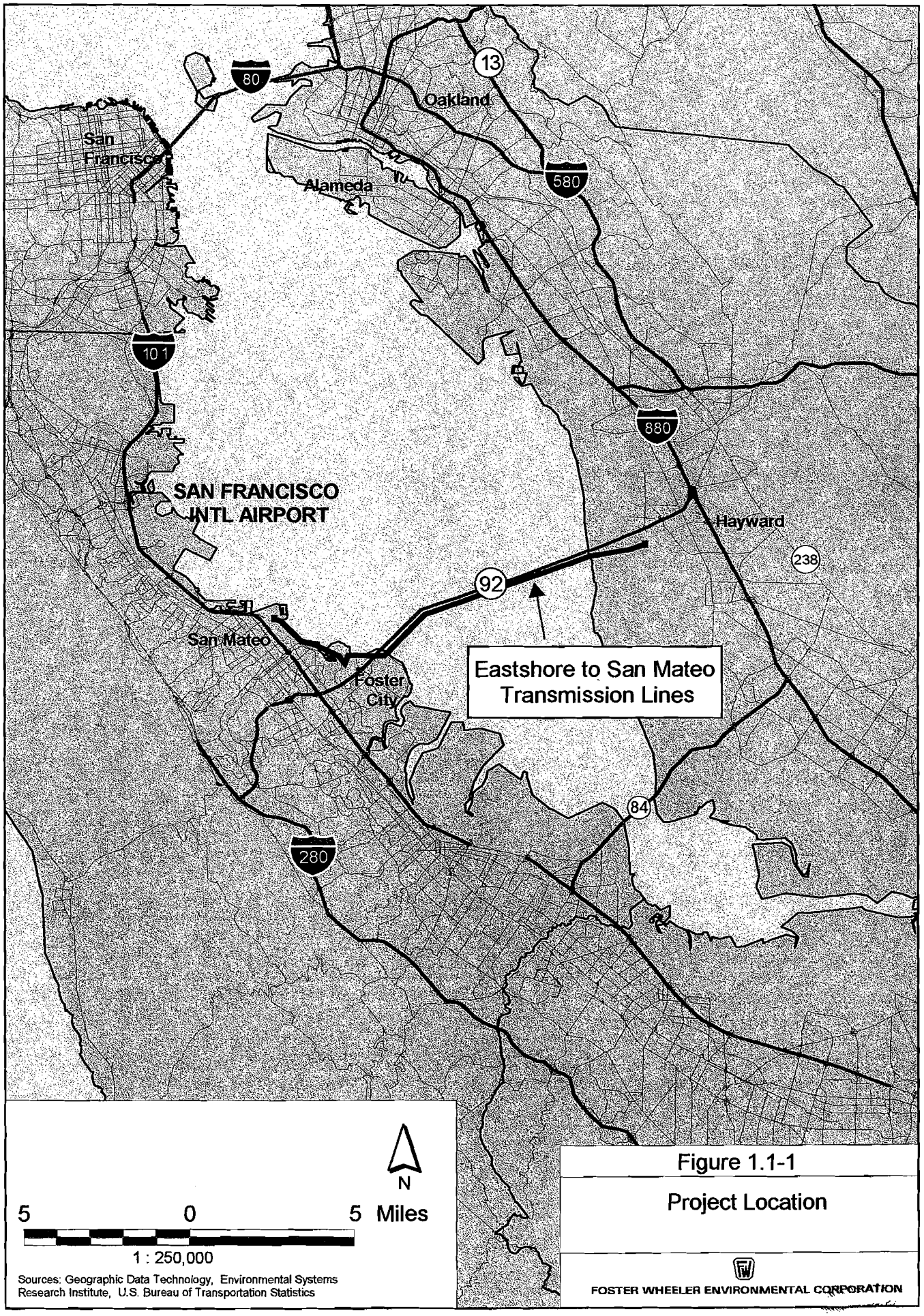


Figure 1.1-1

Project Location

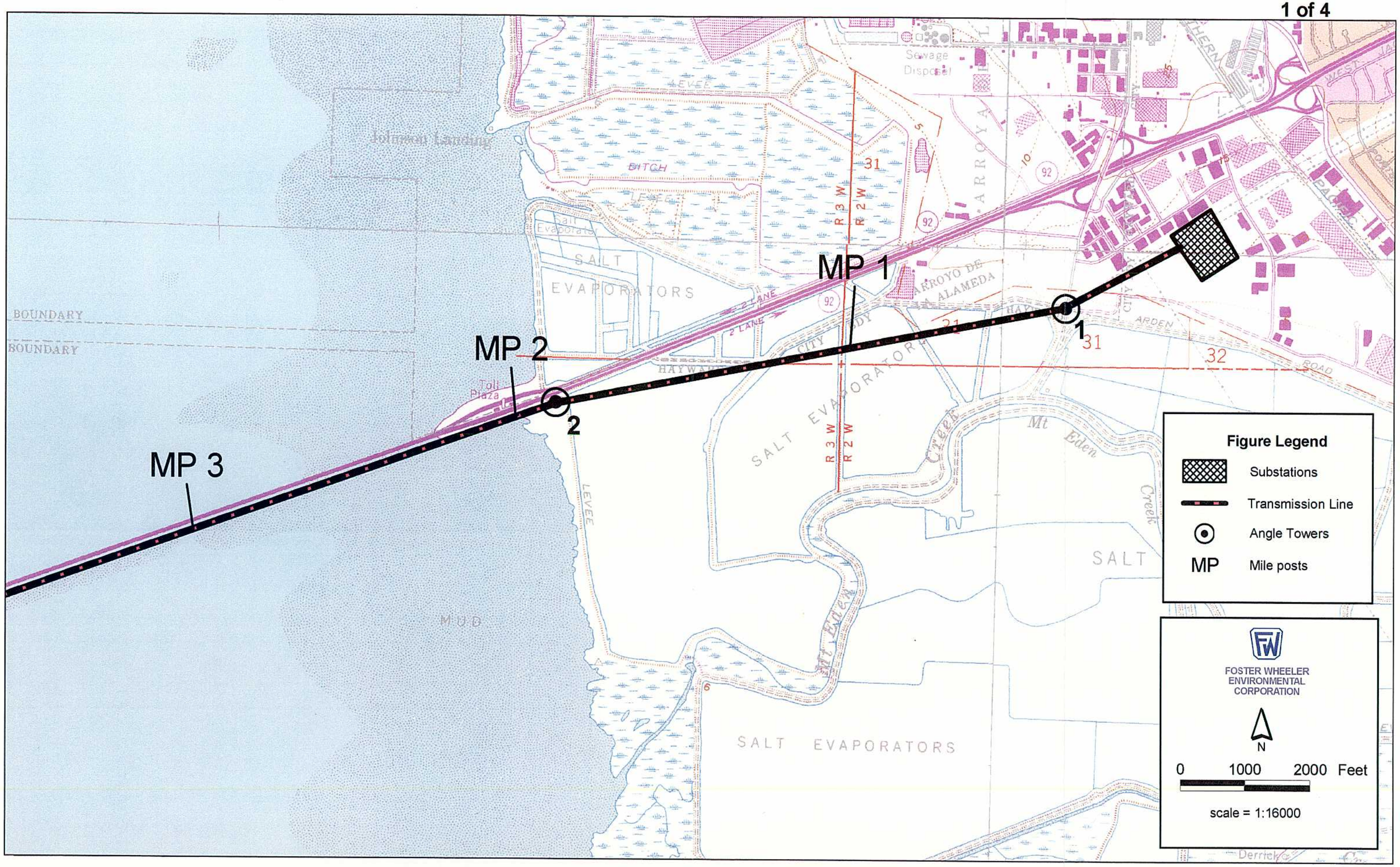


Figure 1.2-1(a)
Eastshore to San Mateo transmission line.

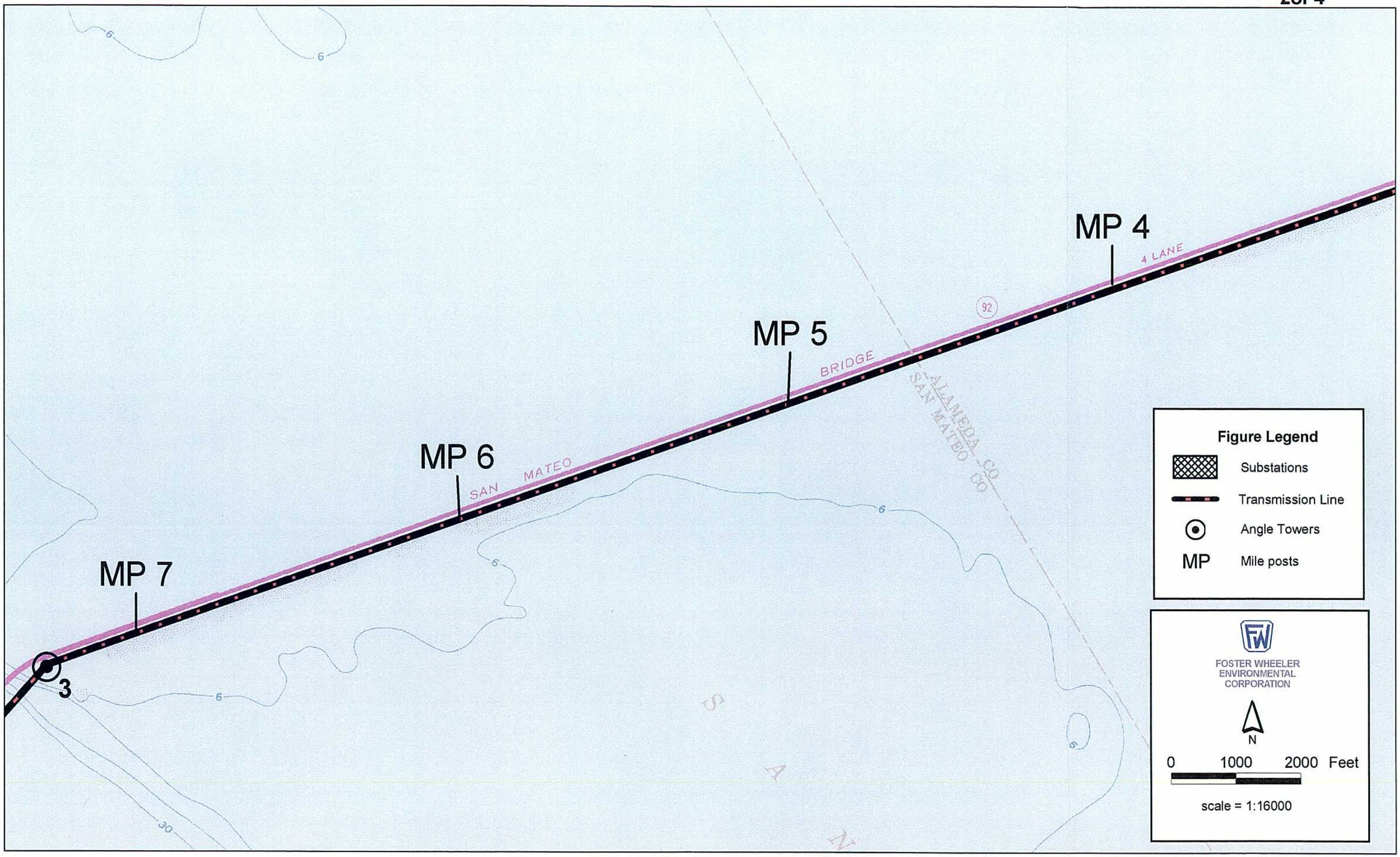


Figure 1.2-1(b)
Eastshore to San Mateo transmission line

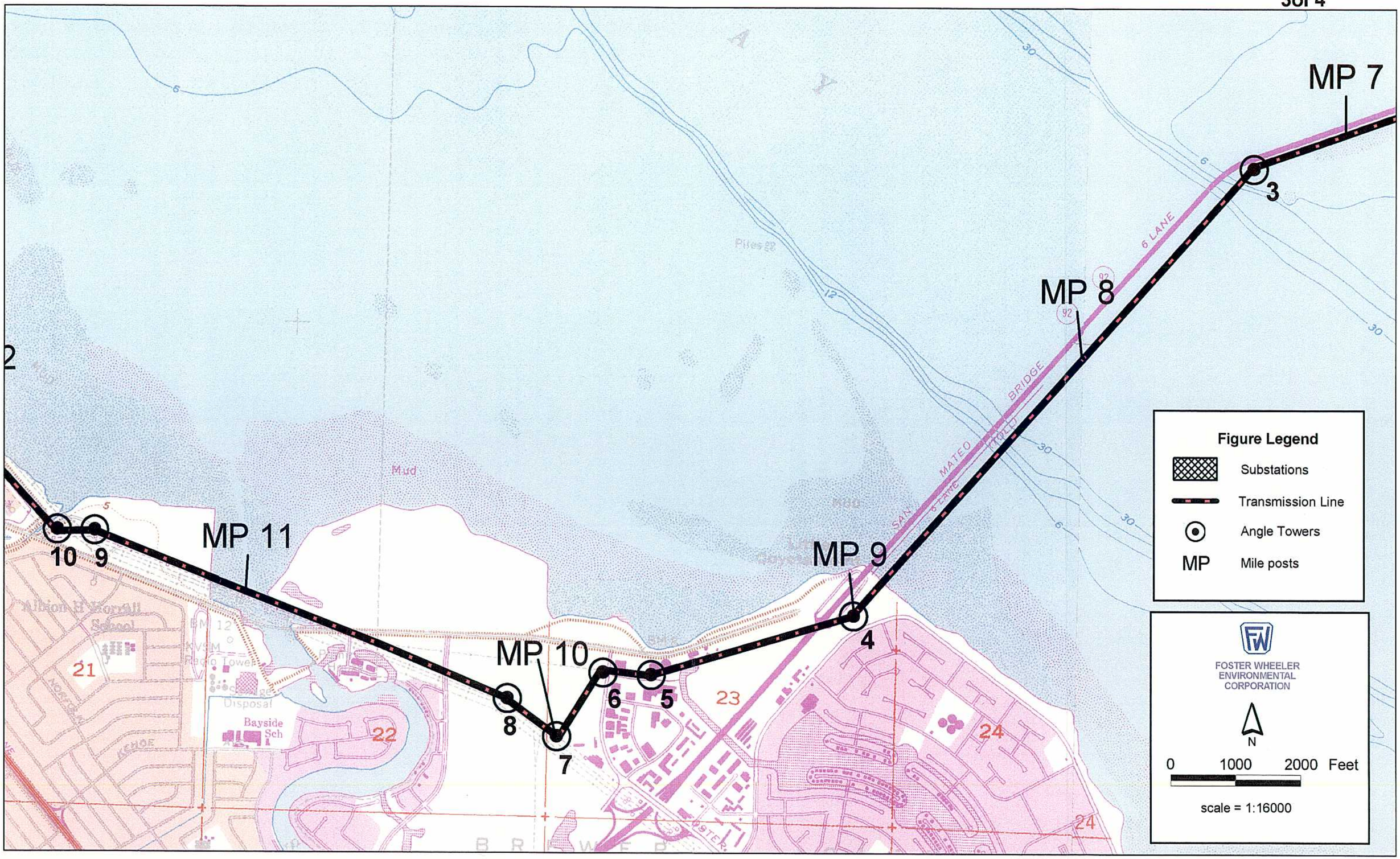


Figure 1.2-1(c)
Eastshore to San Mateo transmission line

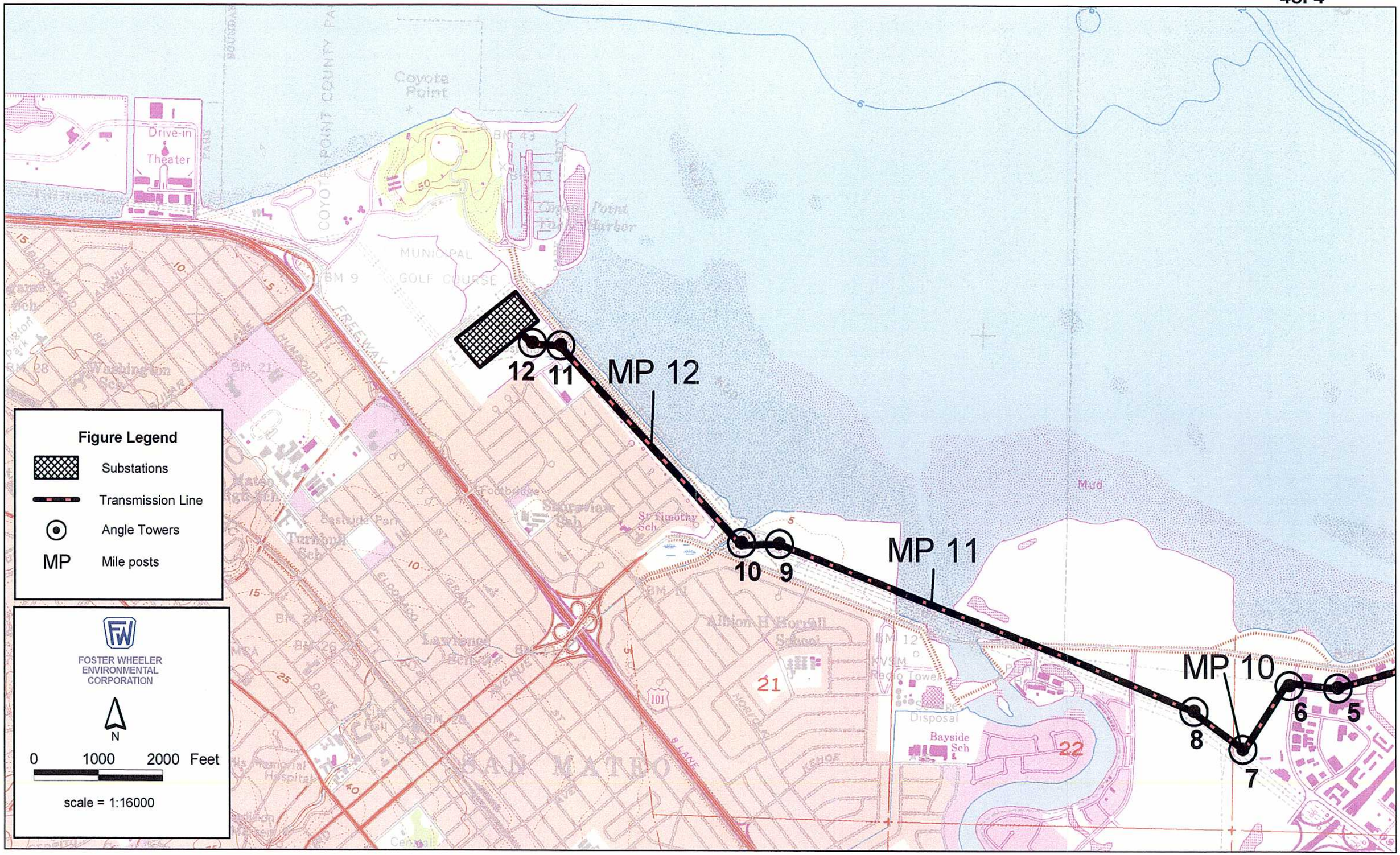


Figure 1.2-1(d)
Eastshore to San Mateo transmission line

space area that is part of an undeveloped shoreline park paralleling J. Hart Clinton Drive. Residential land uses are located across the drive to the west. The landfill and San Francisco Bay lie to the east.

At milepost 11.5, the line crosses two of the other three lines, taking a place as the second line (west to east) of the four from this point and for the remaining mile to the San Mateo Substation. The line runs northwest from this point through a grassy strip immediately west of a large levee on the San Francisco bayshore, finally turning northwest to connect with the San Mateo Substation. Land to the east of the levee and grassy strip is residential.

1.3 PULL AND TENSIONING SITES

It is usual to pull new conductor through two or more miles of transmission towers at a time. The seven-mile-long section crossing the bay adjacent to the San Mateo bridge can apparently be reconductored with pull and tensioning sites at each end (based on preliminary indications from PG&E). Because the potential for environmental impact is very low between the places where conductor pulling and tensioning takes place (pull and tensioning sites), this environmental analysis focuses particularly on the most likely places to be used for pulling and tensioning.

Activities between the pull and tensioning sites are generally restricted to 1) accessing the towers (manually by climbing or using a truck-mounted aerial bucket) to place the pulleys, or sheaves blocks, through which the conductor is pulled once it is disconnected and to remove the conductor from the sheave blocks and refasten it once stringing is completed; and 2) work on the tower structure itself to repair or replace spars that are damaged. Under some circumstances, it is necessary to replace towers with stronger towers to accommodate heavier conductor or to raise the height of the towers to allow for greater conductor sag. For the East Shore to San Mateo reconductoring project, it will not be known whether or not towers will require raising or repair until the project is in the final design stages.

Though it is not possible to determine at this point precisely where the pull and tensioning sites would be located for a particular reconductoring effort, these are generally sited at angle towers, which are towers located where the line makes a change in direction of more than 10 degrees. Pulling old conductor off of the transmission line and reeling new conductor onto the line is easier at these locations because the pulling and tensioning equipment can be arranged in line with the transmission line in places where the line turns. Furthermore, pull and tensioning sites are necessary where there are high-angle turns because the conductor cannot be efficiently pulled through such an angle. Pulling and tensioning can also take place at deadend sites located on towers that are in-line, rather than set at an angle to adjacent towers. The locations of deadend towers on the East Shore to San Mateo transmission line, however, are not known at this time. Deadend towers are towers at which conductor is attached, marking a reel-end splice location.

Field studies conducted on April 25, 2002, located the angle towers between the East Shore and San Mateo substations (Table 1.3-1, Figures 1.3-1 and 1.3-2). Most of the environmental impact analyses that follow will focus particularly on these towers, which we have sequentially numbered, beginning at East Shore Substation and proceeding to San Mateo Substation. Note that it may be possible to pull through the angles on some of these towers (less than 20-30 degrees). For example, PG&E has indicated that they would be able to pull the entire Hayward-San Mateo bridge span in a single step from pull and tensioning sites on either side (Al McKuen, California Energy Commission, personal communication). Such a pull would avoid pulling from boat-mounted reels and tensioning equipment in San Francisco Bay. It would also involve pulling through angle tower 3, which is located adjacent to the bridge, where the bridge turns to the southwest and enters an elevated span segment to allow for ship traffic. The angle the transmission line forms at this point is approximately 28 degrees. Angles greater than 20 degrees are indicated in boldface type in the table. These are the most likely pull and tensioning locations. Pulling and tensioning is also very likely at or near tower 2, because it is at one end of the Hayward-San Mateo Bridge.

Table 1.3-1. Angle towers.

Tower	Milepost	Angle (°)[1]	Comment
Substation	0	0	Site between East Shore substation and first tower probable – in open field covered by ruderal vegetation.
1	0.4	17	Gated, paved access road to tower. Ruderal vegetation.
2	1.9	9	Near Hayward-San Mateo Bridge toll plaza in former salt evaporation ponds.
3	7.4	28	On the bridge near at the ship channel overpass. PG&E can pull through this angle.
4	9.0	**30**	At western bridge approach in open lot with access.
5	9.6	23	In commercial storage lot at edge of canal
6	9.8	**63**	In commercial parking lot adjacent to street.
7	10.0	**85**	Right angle tower in landscaping strip between street and parking lot and adjacent to paved lots and four-lane, divided street
8	10.2	17	In very large parking lot for new commercial office building.
9	11.5	20	Line crosses two other lines in open space area with ruderal and wetland vegetation.
10	11.6	**50**	Same as Tower 9, in open space.
11	12.4	**55**	In grassy strip next to shore levee
12	12.5	**65**	Tower next to San Mateo Substation fence
Substation	12.5	0	Pull from inside San Mateo Substation.

[1]Towers at angles greater than 30 degrees indicated in bold, as likely pull and tensioning sites.

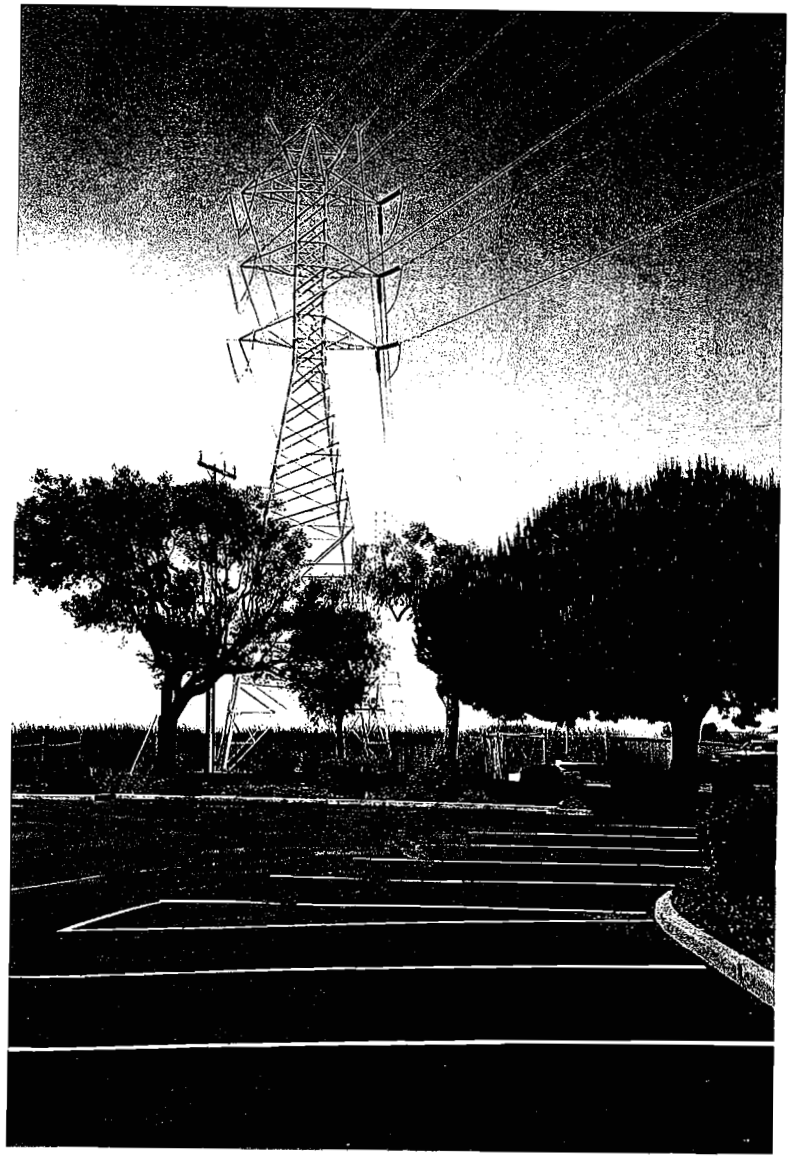


Figure 1.3-1. Angle tower 1, looking west.

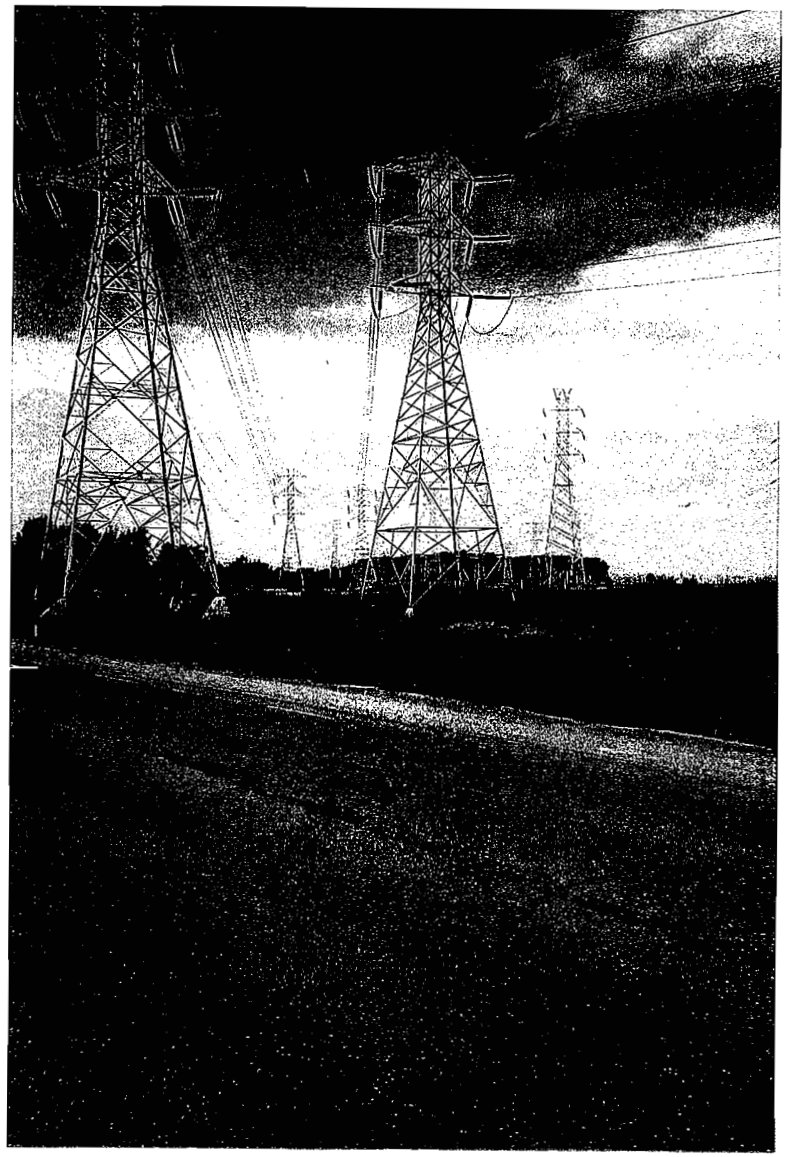


Figure 1.3-2. Angle tower 10 (middle), looking northwest.

2.0 PROJECT DESCRIPTION

2.1 GENERAL INSTALLATION METHODS AND PROCEDURES

Reconductoring involves the replacement of existing electrical transmission wire (conductor) with new wire. To make this replacement, the old conductor must be pulled back through the existing transmission towers supports to a takeup reel. If the existing wire is in good condition, then it is also used to pull in the new conductor, by attaching the two together. Otherwise, the existing wire is used to pull a carrier cable, or sock line onto the tower sheaves. The new conductor is then pulled back through the same supports from in the opposite direction from a pull and tensioning site at the other end of the stringing segment. In order for the old line to be reeled off of the towers, it must be first disconnected from its insulator clamps and placed on sheaves blocks (pulleys) or travelers that hang from the towers spars. The new line is pulled back through the sheave blocks. Workers then remove the new conductor from the sheaves and attach it to the structure. Typically, conductor is pulled for about two to three miles at a time.

Due to limits in the size of conductor reels, the reconductoring must be staged between tower sites that are called deadends. Deadends are towers where the line running in each direction is securely attached to, rather than passing through, the tower support. If deadends are too far apart or terrain interferes, shorter line segments may be chosen. Deadends are often placed at angle towers, where the lines change direction. If the inside angle formed by the transmission lines at an angle tower is large (generally larger than 30 degrees for a single suspension, 60 for a double suspension), the lateral tension of pulling the conductor or sock line on the sheave will be too high for safe and efficient reconductoring. The following generic description of a typical reconductoring process was prepared for Calpine Corporation by Power Engineering (Power Engineering 2001) for the Gilroy Energy Center Phase II Project. It has been modified slightly to reflect the circumstances of the East Shore to San Mateo reconductoring project.

2.1.1 Temporary Staging Areas

Temporary staging areas for equipment and materials storage are required for any reconductoring project. The East Shore to San Mateo reconductoring project, will require two staging yards of about one acre in size each, with one located near each end of the transmission line. These marshalling yards would likely be located at an existing industrial storage lot rented or leased for the four- to five-month construction period.

2.1.2 Pull/Tensioning Sites

Concentrated work for the East Shore to San Mateo reconductoring will be most likely to occur at some of the transmission tower deadend locations, many of these at angle towers (see Table 1.3-1). Conductor pulling, payout, and sagging/tensioning equipment will be stationed at some these locations. Each work area will be approximately 100 by 200 feet in size (0.46 acre). Work

areas will avoid sensitive biological and cultural resources. Impacts to sensitive areas that cannot be avoided will be minimized by applying appropriate mitigation measures (see Chapter 3).

2.1.3 Pre-Marking / Environmental Survey of Right of Way

Environmentally sensitive areas in the right of way will be identified through agency consultation, existing data or field surveys. Areas requiring avoidance or special mitigation measures to be taken during reconductoring are located and marked on engineering drawings and in the field as appropriate.

2.1.4 Access

The project area consists of urban land uses, including commercial and residential areas, and open space. All of the sites identified as angle towers are accessible from existing roads. A few of the non-angle towers are not accessible from existing roads. These include the several towers south of the eastern approach to the Hayward-San Mateo Bridge, all of the towers in the San Francisco Bay where the transmission line parallels the bridge, one tower in the bay north of the bridge, and one or more towers in open space in San Mateo south of the substation. Workers will need access to these towers to install the pulling sheaves. For these towers, linemen will climb the towers to place the sheaves, rather than using a truck-mounted aerial bucket for access.

Construction traffic will be restricted to existing roads during reconductoring.

2.1.5 Installation and Tension Stringing

The "tension stringing" method is used most often to install new conductor. Following is a step-by-step description of reconductoring using tension stringing. The steps using other methods such as stringing without tension are similar.

- Splice locations will be determined before installation. The reel length then can be calculated to allow enough conductor for stringing and splicing.
- An approved line outage schedule will be developed before reconductoring activities commence. The outage schedule will provide periods when lines are de-energized to safely and efficiently perform the reconductor work.
- Equipment set-up locations would be established in advance of fieldwork. These locations are generally chosen for their ease of access, site suitability, and existing line configuration. Figure 2-1 illustrates the layout of typical wire handling equipment. Tension stringing is generally performed in the following steps:
    1. Install conductor support sheaves (pulleys) on towers
    2. Attach pulling line to old conductor
    3. Take up old conductor on reel

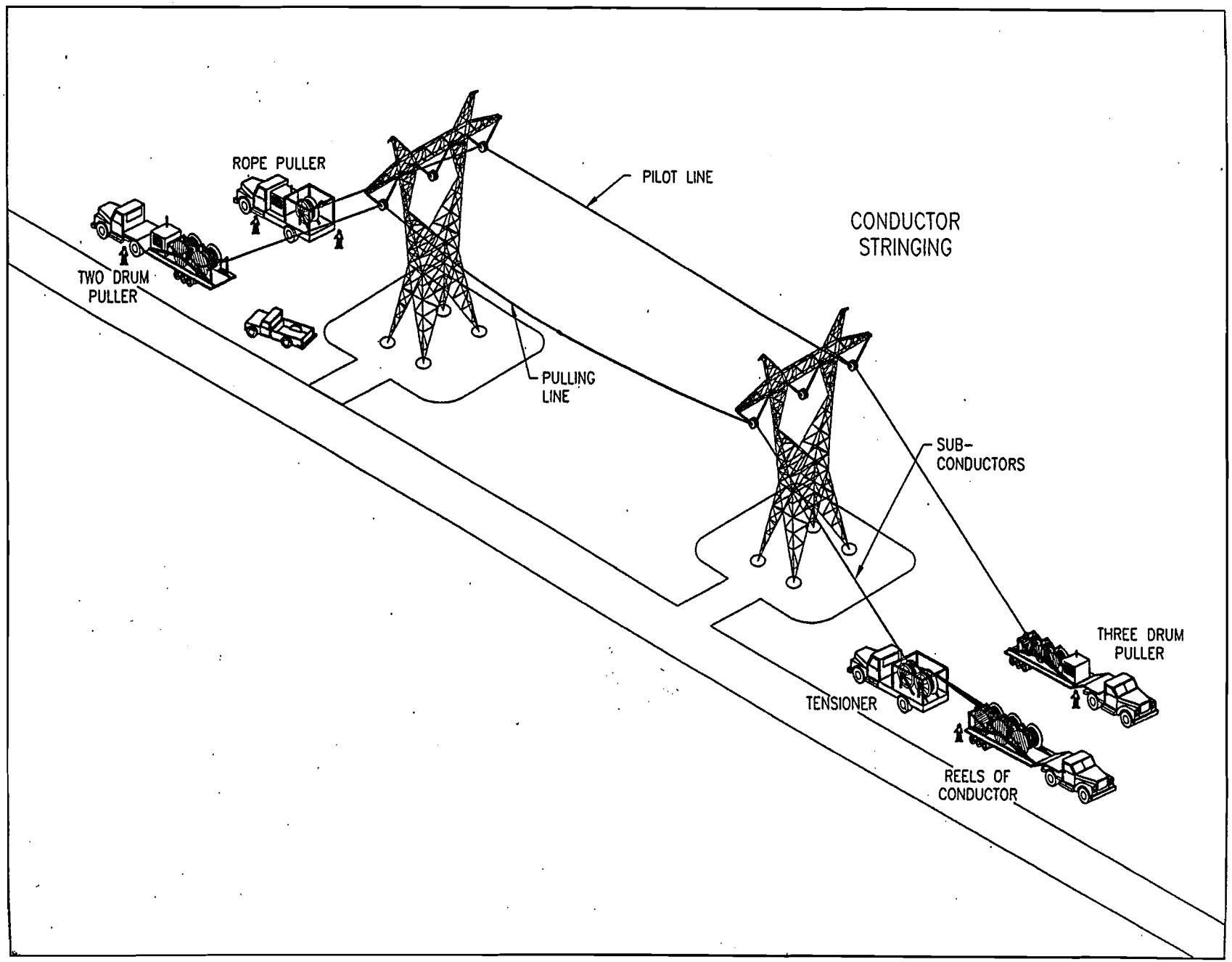


Figure 2.1-1. Typical equipment layout for pulling and tensioning (Source: Power Engineers 2001).

4. Attach pulling line to new conductor
5. Pull new conductor sections
6. Sag new conductor and adjust to correct tension
7. Attach new conductor to deadend tower
8. Remove stringing sheaves and attach new conductor to insulators
9. Restore right of way

Install Conductor Stringing Sheaves

Sheave blocks are installed on each structure. Linemen climb the structures or are lifted in aerial bucket trucks to attach the sheaves using the necessary hand tools and hardware. The existing conductor is removed from its clamps and placed into the stringing sheaves. If required, existing insulators would be removed and replaced as part of this operation.

On angle structures where one or two sheave assemblies are being used, care is taken to see that the sheave assembly is installed properly so the conductor will not jump out of its groove in the sheave and be damaged.

Attach Pulling Line to Old Conductor

The conductor is attached with Kellem grips of the appropriate size and firmly fastened to the pulling cable with screw type or punch clamps. The Kellem grip then is attached to a dummy swivel, which is, in turn, attached to a running board. The leading edge of the running board is attached to the pulling line with a full swivel.

Take Up Old Conductor

Pulling equipment generally includes a motorized puller, snubs (anchors), reel trailer, splicing equipment, and support equipment. The pulling site would be approximately 100 x 200 feet. A motorized retrieval unit with take-up reel is used to pull the old conductor off of the towers. Constant tension is applied to the conductor by the pulling equipment at each end. Either the new conductor or the sock line is used to supply back tension so that the old conductor does not sag or drop to the ground as it is pulled. Sheave blocks support the conductor until take up is complete.

At inclines or low points in a section, uplift rollers (which attach to the installation sheave wheel) or hold-down blocks (which are separate blocks) are used to counter the potential for the pulling line to lift up from the sheave at low points due to the pulling tension. These devices may also have a breakaway feature in the event of fouling or incorrect installation.

Attach Pulling Line to New Conductor

If the sock line (pulling line) was used, it is now attached to the new conductor (otherwise, the old conductor serves as the pulling line). To do so, a Kellem grip is attached to a dummy swivel, which then is attached to a running board. The leading edge of the running board is attached to the pulling line with a full swivel.

Pull New Conductor Sections

The new conductor is strung onto the towers using powered pulling equipment at one end and powered tensioning equipment at the other end. The tensioner in concert with the puller maintains proper tension on the conductor. Tension maintains clearance above any potential obstacles. Temporary structures may be installed at major road crossings and other locations requiring an extra measure of safety. These structures would help to ensure that proper clearance is maintained thus enhancing safety. Clearance is necessary to avoid potential damage to the conductor and any objects below the stringing operation.

Tensioning sites will be approximately 100 x 300 feet in size. Tensioner station equipment generally includes a take-up reel, bull wheel (tensioner), reel trailers, cranes, splicing equipment, trucks, tractors, and support equipment.

Sag New Conductor

After installation, the new conductor must be properly tensioned to reach the correct amount of sag between towers. Sag checks will be made at predetermined intervals to assure proper sags and tensions between deadend towers. The correct sag and tension is dependent on a number of factors including span length, clearance requirements, and temperature.

Sagging is generally done with a tractor-mounted sagging winch. The winch is used to sag the line to approximate specifications. Hand-operated equipment, such as a sagging hoist, is then attached and the final sagging accomplished.

Attach New Conductor to Deadend

Deadends are installed at the first and last tower of any stringing section and on vertical or horizontal angles that are too great for suspension clamp. Suspensions or double suspensions are used at all other towers. The maximum angles for single and double suspensions are 30 degrees and 60 degrees, respectively.

Remove Stringing Sheaves, Attach New Conductor to Insulators

Linemen remove the sheave blocks from each structure. The new conductor is then attached to the insulators using appropriate hardware. Linemen climb the structures or are lifted in aerial bucket trucks to remove the sheaves using the necessary hand tools.

Restore Right of Way

Right-of-way cleanup would occur after reconductoring activities are complete. Project-related debris would be removed from the right of way and disposed of at an appropriately licensed facility. The appropriate land management agency and landowner(s) would approve these locations. Ruts and other similar disturbances would be smoothed. Any areas requiring revegetation would be seeded with a weed-free seed mix approved by the appropriate land management agency and landowner(s).

Splicing

Consecutive stringing sections must be spliced together to form an uninterrupted electrical path. Several methods are available to splice the conductor. Allowance must be made for splicing when selecting reel lengths in advance of installation considering access and when cutting the conductor after pulling.

2.1.6 Typical Equipment

The equipment used in reconductoring includes a tensioner and cable puller. These vehicles are large, 10-wheel trucks designed for heavy loads. Tensioners also may be mounted on a trailer. A conductor-cable reel trailer will be used with each tensioner setup location. Reels may also be mounted on a boom truck. Aerial bucket trucks can be effective support vehicles.

Depending on the nature of the project, a helicopter can be used to string the sock line and transport workers and materials to the structures. Helicopter reconductoring methods have proven highly effective where access is difficult or in areas where impacts from access create concern.

Vehicles used for the proposed project will be similar to the types currently used to build and maintain similar existing lines.

2.1.7 Fences, Other Improvements, and Existing Land Uses

Reconductoring crews must protect all fences and other improvements and all public survey monuments found within or adjacent to the right of way. Survey monuments include but are not limited to General Land Office and Cadastral Survey Corners; reference corners; witness points; U.S. Coastal and Geodetic benchmarks and triangulation stations; military control monuments; and recognizable civil (both public and private) survey monuments. Where monuments or references are obliterated during operations, reconductoring crews must secure the service of a registered land surveyor or a staff cadastral surveyor to restore the disturbed monument according to procedures found in the latest edition of the Manual of Surveying Instructions for the Survey of the Public Lands of the United States.

2.1.8 Work Force

Typical conductor stringing crews require 15 to 20 workers, which include foremen, equipment operators, general laborers, environmental monitors and inspectors. Each cable stringing operation requires three to five pieces of equipment and support vehicles. The entire reconductoring project will take approximately 4 to 5 months, overall. However, it might be necessary to reconductor the transmission line's two circuits separately to protect system reliability. Also, the project would probably be undertaken during times of relatively low electrical demand, also to protect system reliability while the line is taken out of commission. This may mean that the project would take two seasons to accomplish.

2.2 TYPICAL MITIGATION MEASURES

Reasonable measures will be taken to reduce impacts to the environment. Vegetation clearing and trimming will be kept to the minimum necessary for safe construction, operation and maintenance of the line. Dragging and whipping of conductors and sock lines will be avoided to further minimize vegetation and ground disturbance. Use of materials labeled as potential pollutants will be minimized to the extent practicable. Where possible, use of potential pollutants that could ooze, drip, flake, or crumble will be avoided in and around wetland areas.

Table 2.2-1 is a list of typical mitigation measures. Thoughtful application of these measures, singly or in combination, will help to minimize or eliminate impacts associated with the project. Other mitigation measures, either generic or site/species specific, may be identified as more specific engineering and environmental information is developed and analyzed.

Table 2.2-1. Typical reconductoring environmental mitigation measures.

1. All project related vehicle movement outside the right-of-way normally will be restricted to pre-designated access, contractor-acquired access, or public roads. Should unforeseeable circumstances occur during reconductoring that requires more areas than initially requested, the landowner must grant permission.
2. The aerial limits of reconductoring activities normally will be predetermined, with activity restricted to and confined within those limits. No paint or permanent discoloring agents will be applied to rocks or vegetation to indicate limits of survey or reconductoring activity.
3. Vegetation will be left in place wherever possible and original contour will be maintained to avoid root damage and allow for re-sprouting of existing vegetation.
4. If ground disturbance is necessary or where re-contouring is required, surface restoration will occur as required by the landowner or land management agency. The method of restoration normally will consist of removing and stockpiling topsoil and large rocks from disturbed areas to return temporarily disturbed areas back to original contours. Other methods include reseeding (if required), installing cross drains for erosion control, placing water bars in the road, and filling ditches.
5. Existing improvements will be repaired or replaced if they are damaged or destroyed by reconductoring activities to their condition prior to disturbance as agreed to by the parties involved.

Table 2.2-1. Typical reconductoring environmental mitigation measures.

6. Towers and/or ground wire will be marked with highly visible devices where required by governmental agencies (e.g., Federal Aviation Administration).
7. Prior to reconductoring, all supervisory personnel will be instructed on the protection of cultural, paleontological, and ecological resources. To assist in this effort, appropriate contracts will address: (a) federal, state, and tribal laws regarding antiquities, fossils, plants and wildlife, including collection and removal; (b) the importance of these resources and the purpose and necessity of protecting them.
8. Cultural resources will continue to be considered during project implementation. If necessary, pedestrian surveys will be performed to inventory and evaluate cultural resources within the project area and any appurtenant impact zones beyond the corridor, such as access roads and equipment yards. In consultation with appropriate land managing agencies and state historic preservation officers, specific mitigation measures will be developed and implemented to mitigate any identified adverse impacts. These may include plan modifications to avoid adverse impacts, monitoring of activities, and data recovery studies.
9. The project sponsors will respond to complaints of radio or television interference generated by the transmission line by investigating the complaints and implementing appropriate mitigation measures. The transmission line will be patrolled on a regular basis, so that damaged insulators or other transmission line materials, which could cause interference, are repaired or replaced.
10. The project sponsors will apply mitigation needed to eliminate problems of induced currents and voltages onto conductive objects sharing a right of way to the mutual satisfaction of the parties involved.
11. All activities will be conducted in a manner that will minimize disturbance to vegetation and drainage channels. All existing roads will be left in a condition equal to or better than their condition prior to reconductoring of the transmission line.
12. All requirements of those entities having jurisdiction over air quality matters will be adhered to and any permits needed for reconductoring activities will be obtained.
13. Fences and gates will be repaired or replaced to their original condition prior to plan disturbance as required by the landowner or the land management agency if they are damaged or destroyed by reconductoring activities. Temporary gates will be installed only with the permission of the landowner or the land management agency and will be restored to original condition prior to plan disturbance following reconductoring.
14. A bundle configuration of conductors will be used to limit the audible noise, radio interference, and television interference due to corona. Tension will be maintained on all insulator assemblies to assure positive contact between insulators, thereby avoiding sparking. Caution will be exercised during reconductoring to avoid scratching or nicking the conductor surface, which may provide points for corona to occur.
15. No non-biodegradable debris will be deposited in the right of way.
16. Hazardous materials will not be drained onto the ground or into streams or drainage areas. Totally enclosed containment will be provided for all trash. All waste including trash and litter, garbage, other solid waste, petroleum products, and other potentially hazardous materials will be removed to a disposal facility authorized to accept such materials.
17. Non-specular conductors will be used to reduce visual impacts.

Table 2.2-1. Typical reconductoring environmental mitigation measures.

18. The contractor will use weed-free, seed mixes for revegetation. No species on the "state noxious weed list" will be included in the revegetation seed mixes. Weed control agencies located within the project area will be consulted and a weed control plan will be developed and implemented as required.
19. All heavy equipment brought in from out of state or county will go through high pressure washing before use on site.
20. Dust will be controlled by applying water or chemicals as required during reconductoring.

2.3 REFERENCES CITED

Power Engineers, Inc. 2001. Gilroy Energy Center Phase II Project: Overview of Transmission Line Reconductoring. Prepared for Calpine Corporation, October 2001. Prepared by Power Engineers, Inc., Hailey, Idaho.

3.0 ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

3.1 AIR QUALITY

Air quality impacts associated with construction and operation of the Russell City Energy Center are discussed in Section 8.1, Air Quality, of Calpine's AFC (01-AFC-07). Included in that discussion is an assessment of the impact of the construction of the proposed generating units and associated power plant equipment, including an assessment of emissions from vehicle and equipment exhaust and fugitive dust from materials handling. Based on dispersion modeling of these emissions, construction impacts on ambient air quality would be below state and federal standards for all criteria pollutants emitted, given that best available emission control techniques would be used. The carcinogenic risk of combustion diesel PM_{10} emissions was found to be below one in one million as well.

The reconductoring will utilize some of the same basic equipment and construction practices used to construct the power plant, will result in less ground disturbance, and will be spread out over 12.52 miles along the rights-of-way. Air quality impacts are not expected to differ significantly from those described in the applicant's AFC.

3.2 BIOLOGICAL RESOURCES

This section describes the biological resources along the transmission line route and vicinity; the potential impacts associated with construction, operation, and maintenance of the transmission line; and the measures to mitigate potential environmental impacts to a less than significant level.

3.2.1 Affected Environment

Coastal habitats along the eastern shore of San Francisco Bay include salt marshes, brackish sloughs, coastal prairies, and coastal sage scrub communities. The largest salt marsh community in California is located around San Francisco Bay. Community types in the project study areas include coastal salt marsh, brackish sloughs, mud flats, emergent marsh, and annual grassland.

3.2.1.1 Regional Biological Resources

The proposed East Shore to San Mateo transmission line reconductoring project is located on the alluvial coastal plain of the San Francisco Bay. The alluvial coastal plains have been largely converted to urban development, salt evaporation ponds, or ruderal (disturbed and weedy) areas. Remnants of the historic northern coastal salt marsh complex remain protected in parks and preserves. These include the Hayward Regional Shoreline (west of the project site), the San Leandro Shoreline Park and Oyster Bay Regional Shoreline (northwest of the project site), the San Francisco Bay National Wildlife Refuge (south of the project site), and Coyote Hills Regional Park (southeast of the project site). Other biological resources include brackish sloughs such as Alameda Creek, and brackish marshes and abandoned salt evaporation ponds with the potential for restoration.

Biological habitats within the transmission line corridor consist primarily of coastal salt marsh, brackish/freshwater marsh, salt production facilities (evaporation ponds), ruderal areas, and urban landscapes with horticultural trees and shrubs. The majority of the habitat types of the transmission line corridor are fragmented and degraded.

The only sensitive plant community found within the project area is the northern coastal salt marsh habitat. Representative species found in the salt marsh community include pickleweed (*Salicornia virginica*), salt grass (*Distichlis spicata*), and alkali heath (*Frankenia salina*). Much of the historic salt marsh community within the transmission line corridor has been altered or eliminated by urban development, sewage treatment facilities, salt evaporation ponds, and the construction of dikes and levees to prevent flooding and intrusion of saltwater. Listed species in the northern coastal salt marsh community include the salt marsh harvest mouse (*Reithrodontomys raviventris*), clapper rail (*Rallus longirostris obsoletus*), and salt-marsh wandering shrew (*Sorex vagrans halicoetes*).

Special environmental areas within 1-mile of the transmission line include the Salt Marsh Harvest Mouse Preserve, managed by the East Bay Regional Park District, and the HARD marsh restoration project and Shoreline Interpretive Center, both in Hayward

3.2.1.2 Special Status Species

The designation of special status includes all state- and federally-listed species under the state and federal Endangered Species Acts (ESAs); species proposed for those listings; federal Species of Concern (SC); California Species of Special Concern (CSC); California Fully Protected species under the Fish and Game Code; and plant species designated as Rare, Threatened, or Endangered by the California Native Plant Society (CNPS). Species of concern include those that could be listed in the future and those currently protected under other laws (e.g., the Bald and Golden Eagle Protection Act, and the Migratory Bird Treaty Act).

Standard references used for the biology and taxonomy of plants, plant communities and wildlife included Hickman, ed. (1993); Tibor, eds. (2001). and Zeiner et al. (1988; 1990 a, b). A computerized search of the California Natural Diversity Data Base (CNDDB/RareFind report, March 2002) was conducted for the San Leandro, Hayward, Newark, and Redwood Point USGS topographic quadrangles (the "study Area"). This search was conducted to determine if there were any occurrences of state- or federally-listed species recorded within or near the project study area. Known locations of special status species, based on the database search, are mapped on Figure 3.2-1(a-e). In addition to the CNDDB/RareFind report, a letter was sent to the U.S. Fish and Wildlife Service (USFWS), Sacramento Field Office, requesting file data on special status species that could occur in the project vicinity. Table 3.2-1 lists the species.

In addition to the literature sources mentioned above, site-specific information was gathered during field surveys conducted in the spring of 2002.

3.2.1.3 Results

Biological field surveys for the transmission line corridor were conducted by biologist Brett D. Hartman on April 25, 2002. The survey included a survey of the entire transmission line corridor by automobile, as well as a meandering pedestrian survey of the areas beneath the angle towers, which are the likely pull-tensioning sites. A wetland delineation was not performed for the transmission line corridor.

A list of wildlife species observed during surveys of the project site and associated facilities is provided in Table 3.2-2. A list of plant species observed at the project site and linear facilities during 2001 botanical surveys is presented in Table 3.2-3. Due to their bloom time, certain species with potential habitat in the project area of potential effects could not be surveyed during the time in which this survey was performed.

Table 3.2-1. Special status species potentially occurring in the transmission line corridor.

Scientific Name	Common Name	Federal/ State/ CNPS [a]	Habitat in impact area?	Blooms
Plants				
Astragalus tener var. *tener*	Alkali milk-vetch	SC/--/1B	No	Mar-May
Atriplex depressa	Brittlescale	SC/--/1B	No	May-Oct
Balsamohriza macrolepis var. *macrolepis*	Big-scale balsamroot	--/--/1B	No	Mar-June
Cordylanthus maritimus ssp. *palustris*	Point Reyes bird's-beak	SC/--/1B	Marginal	Jun-Oct
Cordylanthus mollis ssp. *hispidus*	Hispid bird's beak	SC/R/1B	Marginal	Jul-Sep
Fritillaria liliacea	Fragrant fritillary	SC/--/1B	No	Feb-Apr
Helianthella castanea	Diablo rock rose	SC/--/1B	No	Apr-Jun
Hemizonia parryi ssp. *congdonii*	Congdon's tarplant	SC/--/1B	No	Jun-Nov
Horkelia cuneata ssp. *sericea*	Kellog's horkelia	SC/--/1B	No	Apr-Sept
Lasthenia conjugens	Contra Costa goldfields	E/--/1B	No	Mar-Jun
Lathyrus jepsonii	Delta tule pea	SC/--/1B	Marginal	May-Jun
Lilaeopsis masonii	Mason's lilaeopsis	SC/R/1B	No	Apr-Oct
Plagiobothrys glaber	Hairless popcorn flower	SC/--/1A	Yes	Apr-May
Suaeda californica	California seablite	PE/--/1B	No	Jul-Oct
Mammals				
Corynorhinus townsendii townsendii	Pacific western big eared bat	SC/CSC	No	--
Eumops perotis californicus	Greater western mastiff-bat	SC/CSC	No	--
Myotis evotis	Long eared bat	SC/--	No	--
Myotis thysanodes	Fringed myotis bat	SC/--	No	--
Myotis volans	Long legged myotis bat	SC/--	No	--
Myotis yumanensis	Yuma myotis bat	SC/CSC	No	--
Neotoma fuscipes annectens	San Francisco dusky footed woodrat	SC/CSC	No	--
Reithrodontomys raviventris	Salt-marsh harvest mouse	E/E	Yes	--
Sorex vagrans halicoetes	Salt-marsh wandering shrew	SC/CSC	Yes	--
Birds				
Accipeter striatus (nesting)	Sharp-shinned hawk	--/SSC	No	--
Agelaius tricolor (nesting colony)	Tricolored blackbird	SC/CSC	No	--
Amphispiza belli belli	Bell's sage sparrow	SC/CSC	No	--
Aquila chrysaetos (nesting & wintering)	Golden Eagle	--/SSC	No	--
Ardea herodias (rookery)	Great blue heron	--/--	No	--
Asio flammeus (nesting)	Short-eared owl	--/SSC	No	--
Athene cunicularia hypugea (burrow sites)	Western burrowing owl	SC/CSC	Yes	--
Branta canadensis leucopareia	Aleutian Canada goose	T/--	No	--
Buteo regalis	Ferruginous hawk	SC/CSC	Winter foraging	--
Charadrius alexandrinus nivosus (nesting)	Western snowy plover	T/CSC	No	--
Circus cyaneus (nesting)	Northern harrier	--/CSC	Yes	--
Elanus leucurus (nesting)	White-tailed kite	--/--	Yes	--
Falco peregrinus anatum	American peregrine falcon	--/E	Yes-foraging	--

Geothlypis trichas sinuosa	Saltmarsh common yellowthroat	SC/CSC	No-foraging	--
Haliaeetus leucocephalus	Bald eagle	T/E	No	--
Laterallus jamaicensis coturniculus	California black rail	SC/T	No	--
Melospiza melodia pusillula	Alameda song sparrow	SC/CSC	Yes	--
Pelecanus occidentalis californica	California brown pelican	E/E	No	--
Phalacrocorax auritus	Double-crested cormorant	--/SSC	Yes	--
Rallus longirostris obsoletus	California clapper rail	E/E	Yes	--
Rynchops niger	Black Skimmer	--/SSC	Yes	--
Riparia riparia (nesting)	Bank swallow	--/T	No	--
Sterna antillarum browni (nesting colony)	California least tern	E/E	Yes	--
Reptiles				
Clemmys marmorata marmorata	Northwestern pond turtle	SC/CSC	No	--
Clemmys marmorata pallida	Southwestern pond turtle	SC/CSC	No	--
Masticophis lateralis euryxanthus	Alameda whipsnake	T/T	No	--
Phrynosoma coronatum frontale	California horned lizard	SC/CSC	No	--
Amphibians				
Ambystoma californiense	California tiger salamander	C/CSC	No	--
Rana aurora draytonii	California red legged frog	T/CSC	No	--
Rana boylii	Foothill yellow legged frog	SC/CSC	No	--
Fish				
Hypomesus transpacificus	Delta smelt	T/T	No	--
Oncorhynchus kisutch	Coho salmon	T/E	No	--
Oncorhynchus mykiss *	Central California Valley steelhead	T/E	No	--
Oncorhynchus mykiss *	Central California Coast steelhead	T/E	No	--
Oncorhynchus tshawytscha	Winter run chinook salmon	E/E	No	--
Pogonichthys macrolepotus	Sacramento splittail	PT/CSC	No	--
Spirinchus thaleichthys	Longfin smelt	SC/CSC	No	
Invertebrates				
Branchinecta lynchi	Vernal pool fairy shrimp	T/--	No	--
Danaus plexippus	Monarch butterfly	--/--	No	--
Hydrochara ricksecker i	Ricksecker's scavenger beetle	SC/--	Marginal	--
Tryonia imitator	Mimic tryonia (California brackishwater snail)	SC/--	Marginal	--

[a] **Status Categories:**

Federal status determined from a USFWS letter (Knight 2001, personal communication). State status determined from *Special Plants List* (June 1999), and/or *State and Federally Listed Endangered, Threatened, and Rare Plants of California* (April 1999), prepared by CDFG Natural Diversity Data Base. CNPS status determined from *CNPS Inventory of Rare and Endangered Vascular Plants of California* (Skinner and Pavlik 1994). Codes used in table are as follows:

E = Endangered; **T** = Threatened; **R** = California Rare; **PE** = Proposed Endangered

C = Candidate: Taxa for which the USFWS has sufficient biological formation to support a proposal to list as endangered or threatened.

SC = USFWS Species of Concern: Taxa for which existing information may warrant listing, but for which substantial biological information to support a proposed rule is lacking.

SSC = CDFG "Species of Special Concern"

CNPS List: **1A** = Presumed Extinct in CA; **1B** = Rare or Endangered in CA and elsewhere; **2** = R/E in CA and more common elsewhere; **3** = Need more information; **4** = Plants of limited distribution.

-- = Species not state-listed.

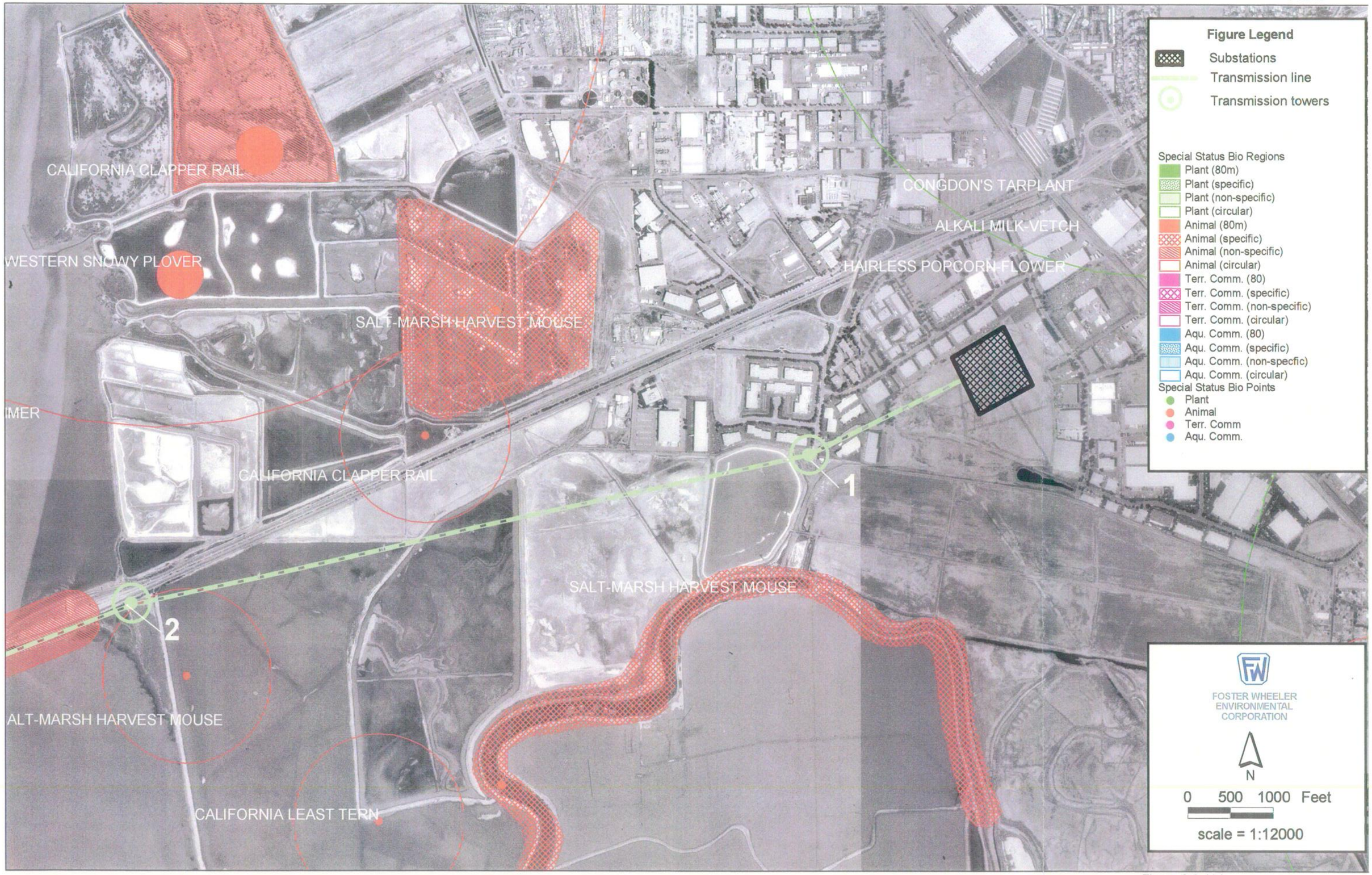


Figure 3.2-1(a)
Biological Resources in the East Shore to San Mateo transmission line corridor.

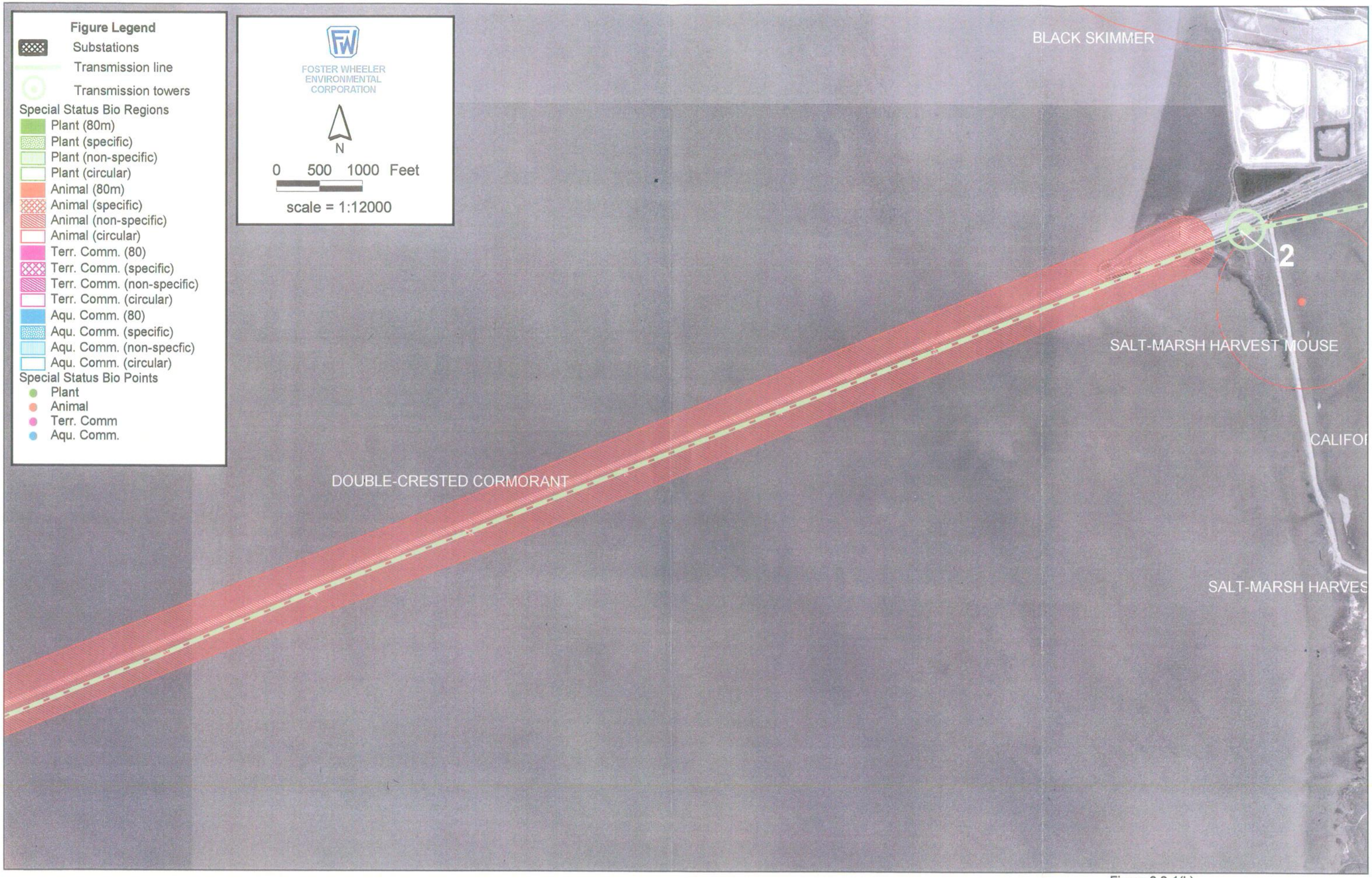


Figure 3.2-1(b)
Biological Resources in the East Shore to San Mateo transmission line corridor

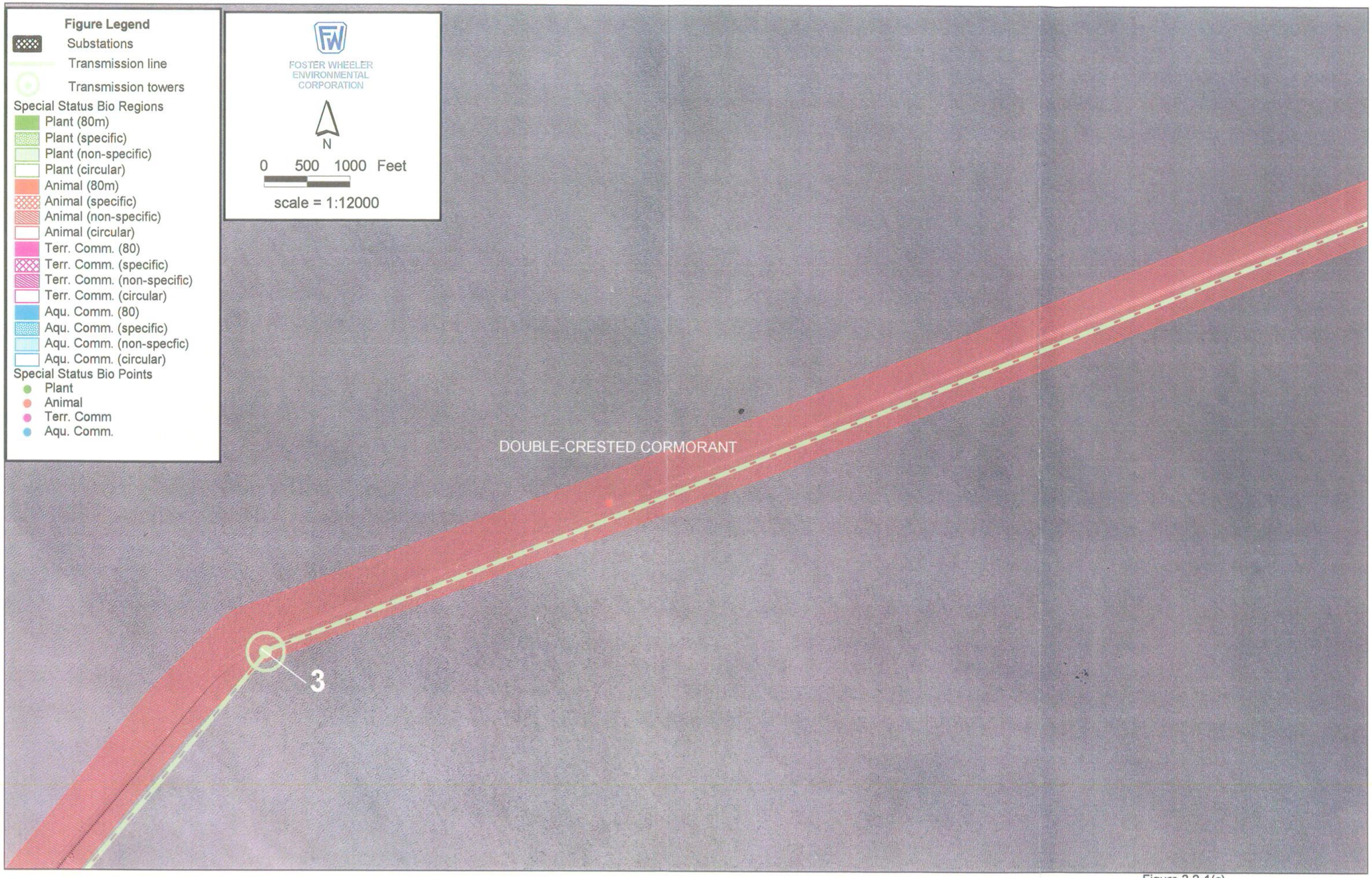


Figure 3.2-1(c)
Biological Resources in the East Shore to San Mateo transmission line corridor

Figure 3.2-1(d)
Biological Resources in the East Shore to San Mateo transmission line corridor.

Figure 3.2-1(e)
Biological Resources in the East Shore to San Mateo transmission line corridor.

The transmission line corridor is dominated by developed urban land. There are three other habitat types within the transmission line corridor. These are: 1) disturbed ruderal areas with minimal native species components, 2) salt marsh and salt marsh remnants, salt ponds, and 3) freshwater marsh.

The disturbed ruderal vegetation is dominated by wild oats (*Avena* spp.), Italian ryegrass (*Lolium multiflorum*), black mustard (*Brassica nigra*), and storksbill (*Erodium cicutarium*), with remnant native plant species such as California poppy (*Eschscholzia californica*). Ruderal areas are of limited value to wildlife species, dominated by jackrabbits, voles, and common birds such as brewers blackbird and meadowlarks. Special status species potentially occurring in ruderal habitats include the burrowing owl, and foraging habitat to other raptor species.

The salt marshes of the transmission line corridor are small fragments, dominated by pickleweed and cordgrass (*Spartina* sp.). The salt marsh areas to the north of Highway 92 on the Hayward side of the transmission line corridor are habitat to several special status species, including California clapper rail, salt marsh harvest mouse, and salt marsh wandering shrew. In addition, the salt ponds to the north of Highway 92 on the Hayward side of the transmission line corridor are known nesting habitat habitat for the western snowy plover.

Adjacent to the San Mateo substation is a freshwater marsh dominated by open water and cattails. Abundant wildlife was observed in this area, including red-winged blackbirds, sparrows, and waterfowl such as mallards and ruddy ducks.

Table 3.2-2. Wildlife species observed during 2002 wildlife surveys.

Common Name
Black-necked stilt
Brewer's blackbird
Canada goose
Common Crow
Double crested cormorant
Killdeer
Great egret
Mallard
Mourning dove
Red-winged blackbird
Rock dove
Ruddy ducks
Western Gull
Western meadowlark

Table 3.2-3. Plant species observed during botanical surveys of the transmission line corridor.

Family	Genus	Species/ subspecies/ variety	N/I*	Common name
DICOTS				
Apiaceae	*Foeniculum*	*vulgare*	I	Fennel
Asteraceae	*Conyza*	*canadensis*	I	Horseweed
	Baccharis	*pilularis*	N	Coyote brush
	Cotula	*coronopifolia*	I	Brassbuttons
	Grindelia	*Stricta* var. *angustifolia*	N	Gumweed
	Sonchus	*oleraceus*	I	Common sow thistle
Brassicaceae	*Brassica*	*nigra*	I	Black mustard
Chenopodiaceae	*Salicornia*	*virginica*	N	Pickleweed
Fabaceae	*Lathyrus*	*Sp.*	N	Wild pea
Frankeniaceae	*Frankenia*	*salina*	N	Alkali heath
Geraniaceae	*Geranium*	*disectum*	I	Wild geranium
	Erodium	*cicutarium*	I	Filaree
Malvaceae	*Malva*	*nicaeensis*	I	Bull mallow
Myrtaceae	*Eucalyptus*	*globulus*	I	Blue gum
Papaveraceae	*Eschscholzia*	*californica*	N	California poppy
Plantaginaceae	*Plantago*	*lanceolata*	I	English plantain
Polygonaceae	*Rumex*	*crispus*	I	Curly dock
Primulaceae	*Anagallis*	*arvensis*	I	Scarlet pimpernell
MONOCOTS				
Cyperaceae	*Cyperus*	*Sp.*	--	Sedge
Juncaceae	*Scirpus*	*sp.*		Rush
Poaceae	*Avena*	*fatua*	I	Wild oat
	Bromus	*diandrus*	I	Ripgut grass
	Cortadaria	*Sp.*	I	Pampas grass
	Cynodon	*dactylon*	I	Bermuda grass
	Distichlis	*spicata*	N	Saltgrass
	Elymus	*glaucus*		Blue wild-rye
	Hordeum	*murinum* ssp. *leporium*	I	--
	Lolium	*multiflorum*	I	Italian ryegrass
	Spartina	*Sp.*	--	Cordgrass
Typhaceae	*Typha*	*sp.*		Cattail

3.2.2 Environmental Consequences

3.2.2.1 Significance Criteria

Impacts to biological resources may result from:

- Habitat loss/disturbance
- Direct impacts to special status species
- Project operation

Appendix G of CEQA addresses the significance criteria with respect to biological resources (Public Resources Code Sections 21000et seq.). An impact would be considered significant if it would:

- Have a substantial adverse effect, on any federal or state listed species identified as a endangered, threatened, or candidate.
- Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, or regulations.
- Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act through direct removal, filling, hydrological interruption, or other means.
- Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites.
- Conflict with any local ordinances protecting biological resources.
- Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional or state habitat conservation plan.

3.2.2.2 Construction Impacts

Environmental consequences from transmission line reconductoring are summarized in Table 3.2-4. Temporary disturbance to ruderal vegetation will potentially occur at the East Shore substation, and angle towers 1, 2, 4, 9, 10, 11, and 12. Wetlands will be avoided at these sites. Impacts to ruderal vegetation is not considered significant, because special status species, wetlands, riparian areas, or migratory fish or wildlife corridors, or nursery sites are not impacted.

Noise and vibration impacts to breeding waterfowl could occur at angle towers 11 and 12. A limited operating period or noise attenuation on construction equipment could reduce impacts to migratory birds to less than significant.

Angle tower 2 is located in a pickleweed wetland. Avoiding this wetland by placing the pull-tensioning site on the paved surfaces of Highway 92 could reduce impacts to wetland resources at this site to less than significant.

Noise and vibration impacts to breeding western snowy plovers north of Highway 92 are considered less than significant, as it is assumed this population has become habituated to the noise and vibration associated with traffic on Highway 92 and bridge construction.

Table 3.2-4. Habitat types, potential impacts, and avoidance measures at the twelve angle towers of the East Shore to San Mateo transmission line.

East Shore Substation	Ruderal vegetation with small areas of saltgrass dominated wetlands. Pull-tensioning site can be located to avoid wetlands
1	Ruderal vegetation and paved access roads. Salt production pond to the west, but pull-tensioning will be located to avoid wetlands.
2	Fragment of pickleweed dominated wetland adjacent to Highway 92. The pull-tensioning site will be located on the paved surfaces of Highway 92 and avoid wetlands. Western snowy plovers are known to nest in the abandoned salt evaporation ponds to the north of Highway 92. However, noise and vibration from the reconductoring equipment will not exceed the current decibel levels associated with highway traffic and bridge construction. It is assumed that the snowy plovers have become habituated to these noise levels.
3	Angle tower in Bay adjacent to Hayward-San Mateo bridge. Double-crested cormorants are known to nest on these towers, which are protected by the Migratory Bird Treaty Act. However, a pull-tensioning station will not be required at this site, and the cormorants will be avoided.
4	Ruderal species and salt flats dominated by sedges, with paved access areas. Pull-tensioning sites will be located on upland ruderal areas or paved access areas.
5	Paved urban area. There is a canal to the east that will be avoided.
6	Paved urban area.
7	Paved urban area.
8	Paved urban area.
9	Ruderal area with patches of wetland vegetation. Pull-tensioning sites will be located to avoid wetlands.
10	Ruderal area with patches of wetland vegetation. Pull-tensioning sites will be located to avoid wetlands.
11	Ruderal area adjacent to freshwater marsh. Pull-tensioning sites will be located to avoid the wetland. However, noise and vibration could affect waterfowl during the breeding season.
12	Ruderal area adjacent to freshwater marsh. Pull-tensioning sites will be located to avoid the wetland. However, noise and vibration could affect waterfowl during the breeding season.

3.2.2.3 Cumulative Impacts

Reconductoring of the East Shore to San Mateo transmission line is not expected to cause significant impacts to biological resources. Therefore there will be no cumulative impacts from the project.

3.2.3 Mitigation Measures

All wetlands will be avoided by placing the pull-tensioning sites on upland ruderal areas or paved surfaces. Ruderal areas will reseed naturally due to the abundant seed bank. Breeding birds will be avoided through limited operating periods or noise attenuation on construction equipment. In wetland areas and areas where sensitive habitats exist (angle towers 2, 9, 10, 11, and 12 as well as several in-line towers), linemen will climb the towers to place stringing sheaves manually, as necessary. This will avoid disturbance of sensitive habitats that would

otherwise occur due to the use of a truck-mounted aerial bucket to access the towers for sheave stringing.

If these means of impact avoidance are found to be infeasible at the time of construction, the helicopter method could be used to avoid disturbances at ground level.

Monitoring of construction activities will be carried out by personnel trained to detect any potential and unforeseen impacts on listed, sensitive, or migratory wildlife and their habitats adjacent to the project site. If actual or potential effects are detected, the construction foreman will cease the activities that are potentially affecting these species and will consult with a professional biologist qualified to assess the situation and make recommendations to alter or alleviate any activities that are resulting in these effects.

3.2.4 References

Hickman, J.C. 1993. *The Jepson manual: Higher plants of California.* University of California Press. University of California.

Tibor, D.P. (ed.). 2001. CNPS Inventory of rare and endangered plants of California. California Native Plant Society.

Zeiner, D. 1988. *California's wildlife, volume I: Amphibians and reptiles.* California Statewide Wildlife Habitat Relationships System.

Zeiner, D. 1990a. *California's wildlife, volume II: Birds.* California Statewide Wildlife Habitat Relationships System.

Zeiner, D. 1990b. *California's wildlife, volume III:* Mammals. California Statewide Wildlife Habitat Relationships System.

3.3 CULTURAL RESOURCES

Cultural resources in the general project area include historic and prehistoric archaeological sites, historic buildings and structures, and resources of traditional cultural significance to Native Americans and other groups. This section analyzes the potential effects of reconductoring the transmission line to cultural resources within the project area of potential effect (APE).

3.3.1 Affected Environment

Cultural resources are the traces of human occupation and activity that, in northern California, extend back in time for at least 11,500 years. Archaeologists have reconstructed general trends of prehistory. Written historical sources tell the story of the past 200 years. A cultural resources archival search of the project area, has located one cultural resource site within the project APE.

3.3.1.1 Prehistoric Background

The general trend throughout California prehistory was the increase in population density over time, coupled with greater sedentism and the use of a greater diversity of food resources. Chartkoff and Chartkoff (1984) identified three major periods of prehistory observed throughout California: Pre-Archaic, Archaic, and Pacific. These patterns are roughly correlated with the Paleoindian, Archaic, and Emergent periods, developed by Fredrickson (1974) for west–central California. As Chartkoff and Chartkoff observe, culture change occurred in different ways and at different times throughout California. These changes nevertheless followed a broad pattern, outlined below. Northern California prehistory is briefly summarized here. For a more detailed description, consult the RCEC AFC.

Prehistoric periods in northern California prehistory are:

Pre-Archaic Period (Prior to 11,000 years before present [BP])

Early to Middle Archaic Period (11,000–6,000 years BP)

Late Archaic Period (6,000–4,000 years BP)

Early and Middle Pacific Periods (4,000–1,500 years BP)

Late and Final Pacific Period (1,500 years BP-Historic Era)

3.3.1.2 Archaeology and Archaeological Sensivity in the Project Area

Upland areas near watercourses were favored locations for prehistoric occupation. In the San Francisco Bay Area, the Bay margins are also high sensitivity areas for archaeological resources, due to their proximity to fish and shellfish resources in the Bay.

Mt. Eden Creek is located within one-quarter mile of the East Shore Substation. From the creek estuary and banks, the prehistoric occupants were able to exploit a variety of ecological niches on the alluvial plain and foothills and to take advantage of marine resources. Along the shores of

San Francisco Bay, including the project area, occupation was intermittent and sparse prior to around 5,000 to 7,000 years ago. In addition, evidence for occupation prior to 7,000 years ago was hidden by rising sea levels or buried under sediments caused by natural and man-made Bay marshland infilling along estuary margins.

3.3.1.3 Ethnographic Background

The project area is situated within the historical Chochenyo territory of the Costanoan Indians. The term "Costanoan" is derived from "Costaños", the Spanish word for "coast people". The term refers to a language family found throughout a large area that included the eastern perimeter of the San Francisco Bay and San Francisco Peninsula, or from the Carquinez Straits down to the southern margin of the Bay, and up to the Golden Gate. The Costanoan language family included eight distinct languages, Chochenyo among them. These eight languages have been described as "as different from one another as Spanish is from French" (Levy 1978). All eight Costanoan languages also belong to the Penutian language stock. Penutian languages were spoken throughout north–central California by a number of aboriginal groups, including the Wintu, Maidu, Miwok, and Yokuts. Linguistic evidence suggests that Costanoan speakers occupied the Bay area by 1,500 years ago.

In 1971, Bay area descendants of the Costanoans organized as the Ohlone Nation ("Ohlone" is probably being derived from the Miwok word meaning "people of the west"). Therefore, it is correct to speak of the Costanoans when reviewing the ethnographic background of these people and to speak of the Ohlone when referring to their current status as a nation.

The Chochenyo or East Bay Costanoans occupied the east shore of San Francisco Bay, between Richmond and Mission San Jose, and as far east as Livermore Valley. The project area is at the southern extent of historical Chochenyo territory. To the south, the Tamyen or Santa Clara Costanoan territory extended around the south end of the Bay and into the lower Santa Clara Valley. It is possible that the southern part of the project area was also within Tamyen territory. In 1770, Chochenyo and Tamyen speakers each numbered approximately 1,200.

Ethnographic data pertaining to the Ohlone is incomplete at best. The first Euroamericans to record contact with the Ohlone were Fathers Fages and Crespi, who in 1772 traveled up the east side of San Francisco Bay to the Carquinez Straits and then turned south through the Walnut Creek, San Ramon, and Livermore valleys. Fages and Crespi noted "numerous villages of very gentle and peaceful heathen, many of them of fair complexion" (Cook 1957).

Ethnographic information available for the Ohlone comes primarily from accounts of early explorers, from mission records, and from a few ethnographers who, in the early and middle years of the 20th century, were able to work with the few remaining native informants (e.g., Kroeber 1925; Harrington 1942; Merriam 1967). These lines of evidence indicate that the

Costanoans were hunter–gatherers and that fish and shellfish were an important part of the coastal Ohlone diet. The Ohlone also gathered and made use of acorns, laurel nuts, hazelnuts, and an assortment of wild roots, bulbs, fruits, nuts, and seeds.

3.3.1.4 Historic Background

Recorded history in the project area begins with early Spanish exploration in the area, the arrival of missionaries, and the establishment of Mission San Jose approximately 10 miles inland (east) from the linear route. This was followed by secularization of the missions and division of lands in the project vicinity into a number of large ranchos, the development of an agricultural land use pattern, and the expansion of shipping during the Hispanic Period continuing into the American Period. The agricultural land use pattern was eventually replaced with the arrival of rail transport and subsequent rapid urban expansion. Urban expansion included the formation and incorporation of cities, such as San Mateo, Hayward, San Leandro, Fremont, Newark, and Union City, as well as the growth of large-scale industries such as salt production.

Documented historic-era resources in the project area are associated chiefly with the various industries that developed here from the mid-1800s to the mid-1900s. The industrial history of the project area can be divided into several historic themes: agriculture and ranching, the landings and shipping industry, railroads and other transportation-related industries, and the salt production industry. These are discussed further in the RCEC AFC. Key historic-era periods include the following:

Hispanic Period: 1797 to 1848

American Period: 1848 to present

Electrical Distribution System

Electrical power plants began to be constructed in the late 1880s. Long distance transmission was pioneered in California in 1891, with a 14-mile-long line constructed for a hydroelectric facility in San Bernardino County. In the 1890s, a PG&E predecessor constructed a 22-mile-long electrical transmission line between the Folsom hydroelectric plant and downtown Sacramento. This was one of the earliest long-distance transmission lines. By the 1920s, electrical power companies had constructed a number of long-distance lines, a number of these to transmit hydroelectric power from the Sierra Nevada mountains to major population centers in the central Valley and on the California coast. Most early transmission lines were steel truss structures based on the design of steel windmill for the oil industry. The electrical service industry coalesced around private, regulated monopolies like PG&E, and a few municipal utility districts.

A previously recorded historic electrical transmission line (P-01-02269, East Shore to Grant, c. 1922) connects to the East Shore substation from the north and south, crossing the East Shore to San Mateo line. The East Shore Substation was recently (within the past year) replaced on an adjacent lot. The East Shore to San Mateo line does not appear on the 1942 map of Hayward, however it is illustrated on the 1959 USGS Hayward map.

Historic Archaeological and Historic Site Sensitivity

Sensitivity for historic resources and historic archaeological resources along the transmission line route is high. Early historic uses of the area included salt processing and the Bay Area salt industry had its beginnings near the eastern segment of the transmission route. The Oliver Brothers (c. 1937-1982) historic property boundary is just north of the transmission line route, and is considered eligible for the National Register of Historic Places (property number 097186, 1995). The Hayward Area Recreation Department has acquired title to some abandoned salt ponds near the Bay shore, about a mile from the transmission line, and has plans to preserve or interpret some early salt processing features. Some historic archaeological deposits were recorded south and west of the East Shore Substation. These included sites with Chinese ceramics possibly associated with salt pond development or salt production.

3.3.1.5 Resource Inventory Methods

Inventory methods for the project consisted of archival research. Intensive archaeological pedestrian surveys will be conducted by the project sponsor prior to construction, once PG&E identifies the locations of project activity areas.

Archival Research Methods

Foster Wheeler Environmental conducted a records search at the Northwest Center of the California Historical Resources Information System (CHRIS) at Sonoma State University in Rohnert Park, May 1, 2002. The search determined that portions of the APE had been previously surveyed for cultural resources, and several surveys had been performed in immediately adjacent areas. In addition to reviewing available survey reports, lists of historic properties (e.g., the National Register of Historic Places, California Inventory of Historic Resources, California Points of Historic Interest, and California Landmark files) were reviewed to locate historic archaeological sites in the project area. Project staff studied USGS topographic maps and other historical maps to determine where unrecorded historic structures and features were located.

Archival research revealed several previous investigations within portions of the APE. Table 8.3-1 is a list of these previous surveys within 0.25 miles of the APE. Table 3.3-2 list spreviously recorded prehistoric and historic archaeological sites within .25 miles of the project vicinity and Table 3.3-3 lists previously recorded sites within the project APE.

Table 3.3-1. Archaeological survey reports for projects within 0.25 miles of the project route.

Author	Title	Sponsor	Area Surveyed	Survey Type	Visibility	Results
Sawyer, M., Et. al. 1978	An Archaeological Reconnaissance of the Hayward-San Leandro Transportation Corridor, Alameda, Co.	Ecumene Associates	1900 acres	Intensive	fair	2 historic sites
Holman, Miley. 1996	Archaeological Field Inspection of the San Mateo Golf Curse project Area, San Mateo Co.	Schwarz, Powers, & Associates	N/A	Intensive	Good	Negative
Pacific Legacy Incorporated. 2000	Archaeological Survey and Record Search Results for the MCI World Com, Fremont, San Jose 12, San Mateo, and Santa Clara segments in Alameda, San Mateo, Santa Clara Co.	North Sate Resources	6.3 miles	intensive	Good	Negative
Chavez, David. 1983	Citywide Archaeological Investigations, City of San Mateo, CA	The Department fo Community Development Planning Division City of San Mateo, CA	City of San Mateo	general	Fair-Good	No sites recorded, Identification of possible areas.
Chavez, David. 1979	Evaluation of East 3ed Ave.	David Crimp	1.75 miles	N/A	N/A	Negative
Rudo, Mark. 1979	A cultural Resource Survey Report for the Proposed Belmont Marina, Foster City	US Army Corrps of Engineers	Approximately 150 acres	intensive	N/A	Negative
Basin Research and Associates. 1998	A Cultural Resources Assessment For San Francisco Resource Supply Study (San Mateo Substation to Martin Sub) Daily City to San Mateo, San Mateo Co.	PG&E	Over three miles.	Intensive	Good	Negative
Chavez, David. 1981	San Mateo Redevelopment Plan EIR: Bay Meadows and Shoreline Areas	N/A	Over 80 acres.	Intensive	N/A	Negative
California Department of Transportation (CDOT)	Highway Project 4215-003520	CDOT	Approximately 1.5 miles	N/A	N/A	Negative
Hylkema, M, Hope, A. Van Bueren, T. 1996	Archaeological Survey and Historical Reesource Evaluation Report For the Baumberg Biologiccal Mitigation Tract, Alameda Co	CDOT	Over 850 acres	Intensaive	N/A	Eleven previously recorded sites
Chavezs, David. 1979	Cultural Resource Evaluation for the East Bay Discharges Authority Reclamation	Madrone Associates	Approximately 1400 acres	intensive	Fair-good	Negative
Brittin,D. & Guedon, S.	Department of Transportation Negative	CDOT	Over 3 miles.	Non-systematic intuitive	poor	Negative

Author	Title	Sponsor	Area Surveyed	Survey Type	Visibility	Results
	Archaeological Report			pedestrian and windsheild survey		
Dobkin, M., &Anderson, R.	Oliver Bros. Salt Co. Alameda Co., Historic Resource Evaluation	Environmental Planning Branch, District 4-Oakland, CDOT	Over 100 acres	Evaluation	N/A	Historic site "Oliver Bros. Salt Company"
Ananian, B.	An Archaeological Reconnaissance of 1200 acres associated with the proposed Shorelands Project, Alameda, Co.	Cole/Mills Associates	1165 acres	Intensive.	excellent	17 Historic

Table 3.3-2. Recorded archaeological sites within 0.25 miles of the project route (not in the APE).

Primary/Trinomial	Report Citation	7.5' Quad	Distance	Site Type	Effects	Action
CA-ALA-485	Archaeological Survey and Historical Resource Evaluation Report For the Baumberg Biological Mitigation Tract, Alameda Co	Newark	.22	Prehistoric	No effect	None
P-01-000203/CA-ALA-487H	Archaeological Survey and Historical Resource Evaluation Report For the Baumberg Biological Mitigation Tract, Alameda Co	Newark	.23 miles	Historic refuse dump.	No effect	None
P-01-000209/CA-ALA-493H	Archaeological Survey and Historical Reesource Evaluation Report For the Baumberg Biologiccal Mitigation Tract, Alameda Co	Newark	.1 miles	Historic refuse site.	No effect	None
P-01-000217/CA-ALA-489H/497H/501H/	Archaeological Survey and Historical Reesource Evaluation Report For the Baumberg Biologiccal Mitigation Tract, Alameda Co	Newark	.17 miles	Historic shipping station "Eden Landing" (features and historic refuse, late 19th and 20th century)	No effect	None
P-01-002256	Archaeological Survey and Historical Resource Evaluation Report For the Baumberg Biological Mitigation Tract, Alameda Co	Newark	.12	Historic refuse site.	No Effect	None
H-1 (Alameda Co.)	Jerome Hamilton Map	San Mateo	.22	Prehistoric, Sparse shell midden.	No effect	None
C-128	None	San Mateo	.22 miles	No site type given (listed as a destroyed site)	No effect	None

Table 3.3-3. Recorded archaeological sites within the project APE.

Primary/Trinomial	Report Citation	7.5' Quad	Distance from APE	Site Type	Effects	Action
P-01-002269	Historic Evaluation of the East Shore-Grant Transmission Line, Hayward, Alameda Co.	Newark	Crosses line at East Shore Substation	Historic Transmission Line	No effect	Avoid
CA-ALA-500H	Archaeological Survey and Historical Resource Evaluation Report For the Baumberg Biological Mitigation Tract, Alameda Co	Newark	Adjacent line	Historic dump site, and two probable structure pads.	No effect	Monitor or avoid

3.3.2 Environmental Consequences

3.3.2.1 Significance Criteria

Under the California Environmental Quality Act (CEQA), an action may be considered to have a significant impact on cultural resources if it will cause a substantial adverse change to an historical resource or a "unique archaeological resource." Historical resources are those that are eligible for listing on the California Register of Historical Resources (California Public Resources Code [PRC] §5024.1; Title 14, §4852 et seq., California Code of Regulations [CCR]). A property considered for listing can be an object, building, structure, site, area, place, record, or manuscript. A property is historically significant if it "is significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political, economic, or cultural annals of California." (PRC §5020.1[j]). Such a property meets the California Register criteria if it:

a) Is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage;

b) Is associated with the lives of persons important in our past;

c) Embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important creative individual, or possesses high artistic values; or

d) has yielded, or may be likely to yield, information important in prehistory or history (PRC 5024.1).

Archaeological resources may qualify for significance under CEQA if they are determined to be unique archaeological resources as defined in PRC §21083.2. A unique archaeological resources is:

An archaeological artifact, object, or site about which it can be clearly demonstrated that, without merely adding to the current body of knowledge, there is a high probability that it meets any of the following criteria:

1) Contains information needed to answer important scientific research questions and that there is a demonstrable public interest in that information.

2) Has a special or particular quality such as being the oldest of its type or the best available example of its type.

3) Is directly associated with a scientifically recognized important prehistoric or historic event or person (PRC §21083.2).

It may appear that the California Register of Historical Resources was designed for properties of the historic era while the criteria for consideration as a "unique archaeological resource" were designed to apply to prehistoric archaeological resources. Most significant archaeological

resources (prehistoric or historic), however, would qualify for the California Register (particularly criteria A and D). Similarly, most significant historic archaeological sites (but not historic buildings and structures, or sites lacking archaeological deposits) would qualify as "unique archaeological resources."

A significant impact on a historical resource would be one that would cause a "substantial adverse change" to it (CCR, Title 14 §15064.5). That is, an action would be considered a significant adverse impact if it "demolishes or alters in an adverse manner those physical characteristics of an historical resource that convey its historical significance and that justify its inclusion in, or eligibility for inclusion in, the California Register of Historical Resources," or a local register of historical resources.

Because the project route crosses nonfederal land, it will also be necessary to comply with state laws pertaining to the inadvertent discovery of human remains of Native American origin, which falls within the jurisdiction of the Native American Heritage Commission (Pub Res. Code Sec. 5097 et seq.).

3.3.2.2 Construction Impacts

There are three previously recorded archaeological sites within or near the transmission line APE. In addition, a fourth site, the East Shore to San Mateo transmission line may, itself be a historic property. An archaeological field survey to identify cultural resources, and to relocate sites within the APE will be performed by the project sponsor for reconductoring when PG&E identifies access roads, pull sites, towers slated for repair or replacement, or other major work within the project area. The surveys will take place prior to construction.

P-01-00216—This historic refuse site lies within the right-of-way of the East Shore to San Mateo transmission line. The site is associated with two probable structure pads. This site has not been evaluated for the California Register, but does not appear eligible, according to the recorder. If ground-disturbing construction activity is confirmed in this location, the site should be relocated prior to construction and evaluated for significance. If significant, project activities within or near the site should be designed to avoid impacts to it and construction near the site should be monitored to ensure that there will be no significant impacts. If the site cannot be avoided, then the constructing agency should consult with the permitting authority to develop an appropriate method to mitigate any potentially significant impact. This could involve, for example, conducting test excavations at the site to mitigate potential damage to buried archaeological resources.

P-01-002269—This is the Grant to East Shore transmission line; a series of steel lattice towers suspending high-tension electric lines (East Shore-Grant segment c. 1922). This resource has not been evaluated in terms of its eligibility for listing on the California Register of Historical

Resources, but does not appear eligible to the recorder. The project would avoid any impact to the Grant-East Shore transmission line, the conductors of which pass under the East Shore to San Mateo conductors just west of the East Shore substation. Though the construction team may need to take precautions to avoid having the East Shore to San Mateo conductor sag onto the Grant to East Shore conductor, this should cause no significant or lasting impacts in any case.

Oliver Bros. Salt Co.—This site is just north of the transmission line (approximately 10 to 1000 feet) and is described as a salt production facility. This resource is considered eligible for the National Register of Historic Places (property number 097186). This resource can easily be avoided during the reconductoring of the transmission line because it is not located near a transmission tower and does not lie under the conductor line.

East Shore to San Mateo Transmission Line—The East Shore to San Mateo transmission line may, itself, be a historic property. The line appears in the 1959 aerial photographs, but not the 1948 photographs. The line may therefore be more than 50 years old and eligible to be evaluated for historic significance. Reconductoring this line would have the potential to change the line somewhat, since the new conductor would be somewhat different in specification from the original conductor and since it is possible (unknown at this time) whether or not some towers would require repair or replacement. Therefore, the project sponsor should record and evaluate the East Shore to San Mateo transmission line as a historic resource. If this transmission segment is found by a qualified individual to be a significant historic resource (eligible for listing on the California Register of Historical Resources), then the potential effects of the reconductoring program on its integrity as a historic resource should also be evaluated. If reconductoring would cause a significant and adverse impact to the transmission line, then mitigation measures should be developed in consultation with the lead permitting agency.

3.3.2.3 Cumulative Impacts

Since the project would not affect significant cultural resources, it would not be likely to cause significant cumulative impacts. If the project were to encounter a buried prehistoric midden site, the possibility of cumulative impacts would arise because such sites may be highly significant, and those that have been recorded in the project area have been partly damaged or destroyed by agricultural activity and other development. This is unlikely, however, since the reconductoring project would involve little or no ground disturbance.

3.3.3 Mitigation Measures

The following mitigation measures would prevent impacts to cultural resources prior and during project construction, with an emphasis on the avoidance of recorded sites. If these measures are followed, the reconductoring program would not cause a significant adverse impact to historic or cultural resources.

Archaeological Survey— The project sponsor should conduct cultural resource surveys when PG&E determines where the impacts will be. A pedestrian archaeological field survey will take place prior to construction once PG&E identifies access roads, pull sites, tower bases slated for replacement or repair, or other major work within the project area.

Architectural Surveys—The project sponsor should conduct an architectural reconnaissance to determine whether potentially significant historic architecture is located within the APE. This should take place after PG&E identifies access roads, pull sites, tower bases slated for replacement, or other major work within the project area. The architectural historian should also evaluate whether or not the project could significantly affect any historic buildings or structures found significant. This survey should record and evaluate the East Shore to San Mateo transmission line as a historic resource.

Native American Consultation— The project owner should contact the Native American Heritage Commission (NAHC) to request information regarding traditional cultural properties and sacred places, such as Native American cemeteries, in the project area, and to address Native American Concerns.

Preconstruction Assessment and Construction Training—If sensitive archaeological or historical resources are identified at or near places of construction activity (marshalling yards, pull and tensioning sites, etc.), the project owner should appoint a Designated Cultural Resources Specialist. As construction takes place, the Designated Cultural Resources Specialist should conduct a worker education session for construction supervisory personnel to explain the importance of and legal basis for the protection of significant archaeological resources. Information about archaeological resources may be combined with information about cultural resources in the training video that will be presented to construction supervisory personnel.

Construction Monitoring near Archaeological and Historic Sites—As part of the East Shore Reconductoring, an Archaeological Monitor should be present at the construction site 100 percent of the time if and when mechanical excavation is taking place within archaeological sites or when pulling and tensioning or other key project activities are taking place within known archaeological sites.

The monitor's role is to watch for buried archaeological deposits during project activity and to ensure that project activities do not have an adverse effect on significant deposits. If the Archaeological Monitor identifies archaeological resources during construction, he or she should immediately notify the Designated Cultural Resources Specialist and Site Superintendent, who would halt construction in the immediate vicinity of the find, as necessary. The Site Superintendent and Archaeological Monitor will use flagging tape, rope, or some other means as necessary to delineate the area of the find within which construction will halt. This area would include the excavation trench from which the archaeological finds came as well as any piles of

dirt or rock spoil from that area. Construction would not take place within the delineated find area until the Cultural Resources Specialist, in consultation with the lead permitting agency, can inspect and evaluate the find.

If human remains are encountered during construction, project officials are required by law (California Health and Safety Code 7050.5) to contact the County Coroner. If the Coroner determines that the find is Native American, the Coroner is required to contact the NAHC. The NAHC is required (Public Resources Code 5097.98) to determine the Most Likely Descendant, notify that person, and request that they inspect the burial and make recommendations for treatment or disposal.

Site Recording and Evaluation—The Designated Cultural Resources Specialist and Archaeological Monitor will follow accepted professional standards in recording any find and should submit the standard Department of Parks and Recreation historic site form (Form DPR 523) and locational information to the Northwest Information Center of the California Historic Resources Information System at California State University at Sonoma, Rohnert Park.

If the Designated Cultural Resources Specialist determines that the find is not significant, construction should proceed. If the Cultural Resources Specialist determines that further information is needed to determine whether the find is significant, the lead permitting agency and State Historic Preservation Officer (SHPO) should be notified, and the consultant should prepare a plan and a timetable for evaluating the find, in consultation with the lead permitting agency and SHPO.

Mitigation Planning—If the Cultural Resources Specialist and the consulting parties (the lead permitting agency and SHPO) determine that the find is significant, they should prepare and carry out a mitigation plan in accordance with state and federal guidelines. This plan would emphasize the avoidance, if possible, of significant archaeological resources. If avoidance were not possible, the recovery of a sample of the deposit from which the archaeologist could define scientific data to address archaeological research questions would be considered an effective mitigation measure for damage to or destruction of the deposit.

If a mitigation program were necessary, it would be carried out as soon as possible to avoid construction delays. Construction would resume at the site as soon as the field data collection phase of any data recovery efforts was complete. The Cultural Resources Specialist would verify the completion of field data collection by letter to Calpine and the lead permitting agency so that Calpine and the lead permitting agency could authorize for construction to resume.

Curation—The Cultural Resources Specialist would arrange for the curation of any archaeological materials collected during the monitoring and mitigation program at a qualified curation facility; that is, a recognized, non-profit archaeological repository with a permanent

Curator. The archaeologist would submit field notes, stratigraphic drawings, and other materials developed as part of the archaeological excavation program to the curation facility along with the archaeological collection.

Report of Findings—If buried archaeological deposits were found during construction, the archaeologist would prepare a report summarizing the monitoring and archaeological investigatory program implemented to evaluate the find or to recover data from an archaeological site as a mitigation measure. This report would describe the site soils and stratigraphy and describe and analyze artifacts and other materials recovered and explain the site's significance. This report would be submitted to the curation facility with the collection.

3.3.4 References

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3.4 GEOLOGIC RESOURCES AND HAZARDS

This section presents an evaluation of potential impacts to geological resources and the potential geological hazards that might result from reconductoring the East Shore to San Mateo Transmission line. Section 3.4.1 describes the existing environment that the project may affect. Section 3.4.2 identifies potential impacts on the environment. Section 3.4.3 discusses proposed mitigation measures. Section 3.4.4 provides the references used to develop this section.

3.4.1 Affected Environment

3.4.1.1 Geologic Location

The project area is located along the shore of South San Francisco Bay (Bay), which lies centrally within the Coast Ranges Physiographic Province of California. The Bay fills a northwest-trending structural depression in the central Coast Ranges and lies roughly between the San Andreas Fault to the west and the Hayward Fault to the east (Figure 3.4-1). The west end of the transmission line is located approximately 3 miles (5 km) from the San Andreas Fault and the east end is about 3 miles (5 km) from the Hayward Fault.

3.4.1.2 Regional Geologic History

Basement rocks underlying the Bay area are those of the Franciscan Assemblage (50 to 200 million years old) and the Great Valley Sequence (65 to 150 million years old). These are generally overlain by rocks of Miocene age and younger that were deposited at the continental margin during the past 15 million years. Most of the rocks in the Bay area were folded and faulted as a result of early convergence of the North American and Pacific plates. About 10 million years ago, the tectonic regime in the Bay area changed from convergent to a transform boundary between the North American and the Pacific plates. In the Bay area, the relative horizontal (strike-slip) movement along this boundary is about 47 mm/yr, and is being distributed among the various faults of the San Andreas system. Over geologic time, the San Andreas Fault accommodates about 24 mm/yr of this movement, while the Hayward Fault accommodates about 9 mm/yr at Fremont (Petersen et al., 1996).

In general, the Hayward Fault forms the boundary between two distinctly different geologic and geographic provinces. The hills on the east side of the fault are up to 10 million years old, but the flatlands on the west side are barely 10,000 years old. The Bay lies in a structural depression marked by downbowed and/or down-faulted sediment as young as middle Pleistocene. The Bay was formed during the Quaternary (last 2 million years). During the last major glaciation approximately 15,000 years ago, sea level was 330 feet (100 meters) lower than it is currently. At that time, the Bay contained no standing water, and the fluvial systems draining the surrounding hills emptied directly into the Sacramento-San Joaquin River, which flowed to the Pacific Ocean. The sea level began to rise as the ice from the great continental glaciers began to

melt. The sea entered the Bay approximately 10,000 years ago, reaching its present level about 6,000 years ago.

After the Early Holocene sea level rise, sediments formerly carried far into the Pacific Ocean began to be deposited in and around the margins of the Bay. Over time, the rock basin of the Bay has been filled with silt, sand, and clay. "Older Bay mud" is the earliest material at the bottom of the Bay; it ranges in thickness from less than one foot to more than 200 feet (BCDC, 1967). The older Bay mud consists of dark, plastic, semi-consolidated, organic-rich clay and silty clay, and interfingers with older alluvial fan deposits. The thickness of the older Bay mud increases toward the central portion of the Bay (BCDC, 1967).

Overlying the older Bay mud is a sand layer and a layer of "younger Bay mud". The layer of younger Bay mud in some locales is as thick as 130 feet (BCDC, 1967). Age of the younger Bay mud ranges from 2,500 to more than 7,000 years Before Present (BP).

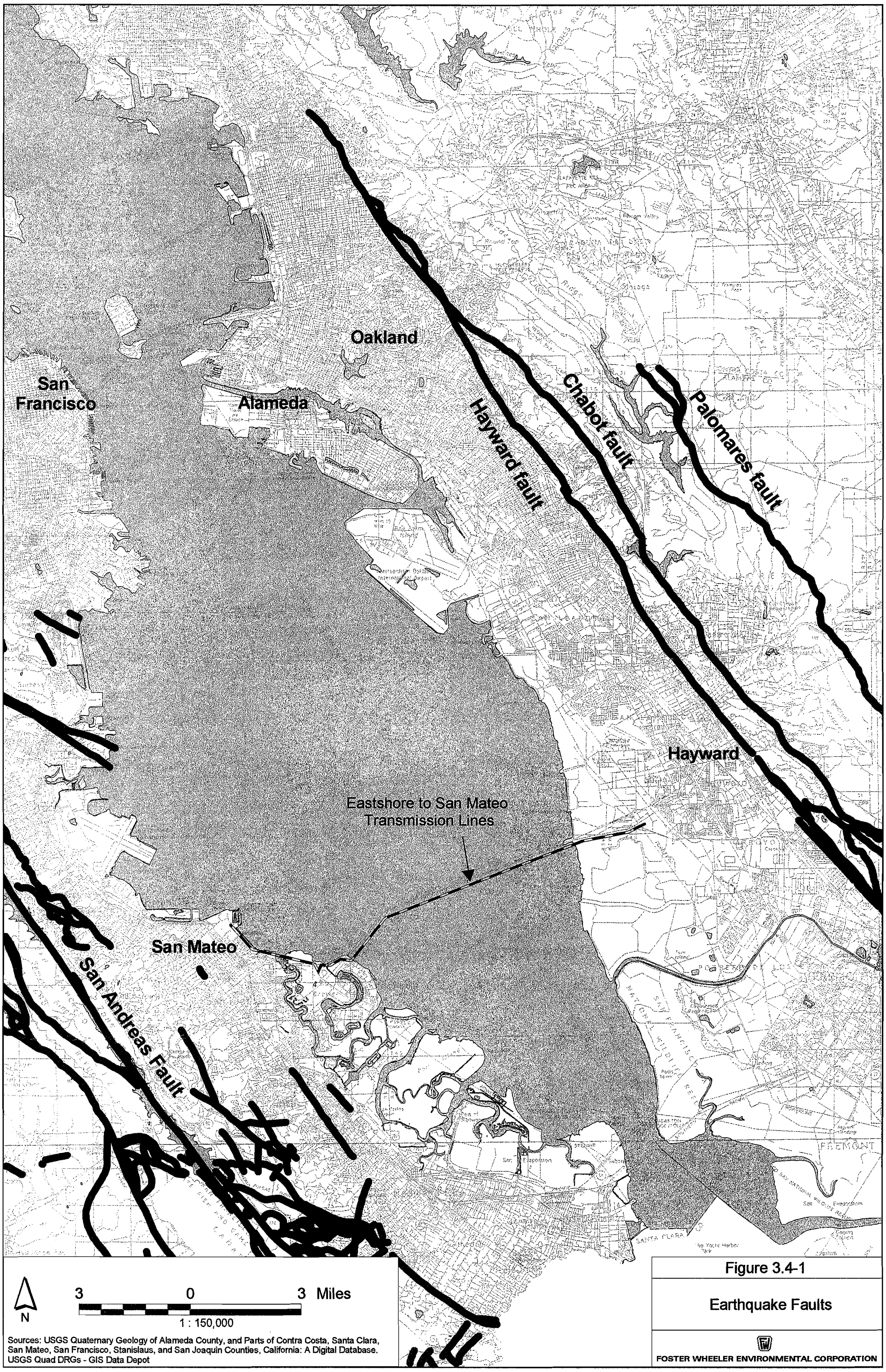
3.4.1.3 Local Geology

The project area is divided into four northwest-trending structural zones. From east to west, they are: (1) the Diablo Range, (2) a zone of alluvial fans grading west to alluvial plains, (3) the Coyote Hills, and (4) muds of San Francisco Bay (Helley and Miller, 1992). The Hayward Fault separates structural zones 1 and 2, and faults inferred by Snetsinger (1976) bound both sides of the Coyote Hills. The site lies within Zone 4, the Bay Mud zone.

3.4.1.4 Seismic Setting

The project site is located in a seismo-tectonically active region. Figure 3.4-1 identifies active faults that may pose a potential geologic hazard to transmission line (Petersen et al.,1996). Active faults are those that show evidence of displacement during Holocene time (11,000 years ago to present).

The San Andreas Fault and Hayward Fault are close to the site and are classified as "A" type faults. Faults with an "A" classification are capable of producing large magnitude events (M > 7.0), have a high rate of seismic activity (i.e., having slip rates greater than 5 mm/yr), and have well constrained paleoseismic data (i.e., evidence of displacement within the last 700,000 years). Class "B" faults, which lack paleoseismic data necessary to constrain the recurrence intervals of large-scale events. Faults with a "B" classification are capable of producing an event of magnitude 6.5 or greater. The San Andreas Fault and Hayward Fault systems are historically the most active in the project area. The RCEC AFC contains detailed information about these and other faults in the project region.



Sources: USGS Quaternary Geology of Alameda County, and Parts of Contra Costa, Santa Clara, San Mateo, San Francisco, Stanislaus, and San Joaquin Counties, California: A Digital Database. USGS Quad DRGs - GIS Data Depot

Figure 3.4-1

Earthquake Faults

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Hayward Fault Zone

The eastern end of the transmission line is located approximately 3 miles (5 km) west of the Hayward Fault Zone. The Hayward Fault Zone consists of one known active strand and as many as three sub-parallel strands that generally lie east of the active strand. The active strand is marked by shutter ridges, offset streams, and cultural features such as offset railroad tracks, roads, sidewalks, and building foundations; and active creep. Evidence for parallel fault strands in the eastern part of the fault zone is less abundant. For the most part, the fault traces are defined by linear features such as topographic benches and narrow ridges (USGS, 1970).

The Hayward Fault Zone is the southern segment of an extensive fracture zone consisting of the Hayward Fault and the Rodgers Creek, Healdsburg, and Macama fault segments. The zone extends northwest to Mendocino County, a total distance of 175 miles (280 km). A 53-mile-(86 km-) long Hayward Fault segment extends from San Pablo Bay to an obscure convergence with the Calaveras fault near Mount Misery east of San Jose, California.

Several segments of the Hayward Fault are undergoing fault creep, a very gradual horizontal displacement that occurs both episodically and continuously (Lienkaemper et al., 1991). While fault creep has been documented along many segments of the Hayward Fault between San Pablo and Fremont, it has not been observed along all segments throughout the fault's length. The displacement is almost purely right-lateral although small segments have a vertical component of displacement.

San Andreas Fault

The western end of the transmission line is located approximately 3 miles (5 km) east of the San Andreas Fault. The San Andreas Fault is part of a complex system of faults, isolated segments of the East Pacific Rise, and scraps of tectonic plates lying east of the East Pacific Rise that collectively separate the North American plate from the Pacific plate (Wallace, 1990). Relative movement between the Pacific and the North American tectonic plates dominates the regional seismo-tectonic setting. The boundary between the Pacific and North American tectonic plates extends from the Rivera triple junction, south of Baja California, northwards to the Mendocino triple junction. Atwater (1970) and, more recently, Irwin (1990) describes the evolution of the Pacific-North American plate boundary. For much of the length of the plate boundary, and certainly for the site region, the San Andreas Fault functions as a transform fault (tectonic plate boundary) with strike-slip displacement (Wilson, 1965).

Local Seismicity

Earthquakes in the San Francisco Bay area during the past 15 years are concentrated near the juncture of the San Andreas Fault and Calaveras faults, and in the East Bay area. Seismicity along the San Andreas Fault on the San Francisco Peninsula is relatively low compared to the

Calaveras-Hayward-Rogers Creek Fault Zone. On the Hayward Fault, small earthquakes are common throughout most of the fault length through San Pablo southeast to Fremont. South of Fremont, the Hayward Fault is seismically quiet. The seismicity, however, continues along a zone trending more southeasterly, denoting an active connection with the Calaveras fault near the Calaveras Reservoir. On the Calaveras fault north of this juncture there is no obvious correlation between seismicity and the mapped trace of the Calaveras fault. This high level of seismic activity present along the Calaveras fault south of Calaveras Reservoir transfers to the Hayward Fault near Fremont (USGS, 1987).

Earthquake History

A number of moderate to great earthquakes (greater than a M6) have affected the Bay Area; 22 such events have occurred in the last 160 years, averaging one every seven years. Earthquakes of magnitudes greater that 6 have occurred within 30 kilometers of the Hayward Fault in 1836, 1858, 1864, 1865, 1868, 1898, 1906, 1911, 1984, and 1989. Only the 1836 and 1868 events caused surface rupture of the Hayward Fault. Historically, more earthquakes greater than magnitude 5 have occurred on the Calaveras-Hayward-Rogers Creek zone than on the adjacent segment of the San Andreas Fault.

3.4.1.5 Project Area Geology

On a regional scale, the project features are underlain by unconsolidated Holocene (Q) inter-tidal and alluvial fan, basin, and plain deposits, ranging from clay to gravel in particle size. The electric transmission line route is underlain by fine grain infterfluvial basin deposits (Qb), medium grain younger fluvial fan and plain deposits (Qyfo), coarse grain younger alluvial fan and basin deposits (Qyf), and fine grain older Bay Mud deposits (Qom).

The interfluvial basin fine grain deposits (Qb) consist of plastic, poorly sorted, organic-rich clay and silty clay and locally contains thin beds of well-sorted silt, sand, and fine gravel and that interfingers with the younger fluvial deposits (Qyfo). The Qyfo deposits consist of loose, moderately sorted fine to medium sand, silt, and silty clay and that interfingers with the younger alluvial fan deposits (Qyf). The Qyf deposits consist of unconsolidated, moderately sorted, permeable fine sand and silt with gravel becoming more abundant toward fan heads, located east of the project area on the Hayward side of the bay, and west of it on the Foster City-San Mateo side.

The sediments that underlie the project features will be referred to as "younger Bay mud." The younger Bay mud is between 20 and 60 feet in thickness and overlies the older Bay mud. The older Bay mud deposits are substantially different from the younger Bay mud. Since it is more deeply buried, the older Bay mud has been consolidated by lithostatic pressure from above and

consequently contains less moisture. As a result, the older Bay deposits provide a good foundation for poles and similar structures (BCDC, 1967).

The older Bay mud overlies bedrock of the Franciscan Formation, which consists of a sequence of greenstones, greywacke, radiolarian chert and serpentinite (Helley and Miller, 1992). The unconformable contact between the older Bay mud and bedrock is approximately 400 feet below ground surface (bgs) in the vicinity of the project site (Hazelwood, 1976).

3.4.1.6 Geologic Hazards

This section analyzes the existing geologic hazards within and surrounding the project site. There are five hazards in this area that could be potentially significant. These hazards are:

- Seismic ground shaking
- Ground rupture
- Ground failure
- Subsidence and settlement
- Seismic seiches

Seismic Ground Shaking

The most important geologic hazard that could affect the project is the risk to life and property from an earthquake generated by the Hayward Fault or the San Andreas Fault, which are capable of producing magnitude 7.1 and 7.9 events, respectively.

The project site is located in Seismic Zone 4 according to the California Building Code (CBC) 1998. This location implies a minimum horizontal acceleration of 0.4g for use in earthquake resistant design. Mualchin and Jones (1992) produced a map of maximum credible earthquake accelerations for California; their figure for the site indicates a horizontal acceleration of 0.5g.

Ground Rupture

Three fault systems can affect the project site: the northern extension of the Silver Creek Fault to the south, the San Andreas Fault to the southwest, and the Hayward Fault to the east, located approximately 5, 14, and 3 miles (8 km, 22 km, and 5 km) from the site, respectively. The northern extension of the Silver Creek Fault is an inferred fault with no reported recent (Holocene) activity and is not considered active. The active faults nearest to the project site are the Hayward Fault and San Andreas Fault. Surface rupture would likely occur immediately along the known trace of the Hayward Fault and San Andreas Fault, while severe shaking would occur at the project site. No known active faults cross the plant site or the water and natural gas pipelines and electric transmission line routes.

Ground Failure/Liquefaction

Liquefaction is a process by which water-saturated materials (including soil, sediment, and certain types of volcanic deposits) lose strength and may fail during strong ground shaking. Liquefaction is defined as "the transformation of a granular material from a solid state into a liquefied state as a consequence of increased pore-water pressure" (Youd, 1992). This behavior is most commonly induced by strong ground shaking associated with earthquakes. In some cases, a complete loss of strength occurs and catastrophic ground failure may result. However, liquefaction may happen where only limited strains develop, and ground surface deformations are much less serious.

Sediments underlying the project site have a high liquefaction potential. The project site is located in a region designated as having a "high potential" for ground failure in the event of a major earthquake. This "high potential" is attributed to the seismic activity of the San Andreas Fault and Hayward Fault, the shallow depth to groundwater (between 5- and 10-feet bgs) in the bayshore zone, and the unconsolidated to weakly consolidated younger Bay mud beneath the transmission route generally.

Subsidence and Settlement

Land surface subsidence can be induced by both natural and human phenomena. Natural phenomena include: subsidence resulting from tectonic deformations and seismically induced settlements; soil subsidence due to consolidation, hydrocompaction, or rapid sedimentation; subsidence due to oxidation or dewatering of organic-rich soils, and subsidence related to subsurface cavities. Subsidence related to human activity includes subsurface fluid or sediment withdrawal. Underground mining may also cause subsidence, but that is not a factor at this locality.

Seismic Seiches

Due to the relative proximity of the project site to the Bay, there is a potential for the project facilities to be impacted by seismic seiches resulting from the occurrence of a major earthquake along the San Andreas Fault and/or Hayward Fault. Earthquakes may affect open bodies of water in two ways: by creating seismic sea waves and by creating seiches. Seismic sea waves (often called "tidal waves") are caused by abrupt ground movements (usually vertical) on the ocean floor in connection with a major earthquake. A rise of water of even two or three feet in the Bay due to a seismic sea wave, if coupled with a high tide and onshore wind, could do serious damage to near-to-sea level developments. A seiche is a sloshing of water in an enclosed basin such as the Bay. It is caused by earthquake motion; the sloshing can occur for a few minutes or several hours. Seiches could be damaging in the Bay in the event of a large earthquake combined with a high tide and onshore winds.

3.4.1.7 Geologic Resources

The production of salt by means of a solar process using evaporation ponds is the only mineral resource in the vicinity of the project. No other geologic resources such as mines or pits were identified in the vicinity of the project.

Recreational geologic resources typically include rock or mineral collecting, volcanoes, surface hydrothermal features, and surface expression of geologic features unique enough to generate recreational interests of the general public (e.g., natural bridges, caves, features associated with glaciation, and geomorphic features such as waterfalls, cliffs, canyons, and badlands). There are no known recreational geologic resources associated with the proposed site.

3.4.2 Environmental Consequences

The potential environmental effects from construction and operation of the East Shore to San Mateo transmission line on geologic resources and risks to life and property from geologic hazards are presented in the following subsections.

3.4.2.1 Significance Criteria

The project would cause a significant adverse impact to geological resources if it would:

- Significantly reduce access to geological or mineral resources of economic importance.
- Present a significant risk of injury by exposing people or structures unnecessarily to the consequences of major geologic hazards such as large seismic events.
- Cause large-scale erosion or land subsidence.

The potential for land subsidence, either seismically induced or by proposed building load factors will be further evaluated in a geotechnical investigation to be performed prior to the start of detailed design of the project facilities.

3.4.2.2 Construction Phase Impacts

Reconductoring the existing transmission towers and stringing the conductors will not require substantial grading or other disturbance to surface soils or geology. Reconductoring the transmission line is not expected to negatively impact mineral resources since there are no known mineral resources associated with these sites. The existing structures are constructed in accordance with Seismic Zone 4 requirements contained in the CBC. No large-scale erosion is anticipated.

The pads for the transmission line towers are founded on piles or piers in unconsolidated deposits of fine sand, silt and silty clay (Qyfo and Qyf). The tower pads were designed and constructed in accordance with CBC, Seismic Zone 4 requirements and are designed to withstand

strong ground motion of a design earthquake. The transmission line will not cross the projected trace of any active faults.

3.4.3 Cumulative Impacts

The project facilities will be constructed to the requirements of the CBC Seismic Zone 4. Site-specific geotechnical investigations will be performed prior to final design and construction. Since construction and operation of the project will not cause significant impacts to geological resources, it will not cause cumulative impacts to geological resources.

3.4.4 Proposed Mitigation Measures

Reconductoring will be designed to meet seismic requirements of the 1998 CBCs. Moreover, the design of plant structures and equipment will be in accordance with CBC, Seismic Zone 4 requirements to withstand the strong ground motion of a design earthquake. No other mitigation measures are necessary.

3.4.5 References

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3.5 HAZARDOUS MATERIALS HANDLING

This section presents an evaluation of potential impacts to human health and the environment from the storage and use of hazardous materials in conjunction with reconductoring the East Shore to San Mateo transmission line. A full description of the project is presented in Section 2.

Section 3.5.1 describes the existing environment that the project may affect. Section 3.5.2 identifies potential impacts on the environment and human health from development of the project. Section 3.5.3 presents proposed mitigation measures.

3.5.1 Affected Environment

The project site is located within the cities of Hayward, Foster City, and San Mateo. Land use in the vicinity of the transmission line route is primarily industrial or commercial.

Acutely hazardous materials as defined under California's La Follette Bill (California Health and Safety Code 25531 et seq.) will not be used during reconductoring of the transmission line.

3.5.2 Environmental Consequences

Hazardous materials used during reconductoring of the transmission line will include gasoline, diesel fuel, motor oil, hydraulic fluid and certain solvents. No acutely hazardous materials will be used or stored on-site during construction. There are no feasible alternatives to motor fuels and oils for operating construction equipment.

The most likely incidents involving these hazardous materials would be associated with minor spills or drips. Impacts from such incidents will be mitigated by thoroughly cleaning up minor spills as soon as they occur. In the case of a large spill of hazardous material, any contaminated soil will be excavated and stored in drums or roll-off bins for off-site disposal as a hazardous waste.

3.5.3 Mitigation Measures

The following subsections describe measures that will be implemented during both the construction and operating phases of the project to mitigate the risk in handling hazardous materials, particularly the risk of inadvertent spills or leaks that might pose a hazard to human health or the environment.

3.5.3.1 Construction Phase

During construction, hazardous materials stored on construction vehicles will be limited to small quantities of solvents, cleaners, sealants, lubricants, and 5-gallon emergency fuel containers. Solvents, cleaners, sealants, and lubricants will be handled per the manufacturer's directions, and replenished as needed. The emergency fuel containers will be Department of Transportation

(DOT) approved 5-gallon safety containers secured to the construction equipment. The emergency fuel will be used when regular vehicle fueling is unavailable.

Fuel, oil, and hydraulic fluids will be transferred directly from a service truck to construction equipment tanks and will not otherwise be stored on-site. Fueling will be performed by designated, trained service personnel either prior to the start of the work day or at completion of the work day. Service personnel and construction contractors will follow standard operating procedures (SOPs) for filling and servicing construction equipment and vehicles. The SOPs are designed to reduce the potential for incidents involving the hazardous materials and include:

- Refueling and maintenance of vehicles and equipment will occur only in designated areas that are either bermed or covered with concrete or asphalt to control potential spills.
- Vehicle and equipment service and maintenance will be conducted only by authorized personnel.
- Refueling will only be conducted with approved pumps, hoses, and nozzles.
- Catch-pans will be placed under equipment to catch potential spills during servicing.
- All disconnected hoses will be placed in containers to collect residual liquids in the hose.
- Vehicle engines will be shut down during refueling.
- No smoking, open flames, or welding will be allowed in refueling or service areas.
- When refueling is completed, the service truck will leave the project site.
- Service trucks will be provided with fire extinguishers and spill containment equipment, such as adsorbents.
- In the event a spill contaminates soil, the soil will be containerized and disposed of as a hazardous waste.
- All containers used to store hazardous materials will be inspected at a minimum of once per week for signs of leaking or failure. All maintenance and refueling areas will be inspected monthly. Results of inspections will be recorded in a log book which will be maintained on-site.

Small spills will be contained and cleaned up immediately by trained, on-site personnel. Larger spills will be reported via emergency phone numbers to obtain help from off-site containment and clean up crews. All personnel working on the project during the construction phase will be trained in handling hazardous materials and the danger associated with hazardous materials.

An on-site health and safety person will be designated to implement health and safety guidelines and contact emergency response personnel and the local hospital, if necessary. Material Safety

Data Sheets (MSDSs) for each on-site chemical will be maintained. Employees will be made aware of the chemicals and the location of MSDS sheets.

3.5.3.2 Hazardous Materials Plans

Hazardous materials handling and storage, and training in the handling of hazardous materials, will be set forth in more detail in hazardous materials plans that will be developed.

Hazardous Materials Business Plan

An HMBP is required by the California Code of Regulations (Title 19) and the Health and Safety Code (Section 25504). These plans will include an inventory and location map of hazardous materials on-site and an emergency response plan for hazardous materials incidents. The topics to be covered in the plans are:

- Facility Identification
- Emergency Contacts
- Inventory Information (for every hazardous material)
- MSDS for every hazardous material
- Site Map
- Emergency Notification Data
- Procedures to Control Actual or Threatened Releases
- Emergency Response Procedures
- Training Procedures
- Certification

Spill Prevention Control and Countermeasure Plan

Federal and State of California regulations require a Spill Prevention Control and Countermeasure (SPCC) plan if petroleum products above certain quantities are stored in aboveground storage tanks (ASTs). Both federal and state laws apply only to petroleum products that might be discharged to navigable waters. If quantities equal to or greater than 660 gallons for a single tank, or equal to or greater than 1,320 gallons total are stored, a SPCC must be prepared. The key elements of a SPCC are:

- Name, location, and telephone number of the facility
- Spill record of the facility and lessons learned
- Analysis of the facility, including:
  - A description of the facilities and engineering calculations
  - A map of the site

  - Storage tanks and containment areas
  - Fuel transfer and storage and facility drainage
  - Prediction and prevention of potential spills
- Spill response procedures
- Agency notification
- Personnel training and spill prevention

3.5.3.3 Monitoring

An extensive monitoring program will not be required because environmental effects during the construction and operation phases of the facility are expected to be minimal. However, sufficient monitoring will be performed during both phases to ensure that the proposed mitigation measures are complied with and that they are effective in mitigating any potential environmental effects.

Visual monitoring during construction and operation will be performed to determine compliance with and the effectiveness of the proposed mitigation measures. Written records of all monitoring events will be kept, including observations, actions taken, persons involved, and any recommendations.

3.6 LAND USE

This section provides a discussion of land use along the East Shore to San Mateo transmission line in order to assess the potential effects of project construction and operation on land use. This section describes land uses and discusses potential environmental effects as they relate to land use compatibility and development, including cumulative impacts and mitigation measures for any impacts determined to be significant.

3.6.1 Affected Environment

3.6.1.1 Land Use Adjacent to the Proposed Electric Transmission Line Route

The East Shore to San Mateo transmission line route begins at the East Shore Substation within an area that is zoned Industrial by the City of Hayward. The land uses in this area include low-rise commercial office buildings, light industrial, and warehousing and distribution uses. At angle tower 1 40.35), the line enters and area of open space that is currently unused, and was formerly used for salt evaporation ponds. This area is classified as Open Space in the City of Hayward zoning ordinance.

Between mileposts 2.0 and 9.0, the transmission line crosses San Francisco Bay adjacent to the Hayward-San Mateo Bridge. Having angled southwest across the last two miles of the bridge, the line turns west. From a tower at the western bridge approach that is located in an open, utility area that is next to a Foster City residential zone, the line crosses over State Route 92 and enters Foster City's industrial zone. Between mileposts 9.0 and 10.7, the line angles its way through the back lots and parking lots of a commercial, light industrial, and warehousing district. At milepost 10.0, it joints three other transmission lines, running in tandem west-northwest and then northwest to the San Mateo Substation.

After passing through a large parking lot, the line crosses an undeveloped shoreline park at milepost 10.4. From there, it crosses the shoreline levee, enters the City of San Mateo, and crosses the small embayment at the estuary of Sedl Slough. From this point, the line runs in undeveloped or partial developed shoreline park open space at the margins of San Francisco Bay to the substation. Adjacent land uses include older residential neighborhoods for this part of the route. A closed landfill lies to the northeast of the line between mileposts 11.1 and 11.5.

3.6.2 Environmental Consequences

Impacts to land use were evaluated by comparing project characteristics with the regional and local land use environment.

3.6.2.1 Significance Criteria

The criteria used in determining whether project-related land use impacts are significant are based on those presented in the California Environmental Quality Act (CEQA) Guidelines, Appendix G. An impact is determined to be significant if it:

- Physically divides an established community;
- Conflicts with any applicable land use plans, policies, or regulations of an agency with jurisdiction over the Project (including, but not limited to the general plan, specific plan, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect;
- Conflicts with any applicable habitat conservation plan or natural communities conservation plan.

3.6.2.2 Potential Effects on Land Use

This section discusses the reconductoring project's effects on land use, in general, followed by specific discussions of potential effects on land use.

The reconductoring project utilizes existing transmission towers in an established utility corridor and will conform to all applicable regulations and plan goals of the City of Hayward, Foster City and the City of San Mateo.

The project uses an existing electrical transmission line route that currently runs through incorporated areas of Hayward, Foster City and San Mateo. The proposed electrical transmission line is consistent with all applicable land use plans (including city general plans and city zoning ordinances) and does not conflict with any applicable habitat conservation plans or natural communities plans. Since the proposed electrical transmission line route and all of the transmission towers are pre-existing, it will not have the capacity to create additional long-term impacts to the current surrounding land uses. Any impacts to land use would be isolated and short-term while construction crews re-conductor the existing transmission lines. The reconductoring of the electric transmission line would require the temporary stockpiling of materials and equipment in approved areas along the pre-existing right of way.

Reconductoring activities will require access to the transmission line right of way by construction vehicles and equipment. Where practical existing travel ways will be utilized; however, vehicle access may require the improvement or installation of new roads. Any improvements generally would be limited in such a way that minimizes impacts.

Existing land uses will be protected and any impacts to land use would be short term as equipment travel and reconductoring activities will be limited to the pre-existing utility right of

way. Any land improvements will be protected and any damage would be repaired immediately to the satisfaction of the owner or land manager.

3.6.2.3 Cumulative Impacts

Since the reconductoring project will not cause significant land use impacts, it will not contribute to any significant cumulative impacts on land use.

3.6.3 Mitigation Measures

There are no significant land use impacts related to the electrical transmission line route and mitigation measures are not warranted.

3.7 NOISE

This section presents an assessment of potential noise effects related to reconductoring the East Shore to San Mateo transmission line. This assessment includes an evaluation of the potential effects on sensitive receptors.

3.7.1 Affected Environment

The surrounding land uses along the transmission line route include industrial land, open areas of the bay, and commercial/industrial areas along the shoreline. The primary source of noise in the area is traffic on major routes such as the San Mateo Bridge and Route 101, and local roads. A high percentage of the traffic noise is from heavy trucks and high volume passenger traffic. Industrial/commercial noises are secondary sources in more urban areas.

Sensitive receptors within one mile of the route are identified in Table 3.7-1, below.

Table 3.7-1. Sensitive receptors within one mile of the transmission line.

Name	Address	City
Elementary & Junior High Schools		
Alameda County		
Brenkwitz School	22100 Princeton St	Hayward
Eden Gardens Elementary School	2184 Thayer Ave	Hayward
Lea's Christian School	26236 Adrian Ave	Hayward
Ochoa Intermediate School	2121 Depot Rd	Hayward
San Mateo County		
Bayside Middle School	2025 Kehoe Ave.	San Mateo
Foster City Reading Institute	1291 E. Hillsdale Blvd.	Foster City
Kids Connection Elementary	1970 Beach Park Blvd.	San Mateo
Parkside Elementary School	1685 Eisenhower St.	San Mateo
North Shoreview Elementary	1301 Cypress Ave.	San Mateo
St. Timothy's Catholic School	1515 Dolan Ave.	San Mateo
Day Care Centers		
Alameda County		
Debbie's Daycare	2664 Hawthorne Ave	Hayward
Children's Choice	185 W Harder Rd	Hayward

3.7.2 Environmental Impacts

Noise will be produced temporarily along the transmission line rights-of-way during reconductoring by construction-type activities. All noise-causing activities will take place between 7 a.m. and 5 p.m. on week days, and standard noise reduction devices will be used to reduce equipment noise. Potential noise impacts and compliance with standards have been assessed and compared with applicable criteria to determine the potential for significant noise impacts.

3.7.2.1 Construction Impacts

For construction projects generally, noise will be produced at varying levels depending upon the construction phase. All activities will take place outside of nighttime hours to avoid impacts to sensitive nighttime receptors. Both the Environmental Protection Agency Office of Noise Abatement and Control and the Empire State Electric Energy Research Company have extensively studied noise from individual pieces of construction equipment as well as from construction sites of various types of facilities (EPA 1971; Barnes et al. 1976). Since specific information on types, quantities, and operating schedules of construction equipment is not available for the project at this point, information from these documents for similar sized industrial projects will be used. Use of this data, which is between 24 and 29 years old, is conservative since the evolution of construction equipment is toward quieter designs as the country becomes more urbanized and the population becomes more aware of the adverse effects of noise.

The noisiest equipment types generally operating at a site during each phase of construction are presented in Table 3.7-2. The composite average or equivalent site noise level, representing noise from all equipment, is also presented in this table for each phase. The highest level of any individual piece of equipment is 98 dBA for a rock drill. However, the use of rock drills will not be necessary. Heavy trucks operating at maximum engine speed are the second loudest equipment items at 91 dBA.

Reconductoring work at each of the pull and tensioning sites will be short term, usually less than one week at any site. Noise levels will be similar to heavy trucks at maximum engine speed. Because the transmission line right-of-way is generally located adjacent to roadways with high traffic noise levels, project impacts are expected to be insignificant. The sensitive receptors identified in Table 3.7-1 are all located more than 300 feet from any of the pull and tensioning sites. Most are separated from these sites by high traffic roadways with high ambient noise levels and the project is not expected to have significant impacts to these receptors.

Table 3.7-2. Construction equipment and composite site noise levels.

Construction Phase	Loudest Construction Equipment	Equipment Noise Level at 50 feet (dBA)	Composite Site Noise Level at 50 feet (dBA)
Site Clearing and Excavation	Dump Truck	91	89
	Backhoe	85	
Concrete Pouring	Truck	91	78
	Concrete Mixer	85	
Steel Erection	Derrick Crane	88	87
	Jack Hammer	88	
Mechanical	Derrick Crane	88	87
	Pneumatic Tools	86	
Clean-Up	Rock Drill	98	89
	Truck	91	

Source: USEPA 1971, Barnes, et al., 1976.

3.7.2.2 Operational Impacts

After the transmission lines are re-conductored, there will be no change in existing noise levels in the project area due to operation of the transmission line.

3.7.3 Mitigation Measures

Although noise impacts are expected to be insignificant, a complaint resolution procedure presented in the following paragraphs will provide an efficient and effective means of receiving and resolving any noise complaints. An outline sample form for the procedure is provided in Figure 3.7-1. Any noise complaints received will be entered in a "Noise Complaint Logbook". The date, time, name, address, and telephone number of complainant, nature of the complaint and name of person receiving the call will be recorded. The logbook entries will be chronological in order and provide evidence that a complaint was received. The caller will then be transferred to a construction supervisor who will obtain a thorough understanding of the complaint so that appropriate action can be taken. The resolution procedure will be explained to the caller and the caller will be provided assurance that the problem will be investigated in a timely manner and corrected to the fullest extent practicable. Information from the logbook will be recorded on a blank "Noise Complaint Resolution" form presented below. This form provides additional space for a description of the problem and measures taken to resolve the problem. These loose-leaf preprinted forms will be kept in a three-ring binder.

The supervisor or designee will investigate the reported noise problem. The offending equipment or activity will be identified and noise levels documented by taking near- and far-field measurements prior to applying any treatment. Near-field noise levels will be taken at a distance of 3 feet from the equipment and far-field measurements will be taken at the complainant's property. Appropriate treatment to reduce or eliminate the noise will be evaluated and, after

Figure 3.7-1. Noise complaint resolution form.

NOISE COMPLAINT RESOLUTION FORM
Complainant's name and address:
Date complaint received: Time complaint received:
Nature of noise complaint:
Definition of problem after investigation by plant personnel:
Initial noise levels at 3 feet: _____ dBA Initial noise levels at the complainant's property: _____ dBA Final noise levels at 3 feet: _____ dBA Final noise levels at the complainant's property: _____ dBA
Description of corrective measures taken:
Approximate installed cost of corrective measures: Date installation completed: Date first letter sent to complainant: (copy attached) Date final letter sent to complainant: (copy attached)
This information is certified to be correct: Construction Superintendent's Signature

(Attach additional pages and supporting documentation, as required.)

application of the treatment, additional noise measurements will be taken at the same locations to document the improved condition.

To the extent practicable, full resolution of small problems will be corrected through a minimal change in procedure or by application of noise control materials costing less than $2000, including installation. After the correction has been fully implemented and reduced noise levels documented, a second letter will be sent to the complainant explaining that the problem has been corrected.

In a situation where the complaint does not appear to be justified, as based on measured levels or other criteria, or where the supervisor believes the problem to be corrected but the complainant is not satisfied, additional recourse measures will be provided to the complainant. These will include the name and telephone number of the appropriate noise code enforcement official

responsible for ensuring compliance with conditions of certification of the Project. The Noise Complaint Logbook, the loose-leaf book of noise forms, copies of letters sent to complainants and any other material documenting changes in procedure or installation of noise control materials will be made available to the officials, as requested.

3.7.4 Cumulative Impacts

Temporary increases in noise levels above existing ambient levels during reconductoring will not be noticeable beyond areas immediately adjacent to the rights-of-way. Thus, direct cumulative impacts with other projects will only occur if the other new projects are located within this distance of the site and take place at the same time. No similar projects are known to be planned in the area during that time period and so no direct cumulative noise impacts will occur.

No significant cumulative noise impacts are anticipated. Thus, no mitigation measures are proposed.

3.7.5 References

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U.S. Environmental Protection Agency (USEPA). 1971. Noise from Construction Equipment and Operations, US Building Equipment, and Home Appliances. Prepared by Bolt Beranek and Newman for USEPA Office of Noise Abatement and Control, Washington, DC.

3.8 PALEONTOLOGICAL RESOURCES

Paleontological resources (fossils) are the remains or traces of prehistoric animals and plants. This section assesses the potential that earth-moving associated with reconductoring the East Shore to San Mateo transmission line would impact scientifically important fossil remains.

Section 3.8.1 discusses the existing environmental setting. Section 3.8.2 discusses the environmental effects of construction and subsequent operation. Section 3.8.3 includes any proposed mitigation measures during construction and operation. Section 3.8.4 contains a list of references cited.

3.8.1 Affected Environment

3.8.1.1 Geographic Location and Physiographic Environment

The project area is located along the gently sloping shores of San Francisco Bay (Bay), which is centrally located within the Coast Ranges Physiographic Province, in west-central California. The Bay fills a north-northwest-trending structural depression in the central Coast Ranges and lies between the San Andreas Fault, to the southwest, and the Hayward Fault, to the northeast.

The project area on the east and west shores of the Bay consists of a gently sloping alluvial fan and floodplain with an average elevation of only 10 to 15 feet above mean sea level (msl). The low alluvial fan and flood basins surrounding the Bay have frequently been referred to as the Bay plain (Robinson 1956). Technically, however, the Bay plain, as defined by Finlayson et al. (1967), is "that area surrounding San Francisco Bay which has an elevation between lower low tide and higher high tide." In other words, the Bay plain is intertidal and distinct from adjacent areas of higher relief which are not affected by tides.

There are two major physiographic units in the immediate project area: tidally influenced Bay plain, and the adjacent non-tidally influenced alluvial fans. Small intermittent streams that empty into tidal sloughs drain the gently sloping alluvial fan

3.8.1.2 Regional Geologic Setting

Project facilities will encounter one major geological formation: the Late Pleistocene-Early Holocene Temescal Formation. The transmission line route is located on unconsolidated, Holocene-age alluvial fan deposits, equivalent to Lawson's (1914) Temescal Formation, although that formation also includes Recent Bay mud and "salt-marsh deposits" (see also Trask and Rolston 1951, Atwater et al. 1977). Older, Pleistocene-aged alluvial fan and mud deposits called Alameda Formation underlay the Temescal formation at the project site, beginning at a depth of approximately 12-15 feet (see Atwater et al. 1977).

3.8.1.3 Paleontological Resources

Mammalian fossils have been the most helpful in determining the relative age of the alluvial fan and Bay plain sedimentary deposits (Louderback 1951, Savage 1951). The mammalian inhabitants of the late Pleistocene and Holocene alluvial fan and floodplain included horses, mastodons, camels, ground sloths, and pronghorns.

Surveys of Late Cenozoic land mammal fossils have been provided by Hay (1927), Stirton (1939), Savage (1951), and Jefferson (1991b). On the basis of his survey of vertebrate fauna from the non-marine Late Cenozoic deposits of the San Francisco Bay region, Savage (1951) concluded that only two divisions of Pleistocene time could be recognized in the San Francisco Bay region. He named the earlier Pleistocene fauna the Irvingtonian and the later Pleistocene and Holocene fauna the Rancholabrean. The age of the later Pleistocene, Rancholabrean fauna was based on the presence of bison and on the presence of many mammalian species which are inhabitants of the same area today. In addition to bison, larger land mammals identified as part of the Rancholabrean fauna include mammoths, mastodons, camels, horses, and ground sloths.

Temescal Formation. Remains of land mammals have been found at a number of localities in younger alluvial deposits referable to the Temescal Formation (Hay 1927, Louderback 1951, Savage 1951; Jefferson 1991b). Jefferson (1991a,b) compiled a database of California Late Pleistocene (Rancholabrean North American Land Mammal Age) vertebrate fossils from published records, technical reports, unpublished manuscripts, information from colleagues, and inspection of museum paleontological collections at over 40 public and private institutions. He lists more than 50 individual sites in Alameda County that have yielded Rancholabrean vertebrate fossils, including several localities near the project area, studied by the University of California Museum of Paleontology (UCMP) in Berkeley, California. These fossils would presumably all be referable to the Temescal Formation. In addition to UCMP localities, Jefferson (1991a, b) lists fossils localities from the Yale Peabody Museum, Chicago Field Museum of Natural History, and the U. S. National Museum.

The occurrence of previously recorded fossil sites near the project area suggests that there is a potential for uncovering additional similar fossil remains during earth-moving activities related to construction of those areas of the project underlain by sediments of the Temescal Formation.

Alameda Formation. When naming the Alameda Formation, Lawson (1914) noted that this unit contained "marine shells". Trask and Rolston (1951) noted the presence of "plant fragments" in several horizons, particularly in the upper portions of the Alameda Formation. Atwater et al. (1977) reported sparse mollusks, foraminifers, ostracodes, and diatoms from boreholes in San Francisco Bay.

The Alameda Formation underlies the Alameda County portion of the transmission line and is lies at a depth of approximately 12-15 feet. Marine fossils have been reported from boreholes in San Francisco Bay.

3.8.2 Environmental Consequences

The potential environmental effects from reconductoring the East Shore to San Mateo transmission lines on paleontological resources are presented in the following subsections.

3.8.2.1 Significance Criteria

Appendix G of California Environmental Quality Act (CEQA) addresses significance criteria with respect to paleontological resources (Public Resources Code Sections 21000 et seq.). Appendix G(V)(c) asks if the project will "directly or indirectly destroy a unique paleontological resource or site or unique geologic feature."

Using both the criteria of the SVP (1995) and CEQA, outlined above, the significance of the potential adverse impacts of earth moving on the paleontological resources of each stratigraphic unit exposed in the project site construction zone was assessed. This assessment reflects the paleontological importance and impact sensitivity of the stratigraphic unit.

3.8.2.2 Construction

The proposed reconductoring of electrical transmission lines will take place in areas containing potentially fossiliferous rock units. However, since reconductoring takes place above the ground, there is no possibility this work could encounter paleontological resources.

Reconductoring of electrical transmission lines may involve limited ground-disturbing activities such as grading of laydown, pulling or deadend sites. These excavations are not expected to penetrate greater than 10 feet below the surface and would not be expected to encounter significant paleontological resources.

3.8.2.3 Operation

Operation of the electrical transmission lines will not cause any ground disturbance, and therefore will not affect paleontological resources.

3.8.2.4 Cumulative Impacts

If paleontological resources were encountered during project-related ground disturbance, the potential cumulative effect on paleontological resources would be low, as long as the mitigation measures proposed below in Section 3.8.4 are implemented to recover the resources. When properly implemented, these mitigation measures would effectively recover the scientific value of significant fossils encountered during transmission line reconductoring. Thus, the proposed

project will not cause or contribute to significant cumulative impacts to paleontological resources.

3.8.3 Proposed Mitigation Measures

If the final project design includes excavation or grading to a depth of more than 6 feet, construction personnel involved with earth-moving activities will be informed of the possibility of encountering fossils, and trained in identification of fossils and proper notification procedures. This worker training will be prepared and presented by the project paleontologist. The trained construction personnel will monitor earth-moving construction activities where this activity will disturb previously undisturbed sediment. Monitoring will not take place in areas where the ground has been previously disturbed, in areas underlain by artificial fill, or in areas where exposed sediment will be buried but not otherwise disturbed.

Implementation of this mitigation measure will reduce the potentially significant adverse environmental impact of project earth-moving activities on paleontological resources to an insignificant level.

3.8.4 References

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3.9 PUBLIC HEALTH

This section presents an assessment of the potential impacts and public exposure associated with airborne emissions from the construction and operation of the reconductored East Shore to San Mateo transmission line.

Air is the dominant pathway for public exposure to project emissions. Emissions to the air will consist primarily of combustion by-products produced by construction vehicles.

3.9.1 Affected Environment

The proposed reconductoring will be located in the cities of Hayward, Foster City, and San Mateo. Surrounding land uses are described in Section 3.6, Land Use. The nearest residences are located approximately 100 feet from the project route.

Sensitive receptors are defined as groups of individuals that may be more susceptible to health risks due to chemical exposure. Schools (public and private), day care facilities, convalescent homes, and hospitals are of particular concern. The nearest sensitive receptors within one mile of the transmission line route are listed in Table 3.9-1, below.

Table 3.9-1. Sensitive receptors within one mile of the transmission line.

Name	Address	City
Elementary & Junior High Schools		
Alameda County		
Brenkwitz School	22100 Princeton St	Hayward
Eden Gardens Elementary School	2184 Thayer Ave	Hayward
Lea's Christian School	26236 Adrian Ave	Hayward
Ochoa Intermediate School	2121 Depot Rd	Hayward
San Mateo County		
Bayside Middle School	2025 Kehoe Ave.	San Mateo
Foster City Reading Institute	1291 E. Hillsdale Blvd.	Foster City
Kids Connection Elementary	1970 Beach Park Blvd.	San Mateo
Parkside Elementary School	1685 Eisenhower St.	San Mateo
North Shoreview Elementary	1301 Cypress Ave.	San Mateo
St. Timothy's Catholic School	1515 Dolan Ave.	San Mateo
Day Care Centers		
Alameda County		
Debbie's Daycare	2664 Hawthorne Ave	Hayward
Children's Choice	185 W Harder Rd	Hayward

3.9.1.1 Construction Phase Impacts

The construction phase of the transmission line reconductoring is expected to take approximately 5 months. At the individual pull and tensioning sites, construction will usually be lost less than one week. No significant public health effects are expected during the construction phase. Strict construction practices that incorporate safety and compliance with applicable laws, ordinances, regulations, and standards (LORS) will be followed. In addition, mitigation measures to reduce air emissions from construction impacts will be implemented as described in Section 2.

Typical conductor stringing crews require 15 to 20 workers, which include foremen, equipment operators, general laborers, environmental monitors and inspectors. Each cable stringing operation requires three to five pieces of equipment and support vehicles. Construction-related emissions are temporary and localized, resulting in no long-term impacts to the public.

Emissions due to the construction phase of the RCEC project and linear facilities have been estimated, including an assessment of emissions from vehicle and equipment exhaust and the fugitive dust generated from material handling. A dispersion modeling analysis was conducted based on these emissions. With the exception of the maximum modeled one-hour NO_2 and 24-hour PM_{10} concentrations, the results of the analysis indicate that the maximum construction impacts will be below the state and federal standards for all the criteria pollutants emitted. Exclusion of the background values results in construction impacts which will not exceed state and federal air quality standards. The best available emission control techniques will be used. The RCEC construction site impacts are not unusual in comparison to most construction sites; construction sites that use good dust suppression techniques and low-emitting vehicles typically do not cause violations of air quality standards. The reconductoring project will add only three to five pieces of equipment and impacts to air quality not operated to be significant.

Small quantities of hazardous waste may be generated during the construction phase of the project. Hazardous waste management plans will be in place so the potential for public exposure is minimal. Refer to Section 3.14 (Waste Management) for more information. No acutely hazardous materials will be used or stored on-site during construction (see Section 3.5, Hazardous Materials Handling). To ensure worker safety during construction, safe work practices will be followed (see Section 3.16, Worker Safety).

3.9.1.2 Operational Phase Impacts

Operation and maintenance of the reconductored transmission line will not result in significant emissions or other impacts to air quality.

3.9.2 Mitigation Measures

3.9.2.1 Construction Emission

The following mitigation measures are proposed to control exhaust emissions from the diesel heavy equipment used during construction of the project:

- Operational measures, such as limiting engine idling time and shutting down equipment when not in use;
- Regular preventive maintenance to prevent emission increases due to engine problems;
- Use of low sulfur and low aromatic fuel meeting California standards for motor vehicle diesel fuel; and
- Use of low-emitting diesel engines meeting federal emissions standards for construction equipment if available.

The following mitigation measures are proposed to control fugitive dust emissions during construction of the project:

- Use either water application or chemical dust suppressant application to control dust emissions from unpaved surface travel and unpaved parking areas;
- Use vacuum sweeping and/or water flushing of paved road surface to remove buildup of loose material to control dust emissions from travel on the paved access road (including adjacent public streets impacted by construction activities) and paved parking areas;
- Cover all trucks hauling soil, sand, and other loose materials, or require all trucks to maintain at least two feet of freeboard;
- Limit traffic speeds on unpaved surfaces to 25 mph;
- Install sandbags or other erosion control measures to prevent silt runoff to roadways;
- Re-plant vegetation in disturbed areas as quickly as possible;
- As needed, use gravel pads along with wheel washers or wash tires of all trucks exiting construction site that carry track-out dirt from unpaved surfaces; and
- Mitigate fugitive dust emissions from wind erosion of areas disturbed from construction activities (including storage piles) by application of either water or chemical dust suppressant and/or use of wind breaks.

3.10 SOCIOECONOMICS

This section provides a discussion of the potential socioeconomic effects of the construction and operation of the East Shore to San Mateo transmission line reconductoring project.

3.10.1 Affected Environment

The project site is located within the cities of Hayward, Foster City, and San Mateo which have a combined population of approximately 242,000. These cities are part of the greater San Francisco Bay area with a population of several million.

3.10.2 Environmental Consequences

3.10.2.1 Significance Criteria

Potential socioeconomic impacts can include effects on a community's population, economic base, employment, housing, and public services and facilities, including water supplies, waste water treatment facilities, fire and police services, and school facilities. CEQA clarifies that an "economic or social change by itself shall not be considered a significant effect on the environment." Rather, a "social or economic change related to a physical change may be considered in determining whether the physical change is significant (Title 14 California Code of Regulations § 15382). CEQA guidelines (Title 14 California Code of Regulations § 15000 et. Seq. Appendix B XII, XIII, XIV) explain that a significant socioeconomic effect may exist if a project would:

- Induce substantial growth or concentration of population, either directly or indirectly
- Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere
- Displace substantial numbers of people, necessitating the construction of housing elsewhere
- Disrupt or divide the physical arrangement of an established community
- Result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the following: fire protection, police protection, schools, parks, or other public facilities
- Increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated
- Does the project include recreational facilities or require the construction of expansion of recreational facilities that might have an adverse physical effect on the environment.

Senate Bill 28 (approved by Governor Gray Davis and filed with the Secretary of State on May 22, 2001) adds new subsection (f) to California Public Resources Code § 25514 setting the following additional requirement:

> . . . whether increased property taxes due to the construction of the project are sufficient to support needed local improvements and public services required to serve the project.

3.10.2.2 Workforce

Actual reconductoring will take place over a maximum of five months. Primary trades in demand will include primarily electricians and others as presented in the Table 3.10-1. Maximum reconductoring personnel requirements for up to five months of construction will be approximately 95 person-months.

Table 3.10-1. Transmission line reconductoring workforce.

Construction Task	Number of workers	Duration (months)	Person-Months
Dolly hanging	4	5	20
Wire pulling	4	5	20
Wire tensioning	4	5	20
Wire sagging and clipping	4	5	20
Material deliveries	3	5	15
Total	**19**	**5**	**95**

The proposed project will provide up to 5 months of short-term job opportunities for approximately 19 electrical transmission line workers. The construction workforce requirement of 19 workers represents a negligible portion of the construction labor pool in the greater San Francisco Bay area.

The proposed project workforce will not significantly affect employment or the economy.

3.10.2.3 Impacts on Fiscal Resources

The total construction cost of the proposed facility is estimated to be between $15 and $20 million dollars, with approximately $1.0 million dollars of this total paid out as wages and salaries, including benefits (estimated using $60.00/hr). A portion of the wages and salaries paid to construction workers will be spent locally generating expenditures in local industries and additional income in the local economy. This is known as the multiplier effect. Wages and salaries paid to construction workers would generate an estimated $1.59 million dollars in total income in the local and regional economy (based on an income multiplier of 1.59).

Local products subject to County taxes will be purchased during the construction process. An estimated $0.5 to $1 million will be purchased from local suppliers during project construction. Local expenditures of $1 million would, therefore, generate total tax revenues of $80,000.

3.10.3 Mitigation Measures

No significant adverse impacts to socioeconomic resources were identified; therefore, no mitigation measures are proposed. Overall, the Project is expected to have a positive socioeconomic effect.

3.11 SOILS AND AGRICULTURE

This section presents an evaluation of the potential environmental effects from reconductoring and operation of the East Shore to San Mateo transmission line on soils and agriculture.

3.11.1 Affected Environment

3.11.1.1 Soil Resources

Identification of soil types and their distribution was accomplished primarily through a review of maps provided by the U.S. Soil Conservation Service (now called the Natural Resources Conservation Service [NRCS]). The soil map units associated with the transmission line are listed in Table 3.11-1. Table 3.11-2 provides a detailed summary of the physical and chemical characteristics of each soil type identified from the project site. This information was obtained from the Soil Survey of Alameda County, California, Western Part (SCS 1981), and Soil Survey of San Mateo County, California, Eastern Part (SCS 1982).

Table 3.11-1. Soil mapping unit identified by county.

Project Component	Soil Mapping Unit
Alameda County	111 – Danville silty clay loam, 0 to 2 percent slopes
	137 – Reyes clay
	138 – Reyes clay, ponded
	154 – Willows clay, drained
San Mateo	125 – Pits and dumps
	134 – Urban land – orthents, reclaimed complex, 0 to 2 percent slopes

3.11.1.2 Agricultural Resources

The cities of Hayward, Foster City, and San Mateo do not have agriculture land uses. Local agricultural uses in the Tri-City area (Union City, Newark, Fremont) to the south include livestock grazing, and cultivation of pumpkins, squash, and cold weather crops (broccoli, lettuce, and cauliflower). None of these agricultural areas are located near the project facilities.

There are no agricultural uses near the construction laydown and worker parking areas.

3.11.2 Environmental Consequences

The following subsections describe the probable environmental effects on agricultural production and soils during the construction and operational phases of the project.

Table 3.11-2. Soil mapping unit descriptions.

Map[1/]	Soil Series Name	Depth (inches)	USDA texture	USCS[2/] Classification	Permeability (in/hr)	Drainage	Erosion Hazard	Erosion Factors[3/] K	Erosion Factors[3/] T	Land Capability[4]	pH	Salinity (mmhos/cm)
Alameda County												
111	Danville	0-21 21-53 53-80	Silty clay loam Clay, silty clay, silty clay loam Clay loam, silty clay loam	CL CL, CH CL	0.2-0.6 0.06-0.2 0.2-0.6	Well drained	None	0.32 0.24 0.28	5	IIIs-3 Nonirrigated IIs-3 Irrigated	6.1-7.3 6.1-7.3 6.6-8.4	<2 <2 <2
137	Reyes	0-6 6-72	Clay Clay, silty clay, silty clay loam	MH ML, MH	0.06-0.2 <0.06	Very poorly drained	None	0.15 0.28	5	VIIIw Nonirrigated	6.6-8.4 6.6-8.4	>8 >16
138	Reyes	0-6 6-72	Clay Clay, silty clay, silty clay loam	MH ML, MH	<0.6 <0.6	Very poorly drained	None	0.15 0.28	5	Ivw-9 Nonirrigated	7.9-9.0 7.9-9.0	>16 >16
154	Willows	0-19 19-72	Clay Clay, silty clay	CH CH	<0.06 <0.06	Poorly drained	None	0.28 0.28	2	IIIs-5 NonirrigatedIis-5 Irrigated	7.4-9.0 8.5-9.0	2-8 >4
San Mateo County												
125	Pits and dumps	--	--	--	--	--	--	--	--	VIII, nonirrigated	--	--
134	Urban land – orthents	--	--	--	--	Poorly drained and somewhat poorly drained	Low	--	--	VIII, nonirrigated	--	--

1/ Soil numbers refer to numbers shown on Figure 5.6-2 (Soil Map of Project Area).
2/ Unified Soil Classification System.
3/ K is a measurement of relative susceptibility to sheet and rill erosion by water. It ranges from 0.10 to 0.64, with lower values representing a lower susceptibility to erosion. T represents soil-loss tolerance, which is defined as the maximum rate of soil erosion (wind and water) without reducing crop production or environmental quality. Values range from 1 to 5 tons of soil loss per acre per year with 5 representing soils less sensitive to erosion.
4/ An indication of the suitability of soils for most kinds of field crops. Land capability classes are I through VIII. Subclasses are designated by letters e, w, s, or c. The land capability units are 0 through 9. See Soil Survey of Alameda County, California, Western Part, p. 31-32, and Soil Survey of San Mateo county, Eastern Part.
NA: Not Applicable
Source: U.S. Soil Conservation Service 1981 and 1982

3.11.3 Soil Resources

The project could cause a significant environmental impact in relation to soil resources by causing:

- Accelerated wind or water-induced soil erosion resulting from project construction or operation
- Increased sedimentation in stream channels and stream crossings

Impacts to soil resources would be significant if construction activities were to occur in areas of high erosion susceptibility and the disturbed areas were left exposed and not properly stabilized.

The reconductored transmission line route is within an existing utility corridor, which will facilitate access and reduce project-related disturbances. Disturbed areas along the route will be allowed to revegetate following construction activities.

Reconductoring of the transmission line could result in soil disturbance and compaction by construction vehicles and activities at pull and tension sites. Soil disturbance, however, will be very slight, because many of these pull sites are currently located in parking lots or other paved areas. At the pull sites where exposed soil is present, soil disturbance and compaction by construction vehicles and activities will result in short-term increased water and wind erosion rates until disturbed areas are stabilized. Increased soil compaction may decrease the ability of vegetation to reestablish following disturbance, which may result in increased erosion.

Implementation of the mitigation measures specified below would limit impacts to the soil resources associated with construction of the transmission system to acceptable levels. Overall, the construction impacts to soils along the transmission line route will not be significant.

Standard operational activities will not involve disruption of soil and will not result in significant impacts to soil from either erosion or compaction. Routine vehicular access to the individual project components during operation of the project will be limited to existing roads, most of which are paved.

3.11.3.1 Agricultural Resources

The following significance criteria were used in evaluating potential impacts to agricultural resources:

- Substantial displacement or curtailment of agricultural land uses
- Degradation of agricultural land productivity
- Impacts to Prime Farmland, agricultural areas of statewide importance, or unique farmland

Impacts could be significant if the project were to alter land with special designations (e.g., Prime Farmland) to the point that the disturbed area would no longer exhibit the inherent characteristics of the special designation.

Since the project will not cause any displacement or curtailment of agricultural land use, or a degradation of agricultural productivity, the construction and operation of the project will not cause a significant impact to agricultural resources.

3.11.4 Mitigation Measures

This section discusses mitigation measures that will be implemented to reduce project-related effects on soil resources. The project will not affect any agricultural lands or resources.

Appropriate erosion control measures will help maintain soil resources and water quality, protect property from erosion damage, and prevent accelerated soil loss (which destroys soil productivity and its capacity to support and maintain vegetation). Temporary erosion control measures will be installed before construction begins and will be removed from the construction site after construction activities are completed.

The following mitigation measures can be implemented to reduce potentially significant soil impacts. An acceptable level of soil erosion, as used herein, is defined as that amount of soil loss that would not affect (i.e., limit) the potential long-term beneficial uses of the soil as a growth medium or adversely affect water resources due to accelerated erosion and subsequent sedimentation.

- Prepare an Erosion Control Plan prior to construction and implement the plan during and following construction. Erosion and sediment control measures may include, but are not limited to, use of sand bags, mulches, protective coverings (e.g., jute netting and rip-rap), installation of culverts under roadways at drainage crossings, installation of sediment detention basins, construction of water diversions along roads, and water bars along pipeline rights-of-way. The plan will conform to the County Hydrology Manual and local ordinances.
- Conduct grading operations, if required, in compliance with the Grading Ordinance.
- Perform construction activities in accordance with the Stormwater Pollution Prevention Plan (SWPPP) and associated Monitoring Program. These items will be required for the project in accordance with California's General Industrial Stormwater Permit for Construction Sites under the United States Environmental Protection Agency (US EPA) National Pollutant Discharge Elimination System (NPDES) Program. The SWPPP will include erosion control measures, including Best Management Practices to reduce erosion and sedimentation.

- Limit soil erosion/dust generation by wetting active construction areas with water (including roads) or by applying commercial dust palliatives (soil binders).

3.11.5 References

California Department of Conservation. 1994. *A guide to the farmland mapping and monitoring program*. Appendix B: Mapping categories and soil taxonomy terms. Division of Land Resource Protection.

U.S. Soil Conservation Service (SCS). 1981. *Soil survey of Alameda County, California, Western Part.*

U.S. Soil Conservation Service (SCS). 1982. *Soil survey of San Mateo County, California, Eastern Part.*

3.12 TRAFFIC AND TRANSPORTATION

This section the potential effects on traffic and transportation resulting from reconductoring the East Shore to San Mateo transmission line.

3.12.1 Affected Environment

3.12.1.1 Regional

The East Shore to San Mateo transmission line is located in the southern portion of the San Francisco Bay region in California. The southern portion of the West and East Bay area is served by an extensive transportation system, including major freeway, highway, airport and rail facilities. Figure 3.12-1 illustrates the regional transportation setting. The reconductoring project is generally parallel to State Route 92 between the cities of Hayward and San Mateo. State Route 92 runs east-west and has two lanes in each direction in the vicinity of the site.

According to the Hayward General Plan (City of Hayward, 1998), State Route 92 is identified as a congested roadway with an E/F Level of Service (LOS) rating. The LOS refers to the amount of congestion at a given roadway segment or intersection. The Hayward General Plan also includes recommended improvements for State Route 92, some of which are either complete or currently underway, such as lane widening between I-880 and the Hayward-San Mateo Bridge. Even with those improvements, however, the General Plan states that there may be congestion on State Route 92 in its 2010 forecast. Access to the East Shore Substation is via the Clawiter-Eden Landing Road interchange with State Route 92 and via Eden Landing Road. The latter is also the access to angle tower 1.

At the west end of the Hayward-San Mateo Bridge, State Route 92 continues for about two miles before connecting with US 101. Local arterials in the Foster City industrial area through which the transmission line runs include Foster City Boulevard and East 3rd Avenue, known as J. Hart Clinton Drive in the City of San Mateo. The latter connects with US 101 at a freeway interchange about a mile south of the San Mateo Substation. Access to the transmission line route northwest of J. Hart Clinton Drive is via local, residential streets or via utility roadways serving the bayshore levee and undeveloped shoreline park in San Mateo.

3.12.2 Environmental Consequences

3.12.2.1 Significance Criteria

Criteria used in determining whether project-related traffic impacts are significant are consistent with standard industry practice and California Code of Regulations Title 14, §15065. A project will have a significant effect on traffic and transportation if it will:

- Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system

- Exceed, either individually or cumulatively, a level of standard service established by the county Congestion Management Agency for designated roads or highways
- Result in a change in traffic patterns, including an increase in traffic levels or a change in location that results in substantial safety risks
- Substantially increase hazards due to a design feature or incompatible uses
- Result in inadequate emergency access
- Result in inadequate parking capacity
- Conflict with adopted policies, plans, or programs supporting alternative transportation.

Construction Phase Impacts

Typical conductor stringing crews require 15 to 20 workers, which include foremen, equipment operators, general laborers, environmental monitors and inspectors. Each cable stringing operation requires three to five pieces of equipment and support vehicles.

Construction at individual pull and tensioning sites will usually last less than one week so that nearby streets will be affected for only a few days. Where necessary, signing or a flagman will be utilized to mitigate potential impacts during ingress and egress from work sites.

Operation Phase Impacts

The only traffic associated with the operation of transmission line would be occasional maintenance vehicles, or repair vehicles in the event of damage to any of the lines. This traffic would not cause any significant change to local traffic conditions.

3.12.3 Mitigation Measures

Reconductoring the East Shore to San Mateo transmission line will not have a significant impact on traffic and transportation resources, therefore no mitigation measures are necessary.

3.12.4 References

City of Hayward. 1998. Hayward General Plan, circulation element (III). Hayward, CA.

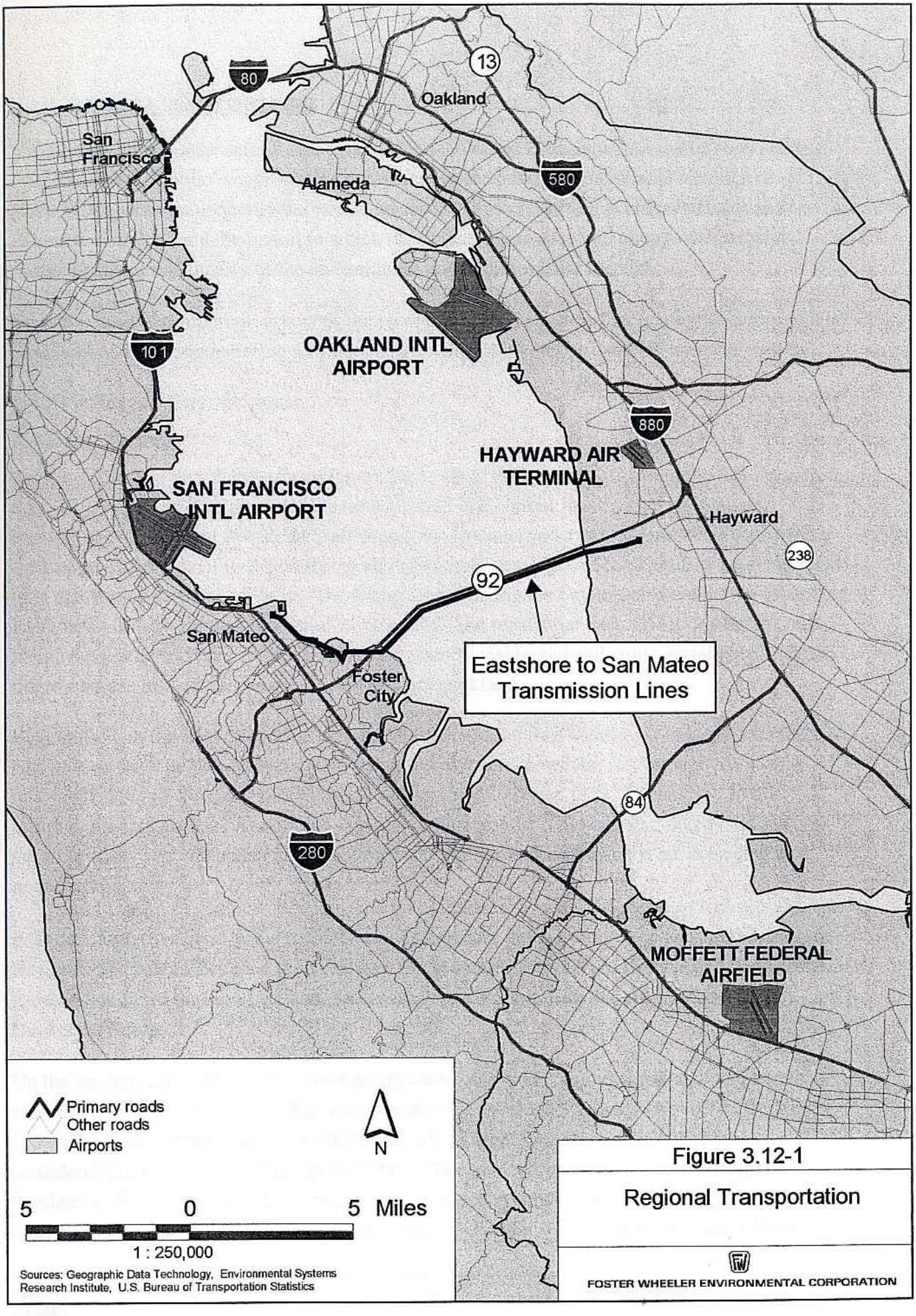

Figure 3.12-1

Regional Transportation

FOSTER WHEELER ENVIRONMENTAL CORPORATION

3.13 VISUAL RESOURCES

Visual resources are the natural and cultural features of the landscape that can be seen and that contribute to the public's appreciative enjoyment of the environment. Visual resource or aesthetic impacts are generally defined in terms of a project's physical characteristics and potential visibility, and the extent to which the project's presence will change the perceived visual character and quality of the environment in which it will be located.

Visually, the most important aspect of the reconductoring project is that no new structure will be required and the reconductoring will not cause changes that can be detected by most viewers.

3.13.1 Affected Environment

3.13.1.1 Setting

The East Shore to San Mateo transmission line is set at the margins of, and in the San Francisco Bay. The bayshore margains near the transmission line consist mostly with open space, including parklands and abandoned salt evaporation ponds, and a closed landfill. Further from the bay on either side of it, the land is gently sloping to the ridges of the East Bay and Peninsula hills that form a distant backdrop. The flatter lands ringing the bay margins are highly urbanized and consist of high-density industrial, commercial, and residential uses. Hills beyond the bay margins on either side are covered with lower density residential and commercial uses. Higher ridges of these hills include some open space and parkland.

Beginning with the East Shore Substation, the transmission line's setting is industrial for the first half mile or so. The line emerges from the industrial zone, however, run through the 1- to 2-mile-wide band of wetlands along the bay that are often referred to as "baylands." In this location, the baylands are abandoned salt evaporation ponds. They are flat, diked, and contain standing water and wetland vegetation. Views across these open baylands are sweeping and unobstructed.

Between mileposts 2 and 7, the transmission line crosses the San Francisco Bay, paralleling the Hayward-San Mateo Bridge a short distance to the south. Views from the bridge extend north towards San Francisco and Oakland, and south towards Santa Jose and the neighboring Dunbarton Bridge.

On the western side of the bridge, the transmission route enters an industrial and commercial zone in Foster City. Portions of this zone are densely developed with low-rise office buildings and warehouses. Other portions are park-like office campus quarters, with broad streets, considerable landscaping, and an artificial lake. The line continues west-northwest up the bayshore in San Mateo, running in the narrow open space between the residential districts of San Mateo and the bay. This open space strip is a utility corridor where four transmission lines,

including East Shore to San Mateo, converge and run together towards the San Mateo Substation.

3.13.1.2 Project Visibility

The East Shore to San Mateo transmission line is most visible in views across the baylands, particularly views from State Route 92 on the Hayward-San Mateo Bridge and US 101 in San Mateo. The facilities are intermittently visible from the industrial areas through which the transmission route passes. The transmission line is also visible at various places within the industrial parks of Foster City and from residential areas and along arterial streets in San Mateo. For example, J. Hart Clinton Drive runs parallel to four transmission lines, including East Shore to San Mateo and the lines are very visible from this roadway. These lines are visible from the adjacent residential neighborhoods mainly from residences located near the lines.

The transmission lines are also very visible from within the open space and undeveloped parklands along the bayshore levee in San Mateo. The open space strip between the bay and residential neighborhoods containing the bayshore levee is also the utility corridor for the four transmission lines. Views from this area extend eastwards across the bay, north towards a forested prominence known as Coyote Point (a park and marina), south down the utility corridor, and west into the residential heart of San Mateo and the Peninsula hills beyond.

3.13.2 Environmental Consequences

The existing East Shore to San Mateo transmission line is a prominent structure and is highly visible to travelers on State Route 92, particularly on the Hayward-San Mateo Bridge. It is also visible to travelers along J. Hart Clinton Drive and Foster City Boulevard and to recreational users of the San Mateo shoreline open space. Large numbers of viewers observe the transmission line at these locations daily. The reconductoring project, however, will not require new transmission towers and will not cause changes that can be detected by most viewers. This project will thus not have any impacts to existing views at any location or from any viewpoint.

3.13.3 Mitigation Measures

The reconductoring project would not have any significant impacts on visual resources, therefore no mitigation measures are necessary.

3.14 WASTE MANAGEMENT

This section presents an evaluation of potential effects on the environment from non-hazardous and hazardous waste generated during reconductoring of the East Shore to San Mateo transmission line.

3.14.1 Affected Environment

The reconductoring project is located within the cities of Hayward, Foster City, and San Mateo. Typical conductor stringing crews require 15 to 20 workers, which include foremen, equipment operators, general laborers, environmental monitors and inspectors. Each cable stringing operation requires three to five pieces of equipment and support vehicles.

3.14.2 Project Waste Generation

3.14.2.1 Construction Phase

Non-Hazardous Solid Waste

Paper, wood, glass, and plastics will be generated from packing materials, waste lumber, insulation, and empty non-hazardous chemical containers. These wastes will be recycled where practical. Waste that cannot be recycled will be placed in on-site dumpsters and disposed of weekly in a Class III landfill.

Non-Hazardous Wastewater

Sanitary waste will be generated during construction of the electric transmission line; this waste will be collected in portable, self-contained toilets.

Hazardous Waste

Minimal quantities of welding, solvent, and paint waste will be generated during construction of the electric transmission line.

The construction contractor will be considered the generator of hazardous construction waste and will be responsible for proper handling of hazardous waste in compliance with all applicable federal, state, and local laws and regulations, including licensing, personnel training, accumulation limits and times, and reporting and record keeping. The hazardous waste will be collected in hazardous waste accumulation containers near the points of generation and moved daily to the contractor's 90-day hazardous waste storage area. Prior to expiration of the regulatory 90-day storage period, the waste will be delivered to an authorized hazardous waste management facility.

3.14.2.2 Operation Phase

No solid wastes will be generated during operation of the electric transmission line.

Non-Hazardous Wastewater

No wastewater will be generated from the electric transmission line operations.

Hazardous Waste

No hazardous wastes will be generated during operation of the electric transmission linear substation.

3.14.3 Waste Disposal Sites

The removal of non-hazardous solid waste (often referred to as solid waste, municipal solid waste [MSW], or garbage) is through recycling or, if not recyclable, through deposit in a Class III landfill. Hazardous wastes, both solid and liquid, will be delivered to a permitted off-site treatment, storage, and disposal (TSD) facility or deposited in a permitted Class I landfill.

Franchised waste collection companies, such as Waste Management, will collect non-hazardous solid waste materials and transport them to a transfer station. Recyclables will be removed at the transfer station, and the remaining residue will be placed in a nearby landfill. Waste collection and disposal will be in accordance with applicable regulatory requirements to minimize environmental, health, and safety impacts.

There is a 90-day limit on the storage of hazardous waste generated at the facility. The waste will be transferred by a permitted hazardous waste transporter to a transfer, storage, and disposal (TSD) facility. These facilities vary considerably in what they can do with the hazardous waste they receive. Some can only store waste, others can treat the waste to recover usable products, while others can dispose of the waste through incineration, deep well injection or landfilling (although incineration and deep-well injection are not permitted in California).

3.15 WATER RESOURCES

This section provides water resources that may be potentially impacted by the reconductoring project. Potential impacts include water supply, water quality, and flooding hazards

3.15.1 Affected Environment

The reconductoring project will be located within the cities of Hayward, Foster City, and San Mateo and will cross San Francisco Bay near the San Mateo Bridge. These areas are located in the eastern and western shoreline of San Francisco Bay, a large semi-enclosed estuary that conveys the freshwater inflows of the Sacramento and San Joaquin Rivers to the Pacific Ocean. The Bay functions as the only drainage outlet for waters of the entire Central Valley region. It also functions as a natural topographic separation between the northern and southern coastal mountain ranges.

On the east side of the Bay, the transmission line is situated on an elongated, northwest-trending, low-lying alluvial fan complex deposited by stream channels. On the west side, the alluvial area is narrower.

3.15.1.1 Climate and Precipitation

The climate in the project area is Mediterranean (NOAA division CA-04: Central Coast) with moderate year-round temperatures and a winter rainy season.

Since 1958, normal temperatures in the area typically have exhibited a seasonal pattern ranging from winters of approximately 40-57°F (mean daily temperature of 49°F) in December and January, to summer temperatures ranging from 53-76°F (mean daily temperature of 65°F) in August and September. The average annual temperature is 59°F. The average annual evaporation pan rate is approximately 55 inches, indicating that the project site experiences evaporation rates significantly exceeding local precipitation.

The closest long-term precipitation gauge is Station 62, located on the Hayward Corporation Yard, at an elevation of 55 feet msl. Between 1957 and 1992, the annual rainfall at that location averaged 17.9 inches per year. The project site falls in an area that typically receives, on average, approximately 16 inches of rain per year. Most of this precipitation occurs during the months of October through April, while summers are relatively dry.

Table 3.15-1 lists the average rainfall amounts by month over a continuous 35-year period from 1957-1992 as recorded at Meteorological Station 62 (Personal communication Frank Codd, Alameda County Public Works Agency, Flood Control and Water Conservation District, 2001).

The California Department of Water Resources and the Alameda County Public Works Agency have compiled precipitation frequency data for all of Alameda County. Table 3.15-2 summarizes the storm duration and recurrence data for the Hayward area for storm events ranging from the 2-year to the 100-year event (Personal communication, Jim Goodridge, California Department of Water Resources, 2001).

Table 3.15-1. Average monthly rainfall amounts at Station 62, Hayward, CA (inches).

Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
0.05	0.05	0.34	1.23	2.57	2.60	3.40	2.95	2.92	1.36	0.28	0.14

Annual Average =17.9 inches Source: Frank Codd, Alameda County Flood Control and Water Conservation District.

Table 3.15-2. Storm duration-recurrence intervals at Station 62, Hayward Corporation Yard.

Recurrence	Maximum precipitation (inches)					
(years)	15-min.	1-hour	6-hour	12-hour	24-hour	Annual Mean
2	0.26	0.53	1.14	1.52	1.98	16.54
10	0.43	0.89	1.92	2.56	3.34	24.58
25	0.52	1.07	2.31	3.08	4.01	27.94
50	0.59	1.20	2.59	3.45	4.50	30.23
100	0.65	1.33	2.86	3.82	4.98	32.37

Sources: Alameda County Public Works Agency: Frank Codd; CA-DWR: Jim Goodridge

3.15.1.2 Groundwater Resources

The reconductoring project will be on exiting PG&E towers. No foundations or other civil work will be required, therefore the project has no potential for impacts to groundwater resources.

3.15.1.3 Surface Water Resources

The entire transmission line route is located close to the San Francisco Bay. Surface water runoff discharges directly into the Bay. At the eastern end of the transmission line, large areas south of the project site and to the west are brackish or saltwater marshes in various stages of restoration that are located in the Hayward Shoreline zone, between the East Shore Substation and the San Francisco Bay shore. These areas include several areas that were formerly salt evaporation ponds that are currently open water; areas formerly salt evaporation ponds, but that have returned to natural wetland vegetation (pickleweed dominant). Small, isolated seasonal wetlands are located close to the San Mateo Substation. The transmission line route passes over flood control ditches but no major stream channels.

3.15.2 Environmental Consequences

The project would cause a significant environmental impact if it would cause substantial flooding, erosion, or siltation; substantially degrade water quality; substantially degrade or deplete groundwater resources; interfere substantially with groundwater recharge; or contaminate a public water supply.

Water for construction will be needed for dust control at some of the pull and tensioning locations. Water requirements will likely be less than one water truck per day.

The reconductoring project will be on exiting PG&E towers. No foundations or other civil work will be required, therefore the project has no potential for impacts to groundwater resources.

During construction temporary erosion and sedimentation control measures will direct stormwater runoff to existing surface drainage. Standard construction mitigation measures for erosion prevention and water quality assurance such as filter fabric or hay bale filtration and temporary or permanent settling ponds will be very effective at this site because of the flat topography. Portable toilets will be supplied by a licensed contractor for collection and disposal of sanitary wastes during the construction period.

3.15.3 Mitigation Measures

This section presents mitigation measures that will reduce impacts to water resources in areas affected by the proposed. Additionally, the measures specified in Section 3.11 (Agriculture and Soils) will be implemented to minimize impacts to the soil resources, erosion control, and associated water quality-related impacts.

- Implement Best Management Practices designed to minimize soil erosion and sediment transport during construction of the project corridor.
- Perform construction activities in accordance with the SWPPP and associated Monitoring Plan, which will likely be required for the project in accordance with the California NPDES General Permit for Stormwater Discharge Associated with Construction Activity. The SWPPP will include Best Management Practices to control erosion, sediment transport, and discharge of pollutants during construction.
- Perform refueling and maintenance of construction equipment only in designated lined and/or bermed areas located away from stream channels. Prepare and implement spill contingency plans in areas where they are appropriate.
- Utilize existing roads as much as possible to limit disturbance.

3.16 WORKER HEALTH AND SAFETY

This section outlines plans and programs that would be implemented during reconductoring of the East Shore to San Mateo transmission line to protect the worker health and safety, both during construction and operation. During its construction, the project will provide short-term job opportunities for approximately 19 workers. The contractors selected for this project and the operators of the facility will develop specific plans and programs as described.

3.16.1 Construction Health and Safety Programs

During construction of the transmission line, a number of programs will be implemented that are designed specifically to mitigate hazards and, in accordance with applicable regulations, to protect the safety and health of the workers.

The key health and safety programs for project construction include:

- Injury and Illness Prevention Plan
- Fire Protection and Prevention Plan
- Personal Protective Equipment Program

The following are brief outlines of these programs.

Injury and Illness Prevention Plan

This plan implements the requirements of the Cal-OSHA program, as specified in Title 8 CCR Section 1509, for construction and includes:

- Responsibility and authority for implementing the plan
- Safety and Health Policy
- Work rules and safe work practices
- Systems for ensuring that employees comply with safe work practices
- Employee communications protocols
- Identification and evaluation of workplace hazards
- Methods and/or procedures for correcting unsafe or unhealthy conditions, work practices and work procedures in a timely manner based on the severity of the hazards
- Specific safety procedures (e.g. fall protection, lockout/tagout, respiratory protection)
- Training and instruction

Fire Protection and Prevention Plan

This plan implements the requirements of the Cal-OSHA occupational health and safety program, as specified in Title 8 CCR Section 1920, and includes:

- General requirements
- Housekeeping requirements
- Employee alarm/communication system
- Portable fire extinguisher placement and operation
- Fixed fire fighting equipment placement and operation
- Fire control methods and techniques
- Hot work (welding, torches, cutting) safety procedures
- Flammable and combustible liquid storage methods
- Flammable and combustible liquids use procedures
- Techniques for dispensing and disposing of liquids
- Methods for servicing and refueling vehicles
- Fire prevention training programs and requirements

Personal Protective Equipment Program

This project's program to provide personal protective equipment to construction workers implements the requirements of Cal-OSHA Title 8 CCR Section 1514-1522 and 3401-3411 and includes:

- Head protection equipment (hard hats, etc.)
- Eye and face protection equipment (such as safety glasses)
- Body protection equipment
- Ear plugs
- Hand protection equipment (gloves)
- Foot protection equipment (steel-toed boots)
- Sanitation equipment (hand washing, etc.)
- Safety harnesses and lifelines
- Electric shock protection equipment
- Medical services and first aid equipment
- Respiratory protection equipment (respirators, supplied air equipment)

3.16.2 Operation Health and Safety Program

After construction, the construction-phase safety and health program will transition into PG&E programs that are oriented towards routine project operation and maintenance. Key health and safety programs for project operation are as follows:

- Injury and Illness Prevention Program
- Fire Protection and Prevention Plan
- Emergency Action Plan
- PPE Program

Cultural Resources

Data Responses 21-27

Cultural Resources (21-27)

Cultural Survey Results

21. *a. Please provide survey results for the portions (transmission line and parking/laydown area) of the City of Hayward parcel that have not been surveyed.*

    b. Please provide a revised Figure 3.3-1 that identifies areas surveyed after the Amendment was submitted. Also, indicate the location of any laydown or staging areas that would be located along the previously surveyed gas line route.

Response: The previously unsurveyed construction parking area was surveyed for cultural resources on January 10, 2007 by Douglas Davy. The area surveyed is in the shape of an inverted "L." (see Figure DR21-1, which is a revised Amendment Petition Figure 3.3-1). This parking area consists of two distinct parcel areas that are separated by a fence. The vertical portion of the inverted "L" shape, from the north to south boundary, consists of an empty lot. At the time of survey, the lot was covered in waist-high weeds that are growing through decomposing asphalt. The parcel was apparently formerly entirely or mostly paved and graveled and ground surface was not visible in any portion of the parcel; only gravel and decomposing asphalt. Nothing else was located on this portion of the construction parking area except for eight wrecked automobiles (lined up in a row in the south-central portion of the lot) and two dirt piles (one in the southwest corner of the site and one in the northwest quadrant). This portion of the parcel is 575 x 215 feet, or approximately 2.8 acres in size. This parcel was surveyed in two 32-meter-wide transects walked to confirm that ground surface of the entire parcel is either asphalt or gravel. No cultural resources or artifacts were noted. If the asphalt is not removed before this lot is used for construction parking, then it is likely that any archaeological deposits located here would be afforded some protection by the asphalt and gravel. If the asphalt is to be removed prior to construction, then the lot should be surveyed by an archaeologist concurrent with the asphalt removal.

The horizontal portion of the inverted "L" shape forms a smaller rectangle, jutting to the west of the first parcel area. This area is currently being used for construction laydown for a project that involves adding additional facilities and equipment to the City of Hayward's Water Pollution Control Facility (WPCF). The area is being actively used for construction and was not accessible for survey. This area is covered partly by graveled driveways and partly by construction equipment and equipment that will be installed as part of the WPCF. Some native soil may be visible in the laydown area between these pieces of equipment and the roadways. RCEC proposes to survey this area after WPCF construction is completed when it will be more accessible and when the ground surface will be visible.

Native American Consultation

22. *Please contact the Native American Heritage Commission (NAHC) to obtain a current list of Native American groups or individuals who may have heritage concerns in the project area. Provide a copy of the letter and map sent to notify Native Americans regarding the project change and provide copies of written comments or summaries of telephone conversations with Native Americans.*

Response: The Native American Heritage Commission (NAHC) was contacted on January 8, 2007. A copy of the letter and map sent to NAHC is provided in Attachment DR22-1. On January 12, 2007, the NAHC provided a list of Native American individuals and groups that may be interested in the project. Letters to these individuals were mailed on January 16, 2007 and are provided in Attachment DR22-1. As of the filing data of these data responses, the individuals have not yet been contacted via telephone conversations. It is anticipated they will be contacted in late January 2007 and copies of the telephone conversations will then be provided to CEC Staff.

23. *Please make a telephone call to Native American individuals or groups listed by the NAHC who have not responded to ensure that they have received the correspondence and to verify that they do not have any information regarding cultural resources in the project area. Please provide a summary of each conversation, and note any comments regarding the project area provided by the Native Americans. During the course of the Amendment proceedings, please provide copies or summaries of any additional information from Native Americans. If the location of archaeological sites may be revealed in the information, please provide the responses under confidential cover.*

Response: A list of Native American individuals or groups was provided on January 12, 2007. Letters to these individuals and groups were sent out on January 16, 2007, and a follow-up call will be performed in late January. Correspondence records from these telephone conversations will be provided to CEC Staff at that time.

Soil Borrow Sites

24. *If removed soils will be disposed of off-site and/or new soils brought in and if disposal and borrow sites are not commercial operations and consequently have not been surveyed for cultural resources, please conduct surveys of the borrow and/or disposal site(s) and provide the survey personnel qualifications, methods, and findings to staff.*

Response: At this time, Russell City Energy Company anticipates purchasing any fill that may be imported to the site and, as such, there is no designated borrow area that is part of the project. Any potential supplier of fill would be independently responsible for compliance with local, state, and federal laws associated with generating fill material.

Geotechnical Borings

25. *If any additional geotechnical borings are completed for this project within the coming months, please have the borings examined by an archaeologist on site and provide a discussion of the findings to the Energy Commission staff.*

Response: No further geotechnical borings are currently planned for the project. However, if such borings are made, the borings will be examined and reported to CEC Staff.

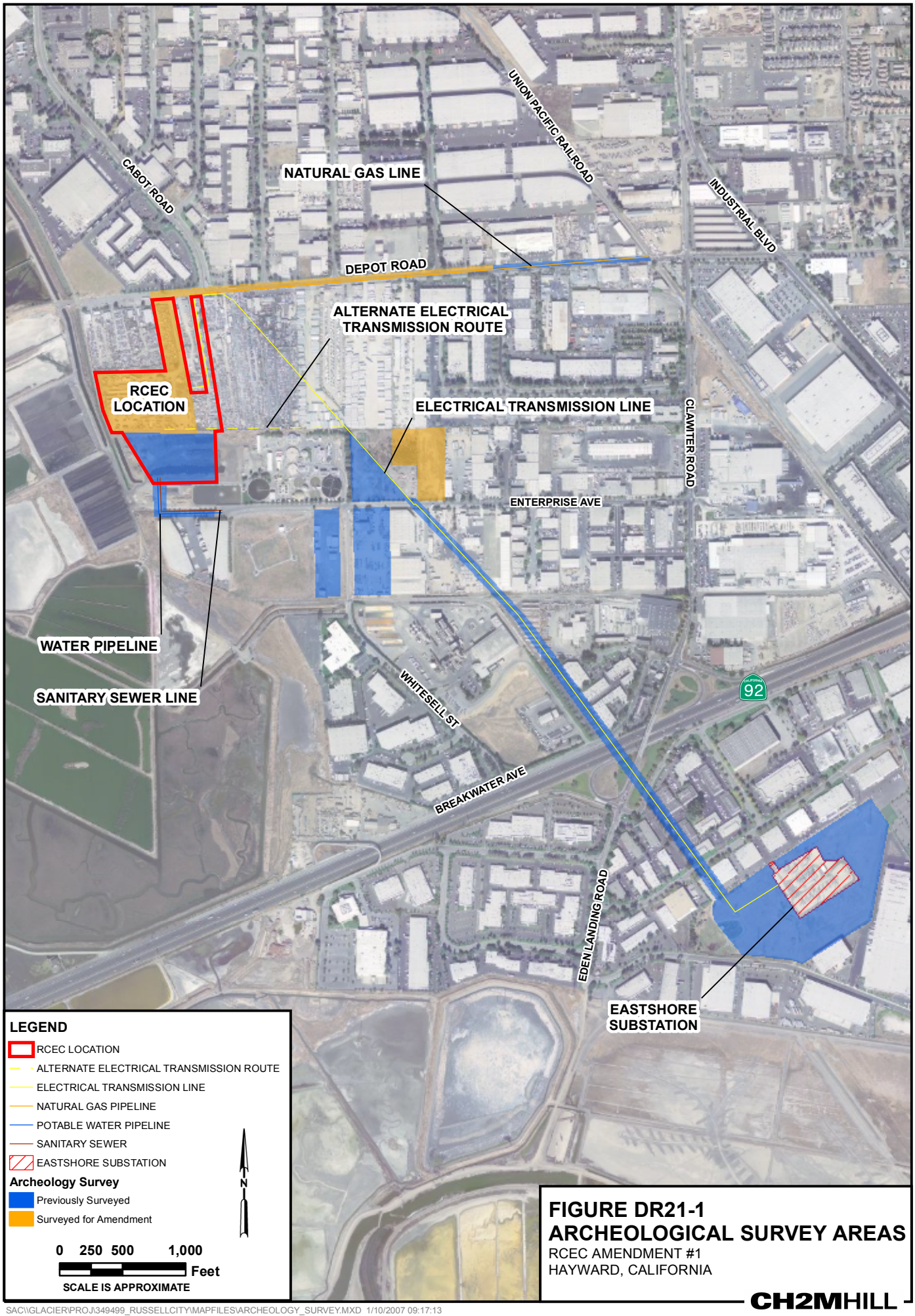

FIGURE DR21-1
ARCHEOLOGICAL SURVEY AREAS
RCEC AMENDMENT #1
HAYWARD, CALIFORNIA

CH2MHILL

SAC\\GLACIER\PROJ\349499_RUSSELLCITY\MAPFILES\ARCHEOLOGY_SURVEY.MXD 1/10/2007 09:17:13

Historic Features in Project Area

26. *a.) Please have an architectural historian who meets the Secretary of the Interior's Standards in architectural history or history (specialty in industrial history) identify all buildings, structures, and features that appear to be older than 45 years on the parcel proposed for the project, in the area one parcel deep around the project parcel and along the gas line route. Include any obvious potential historic resource, not located within the specified one-parcel limit but that might be impacted by the project.*

    b.) Please also have the specialist record any identified buildings, structures, and features (historic trees, cemetery, or fountain, for example) older than 45 years on an unmodified Department of Parks and Recreation (DPR) "Primary" Form 523 and provide copies of the forms to staff. For any properties that appear to be potentially eligible for the CRHR, please complete the "Building, Structure and Object" form and provide copies to staff.

Response: The buildings and structures older than 45 years that are located on the project parcel have been identified by analysis of historical aerial photographs and maps, and DPR-523 forms for those properties have been prepared and were included in the Amendment Petition. These results have been reviewed by a qualified architectural historian, who has conducted background research on the buildings and additional significance evaluation (see response to Data Request 27, below). There are no properties on adjacent parcels that could be older than 45 years and that also would be likely to be subject to indirect effects from the construction of the RCEC. Buildings of this age would be related to agricultural, rural residential, or early salt production activities, or to the Hayward Motor Speedway, which was once located east of the project site. All adjacent parcels other than the City's WPCF are automobile salvage yards. All of the buildings within these salvage yards, furthermore, are in dilapidated condition and are lacking in architectural integrity or, more importantly, integrity of setting, because of the recent industrial development in this area, including a large group of automobile salvage yards. The RCEC would have, at most, an indirect and visual effect on the setting of any such buildings.

Construction of the natural gas pipeline in Depot Road would not have any effect on buildings and structures on parcels adjacent to the gas line. The pipeline will be installed underground in a trench within the roadway using standard excavation equipment. The pipeline could not be seen from the adjacent parcels, and normal construction activity of this type could not cause any adverse effects to adjacent buildings due to noise or vibration. Because there is no potential for impact from this activity on any structures on adjacent parcels, a survey for historical buildings and structures is not necessary.

Background Research on Eash Buildings

27. *Please have an architectural historian or a historian who specializes in industrial history (meets the Secretary of Interior's Standards) conduct sufficient background research on the Eash parcel's history to determine if any persons or activities associated with the buildings there could be historically significant locally. Moreover, please ensure that the specialist compares the form and construction methods present in the Eash buildings with other known historic agricultural utility and vernacular buildings in the area and region, provides a recommendation of CRHR eligibility justified by the researched historical facts and the comparative architectural analysis, and provides that information on DPR 523 "Building, Structure, and Object" forms to staff.*

Response: Architectural Historian Jessica Feldman has prepared Building, Structure, Object records based on information available to date. Ms. Feldman's resume is included as Attachment DR27-1. The Building, Structure, Object records are in Attachment DR27-2.

Attachment DR22-1

Native American Heritage Commission Letters

CH2MHILL FAX

Tel 916.286.0249
Fax 916.614.3449

To:	Ms. Debbie Pilas-Treadway	**From:**	Sarah Madams/CH2M HILL
Company:	Native American Heritage Commission 915 Capitol Mall, #364 Sacramento, CA 95814	**Date:**	January 5, 2007
Fax No.:	916-657-5390	**Total Pages:**	2
RE:	Russell City Energy Center		

Dear Ms. Pilas-Treadway,

CH2M HILL is assisting Russell City Energy Company, LLC with the preparation of an Amendment to an Application for Certification (AFC) before the California Energy Commission (CEC) for the Russell City Energy Center power plant to be located in Hayward, California, located in Township 03S, Range 03W. The project area is indicated on the enclosed copy of the San Leandro 7.5 Minute USGS quadrangle.

We would appreciate your checking the Sacred Lands Files to see if there are any culturally sensitive areas within the immediate project vicinity. We would also like to receive a list of Native American individuals or organizations interested in consulting on the project since we will attempt to contact local Indian groups to solicit their written input/concerns about the project.

Thank you for your cooperation and assistance in this matter. I look forward to your earliest possible reply. Please call me at 916-286-0249 if you have any questions.

Sincerely,

CH2M HILL

SMadams

Sarah Madams

Enclosures: Project Location Map

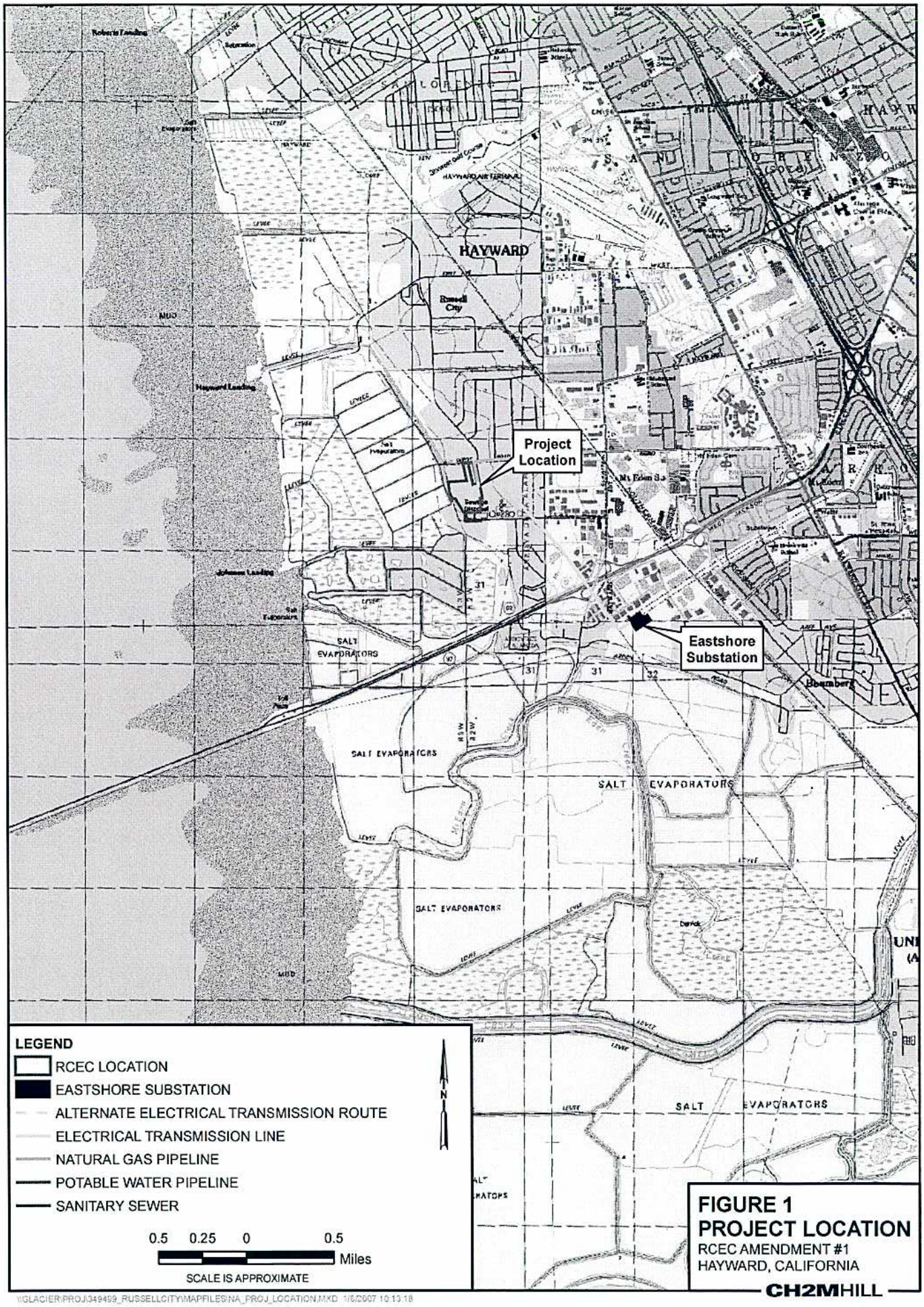

FIGURE 1
PROJECT LOCATION
RCEC AMENDMENT #1
HAYWARD, CALIFORNIA

CH2MHILL

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STATE OF CALIFORNIA Arnold Schwarzenegger, Governor

NATIVE AMERICAN HERITAGE COMMISSION
915 CAPITOL MALL, ROOM 364
SACRAMENTO, CA 95814
(916) 653-4082
Fax (916) 657-5390
Web Site www.nahc.ca.gov

January 12, 2007

Sarah Madams
CH2MHILL

Sent by Fax: 916-614-3449
Number of Pages: 2

Re: Proposed Russell City Energy Center, Alameda County.

Dear Ms. Madams:

A record search of the sacred land file has failed to indicate the presence of Native American cultural resources in the immediate project area. The absence of specific site information in the sacred lands file does not indicate the absence of cultural resources in any project area. Other sources of cultural resources should also be contacted for information regarding known and recorded sites.

Enclosed is a list of Native Americans individuals/organizations who may have knowledge of cultural resources in the project area. The Commission makes no recommendation or preference of a single individual, or group over another. This list should provide a starting place in locating areas of potential adverse impact within the proposed project area. I suggest you contact all of those indicated, if they cannot supply information, they might recommend others with specific knowledge. By contacting all those listed, your organization will be better able to respond to claims of failure to consult with the appropriate tribe or group. If a response has not been received within two weeks of notification, the Commission requests that you follow-up with a telephone call to ensure that the project information has been received.

If you receive notification of change of addresses and phone numbers from any of these individuals or groups, please notify me. With your assistance we are able to assure that our lists contain current information. If you have any questions or need additional information, please contact me at (916) 653-4038.

Sincerely,

Debbie Pilas-Treadway
Environmental Specialist III

Native American Contacts
Alameda County
January 11, 2007

Jakki Kehl
720 North 2nd Street
Patterson , CA 95363
jakki@bigvalley.net
(209) 892-2436
(209) 892-2435 - Fax
Ohlone/Costanoan

Indian Canyon Mutsun Band of Costanoan
Ann Marie Sayers, Chairperson
P.O. Box 28
Hollister , CA 95024
Ohlone/Costanoan

Katherine Erolinda Perez
PO Box 717
Linden , CA 95236
canutes@comcast.net
(209) 474-2602
Ohlone/Costanoan
Northern Valley Yokuts
Bay Miwok

Muwekma Ohlone Indian Tribe of the SF Bay Area
Rosemary Cambra, Chairperson
PO Box 360791
Milpitas , CA 95036
muwekma@muwekma.org
408-434-1668
408-434-1673
Ohlone / Costanoan

Amah/Mutsun Tribal Band
Michelle Zimmer, Cultural Resource Coordinator
PO Box 62-558
Woodside , CA 94062
408-375-4281
Ohlone/Costanoan

The Ohlone Indian Tribe
Andrew Galvan
PO Box 3152
Mission San Jose , CA 94539
chochenyo@AOL.com
(510) 656-0787 - Voice
(510) 882-0527 - Cell
(510) 687-9393 - Fax
Ohlone/Costanoan
Bay Miwok
Plains Miwok
Patwin

Amah/MutsunTribal Band
Irene Zwierlein, Chairperson
789 Canada Road
Woodside , CA 94062
amah_mutsun@yahoo.com
(650) 851-7747 - Home
(650) 851-7489 - Fax
Ohlone/Costanoan

Trina Marine Ruano Family
Ramona Garibay, Representative
16010 Halmar Lane
Lathrop , CA 95330
510-300-5971 - cell
Ohlone/Costanoan
Bay Miwok
Plains Miwok
Patwin

This list is current only as of the date of this document.

Distribution of this list does not relieve any person of statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resources Code and Section 5097.98 of the Public Resources Code.

This list is only applicable for contacting local Native Americans with regard to cultural resources for the proposed Russell City Energy Center, Alameda County.

CH2M HILL
2485 Natomas Park Drive
Suite 600
Sacramento, CA 95833
Tel 916.920.0300
Fax 916.920.8463

CH2MHILL

January 15, 2007

Jakki Kehi
720 North 2nd Street
Patterson, CA 95363

Subject: Russell City Energy Center Cultural Resource Study

Dear Ms. Kehi:

CH2M HILL is conducting a cultural resources study for the Amendment to an Application for Certification (AFC) before the California Energy Commission (CEC) for the Russell City Energy Center power plant. The power plant will be located in Hayward, California, in Township 03S, Range 03W. The project area is indicated on the enclosed copy of the San Leandro 7.5 Minute USGS quadrangle.

We have already contacted the Native American Heritage Commission, and their record search of the sacred land file has failed to indicate the presence of Native American cultural resources in the immediate project vicinity. They have also suggested that we contact knowledgeable Native American individuals and organizations who may be able to supply information or recommend others with specific knowledge to us. They have provided us with your name and address for this purpose.

Should you have any information or concerns that you wish to share regarding this project, please feel free to contact me at (916) 286-0249.

Sincerely,

S Madams

Sarah Madams
CH2M HILL

Attachment

CH2M HILL
2485 Natomas Park Drive
Suite 600
Sacramento, CA 95833
Tel 916.920.0300
Fax 916.920.8463

CH2MHILL

January 15, 2007

Katherine Erolinda Perez
P.O. Box 717
Linden, CA 95236

Subject: Russell City Energy Center Cultural Resource Study

Dear Ms. Perez:

CH2M HILL is conducting a cultural resources study for the Amendment to an Application for Certification (AFC) before the California Energy Commission (CEC) for the Russell City Energy Center power plant. The power plant will be located in Hayward, California, in Township 03S, Range 03W. The project area is indicated on the enclosed copy of the San Leandro 7.5 Minute USGS quadrangle.

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Sincerely,

S Madams

Sarah Madams
CH2M HILL

Attachment

CH2M HILL
2485 Natomas Park Drive
Suite 600
Sacramento, CA 95833
Tel 916.920.0300
Fax 916.920.8463

CH2MHILL

January 15, 2007

Michelle Zimmer
Amah/Mutson Tribal Band
Cultural Resource Coordinator
P.O. Box 62-558
Woodside, CA 94062

Subject: Russell City Energy Center Cultural Resource Study

Dear Ms. Zimmer:

CH2M HILL is conducting a cultural resources study for the Amendment to an Application for Certification (AFC) before the California Energy Commission (CEC) for the Russell City Energy Center power plant. The power plant will be located in Hayward, California, in Township 03S, Range 03W. The project area is indicated on the enclosed copy of the San Leandro 7.5 Minute USGS quadrangle.

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Should you have any information or concerns that you wish to share regarding this project, please feel free to contact me at (916) 286-0249.

Sincerely,

SL Madams

Sarah Madams
CH2M HILL

Attachment

CH2M HILL
2485 Natomas Park Drive
Suite 600
Sacramento, CA 95833
Tel 916.920.0300
Fax 916.920.8463

CH2MHILL

January 15, 2007

Irene Zwierlein
Amah/Mutsun Tribal Band
Chairperson
789 Canada Road
Woodside, CA 94062

Subject: Russell City Energy Center Cultural Resource Study

Dear Ms. Zwierlein:

CH2M HILL is conducting a cultural resources study for the Amendment to an Application for Certification (AFC) before the California Energy Commission (CEC) for the Russell City Energy Center power plant. The power plant will be located in Hayward, California, in Township 03S, Range 03W. The project area is indicated on the enclosed copy of the San Leandro 7.5 Minute USGS quadrangle.

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Should you have any information or concerns that you wish to share regarding this project, please feel free to contact me at (916) 286-0249.

Sincerely,

SMadams

Sarah Madams
CH2M HILL

Attachment

CH2M HILL
2485 Natomas Park Drive
Suite 600
Sacramento, CA 95833
Tel 916.920.0300
Fax 916.920.8463

CH2MHILL

January 15, 2007

Ann Marie Sayers
Indian Canyon Mutsun Band of Costanoan
P.O. Box 28
Hollister, CA 95024

Subject: Russell City Energy Center Cultural Resource Study

Dear Ms. Sayers:

CH2M HILL is conducting a cultural resources study for the Amendment to an Application for Certification (AFC) before the California Energy Commission (CEC) for the Russell City Energy Center power plant. The power plant will be located in Hayward, California, in Township 03S, Range 03W. The project area is indicated on the enclosed copy of the San Leandro 7.5 Minute USGS quadrangle.

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Should you have any information or concerns that you wish to share regarding this project, please feel free to contact me at (916) 286-0249.

Sincerely,

SMadams

Sarah Madams
CH2M HILL

Attachment

CH2M HILL
2485 Natomas Park Drive
Suite 600
Sacramento, CA 95833
Tel 916.920.0300
Fax 916.920.8463

CH2MHILL

January 15, 2007

Rosemary Cambra
Muwekma Ohlone Indian Tribe of the SF Bay Area
P.O. Box 360791
Milpitas, CA 95036

Subject: Russell City Energy Center Cultural Resource Study

Dear Ms. Cambra:

CH2M HILL is conducting a cultural resources study for the Amendment to an Application for Certification (AFC) before the California Energy Commission (CEC) for the Russell City Energy Center power plant. The power plant will be located in Hayward, California, in Township 03S, Range 03W. The project area is indicated on the enclosed copy of the San Leandro 7.5 Minute USGS quadrangle.

We have already contacted the Native American Heritage Commission, and their record search of the sacred land file has failed to indicate the presence of Native American cultural resources in the immediate project vicinity. They have also suggested that we contact knowledgeable Native American individuals and organizations who may be able to supply information or recommend others with specific knowledge to us. They have provided us with your name and address for this purpose.

Should you have any information or concerns that you wish to share regarding this project, please feel free to contact me at (916) 286-0249.

Sincerely,

S Madams

Sarah Madams
CH2M HILL

Attachment

CH2M HILL
2485 Natomas Park Drive
Suite 600
Sacramento, CA 95833
Tel 916.920.0300
Fax 916.920.8463

CH2MHILL

January 15, 2007

Andrew Galvan
The Ohlone Indian Tribe
P.O. Box 3152
Mission San Jose, CA 94539

Subject: Russell City Energy Center Cultural Resource Study

Dear Mr. Galvan:

CH2M HILL is conducting a cultural resources study for the Amendment to an Application for Certification (AFC) before the California Energy Commission (CEC) for the Russell City Energy Center power plant. The power plant will be located in Hayward, California, in Township 03S, Range 03W. The project area is indicated on the enclosed copy of the San Leandro 7.5 Minute USGS quadrangle.

We have already contacted the Native American Heritage Commission, and their record search of the sacred land file has failed to indicate the presence of Native American cultural resources in the immediate project vicinity. They have also suggested that we contact knowledgeable Native American individuals and organizations who may be able to supply information or recommend others with specific knowledge to us. They have provided us with your name and address for this purpose.

Should you have any information or concerns that you wish to share regarding this project, please feel free to contact me at (916) 286-0249.

Sincerely,

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Sarah Madams
CH2M HILL

Attachment

CH2M HILL
2485 Natomas Park Drive
Suite 600
Sacramento, CA 95833
Tel 916.920.0300
Fax 916.920.8463

CH2MHILL

January 15, 2007

Ramona Garibay
Trina Marine Ruano Family
16010 Halmar Lane
Lathrop, CA 95330

Subject: Russell City Energy Center Cultural Resource Study

Dear Ms. Garibay:

CH2M HILL is conducting a cultural resources study for the Amendment to an Application for Certification (AFC) before the California Energy Commission (CEC) for the Russell City Energy Center power plant. The power plant will be located in Hayward, California, in Township 03S, Range 03W. The project area is indicated on the enclosed copy of the San Leandro 7.5 Minute USGS quadrangle.

We have already contacted the Native American Heritage Commission, and their record search of the sacred land file has failed to indicate the presence of Native American cultural resources in the immediate project vicinity. They have also suggested that we contact knowledgeable Native American individuals and organizations who may be able to supply information or recommend others with specific knowledge to us. They have provided us with your name and address for this purpose.

Should you have any information or concerns that you wish to share regarding this project, please feel free to contact me at (916) 286-0249.

Sincerely,

SMadams

Sarah Madams
CH2M HILL

Attachment

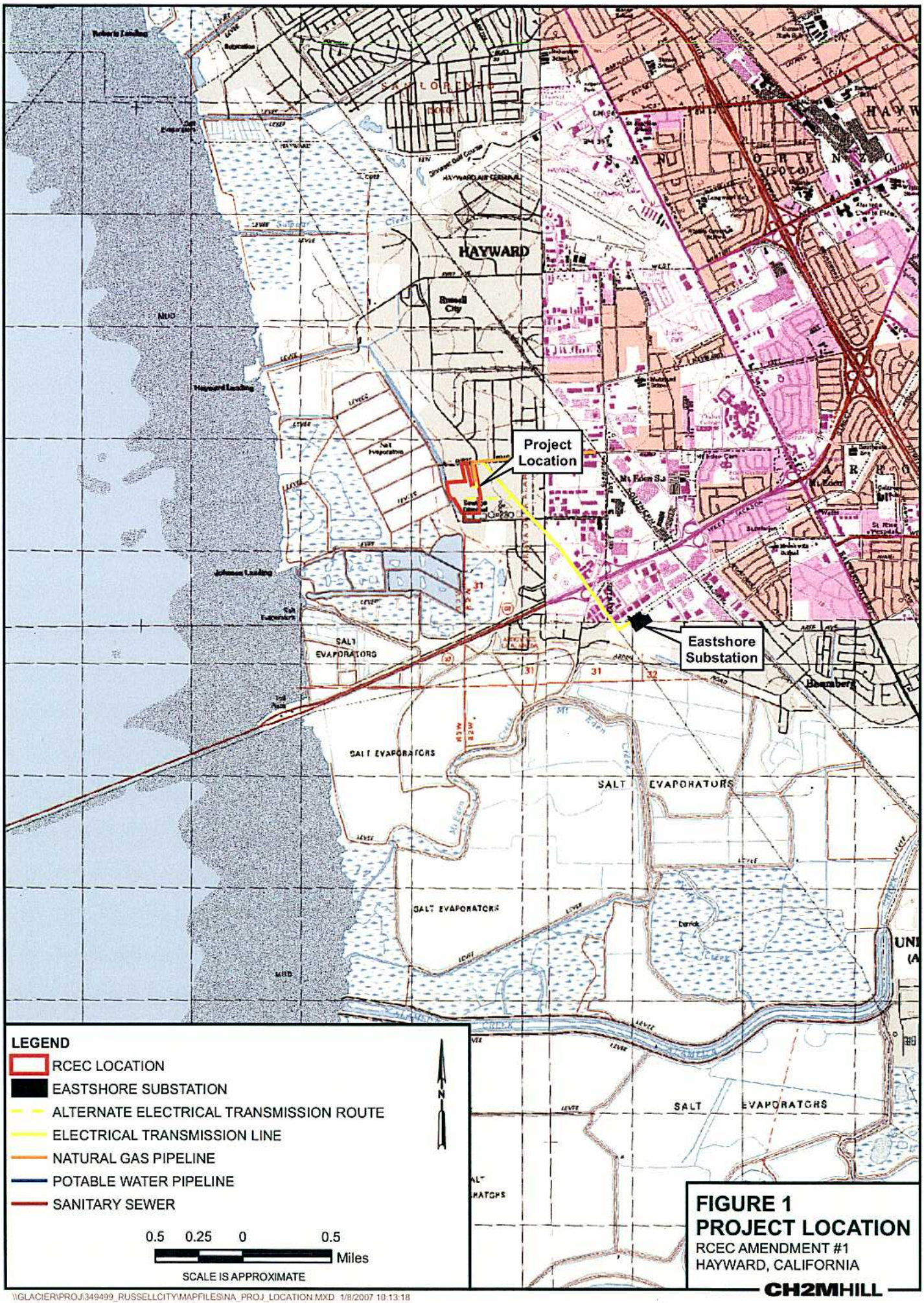


FIGURE 1
PROJECT LOCATION
RCEC AMENDMENT #1
HAYWARD, CALIFORNIA

CH2MHILL

\\GLACIER\PROJ\349499_RUSSELLCITY\MAPFILES\NA_PROJ_LOCATION.MXD 1/8/2007 10:13:18

Attachment DR27-1

Architectural Historian's Resume

Jessica B. Feldman
Architectural Historian

Education

Master of Arts, Historic Preservation Planning

Bachelor of Arts, History with a Minor in Art/Architecture

Distinguishing Qualifications

- Qualified as a historian, an architectural historian, and a historic preservationist under the Secretary of the Interior's Historic Preservation Professional Qualification Standards, as defined in 36 Code of Federal Regulations (CFR) 61.
- Experienced in cultural resource investigations in compliance with the National Environmental Policy Act (NEPA), the National Historic Preservation Act (NHPA), and a variety of other federal cultural resource regulations.

Relevant Experience

Ms. Feldman is a cultural resource specialist with more than 9 years of experience in compliance with federal, state, and local laws relating to cultural and community resources and land use planning. Ms. Feldman has been extensively involved in the management of and participation in cultural resource investigations in compliance with NEPA, NHPA, and a variety of other federal, state, and local cultural resource regulations.

Representative Projects and Dates of Involvement

Experience Prior to CH2M HILL

Architectural Historian; Jones & Stokes (formerly Myra L. Frank and Associates); November 2000 to June 2006.

Preparation of Section 106 documents in support of the EIS for the Dallas Area Rapid Transit NW alignments and Mid-Jordan Light Rail (Salt Lake City, Utah); preparation of historic bridge evaluations for Caltrans in support of Historic Property Survey Reports and Finding of Effect Reports, used as basis for EIRs, for Los Angeles, Riverside, San Bernardino and Madera counties; preparation of National Register nominations for GSA-owned courthouses/post offices throughout the United States; preparation of HABS/HAER level data forms for properties in Long Beach; historical assessments and CEQA-level effects analysis for public and private properties in West Hollywood, Los Angeles, and Long Beach; and peer review. Past responsibilities include: directed a survey team for the Caltrans state-wide historic bridge inventory update; led an intensive architectural survey for the City of Riverside of over 1,300 parcels in the downtown area that led to the preparation of determinations of eligibility and historic property inventory forms; surveyed proposed Historic Preservation Overlay Zones for the City of Los Angeles to determine contributing and non-contributing buildings; and conducted historical documentation and evaluation of state-owned buildings in Sacramento, Los Angeles, and Marysville resulting in

environmental analysis of those structures in anticipation of seismic retrofitting and/or other proposed alterations.

Architectural Historian/Lead LCS Historian; National Park Service, National Capital Region; February 1996 to July 1998 and May 1999 to August 1999.

Responsible for editing and maintaining regional historic structures database; identified, monitored and evaluated cultural resources at regional parks, including Rock Creek Park and Harpers Ferry National Historical Parks; advised park management on treatment of cultural resources; identified potential threats to structures; planned and conducted historical research to be used for park planning documents and Section 110 review; provided peer review for NPS and non-NPS historical studies; supervised seasonal employees and interns; made contributions to the preparation of historic preservation documentation; conducted intensive survey of and compiled background materials on 19th century homestead and cemetery sites at Prince William Forest Park; made presentations to park staff and public organizations on research results, beta-tested new historic structures database for entire national park system (summer 1999).

Professional Organizations/Affiliations

National Trust for Historic Preservation
California Preservation Foundation
Society for Architectural Historians/Southern California Chapter

Professional Development

Preservation of Historic Bridges. 2004. American Society of Civil Engineers.

Determining Eligibility Workshop. 2003. California Preservation Foundation.

CEQA and Historic Resources. 2003, California Preservation Foundation.

Section 106 – National Historic Preservation Act: Federal Law at the Local Level." 2002. UCLA Extension.

Mitigating Environmental Impacts: Law, Policy, and Practice. 2001. UCLA Extension.
Successful CEQA Compliance. 2000. UCLA Extension.

Attachment DR27-2

Building, Structure, Object Forms (DPR523b)

State of California — The Resources Agency DEPARTMENT OF PARKS AND RECREATION **PRIMARY RECORD**	Primary # HRI # Trinomial NRHP Status Code	
Other Listings Review Code	Reviewer	Date

 *Resource Name or #: RCEC-1

P1. Other Identifier:

***P2. Location:** ☐ **Not for Publication** ☒ **Unrestricted** ***a. County:** Hayward
and (P2b and P2c or P2d. Attach a Location Map as necessary.)

***b. USGS 7.5' Quad:** San Leandro **Date:** 1964 (1976)

c. Address: 3862 Depot Road City: Hayward, CA Zip: 94545

d. UTM: Zone: 10 ; 576,434 mE/ 4,165,788 mN (G.P.S.)

e. Other Locational Data: (e.g., parcel #, directions to resource, elevation, etc., as appropriate) Elevation:

From State Route 92 in Hayward, California, take Clawiter Avenue north for 0.72 miles to Depot Road. Turn west on Depot Road and travel 0.79 miles to 3862 Depot Road. Turn south down a narrow lane at a sign that says “All Good Pallets” that extends for 620 feet. The small shed-like structure immediately in front of you when you reach the end of the lane is the property.

***P3a. Description:** (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries)

This garage-like structure has a simple gable roof, board-and-batten siding supplemented by corrugated metal in places, and a sliding door that opens the entire front. The roofing material is corrugated metal. There is a small lean-to shed on the southwest side. There is a large window in the northeast wall. The building measures 45 x 30 feet, not including the lean-to, which measures 15 x 10 feet. This structure appears as part of a farmstead on a 1939 aerial photograph.

***P3b. Resource Attributes:** (List attributes and codes)

***P4. Resources Present:** ☒Building ☐Structure ☐Object ☐Site ☐District ☐Element of District ☐Other (Isolates, etc.)

P5a. Photo or Drawing (Photo required for buildings, structures, and objects.)

P5b. Description of Photo: (View, date, accession #)
View of the northeast and northwest elevations

***P6. Date Constructed/Age and Sources:** ☒Historic ☐Prehistoric ☐Both

***P7. Owner and Address:**
Jon and Margaret Eash

***P8. Recorded by:** (Name, affiliation, and address)
Doug Davy, CH2M HILL, 2485 Natomas Park Drive, Suite 600 Sacramento, CA 95833

***P9. Date Recorded:** October 5, 1006

***P10. Survey Type:** (Describe)
Intensive pedestrian survey and architectural reconnaissance

***P11. Report Citation:** (Cite survey report and other sources, or enter "none). Russell City Energy Center (01-AFC-07) Amendment No. 1. Submitted to the California Energy Commission. Submitted by Russell City Energy Company, LLC. November 17, 2006.

***Attachments:** ☐NONE ☒Location Map ☐Sketch Map ☐Continuation Sheet ☐Building, Structure, and Object Record ☐Archaeological Record ☐District Record ☐Linear Feature Record ☐Milling Station Record ☐Rock Art Record ☐Artifact Record ☐Photograph Record ☐ Other (List):

BUILDING, STRUCTURE, AND OBJECT RECORD

*NRHP Status Code 7R

*Resource Name or # (Assigned by recorder) RCEC-1

B1. Historic Name: None
B2. Common Name: Garage at 3862 Depot Road, Hayward
B3. Original Use: Unknown **B4. Present Use:** Garage
***B5. Architectural Style:** Other - Garage
***B6. Construction History:** (Construction date, alterations, and date of alterations)
The actual date of construction for this building is unknown; however, it appears on an aerial map of the region in 1939.

***B7. Moved?** ☒No ☐Yes ☐Unknown **Date:** **Original Location:**
***B8. Related Features:**
RCEC-2, RCEC-3

B9a. Architect: Unknown **b. Builder:** Unknown
***B10. Significance: Theme:** Light Industrial Development **Area:** Hayward
Period of Significance: N/A **Property Type:** Light Industrial **Applicable Criteria:** N/A
(Discuss importance in terms of historical or architectural context as defined by theme, period, and geographic scope. Also address integrity.)
Assuming, based on aerial photography, that there was an adjacent farmhouse structure at one time, the removal of that structure has left the site without its primary focal point. It is unclear when the garage was first built. Other buildings have been added and removed over the past sixty years; during the 1940s, it was the site of a fertilizer plant. Its more recent history has been as a lumber storage yard, metal fabricating business, and pallet recycling facility. Therefore, it is difficult to gauge both a period of significance and a complete construction history. The architectural style could be classified as vernacular; without more research, it cannot be clearly stated whether or not there are any other examples of garages of this style in the immediate area, or in the City of Hayward or Alameda County. This style of garage is fairly common throughout the United States, as are the materials that were used to construct and adorn the individual structures. It has likely lost integrity of setting, feeling, and association which are important in determining its overall significance. Without more information, it cannot be determined is this structures is the work of a master. There are no known persons of significance associated with this building, and there is no evidence that any events that have importance on a local, state, or Federal level occurred here. Without any other data, it appears that this structure lacks historic context within which to evaluate the importance of any information which could be gained.

B11. Additional Resource Attributes: (List attributes and codes)

***B12. References:**
LFR Levine-Fricke, "Phase I Environmental Site Assessment, 3862 and 3878 Depot Road, Hayward, California," December 2, 2004.

Historical Aerial Maps (1939, 1946, 1958, 1965, 1974, 1982, 1993, 1998)

Historical Topographical Maps (1899, 1948, 1959, 1968, 1973, 1980, 1993)

B13. Remarks:

***B14. Evaluator:** Jessica B. Feldman

***Date of Evaluation:** January 15, 2007

(Sketch Map with north arrow required.)

Sketch Map provided on page 3.

(This space reserved for official comments.)

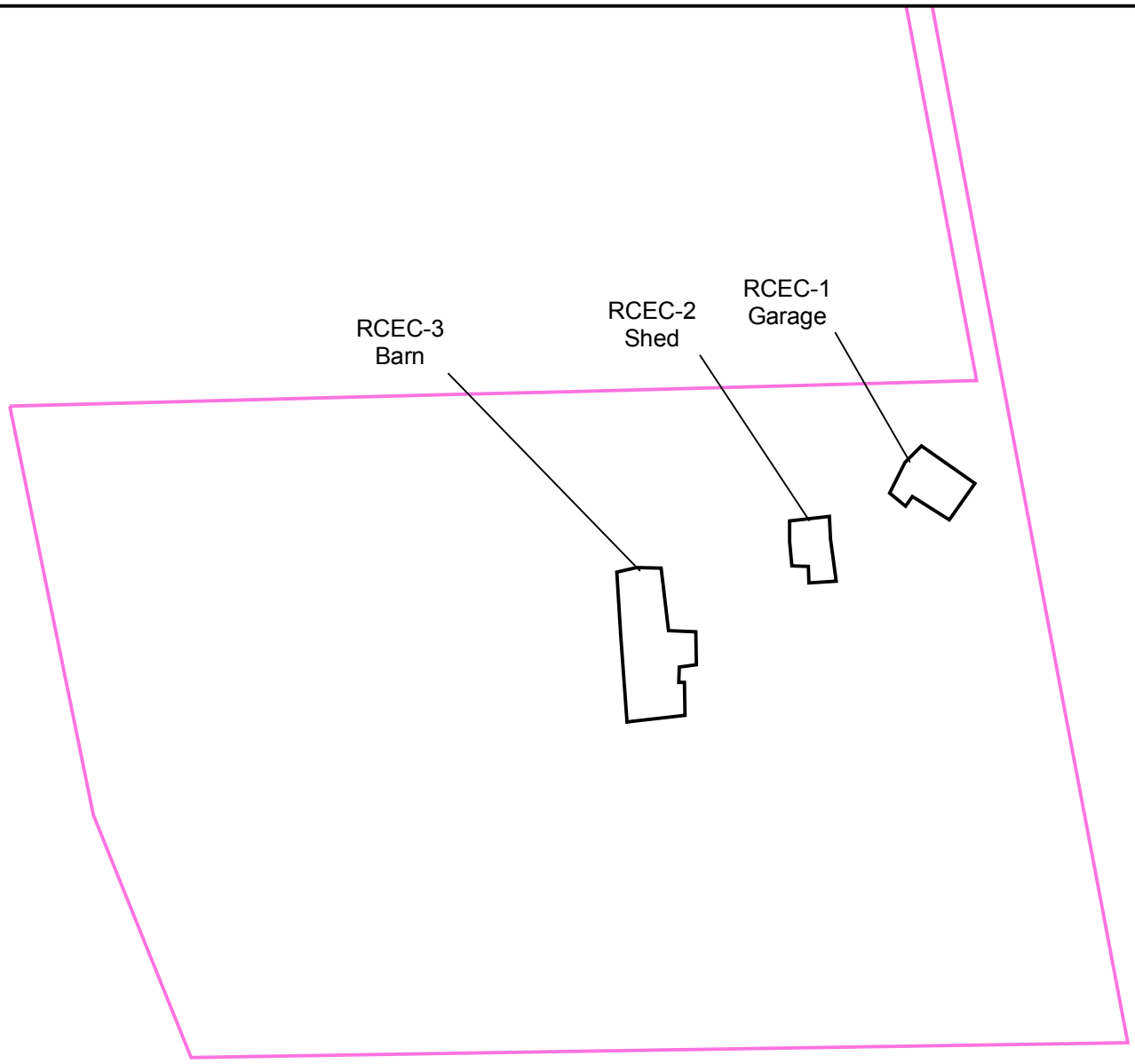
State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

Primary #
HRI#
Trinomial:

SKETCH MAP

Resource Name:

Drawn by: Mike Haskell
Date of Map: 1/16/07



LEGEND

Parcel # 439-0070-009

Building Locations

N

0 19 38 Meters

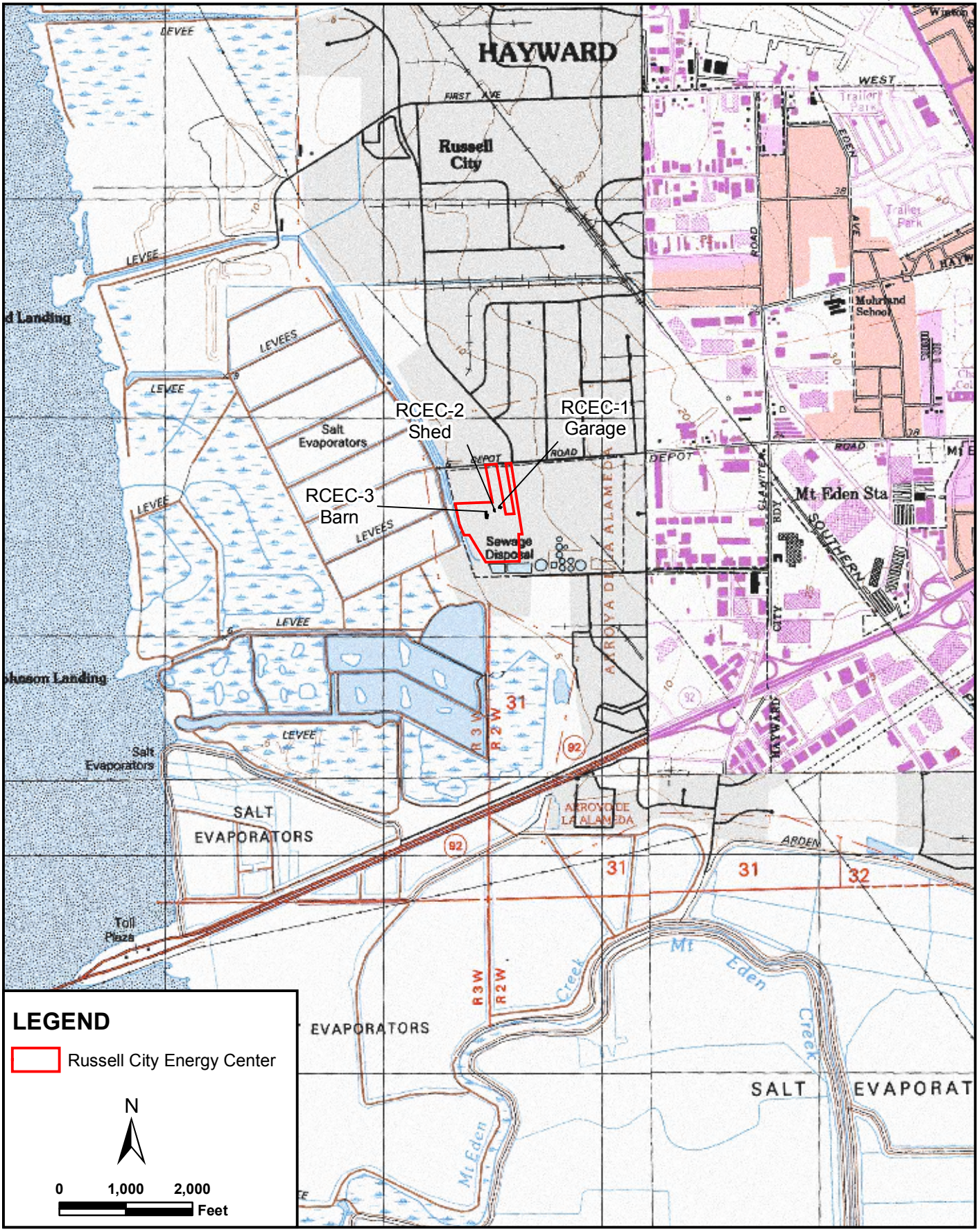
State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

Primary #
HRI#
Trinomial:

LOCATION MAP

Resource Name:

Map Name: San Leandro 7.5 min. Topographic Quadrangle Scale: 1:24000 Date of Map: 1/16/07



State of California — The Resources Agency DEPARTMENT OF PARKS AND RECREATION **PRIMARY RECORD**	Primary # HRI # Trinomial NRHP Status Code	
Other Listings Review Code	Reviewer	Date

 *Resource Name or #: RCEC-2

P1. Other Identifier:

***P2. Location:** ☐ **Not for Publication** ☒ **Unrestricted** ***a. County:** Hayward
and (P2b and P2c or P2d. Attach a Location Map as necessary.)

***b. USGS 7.5' Quad:** San Leandro **Date:** 1964 (1976)

c. Address: 3862 Depot Road City: Hayward, CA Zip: 94545

d. UTM: Zone: 10 ; 576,408 mE/ 4,165,773 mN (G.P.S.)

e. Other Locational Data: (e.g., parcel #, directions to resource, elevation, etc., as appropriate) Elevation:

From State Route 92 in Hayward, California, take Clawiter Avenue north for 0.72 miles to Depot Road. Turn west on Depot Road and travel 0.79 miles to 3862 Depot Road. Turn south down a narrow lane at a sign that says “All Good Pallets” that extends for 620 feet. The small shed-like structure immediately to the right of you when you reach the end of the lane is the property.

***P3a. Description:** (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries)

This structure also has a simple gable-roof, board and batten siding and corrugated metal roofing. It has a two entry doors and one window, and a small lean-to shed on the south side. It measures 30 x 30 feet, not including the lean-to, which measures 20 x 10 feet. This property is seen as part of a complex, probably a farmstead, on the 1939 aerial photograph.

***P3b. Resource Attributes:** (List attributes and codes)

***P4. Resources Present:** ☒Building ☐Structure ☐Object ☐Site ☐District ☐Element of District ☐Other (Isolates, etc.)

P5a. Photo or Drawing (Photo required for buildings, structures, and objects.)

P5b. Description of Photo: (View, date, accession #)
View of the east elevation

***P6. Date Constructed/Age and Sources:** ☒Historic ☐Prehistoric ☐Both

***P7. Owner and Address:**
Jon and Margaret Eash

***P8. Recorded by:** (Name, affiliation, and address)
Doug Davy, CH2M HILL, 2485 Natomas Park Drive, Suite 600 Sacramento, CA 95833

***P9. Date Recorded:** October 5, 1006

***P10. Survey Type:** (Describe)
Intensive pedestrian survey and architectural reconnaissance

***P11. Report Citation:** (Cite survey report and other sources, or enter "none). Russell City Energy Center (01-AFC-07) Amendment No. 1. Submitted to the California Energy Commission. Submitted by Russell City Energy Company, LLC. November 17, 2006.

***Attachments:** ☐NONE ☒Location Map ☐Sketch Map ☐Continuation Sheet ☐Building, Structure, and Object Record ☐Archaeological Record ☐District Record ☐Linear Feature Record ☐Milling Station Record ☐Rock Art Record ☐Artifact Record ☐Photograph Record ☐ Other (List):

BUILDING, STRUCTURE, AND OBJECT RECORD

*NRHP Status Code 7R

*Resource Name or # (Assigned by recorder) RCEC-2

B1. Historic Name: None
B2. Common Name: Shed at 3862 Depot Road, Hayward
B3. Original Use: Unknown **B4. Present Use:** Shed
***B5. Architectural Style:** Other - Shed
***B6. Construction History:** (Construction date, alterations, and date of alterations)
The actual date of construction for this building is unknown; however, it appears on an aerial map of the region un 1939.

***B7. Moved?** ☒No ☐Yes ☐Unknown **Date:** **Original Location:**
***B8. Related Features:**
RCEC-1, RCEC-3

B9a. Architect: Unknown **b. Builder:** Unknown
***B10. Significance: Theme:** Light Industrial Development **Area:** Hayward
Period of Significance: N/A **Property Type:** Light Industrial **Applicable Criteria:** N/A
(Discuss importance in terms of historical or architectural context as defined by theme, period, and geographic scope. Also address integrity.)
Assuming, based on aerial photograph analysis, that there was an adjacent farmhouse structure at one time, the removal of that structure has left the site without its primary focal point. The shed appears to have been built very close to, as part of, the farmhouse structure; between 1939 and 1946 that building was demolished and by 1965 a different structure was in its place. Its close proximity to the shed mimics the footprint of the original structure, and it is still on site. It is unclear when the structure was first built. Other buildings have been added and removed over the past sixty years; during the 1940s, it was the site of a fertilizer plant. Its more recent history has been as a lumber storage yard, metal fabricating business, and pallet recycling facility. Therefore, it is difficult to gauge both a period of significance and a complete construction history. The architectural style could be classified as vernacular; without more research, it cannot be clearly stated whether or not there are any other examples of sheds of this style in the immediate area, or in the City of Hayward or Alameda County. This style of shed is fairly common throughout the United States, as are the materials that were used to construct and adorn the individual structures. It has likely lost integrity of setting, feeling, and association which are important in determining its overall significance. Without more information, it cannot be determined is this structures is the work of a master. There are no known persons of significance associated with this building, and there is no evidence that any events that have importance on a local, state, or Federal level occurred here. Without any other data, it appears that this structure lacks historic context within which to evaluate the importance of any information which could be gained.

B11. Additional Resource Attributes: (List attributes and codes)

***B12. References:**
LFR Levine-Fricke, "Phase I Environmental Site Assessment, 3862 and 3878 Depot Road, Hayward, California," December 2, 2004.

Historical Aerial Maps (1939, 1946, 1958, 1965, 1974, 1982, 1993, 1998)

Historical Topographical Maps (1899, 1948, 1959, 1968, 1973, 1980, 1993)

B13. Remarks:

***B14. Evaluator:** Jessica B. Feldman

***Date of Evaluation:** January 15, 2007

(Sketch Map with north arrow required.)

Sketch Map provided on page 3.

(This space reserved for official comments.)

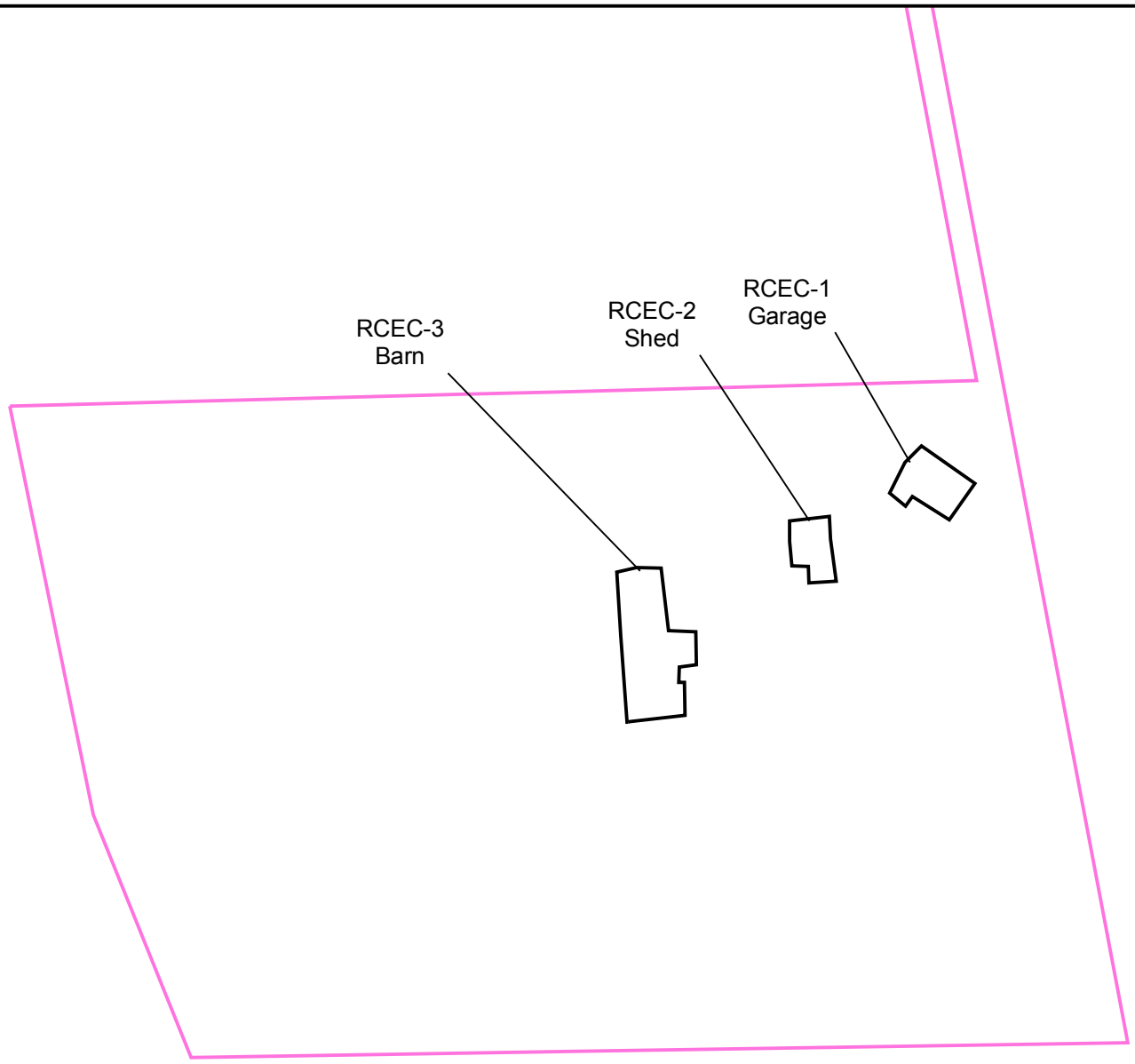
State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

Primary #
HRI#
Trinomial:

SKETCH MAP

Resource Name:

Drawn by: Mike Haskell
Date of Map: 1/16/07



LEGEND

Parcel # 439-0070-009

Building Locations

N

0 19 38 Meters

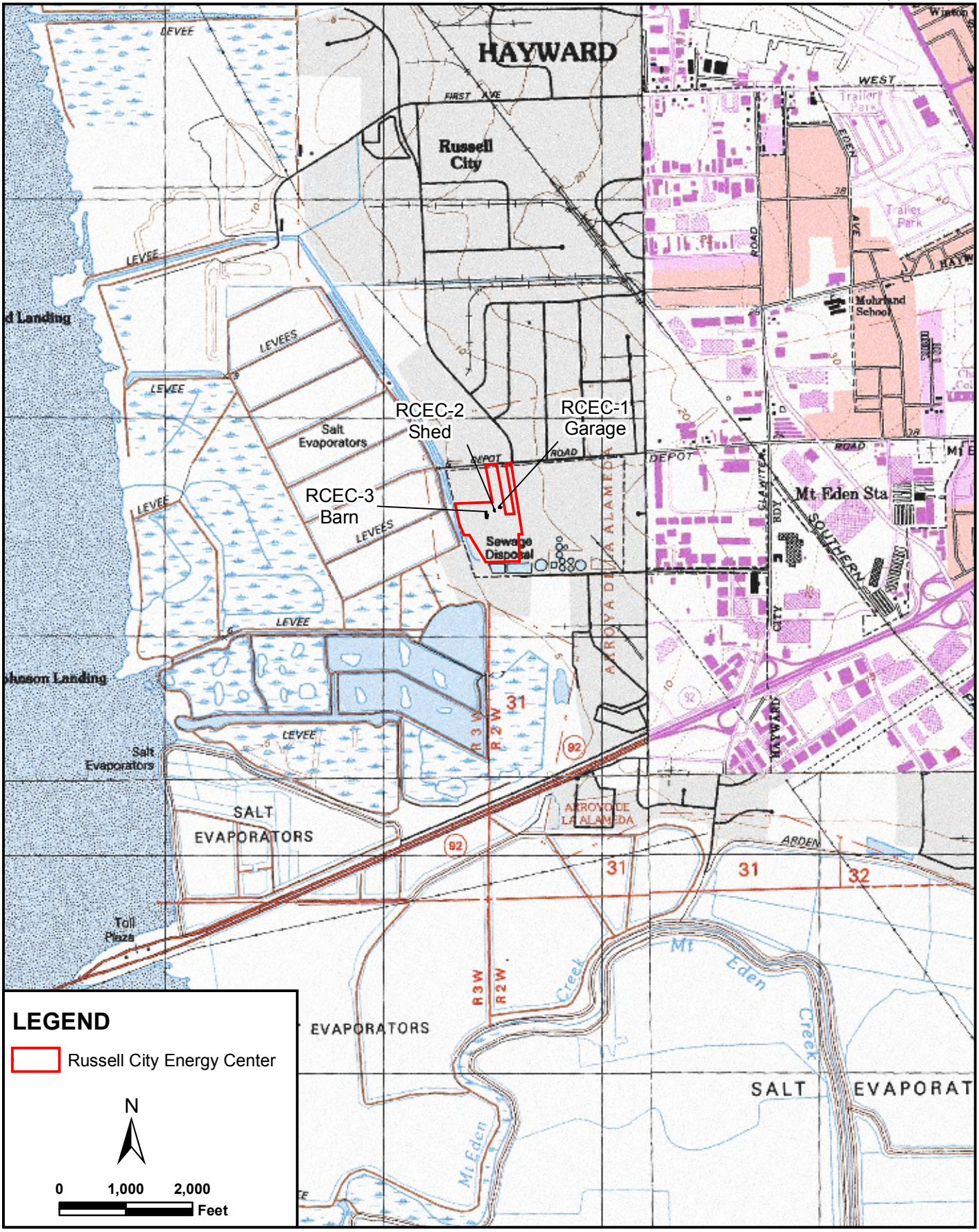
State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

Primary #
HRI#
Trinomial:

LOCATION MAP

Resource Name:

Map Name: San Leandro 7.5 min. Topographic Quadrangle Scale: 1:24000 Date of Map: 1/16/07



State of California — The Resources Agency DEPARTMENT OF PARKS AND RECREATION **PRIMARY RECORD**	Primary # HRI # Trinomial NRHP Status Code	
Other Listings Review Code	Reviewer	Date

 *Resource Name or #: RCEC-3

P1. Other Identifier:

***P2. Location:** ☐ **Not for Publication** ☒ **Unrestricted** ***a. County:** Hayward
and (P2b and P2c or P2d. Attach a Location Map as necessary.)

***b. USGS 7.5' Quad:** San Leandro **Date:** 1964 (1976)

c. Address: 3862 Depot Road City: Hayward, CA Zip: 94545

d. UTM: Zone: 10 ; 576,372 mE/ 4,1657,51 mN (G.P.S.)

e. Other Locational Data: (e.g., parcel #, directions to resource, elevation, etc., as appropriate) Elevation:

From State Route 92 in Hayward, California, take Clawiter Avenue north for 0.72 miles to Depot Road. Turn west on Depot Road and travel 0.79 miles to 3862 Depot Road. Turn south down a narrow lane at a sign that says “All Good Pallets” that extends for 620 feet. At the end of the lane, turn right and go 200 feet to the west, past the larger, more recent building to the south. The property is the barn-line structure 80 south of the lane.

***P3a. Description:** (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries)

The foundation of this barn-like structure is elevated about 6 inches above the surrounding area, perhaps because of flooding risk. The structure has two parts: a larger two-story barn, and a smaller one-story shed. Together, the two buildings are 115 feet long. The smaller structure is 45 feet long and the large one is 70 feet long. They are the same width, at 30 feet, although the larger building has a 15-foot-wide awning on the east side. As with the other two buildings, they have board-and batten siding and corrugated metal roofing. The small building has a door on the east side and no windows. The larger building has small windows on the east and west and a door on the west side. Facing the south wall is a hopper apparatus for handling agricultural products of some kind. This apparatus extends through the floor of the second floor. The first floor has a receiving bin and a small conveyor apparatus leading to a large hopper on the second floor. A small conveyor extends from this hopper out the second floor opening, so that the article processed or stored here could be deposited in a truck or other container. This structure appears as part of a farmstead on a 1939 aerial photograph.

***P3b. Resource Attributes:** (List attributes and codes)

***P4. Resources Present:** ☒Building ☐Structure ☐Object ☐Site ☐District ☐Element of District ☐Other (Isolates, etc.)

P5a. Photo or Drawing (Photo required for buildings, structures, and objects.)

P5b. Description of Photo: (View, date, accession #)
View of the east elevation

***P6. Date Constructed/Age and Sources:** ☒Historic ☐Prehistoric ☐Both

***P7. Owner and Address:**
Jon and Margaret Eash

***P8. Recorded by:** (Name, affiliation, and address)
Doug Davy, CH2M HILL, 2485 Natomas Park Drive, Suite 600 Sacramento, CA 95833

***P9. Date Recorded:** October 5, 1006

***P10. Survey Type:** (Describe)
Intensive pedestrian survey and architectural reconnaissance

***P11. Report Citation:** (Cite survey report and other sources, or enter "none). Russell City Energy Center (01-AFC-07) Amendment No. 1. Submitted to the California Energy Commission. Submitted by Russell City Energy Company, LLC. November 17, 2006.

***Attachments:** ☐NONE ☒Location Map ☐Sketch Map ☐Continuation Sheet ☐Building, Structure, and Object Record ☐Archaeological Record ☐District Record ☐Linear Feature Record ☐Milling Station Record ☐Rock Art Record ☐Artifact Record ☐Photograph Record ☐ Other (List):

BUILDING, STRUCTURE, AND OBJECT RECORD

*NRHP Status Code 7R

*Resource Name or # (Assigned by recorder) RCEC-3

B1. Historic Name:

B2. Common Name: Barn at 3862 Depot Road, Hayward

B3. Original Use: Unknown **B4. Present Use:** Barn

***B5. Architectural Style:** Other - Barn

***B6. Construction History:** (Construction date, alterations, and date of alterations)

The actual date of construction for this building is unknown; however, it appears on an aerial map of the region in 1939. Between 1939 and 1946, an addition was built on the west side of the barn. This addition no longer appears on a 1965 aerial map

***B7. Moved?** ☒No ☐Yes ☐Unknown **Date:** **Original Location:**

***B8. Related Features:**

RCEC-1, RCEC-2

B9a. Architect: Unknown **b. Builder:** Unknown

***B10. Significance: Theme:** Light Industrial Development **Area:** Hayward

Period of Significance: N/A **Property Type:** **Applicable Criteria:** N/A

(Discuss importance in terms of historical or architectural context as defined by theme, period, and geographic scope. Also address integrity.)

Assuming, based on aerial photograph analysis, that there was an adjacent farmhouse structure at one time, the removal of that structure has left the site without its primary focal point. It is unclear when the structures were first built, but the farmhouse was removed within a few years of the first photographs taken aerially. Additionally, buildings have been added and removed over the past sixty years and the use of the site during that is not known. It was at one time the site of a fertilizer plant. Its more recent history has been as a lumber storage yard, metal fabricating business, and pallet recycling facility. Therefore, it is difficult to gauge both a period of significance and a complete construction history. The architectural style could be classified as vernacular; without more research, it cannot be clearly stated whether or not there are any other examples of barns of this style in the immediate area, or in the City of Hayward or Alameda County. This style of barn is fairly common throughout the United States, as are the materials that were used to construct and adorn the individual structures. The building appears to be intact; although for approximately 20 years, it was enlarged by an addition on the west façade. It has likely lost integrity of setting, feeling, and association, which are important in determining its overall significance. Without more information, it cannot be determined is this structures is the work of a master. There are no known persons of significance associated with this building, and there is no evidence that any events that have importance on a local, state, or federal level occurred here. Without any other data, it appears that this structure lacks historic context within which to evaluate the importance of any information which could be gained.

B11. Additional Resource Attributes: (List attributes and codes)

***B12. References:**

LFR Levine-Fricke, "Phase I Environmental Site Assessment, 3862 and 3878 Depot Road, Hayward, California," December 2, 2004.

Historical Aerial Maps (1939, 1946, 1958, 1965, 1974, 1982, 1993, 1998)

Historical Topographical Maps (1899, 1948, 1959, 1968, 1973, 1980, 1993)

B13. Remarks:

***B14. Evaluator:** Jessica B. Feldman

***Date of Evaluation:** January 15, 2007

(Sketch Map with north arrow required.)

Sketch Map provided on page 3.

(This space reserved for official comments.)

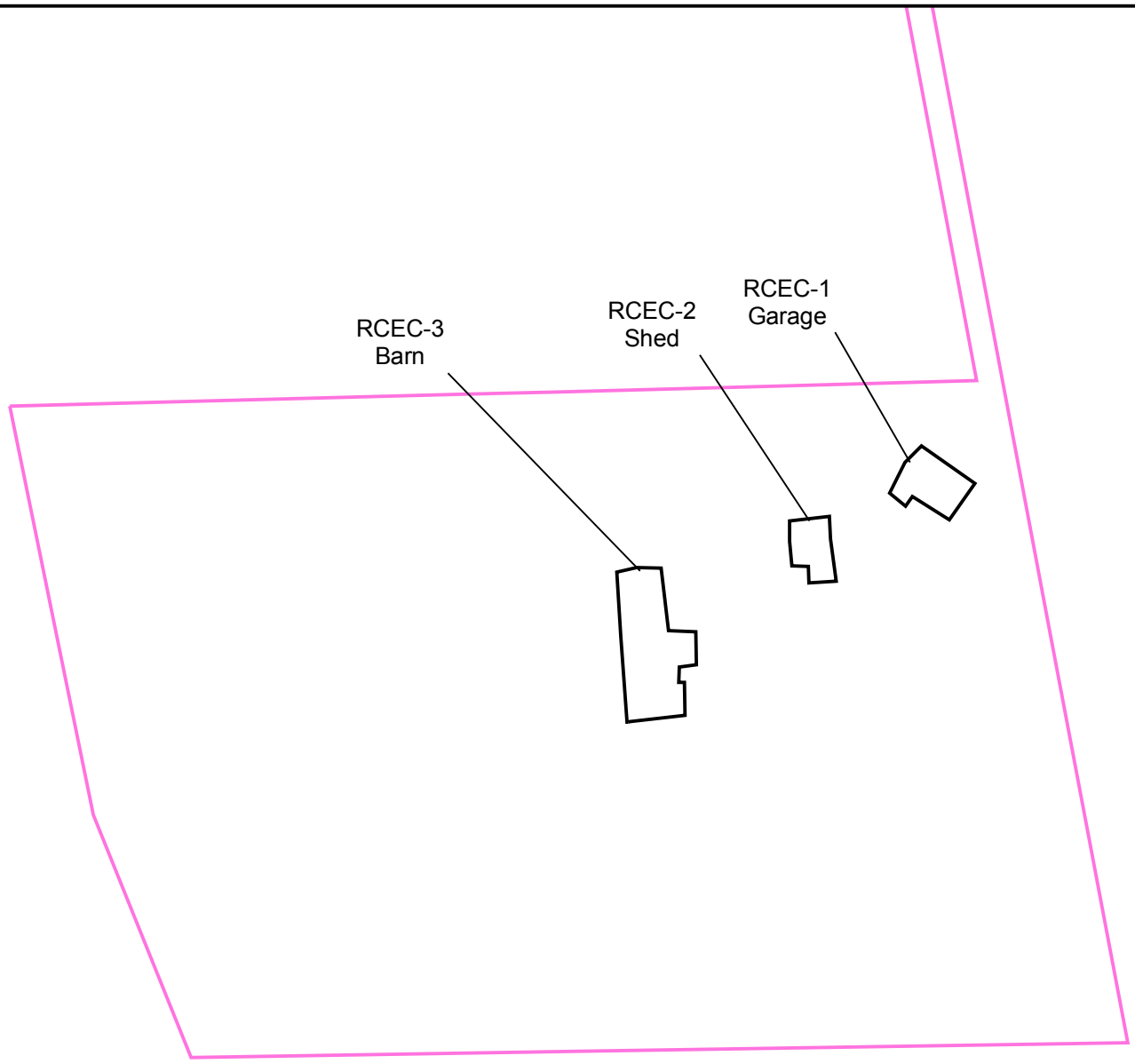
State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

Primary #
HRI#
Trinomial:

SKETCH MAP

Resource Name:

Drawn by: Mike Haskell
Date of Map: 1/16/07



LEGEND

Parcel # 439-0070-009

Building Locations

N

0 19 38 Meters

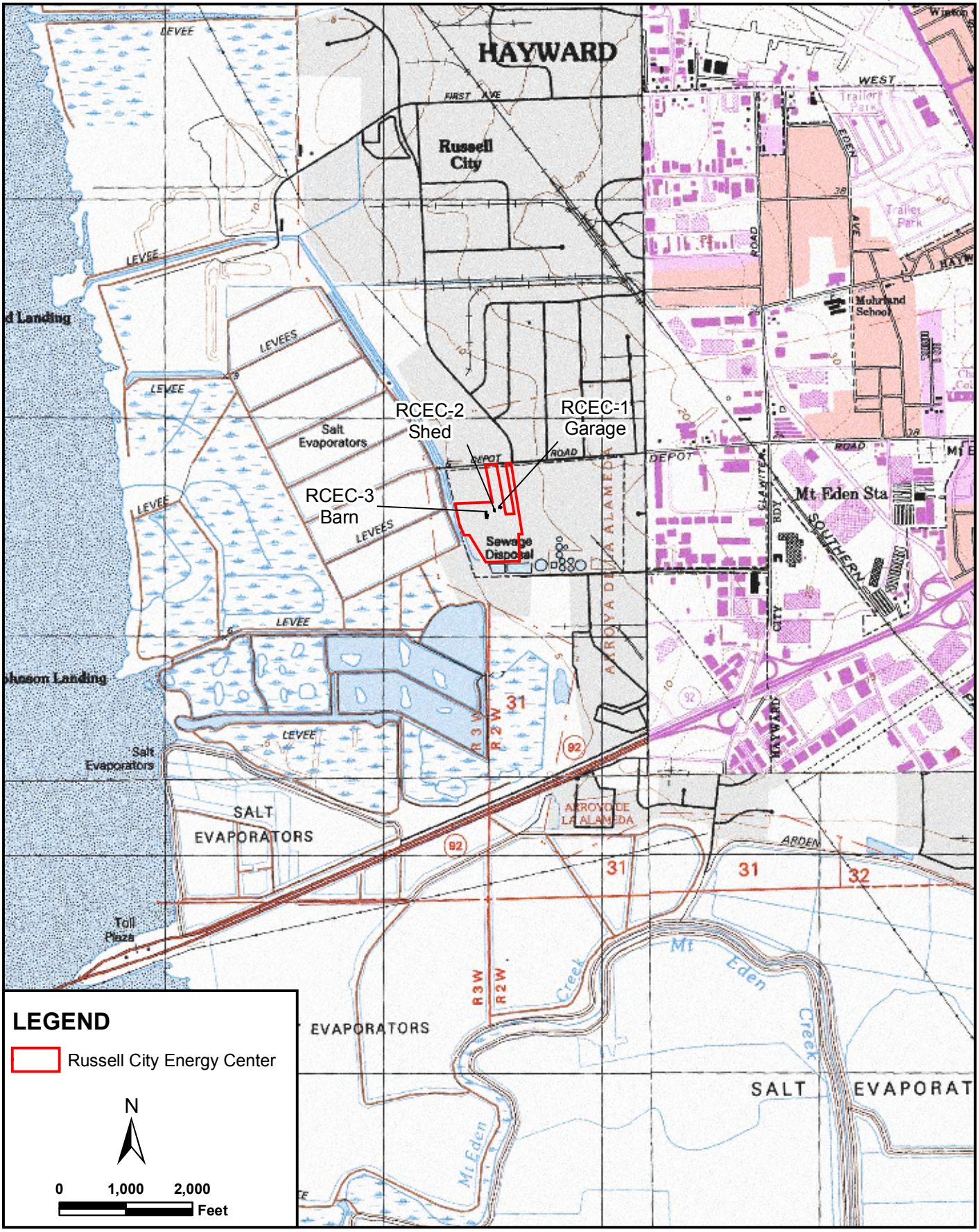
State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

Primary #
HRI#
Trinomial:

LOCATION MAP

Resource Name:

Map Name: San Leandro 7.5 min. Topographic Quadrangle Scale: 1:24000 Date of Map: 1/16/07



Geology and Paleontology

Data Response 28

Geology and Paleontology (28)

Geotechnical studies

28. *Please provide a copy of any available site-specific geotechnical data for the project site.*

Response: Site-specific geotechnical field investigations were completed in November and December 2006. The final geotechnical report should be available on or before February 9, 2007.

As part of the original licensing for this project, geotechnical investigations were performed for the Advanced Water Treatment Facility, including three borings on the City of Hayward's Water Pollution Control Facility property. A copy of the geotechnical data from this previous study is included as Attachment DR28-1. Boring CB-2 from this previous study is located approximately 40 feet southwest of the recycled water tank shown in Figure 2.1-2 of the Amendment to the AFC.

Attachment DR28-1

Geotechnical Data

ATTACHMENT DR-28-1

Geotechnical Data Report
Subsurface Investigation
Advanced Water Treatment System
Russell City Energy Center
Hayward, California

Prepared for

Calpine/Bechtel Joint Development
4160 Dublin Boulevard, Second Floor
Dublin, California 94568-3139

Harding ESE Project No. 53483 007

December 7, 2001

Harding ESE
A MACTEC COMPANY

Engineering and Environmental Services
90 Digital Drive
Novato, CA 94949 - (415) 883-0112

Harding ESE
A MACTEC COMPANY

Harding ESE, Inc.
90 Digital Drive
Novato, CA 94949

Home Page: www.mactec.com

December 7, 2001

53483 007

Mr. Peter Mason
Calpine/Bechtel Joint Development
4160 Dublin Boulevard, Second Floor
Dublin, California 94568-3139

Geotechnical Data Report
Subsurface Investigation
Advanced Water Treatment System
Russell City Energy Center
Hayward, California

Dear Mr. Mason:

This letter report summarizes the results of our subsurface investigation for the proposed advanced water treatment system (AWT) at the Russell City Energy Center in Hayward, California.

1. PURPOSE

The purpose of the subsurface investigation was to acquire geotechnical information beneath two parcels that are proposed for two advanced water treatment facilities, as part of a 600 MW gas-fired power generation facility, in Russell City, California. It is our understanding that these data will be used by CH2M Hill for design of the AWT system.

2. SCOPE OF INVESTIGATION

The scope of the investigation is provided in Change Order No. 003 to the base contract between Bechtel Power Corporation and Harding ESE, dated October 23, 2001. Field and laboratory activities were based on the original contract documents including the specification titled, *Technical Specification for Subsurface Investigation and Laboratory Testing for the Russell City Energy Center Project, Russell City, California, Rev. 0,* dated 2/27/01. In summary, the scope of work by Harding ESE included:

- Obtaining drilling permits and utility clearances
- Layout of boring locations
- Drilling and sampling of soil borings
- Providing field oversight and preparation of field boring logs
- Collect water level measurements, when available

- Handling, containment, and offsite disposal of drill cuttings and fluids
- Site restoration
- Performing selected laboratory testing of soil samples
- Preparation of a geotechnical data report including the results of the subsurface investigation.

Technical field oversight was provided by engineers, geologists, and geophysicists of Harding ESE, Inc. of Novato, California. Additional oversight was provided by geotechnical engineers from CH2M Hill of Oakland, California.

Drilling, laboratory testing, and waste handling services were provided by subcontractors to Harding ESE. Drilling subcontract services were provided by Pitcher Drilling Company, Palo Alto, California. Laboratory investigations were performed by Soil Mechanics Laboratory of Oakland, California. PSC Industrial Services of Benicia, California, provided drilling waste containment, hauling, and disposal services.

2.1 Borehole Layout and Utility Clearance

Subsurface drilling activities were conducted at 4 locations as shown on Plate 1, Site Exploration Plan North, and Plate 2, Site Exploration Plan South.

Each of these locations was staked by representatives of Harding ESE and CH2M Hill as per horizontal and vertical coordinates provided by CH2M Hill and as shown on the Site Exploration Plan (Plates 1 and 2). Three (3) borings were on the City of Hayward Sewage Treatment Facility property adjacent to Whitesell and Enterprise streets. The remaining boring was at the Salem property, to the South across Enterprise Street. The coordinates are provided in Table 1, Summary of Borehole Data. Prior to drilling, each location had a geophysical utility clearance performed by a Harding ESE geophysicist to document the presence of underground obstructions. This was of special significance on the Salem property, where each of 4 radio towers is underlain by extensive, radial grounding grids.

2.2 Drilling and Sampling (SPT Boreholes)

Pitcher Drilling mobilized a Failing 1500, truck-mounted mud-rotary drilling rig to the site on October 29, 2001. Drilling and sampling was completed by November 2, 2001. A total of four (4) deep mud-rotary boreholes were drilled and sampled to depths of between 100 and 150 feet. All boreholes were logged by Harding ESE field geologists. All borings were backfilled with cement grout using the tremie method. A summary table of the drill holes is presented in Table 1. Field (non-digitized) boring logs are included in Appendix A.

2.3 Water Level Monitoring

Water level measurements were collected when available. Most of the borings were left open overnight and allowed to stabilize. The water level measurement was collected on the following morning. The water level measurement for CB-1 was collected immediately before introducing the tremie pipe for backfilling. CB-1 was not left open overnight.

2.4 Laboratory Testing

Samples acquired during drilling were transported to Soil Mechanics Laboratory. Tests to determine engineering properties of the soil samples from the borings were assigned by the CH2M Hill geotechnical engineer. These tests included Moisture Content (ASTM D 2216), Atterberg Limits (ASTM D 4318), Sieve Analysis (ASTM D 422), Unconsolidated-Undrained (UU) Triaxial Compression (ASTM D 2850), Consolidation (ASTM D 2435), and Unconfined Compressive Strength (ASTM D 2166). Additional chemical testing including resistivity, sulfate, pH, and chloride was performed by CERCO Analytical, Inc., on selected samples. The laboratory test results are provided in Appendix B and shown on the boring logs (Appendix A).

3. RESULTS OF INVESTIGATION

The results of this investigation are provided in Appendices A and B of this report.

Harding ESE appreciates having had the opportunity to provide these geotechnical services for Calpine/Bechtel Joint Development. If you have any questions, please contact William Godwin at 415/884-3275.

Yours very truly,

Harding ESE, Inc.

Matthew H. Walraven
Senior Staff Environmental Scientist

William H. Godwin, C.E.G.
Senior Engineering Geologist

MHW/WHG:gj/GJ58106-Geotech

Attachments:

	Table 1	Summary of Borehole Data
	Table 2	Summary of Laboratory Test Results
	Plate 1	Site Exploration Plan North
	Plate 2	Site Exploration Plan South
	Appendix A	Boring Logs
	Appendix B	Laboratory Test Results

TABLES

Table 1. Summary of Borehole Data

Final Geotechnical Data Report
Subsurface Investigation
Advanced Water Treatment System
Russell City Energy Center
Hayward, California

Boring No.	Northing	Easting	Elevation* (ft)	Depth (ft)	Comments
CB-1	2056775	6089165	6.0	100	
CB-2	2057700	6088800	7.5	100	
CB-3	2057700	6088950	9.0	150	
CB-4	2057700	6089100	11.0	100	Includes shallow makeup Boring CB-4A

NOTES:

No. = Number.
* = Elevations are approximate.
ft = Feet.

Table 2. Summary of Laboratory Test Results

Geotechnical Data Report
Subsurface Investigation
Advanced Water Treatment Plant
Russell City Energy Center
Hayward, California

	Sample		Laboratory Test											
Boring Number	Depth (ft)	Type	USCS	% Fines	Sieve Analysis	Moisture Content %	Liquid Limit	Plastic Limit	Unconfined Compression (psf)	Consolidation	pH	Resistivity (ohms-cm)	Chloride (mg/kg)	Sulfate (mg/kg)
CB-1	5.0-6.5	SS	CL				61	21			8.1	300	640	230
	10.0-12.5	ST	CL	81.8	a	22.6	35	12	491	b				
	15.0-16.5	SS	CL				37	16			7.8	550	420	110
	20.0-21.5	SS	CL				36	19						
	30.0-31.0	ST	CL	86.6	a	18.5	38	13	1837					
	45.0-47.0	ST	CL	83.1	a	21.9	35	15	764	b				
	67.0-69.5	ST	CL			27.5	42	20	3049	b				
CB-2	10.0-11.5	SS	CL	83.4	a	21	31	14						
	12.5-15.5	ST	CL	85.7	a	20.1	34	12	2568	b	8.1	1,400	24	73
	25.0-26.5	SS	CL	89.9	a	21	46	16						
	31.5-34.5	ST	CL			19.4	30	12	2224	b				
	49.0-51.5	ST	GC	35.0	a	21.8	34	13	643					
	70.0-72.5	ST	CL			24.6	32	20	3358					
	90.0-91.5	SS	ML				26	22						
CB-3	5.0-6.5	SS	CL	67.4	a		39	15						
	10.0-12.5	ST	CL	79.2	a	25.1	29	12	949	b	8.1	2,200	ND	28
	20.0-21.5	SS	CL	57.6	a	19	31	14						
	27.0-29.5	ST	CL	71.6	a	20.5	32	18	1606	b				
	47.0-49.5	ST	CL			20.9	34	18	2551					
	72.0-74.5	ST	CL			20.8	29	16	4080	b				
	130.0-131.5	ST	SM			24.3			1370					
CB-4A	6.0-8.5	ST	CL			17.3	29	13	1370	b	8.2	1,100	100	150
CB-4	7.5-9.0	SS	CL	53.0	a	19	31	15						
	15.0-16.5	SS	CL				34	19						
	20.0-22.5	ST	CL	83.6	a	24.1	32	12	570	b	8.1	1,800	ND	24
	30.0-31.5	SS	CL				32	16						
	45.0-47.5	ST	CL			18.7	33	12	2118	b				
	65.0-67.5	ST	CL	99.4	a	26.9	44	16	4312	b				

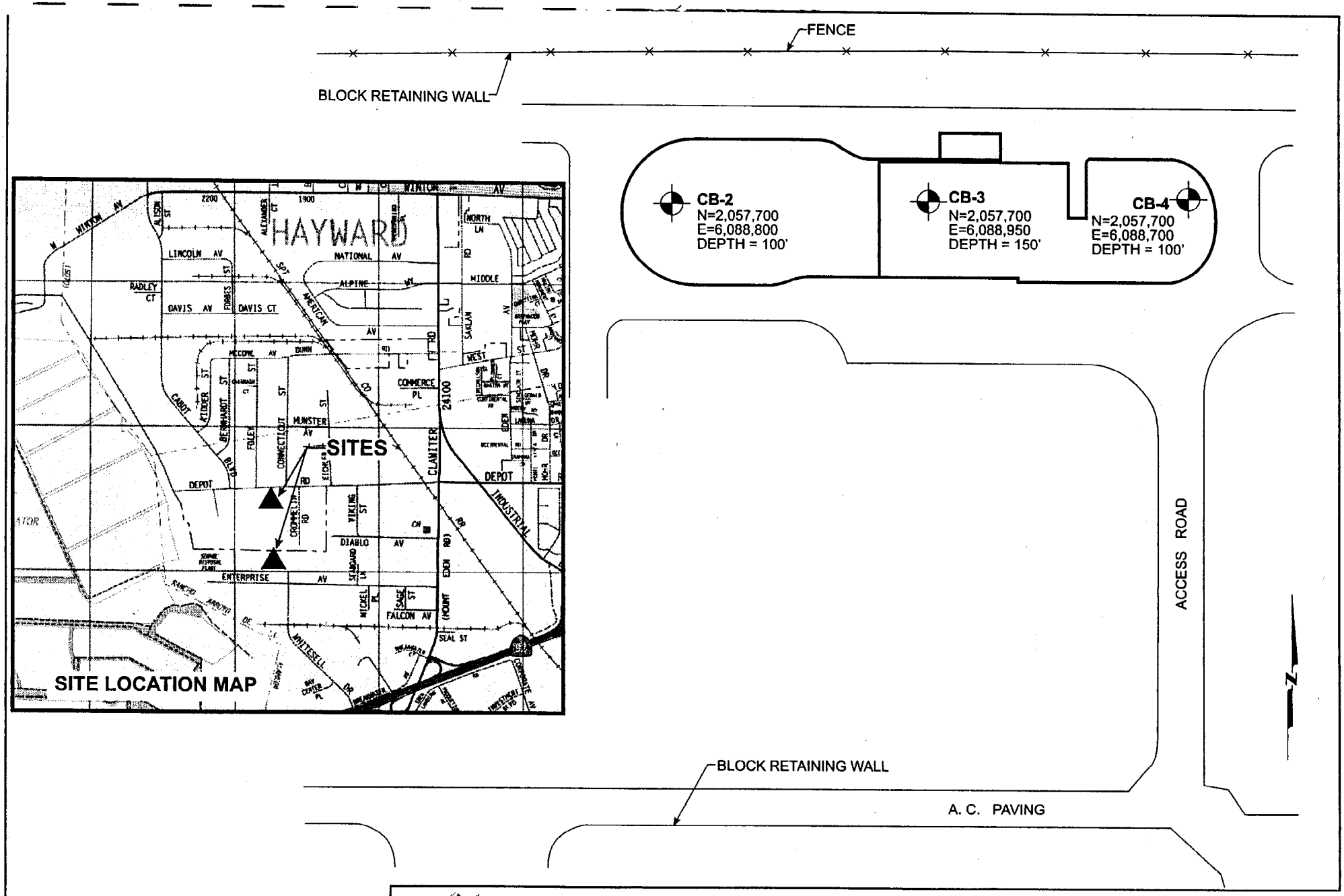
Table 2. Summary of Laboratory Test Results

Geotechnical Data Report
Subsurface Investigation
Advanced Water Treatment Plant
Russell City Energy Center
Hayward, California

NOTES:

a	=	See Particle Size Analysis Test Report Graphs (ASTM D 422-63) in Appendix B for details.
b	=	See Consolidation Test Report Graphs (ASTM D 2435) in Appendix B for details.
ft	=	Feet
mg/kg	=	Milligrams per kilogram
psf	=	Pounds per square foot
USCS	=	Unified Soil Classification System
CH	=	See Plate A-1
CL	=	See Plate A-1
ML	=	See Plate A-1
SC	=	See Plate A-1
SM	=	See Plate A-1
SP-SM	=	Dual Classification, See Plate A-1
SW-SM	=	Dual Classification, See Plate A-1
ND	=	Not Detected
NP	=	Non Plastic
NV	=	Non Viscous
ST	=	Shelby Tube
SS	=	Split Spoon

PLATES

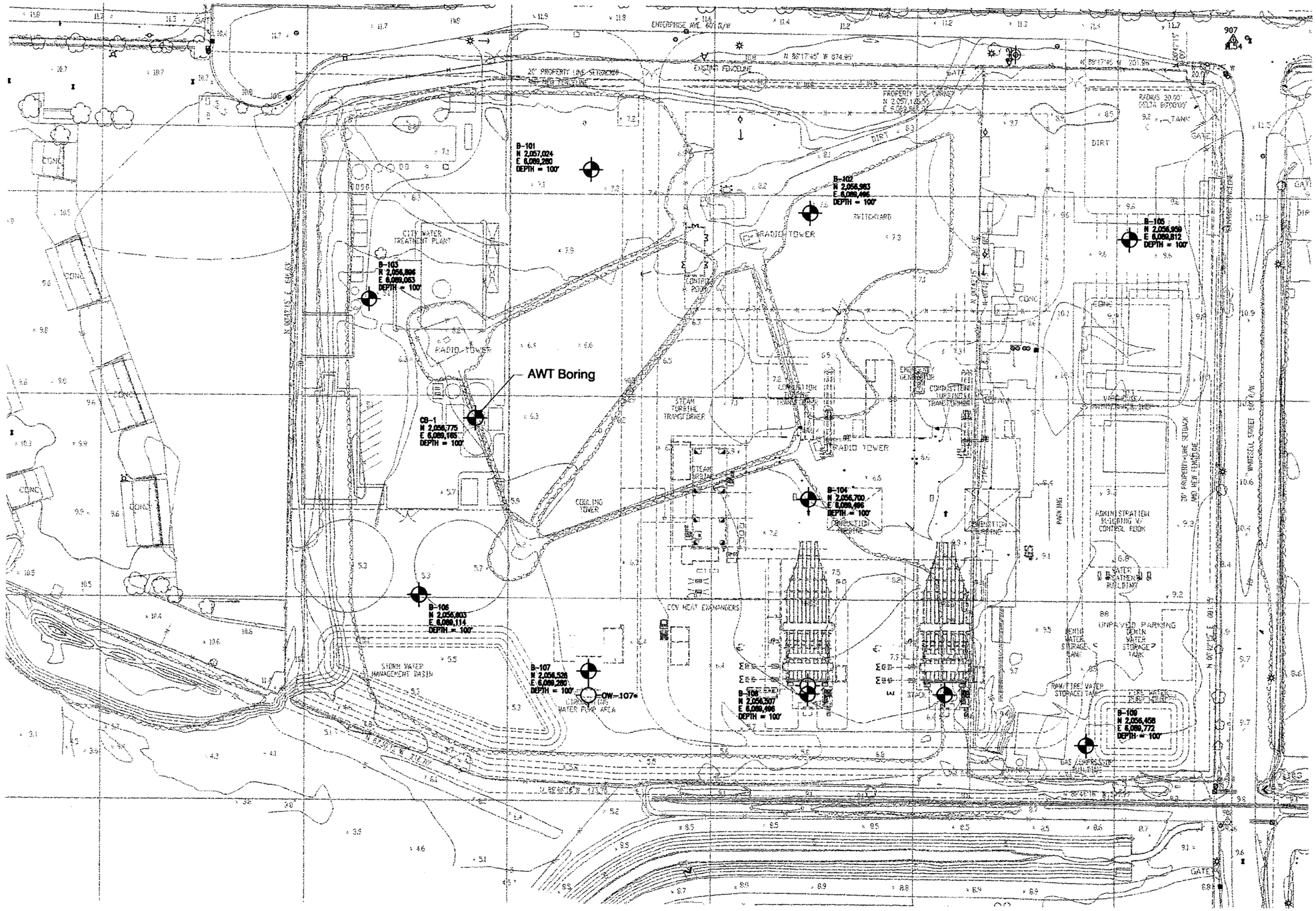


Harding ESE
A MACTEC COMPANY

Site Exploration Plan North
Russell City Energy Center
Advanced Water Treatment Plant
Hayward, California

PLATE
1

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED
CN	53483 007		12/01	



0 100 200

APPROX. SCALE IN FEET

EXPLANATION

EXPLORATORY BORING

PIEZOMETER

Harding ESE

A MACTEC COMPANY

Site Exploration Plan South
Russell City Energy Center
Advanced Water Treatment Plant
Hayward, California

PLATE

2

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
CN	53483 007	WH	12/01	

53483006.DWG 1.0
20012071505

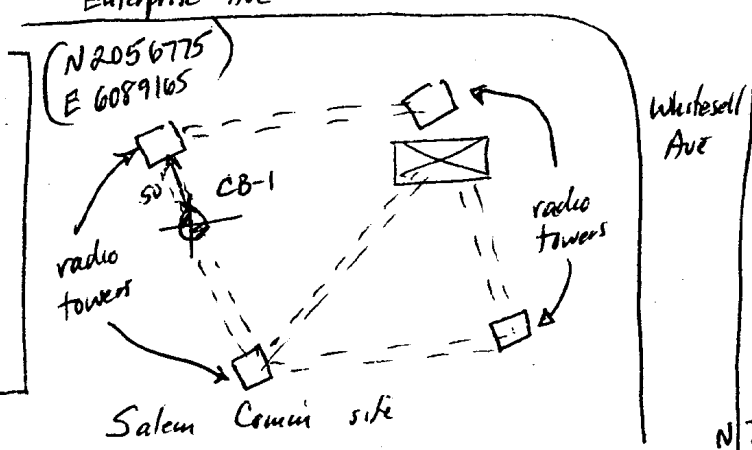
APPENDIX A

BORING LOGS

FIELD LOG OF BORING

SHEET 1 OF 6

LOCATION OF BORING: Water Treatment Plant to AWT



PROJECT: ADVANCED WATER TREATMENT SYSTEM (AWTS) RUSSELL CITY	BORING NO. CB-1
	TOTAL DEPTH: 100'
JOB NO.: 53483 007	LOGGED BY: M. WALRAVE
PROJ. MGR.: W. GODWIN	EDITED BY: W. Godwin
DRILLING CONTRACTOR: PITCHER DRILLING CO	
DRILL RIG TYPE: FAILING 1500	
DRILLERS NAME: RALPH DE LORRE	
SAMPLING METHODS: SPT & SHELBY	
HAMMER WT.: 140#	DROP: 30" CATHEAD WINCH
STARTED, TIME: 0750	DATE: 11/2/01
COMPLETED, TIME: 1500	DATE: 11/2/01
BORING DEPTH (ft.) 100'	
CASING DEPTH (ft.) Ø	
WATER DEPTH (ft.) 5.3' bgs	
TIME: 1550	
DATE: 11/2/01	
BACKFILLED, TIME: 1630	DATE: 11/2/01 BY: PITCHER
SURFACE ELEV.:	DATUM:
CONDITIONS:	

SAMPLE TYPE	BLOWS/6-IN.	INCHES DRIVEN	INCHES RECOVERED	SAMPLE CONDITION	DRILLING RATE (min/ft)	POCKET PENETROMETER T/FT²		TIME	DEPTH IN FEET	GRAPHIC LOG	
									1		
									2		
SPT	2	6	0	—				0754	3		Brown (7.5YR 4/2) clayey sand (SC), dry, loose, ~~granular~~
	6	6	5	P							15% clay, 85% poorly graded fine sand
	10	6	6	G		2.25			4		Brown (7.5YR 4/2), lean clay (CL) moist, medium plasticity, hard
									5		
	3	6	6	G				0800			Dark grayish brown (10YR 4/2), lean clay (CL)
SPT	7	6	6	G		1.5			6		moist, med. plast, ~~soft~~ firm
	9	6	6	G							
SHELBY		6	0	—		150 PSI		0815	7		- no recovery (≈ 6") -
		6	0	—							
		6	0	—					8		
		6	0	—							
		6	6	P		0.5 T/FT²			9		As above - wet, soft
Shelby		6	0	—		250 PSI		0830	10		Brown (10YR 4/3) clayey sand (SC), wet, loose

FIELD LOG OF BORING (CONTINUED)

PROJECT: 53483 | NO 007 | BORING NO CB-1

AWTS / RUSSELL CITY

DEPTH	TYPE	BLOWS	DRIVEN	REC'V'D	COND.	D.RATE	PEN. T/FT²		TIME	DEPTH	GRAPHIC LOG	
	Shelby		6	0	–		250 PSI			11		20% lean clay 80% well graded sand
			6	0	–							samples are saturated, most of sample
10.0			6	6	G					12		fell out of tube
			6	6	G			0.25 T/FT²				
	SPT	6	6	6	G				0840	13		SPT : Yellowish brown (10YR5/6) sandy
13.0		8	6	6	G		3.25					~~Brown~~ lean clay (CL), med plasticity
		11	6	6	G		2.25			14		moist, hard ~~graded~~ to clayey sand (SC)
												moist, loose, 30% lean clay, 70% poorly
										15		graded fine sand
	SPT	6	6	6	F				0850			Yellowish brown (10YR5/4) clayey sand
15.5		9	6	6	G		2.25			16		(SC), wet, loose, 20% lean clay, 80%
		12	6	6	G							poorly graded very fine sand, <1% concretions
										17		
										18		
										19		
	SPT	2	6	6	G		0.75		0900	20		
20.5		4	6	6	G					21		As above - clay concentrations
		6	6	6	G		0.25					vary at ≈ 2" intervals, from
										22		0 - 40% any given interval, sands
												are poorly graded and range from
										23		very fine to medium
												- overbank type alluvial deposits. -
												- small concretions occur in discrete
										24		zones
	SPT	3	6	6	G		0.25		0910	25		
25.5		7	6	6	G		1.25 0.25			26		
		9	6	6	G		0.5					
										27		
										28		
										29		
30.0	Shelby		6	6	G		150 PSI		0920	30		As above - concretions to fine gravel size

FIELD LOG OF BORING (CONTINUED)

PROJECT: 53483 | NO 007 | BORING NO CB-1

AWTS / RUSSELL CITY

DEPTH	TYPE	BLOWS	DRIVEN	REC'V'D	COND.	D.RATE	PEN. T/FT²		TIME	DEPTH	GRAPHIC LOG	
30.0	Shelby		6	6	G		300 PSI			31		– Recovered 2' of sample – Yellowish brown (10YR 5/4) clayey sand (SC), moist-wet, loose, clay varies to 2-3" zones from 0-40% poorly graded sands from VF - Med.
										32		
										33		
										34		
	SPT	4	6	6	G				0941	35		As above
35.5		6	6	6	G		1.5			36		Grades downward to: ~~Yellowish~~ Brown (10YR 5/3) elastic silt (MH), moist, soft
		9	6	6	G							
										37		
										38		
										39		
	SPT	2	6	6	F				1000	40		Light olive brown (2.5Y 5/3) fat clay (CH) moist, soft grading downward to clayey fine sand (SC), moist, loose, 30% clay 70% poorly graded fine sand
40.5		5	6	6	G		0.75			41		
		8	6	6	G							
										42		
										43		
										44		
45.0	Shelby		6	6	G		150 PSI		1015	45		– Recovered full sample tube (2.75') –
			6	6	G					46		
			6	6	G							Olive (5Y 4/3) elastic silt (MH) high plasticity, moist (wet in fractures), Firm
			6	6	G		300 PSI	1.25 T/FT²		47		
	SPT	8	6	5	F				1025			
47.5		16	6	6	G			2.0		48		Olive gray (5Y 4/2) sandy clay (CL) grading downward to clayey sand (SC), moist, CL = Firm, med plasticity, V.F. sand SC = medium dense, 40% clay, 60% V.F. sand
		21	6	6	G							
										49		
	SPT	11	6	6	G				1105	50		

HARDING LAWSON ASSOCIATES

PROJECT: 53483 NO 007 BORING NO CB-1

AWTS / Russell City

DEPTH	TYPE	BLOWS	DRIVEN	REC'V'D	COND.	D.RATE	PEN T/FT²		TIME	DEPTH	GRAPHIC LOG	
50.5	SPT	13	6	6	G		2.75			51		
		17	6	6	G							Convections in fractures / Olive brown (2.5Y 4/3)
										52		poorly graded fine sand (SP), wet, medium
												dense. (<5% clay)
										53		
										54		
										55		
	SPT	6	6	6	G				1120			Brown (10YR5/3) fat clay (CH) moist, firm
55.5		6	6	6	G		1.25			56		Convections in fractures
		13	6	6	G							Brown (10YR5/3) poorly graded sand (SP)
										57		wet, medium dense, medium sand
										58		
										59		
										60		
60.5	SPT	5	6	6	G				1135			Dark grayish brown (2.5Y 4/2) elastic silt (MH)
		7	6	6	G		0.75			61		moist, soft, fining downward to
		9	6	6	G							fat clay (CH), moist, soft, high plasticity
										62		
										63		
										64		
												Olive gray (5Y 4/2) poorly graded V.F. sand (SP)
										65		Wet, loose
	SPT	5	6	6	G				1155			Olive gray (5Y 5/2), lean clay (CL), med
5.5		10	6	6	G		1.25			66		plasticity, moist, ~~soft~~ firm.
		11	6	6	G							
										67		
7.0	Shelby		6	6	G		150 PSI		1215			
			6	6	G					68		
			6	6	G							
			6	6	G							
			6	6	G		250 PSI			69		
							1.25 T/FT²					
										70		
	SPT	4	6	6	F				1225			Olive (5Y 5/3) poorly graded medium sand (SP)

FIELD LOG OF BORING (CONTINUED)

PROJECT: 53483 | NO 007 | BORING NO CB-1

AWTS / Russell City

DEPTH	TYPE	BLOWS	DRIVEN	REC'V'D	COND.	D.RATE	PEN T/FT²		TIME	DEPTH	GRAPHIC LOG	
70.5	SPT	5	6	6	F					71		wet, very loose, - no clay, samples
		8	6	6	F							~~As above~~ deformed immediately. - no
										72		Penetrometer possible
										73		
										74		
	SPT	6	6	6	F				1250	75		Olive (5Y5/3) clayey sand (SC) moist,
75.5		10	6	6	F		0.75			76		loose, 20% clay, 80% poorly graded
		17	6	6	F							very fine sand. (No clay in shoe materials)
										77		
										78		
										79		
	SPT	7	6	6	G				1315	80		Light olive brown (2.5Y5/3) lean clay (CL)
0.5		14	6	6	G		1.25			81		moist, firm, medium plasticity.
		19	6	6	G							
										82		
										83		
										84		
	SPT	5	6	6	G		1.25		1340	85		
5.5		10	6	6	G					86		Light olive brown (2.5Y5/3) clayey sand (SC)
		16	6	6	G		0.75					moist, medium dense, 20% clay, 80%
										87		poorly graded V.F sand.
												Poorly graded fine sand lens (<2") (SP)
										88		overlying (SC)
										89		
	SPT	7	6	6	G				1400	90		Olive brown (2.5Y4/3) fat clay (CH)

FIELD LOG OF BORING (CONTINUED)

PROJECT: 53483 | NO 007 | BORING NO CB-1

AWTS / RUSSELL CITY

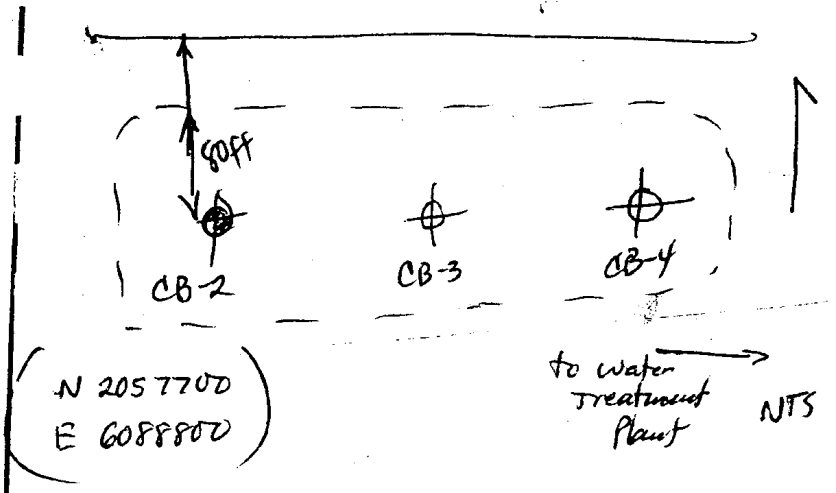
DEPTH	TYPE	BLOWS	DRIVEN	REC'V'D	COND.	D.RATE	PEN. T/FZ		TIME	DEPTH	GRAPHIC LOG	
90.5	SPT	10	6	6	G		1.50		1400	91		moist, firm.
		15	6	6	G							
										92		
										93		
										94		
										95		
	SPT	7	6	6	G				1430			Dark grayish brown (2.5Y4/2) lean
95.5		11	6	6	G		2.25			96		clay (CL) moist, hard, high plasticity
		18	6	6	G							
										97		
										98		
										99		
	SPT	6	6	3	P				1445	100		Dark greenish gray (5G4/1) fat clay
00.5		10	6	6	G		2.75			101		slightly moist, hard – bay mud facies
		16	6	6	G							
										102		TD = 100.0'
										103		
										104		1450 Water level in boring at 5.3' bgs
										105		
										106		
										107		
										108		
										109		
										110		

F8

FIELD LOG OF BORING

SHEET 1 OF 6

LOCATION OF BORING:



PROJECT: Russell City Energy Center Advanced Water Treatment System (AWTS)	BORING NO. CB-2
	TOTAL DEPTH: 100'
JOB NO.: 53483 007	LOGGED BY: M. Walrave
PROJ. MGR.: Bill Godwin	EDITED BY: W. Godwin
DRILLING CONTRACTOR: Pitcher Drilling Co.	
DRILL RIG TYPE: Failing 1500	
DRILLERS NAME: Ralph Deletoff	
SAMPLING METHODS: CAMod / SPT / Shelby	
HAMMER WT.: 140	DROP: 30" - Cathead
STARTED, TIME: 0855	DATE: 10/29/01
COMPLETED, TIME: 1630	DATE: 10/29/01
BORING DEPTH (ft.)	100'
CASING DEPTH (ft.)	
WATER DEPTH (ft.)	
TIME:	
DATE:	
BACKFILLED, TIME: AM	DATE: 10/30 BY: Driller
SURFACE ELEV.: 7.8' est	DATUM: MSL
CONDITIONS: Flat, dirt area, sludge drying area	

SAMPLE DEPTH	SAMPLER TYPE	BLOWS/6-IN.	INCHES DRIVEN	INCHES RECOVERED	SAMPLE CONDITION	DRILLING RATE (min/ft)	POCKET PEN T/FT²	PRESSURE (PSI)	TIME	DEPTH IN FEET	GRAPHIC LOG	
										1		Brown (10YR4/3) (Surface - dry)
	CAMod	12	6	0					900	2		
		17	6	5	F		2.75			3		Very dark grey (5YR3/1) clayey silt (ML) moist, hard
3.5		18	6	6	G	4.5	1.50			4		
	CAMod	8	6	0					915	5		
		16	6	3	P		3.0			6		As above ~1% organic matter, ~1% fine gravel
6.0		18	6	6	G		2.5					Dark grey (N4) sandy clay, firm, moist
										7		Fine gravel, well rounded, med sphericity - from cuttings
		4								8		
		7								9		
	SPT CAMod	0	6	5			0.5		0930	10		Brown (10YR5/3) fat clay (CH), soft, moist-wet

FF7

FIELD LOG OF BORING (CONTINUED)

SHEET 2 OF 6

PROJECT: 53483 | NO 007 | BORING NO CB-2

AWTS on/ Russell City

DEPTH	TYPE	BLOWS	DRIVEN	REC'V'D	COND.	D.RATE	Pen (T/Ft)	Pressure (PSI)	Time	DEPTH	GRAPHIC LOG	
	SPT	4	6	6			0.75			11		Sandy clay loose – wet
11.0		7	6	6			2.0					Drier, denser, silty w/ ~ 1% med sand
										12		
Shelby	Shelby							100psi	0945	13		
12.5-15.5										14		
							2.3			15		
							2.3	100psi				
CAMod	CAMod	6		4					1000	16		Brown (10YR5/3) poorly graded gravel with sand (GP) loose, wet; 70% fine, well rounded, high specificity
		10		6								
16.5		12		6						17		gravel, 20% VF sand, 10% fat clay
							2.25					Mottled light grayish brown (10YR6/2) poorly
										18		graded clayey fine sand, medium dense, moist
												15% lean clay. (SP)
										19		
										20		
	SPT	84		6			1.25		1020			Mottled grayish brown and strong brown (10YR5/2 – 7.5YR5/6)
25		8		6			1.75			21		poorly graded clayey fine sand (SP) loose
		10		6			2.25					moist
										22		
										23		
										24		
	SPT	5		4			2.5		1035	25		
25		8		6			2.5					Brown (10YR5/3) poorly graded clayey VF sand (SC)
		10		6			2.5			26		medium dense, moist, 35% high
												plasticity clay
										27		
										28		
										29		
	SPT Shelby	4		0						30		

FIELD LOG OF BORING (CONTINUED)

PROJECT: 53483 | NO 007 | BORING NO CB-2

AWTS / RUSSELL CITY

DEPTH	TYPE	BLOWS	DRIVEN	REC'V'D	COND.	D.RATE	Pen (T/Ft²)	Pressure (PSI)	Time	DEPTH	GRAPHIC LOG	
		5		2						31		Yellowish brown (10YR5/6) clayey sand (SC) loose, moist; vf-~~m~~ sands, 20% lean clay.
31.0	(SPT)	6		6			1.25					
31.5	SHELBY		6					100 psi	1045	32		
			6	6								
			6	6						33		⅞ CONCRETIONS – UP TO 1-IN. ϕ. (R) (REPORTED BY LABORATORY)
			6	6								
			6	6								
			6	6			2.75	200 psi		34		
								120 psi		35		
										36		
										37		
										38		
										39		
	SPT	4		6					1110	40		Brown (10YR4/3) clay (CL) medium plasticity, moist, soft, grading to sandy clay, grayish brown (10YR5/2), 15% vf sand.
0.5		6		6			1.25			41		
		8		6								
										42		
										43		
										44		
	SPT	4		6					1125	45		Greenish gray (5GY5/1) lean clay (CL) medium plasticity, moist, soft.
5.5		7		6						46		
		9		6			1.0					
										47		
	Shelby									48		
.0	Shelby						150	1145		49		
										50		

FIELD LOG OF BORING (CONTINUED)

PROJECT: 53483 | NO 007 | BORING NO CB-2

AWTS / Russell City

DEPTH	TYPE	BLOWS	DRIVEN	REC'V'D	COND.	D.RATE	Pen (T/Ft)	Pressure (PSI)	Time	DEPTH	GRAPHIC LOG	
	Shelby			6				150		51		
				6			1.5	250				
										52		
										53		
										54		
										55		
	SPT	4		0					1210			Olive gray (5Y4/2) elastic silt (MH), moist
		6		6						56		soft. plastic, fat
56.0		9		6			1.25					
										57		
										58		
										59		
		6		6						60		
0.5		9		6			1.25		1310	61		Olive gray (5Y4/2) elastic silt, moist
		13		6								med to high plasticity
										62		
										63		
										64		
										65		
										66		
										67		
										68		
										69		
70	Shelby						150psi		1345	70		

FIELD LOG OF BORING (CONTINUED)

SHEET 5 OF 6

PROJECT: 53483 | NO 007 | BORING NO CB-2

AWTS / Russell City

DEPTH	TYPE	BLOWS	DRIVEN	REC'V'D	COND.	D.RATE	Pen T/Ft²	Pressure PSI	Time	DEPTH	GRAPHIC LOG	
	Shelby		6							71		
			6									
			6							72		
			6	6			2.75					
										73		
										74		
	SPT	6	6	6					1400	75		Dark greenish gray (5G 4/1) elastic silt (MH) soft, moist - wet, channeled
75.5		10	6	6								
		11	6	6			1.0			76		
										77		
										78		
										79		
	SPT	6	6	6				1.5	1425	80		Olive gray (5Y 4/2) clayey sand (SC) grading to poorly graded V.F. sand (SP), moist, loose - medium dense. Clay 30% → 10%
0.5		11	6	6								
		18	6	6				3.5-failure		81		
										82		
										83		
										84		
	SPT	9		6					1445	85		Mottled Yellowish brown (10YR 5/4) elastic silt (MH) grading downward to a clayey V.F. sand (SC), moist, channeled, firm. Clay 50% → 20%
5.5		13		6			1.5	1.5				
		21		6						86		
										87		
										88		
										89		
	SPT	14	6	6			1.0		1520	90		

FIELD LOG OF BORING (CONTINUED)

PROJECT: 53483 | NO 007 | BORING NO. CB-2

AWTS / Russel City Energy Ctr.

DEPTH	TYPE	BLOWS	DRIVEN	REC'V'D	COND.	D RATE	Pen. T/FT²	PRESSURE	TIME	DEPTH	GRAPHIC LOG	
90.5	SPT	15		6			0.5 1.25			91		Light olive brown (2.5Y 5/3) clayey sand (SC) medium dense, moist. Clay grades from 0-20%; sands; bedded poorly graded, range from fine to silt
		21		6			2.0					
										92		
										93		
										94		
	SPT	8		6			1.75		1546	95		
95.5		15		6			2.0 2.5	~~2.5~~		96		Very dark grayish brown (2.5Y 3/2) elastic silt (MH) moist, hard.
		22		6			3.75	~~3.75~~				
										97		
										98		
										99		
		11		6					1605	100		
00.5		15		6			2.5			101		Dark olive gray (5Y 3/2) fat clay (CH), hard slightly moist.
		19		6								
										102		TD = 100' Backfilled with neat cement grout
										103		
										104		
										105		
										106		
										107		
										108		
										109		
										110		

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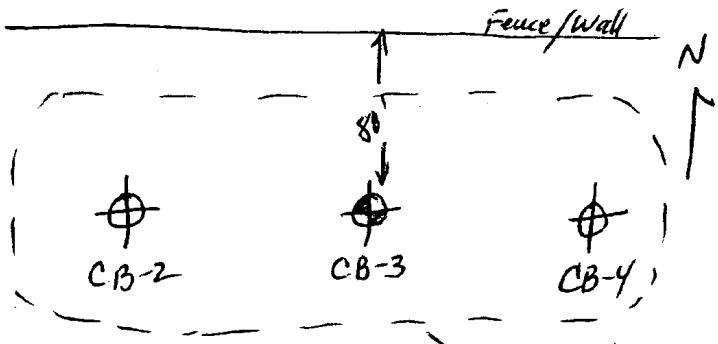
6
8
14

FIELD LOG OF BORING

SHEET 1 OF 9

LOCATION OF BORING:



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NTS

PROJECT: Advanced Water Treatment System Russell City (AWTS)	BORING NO. CB-3
	TOTAL DEPTH: 150'
JOB NO.: 53483 007	LOGGED BY: M. Walraven
PROJ. MGR.: W. Godwin	EDITED BY: W. Godwin
DRILLING CONTRACTOR: Pitcher Drilling Co.	
DRILL RIG TYPE: Failing 1500	
DRILLERS NAME: Ralph DeLorre	
SAMPLING METHODS: SPT & Shelby Tube	
HAMMER WT.: 140#	DROP: 30" - cathead winch
STARTED, TIME: 0830	DATE: 10/31/01
COMPLETED, TIME: 1215	DATE: 11/1/01

BORING DEPTH (ft.)	90.0'		
CASING DEPTH (ft.)	Ø		
WATER DEPTH (ft.)	7.0'		
TIME:	0705		
DATE:	11/1/01		

BACKFILLED, TIME: 1400 DATE: 11/1/01 BY: Pitcher

SURFACE ELEV.: DATUM:

CONDITIONS:

SAMPLE DEPTH	SAMPLER TYPE	BLOWS/6-IN.	INCHES DRIVEN	INCHES RECOVERED	SAMPLE CONDITION	DRILLING RATE (min/ft)	Pocket Penetrometer T/Ft²		Time	DEPTH IN FEET	GRAPHIC LOG	
										1		Very dark brown (10YR 2/2), sandy clay (CL), dry very hard, reworked treatment solids.
										2		
	SPT	5	6	3	F				0835	3		Black (N 2.5) sandy clay (CL), dry, firm in ≈4" lifts – varying amounts of sand & fine gravel, similar to sludge materials in piles.
3.0		8	6	6	G							
		14	6	6	G		2.5			4		
										5		
	SPT	6	6	6	G				0845			As above, softer.
5		12	6	6	G		2.0			6		
		13	6	6	G							
0	Shelby		6	0	—		125 PSI		0900	7		Grayish brown (2.5Y 5/2) clayey fine sand (SC), loose, dry, 40% clay, 60% vf – fine sand shells, rootlets, fine gravels
			6	0	—		1.5					
			6	0	—					8		
			6	0	—							
			6	6	F					9		
							1.5					
10	Shelby		6	6	G		125 PSI		0910	10		

F7

HARDING LAWSON ASSOCIATES

FIELD LOG OF BORING (CONTINUED)

PROJECT: 53483 | NO 007 | BORING NO CB-3

AWTS / Russell City

DEPTH	TYPE	BLOWS	DRIVEN	REC'V'D	COND.	D.RATE			TIME	DEPTH	GRAPHIC LOG	
			6	6	G		125 PSI			11		
			6	6	G							Brown (10YR 4/3) elastic silt (MH), moist soft,
			6	6	G					12		
			6	6	G		150 PSI					
	SPT	5	6	6	G		0.75 T/ft²		0920	13		
13.0		9	6	6	G		2.0					
		13	6	6	G					14		
	SPT	6	6	6	G				0930	15		As above.
15.5		11	6	6	G		2.5			16		
		15	6	6	G							
										17		
		~~4~~							~~0944~~	18		
		~~6~~					2.					
		~~8~~								19		
	SPT	4	6	6	G				0940	20		Yellowish brown (10YR 5/4) clayey sand (SC)
20.5		6	6	6	G		1.25			21		moist, loose, 30% clay, 70% poorly
		8	6	6	G							graded, V.F. sand
										22		(similar to above - coarsening)
										23		
										24		
												Yellowish brown (10YR 5/4) poorly graded fine
	SPT	3	6				1.0		0955	25		sand (SP), wet, very loose, 10% clay
25.5		6	6									Yellowish brown (10YR 5/4) elastic silt (MH)
		6	6				1.75			26		moist, soft.
27'	Shelby		6	6	G		150 PSI		1005	27		
			6	6	G							
			6	6	G					28		
			6	6	G							
			6	6	G		200 PSI			29		
							2.75					
	SPT	5	6	6	G				1015	30		

FIELD LOG OF BORING (CONTINUED)

PROJECT: 53483 | NO 007 | BORING NO CB-3

AWTS Russell City

DEPTH	TYPE	BLOWS	DRIVEN	REC'V'D	COND.	D.RATE	REN.		TIME	DEPTH	GRAPHIC LOG	
30.5	SPT	7	6	6			1.25			31		Yellowish brown (10YR5/6) clayey sand (SC) moist, loose, 30% clay, 70% V.F. sand - poorly graded
		11	6	6								
										32		Gravel lens, ~~fine coarse gravel~~ cemented fine sand - wet
										33		Light yellowish brown (10YR6/4) clayey sand (SC) moist, loose, 15% clay, 1% coarse sands and fine gravel, 84% poorly graded VF Sand
										34		
	SPT	4	6	6	G				1025	35		Yellowish brown (10YR5/4) poorly graded fine sand (SP), loose, wet, 10% clay
35.5		7	6	6	G		1.0			36		
		8	6	6	G							
										37		
										38		
										39		
	SPT	4	6	6	G				1040	40		Dark yellowish brown (10YR4/4) fat clay (CH), firm, moist. ~~gradual~~ Grades downward to elastic silt (MH).
40.5		7	6	6	G		1.75			41		
		11	6	6	G							
										42		
										43		
										44		
	SPT	4	6	6	G		1.0		1100	45		
5.5		6	6	6	G		0.5					Dark grayish brown (2.5Y4/2) clayey sand (SC) very loose, wet, clay ranges from 10% - 40%, bedded
		8	6	6	G		1.0			46		Dark olive gray (5Y3/2) elastic silt (MH) soft, moist
7.0	SHELBY		6	6	G		150 PSI		1125	47		
			6	6	G							
			6	6	G					48		
			6	6	G							
			6	6	G		225 PSI	1.5T/ft²		49		
	SPT	4	6	6	G				1130			
50.0		10	6	6	G		0.75			50		Olive gray (5Y4/2) clayey sand (SC), moist loose, 20% clay, 80% poorly graded VF-F sand

FIELD LOG OF BORING (CONTINUED)

PROJECT: 53483 | NO 007 | BORING NO CB-3

AWTS / Russell City

DEPTH	TYPE	BLOWS	DRIVEN	REC'V'D	COND.	D.RATE	Pen. T/Ft²		TIME	DEPTH	GRAPHIC LOG	
	SPT	13	6	6	G					51		
										52		
										53		
										54		
	SPT	11	6	6	F		2.5		1150	55		
55.5		12	6	6	G							Olive brown (2.5Y 4/3) poorly graded fine sand (SP), ~~moist~~ wet, med. dense. 0-5% clay
		13	6	6	G		1.25			56		Olive brown (2.5Y 4/4) fat clay (CH), moist, firm, concretions
										57		
										58		
										59		
	SPT	10	6	6	G		1.0		1215	60		
60.5		20	6	6	G		3.5 / 0.5					Light olive brown ~~clayey~~ sand (SP) wet, loose - ~~medium dense~~, ~~concreted~~ layer, sands in poorly graded layers (2"-3") vary from VF - Med. some layers up to 10% clay
		16	6	6	G		1.0			61		
										62		
										63		
										64		
	SPT	6	6	6	G				1230	65		
65.5		9	6	6	G		1.25					Olive gray (5Y 4/2) fat clay (CH), dry - moist, Firm.
		12	6	6	G					66		
										67		
										68		
										69		
	SPT	6	6	6	P				1245	70		Olive gray (5Y 5/2) clayey sand (SC), wet

FB

FIELD LOG OF BORING (CONTINUED)

PROJECT: 53483 | NO 007 | BORING NO CB-3

AWTS / Russell City

DEPTH	TYPE	BLOWS	DRIVEN	REC'V'D	COND.	D.RATE	PEN. T/ft²		TIME	DEPTH	GRAPHIC LOG	
70.5	SPT	9	6	6	P		0.75			71		loose, grading downward to elastic silt (MH), soft, moist
		11	6	6	P							SC = 40% clay, 60% poorly graded VF sand
72.0	SHELBY		6	6	G		150 PSI		1300	72		-sample dis-consolidated-
			6	6	G		↓					
			6	6	G		275 PSI			73		Dark Greenish gray (5G4/1) fat clay (CH)
			6	6	G		↓					dry, hard (marine facies)
			6	6	G		275 PSI			74		
			6				2.25 T/ft²					
	SPT	5	6	6	F				1320	75		As above
75.5		18	6	6	G		2.1			76		
		29	6	6	G							
										77		
										78		
										79		
	SPT	6	6	6	G				1345	80		Dark greenish gray (5G4/1) elastic silt
		11	6	6	G		1.0			81		(MH), moist, soft
		14	6	6	G							
										82		
										83		
										84		
	SPT	8	6	6	F				1405 1345	85		Brown (10YR 4/3) fat clay (CH), moist-dry
85.5		15	6	6	G		2.5			86		hard (mostly alluvial, non marine)
		19	6	6	G							
										87		
										88		
										89		
	SPT	7	6	6	P				1430	90		As above - grading downward to

FIELD LOG OF BORING (CONTINUED)

PROJECT: 53483 | NO 007 | BORING NO CB-3

AWTS / Russel City

DEPTH	TYPE	BLOWS	DRIVEN	REC'V'D	COND.	D.RATE	PEN T/Ft²		TIME	DEPTH	GRAPHIC LOG	
90.5	SPT	12	6	6	P		1.5			91		
		17	6	6	P							Brown (10YR 4/3) clayey sand (SC) moist, med dense. 40% clay, 60% poorly graded VF sand
										92		
									1445	93		14:45 Work stopped for today. CB-3 at 90.' bgs
										94		
								11/1/01				11/1/01 0715 resume drilling CB-3
	SPT	11	6	6	P				0735	95		Olive gray (5Y4/2) fat clay (CH), moist, firm high plasticity.
95.5		17	6	6	G		1.25			96		
		20	6	6	P							
										97		
										98		
										99		
	SPT	18	6	6	F				0805	100		Dark gray (5Y4/1) fat clay (CH), moist-dry, very hard, high plasticity, small zones of cementation (concretions)
100.5		28	6	6	G		4.0			101		
		37	6	6	G							
										102		
										103		
										104		Difficult drilling (very hard clays) - clays have formed ring -
										105		
										106		
										107		
										108		
										109		
	SPT	5	6	6	P		1.25		0845	110		Greenish gray (5GY4/1) clayey sand (SC)

FIELD LOG OF BORING (CONTINUED)

PROJECT: 53483 | NO 007 | BORING NO CB-3

AWTS / Russell City

DEPTH	TYPE	BLOWS	DRIVEN	REC'V'D	COND.	D.RATE	PEN T/FT		TIME	DEPTH	GRAPHIC LOG	
110.5	SPT	7	6	6	F					111	X	moist, loose, 40% clay, 60% poorly graded VF sand. grades downward to:
		20	6	6	P		1.0			112		Greenish gray poorly graded fine sand (SP), moist, very loose, clay lenses (~ 1/4" thick) ~ 2" apart.
										113		
										114		
										115		
										116		
										117		
										118		
										119		
	SPT	17	6	0	—				0930	120		Dark greenish gray (5G 4/1), clayey sand (SC) wet, loose, 30% clay, 70% poorly graded fine - medium sand.
		18	6	0	—							
		21	6	3	P					121		abundant shell fragments: ~20% of total sample.
										122		
										123		
										124		
										125		
										126		
										127		
										128		
										129		
120.0	Shelby		6	6	G		300 PSI		1000	130	X	— may be ~ 8" slough on top of sample — Dark greenish gray (5G 4/1) clayey sand (SC)

FB

FIELD LOG OF BORING (CONTINUED)

PROJECT: 53483 | NO 007 | BORING NO CB-3

AWTS / RUSSELL CITY

DEPTH	TYPE	BLOWS	DRIVEN	REC'V'D	COND.	D.RATE	PEN T/FT		TIME	DEPTH	GRAPHIC LOG	
	Shelby		6	6	G		30			131		Moist, dense, 30% clay, small concretions.
			6	6	G		300 PSI					- Sample alternated from soft-hard pushing
	SPT	7	6				3.25		1033	132		Dark greenish gray (5G4/1) poorly graded
132		32	6				1.0					medium sand (SP), wet, medium dense,
		50	4							133		< 1% fine gravel
										134		
										135		
										136		
										137		
										138		
										139		
	SPT	32	6	1	P		very loose		1110	140		
140.5		50	6	6	G		unconsolidated			141		Gray (N5) well graded sand with gravel
												(SW), dense, wet, 60% fine-VCoarse sand
										142		40% fine gravel (to 1/4" ϕ), angular
										143		
										144		
										145		
										146		
										147		Change in drilling - more clays
										148		
										149		
	SPT	10	6	6	F				1200	150		Dark greenish gray (5G4/1) fat clay (CH)

FF8

HARDING LAWSON ASSOCIATES

FIELD LOG OF BORING (CONTINUED)

PROJECT: 53483 | NO 007 | BORING NO CB-3

AWTS / Russell City

DEPTH	TYPE	BLOWS	DRIVEN	REC'V'D	COND.	D.RATE	$P_{EN.}$			TIME	DEPTH	GRAPHIC LOG	
150.5	SPT	10	6	6	G		1.25				151		dry-moist, Firm, vestigal fractures - silt filled high plasticity.
		13	6	6	G								
											152		TD = 150'
											153		
											154		
											155		
											156		
											157		
											158		
											159		
											160		
											161		
											162		
											163		
											164		
											165		
											166		
											167		
											168		
											169		
											170		

PFB

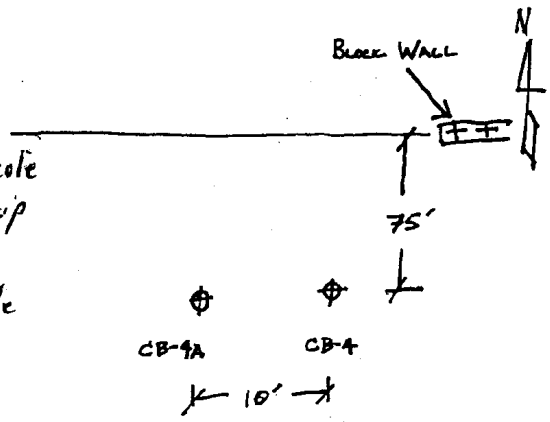
FIELD LOG OF BORING

SHEET 1 OF 1

LOCATION OF BORING:

NOTE:

This shallow hole was a make up for missed Shelby sample @ 6 ft in CB-4.



PROJECT: Advanced Water Treatment System Russell City (AWTS)	BORING NO. CB-4A
	TOTAL DEPTH: 8.5'
JOB NO.: 53483 007	LOGGED BY: M. Walkand
PROJ. MGR.: W. Godwin	EDITED BY: W. Godwin
DRILLING CONTRACTOR: Pitcher Drilling Co.	
DRILL RIG TYPE: Failing 1500	
DRILLERS NAME: Ralph DeLorre	
SAMPLING METHODS: Shelby Tube	
HAMMER WT.: —	DROP: —
STARTED, TIME: 1415	DATE: 11/1/01
COMPLETED, TIME: 1430	DATE: 11/1/01
BORING DEPTH (ft.)	8.5'
CASING DEPTH (ft.)	—
WATER DEPTH (ft.)	—
TIME:	1430
DATE:	11/1/01
BACKFILLED, TIME: 1440	DATE: 11/1/01 BY: Pitcher
SURFACE ELEV.:	DATUM:
CONDITIONS:	

SAMPLE DEPTH	SAMPLER TYPE	BLOWS/6-IN.	INCHES DRIVEN	INCHES RECOVERED	SAMPLE CONDITION	DRILLING RATE (min/ft)	PENETROMETER T/Ft.		TIME	DEPTH IN FEET	GRAPHIC LOG	
										1		Dark brown (7YR 3/2) ~~clayey sand~~ sand (SW), moist, 5% medium gravel, 10% clay 85% well graded sand – from cuttings
										2		
										3		
										4		Black (5Y 2.5/1) fat clay (CH), moist, high plasticity, 1% sand – from cuttings
										5		
	SHELBY	—	6				150		1425	6		
			6							7		
			6									
			6							8		Dark greenish gray (5GY 4/1) clayey sand (SC) moist, medium dense, 30% clay, 70% poorly graded very fine sand
			6				250 PSI 2.0 T/Ft			9		
										10		TD = 8.5' Backfilled w/ neat grout

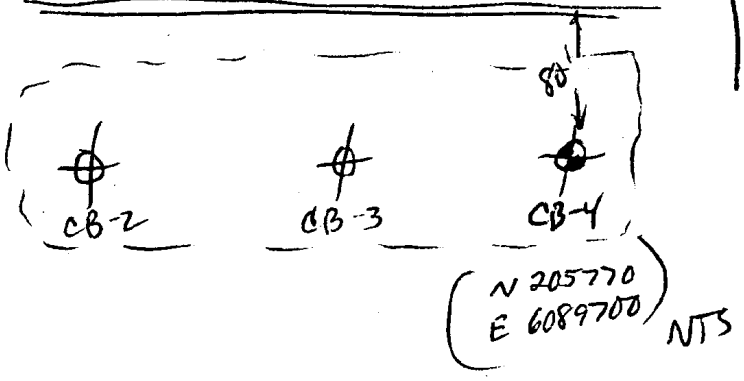
F 7

HARDING LAWSON ASSOCIATES

FIELD LOG OF BORING

SHEET 1 OF 6

LOCATION OF BORING:



PROJECT: Russell City Energy Center Advanced Water Treatment System (AWTS)	BORING NO. CB-4
	TOTAL DEPTH: 100
JOB NO.: 53483 007	LOGGED BY: JTH
PROJ. MGR.: Bill Godwin	EDITED BY: W. Godwin
DRILLING CONTRACTOR: Pitcher Drilling Co.	
DRILL RIG TYPE: Mud Rotary / Failing 1500	
DRILLERS NAME: Ralph / Jose	
SAMPLING METHODS: ~~GAMed~~ JH / SPT / Shelby	
HAMMER WT.: 140	DROP: 30" - Cathead
STARTED, TIME: 08:40	DATE: 10/30/01
COMPLETED, TIME: 15:45	DATE: 10/30/01
BORING DEPTH (ft.) 101'	
CASING DEPTH (ft.)	
WATER DEPTH (ft.)	
TIME:	
DATE:	
BACKFILLED, TIME:	DATE: BY:
SURFACE ELEV.: 10.5 (est)	DATUM: MSL
CONDITIONS: Rain - Morning / Cleared afternoon	

SAMPLE DEPTH	SAMPLER TYPE	BLOWS/6-IN.	INCHES DRIVEN	INCHES RECOVERED	SAMPLE CONDITION	DRILLING RATE (min/ft)	Pocket Pen (T/ft²)	Pressure (PSI)	Time	DEPTH IN FEET	GRAPHIC LOG	
										1		
										2		
		8	6	0	P				08:45	3		Dark Brown to Black, (OH) mainly organic clays
		9	6	6	F							and silts with debris (vegetative debris)
		11	6	6	G		2.25			4		
		4	6	2	P				09:00	5		Dark Gray to Black, (OH) organic clays, some
	SPT	5	6	6	G					6		debris (vegetative debris)
		8	6	6	G		1.25					
										7		Gravel Layer
		5	6	2	P				09:18	8		Dark Gray, (CL) Silty Clay, medium plasticity
	SPT	7	6	6	G		2.25					
		13	6	6	G					9		
		2	6	4	F		0.25		09:25	10		Sandy Clay (CL) Gray, low plasticity

FIELD LOG OF BORING (CONTINUED)

SHEET 2 OF 6

PROJECT: Russell City AWT | NO 53483 | BORING NO B-4

DEPTH	TYPE	BLOWS	DRIVEN	REC'V'D	COND.	D.RATE	Pen (TSF)	Pressure (PSI)	Time	DEPTH	GRAPHIC LOG	
10.5	SPT	3	6	6	G					11		Gravel layer ~~Jit~~ @ 11' (GC) mixture of gravel, sand, clay, well mixed.
		2	6	6	G							
										12		
		0	6	5	F				09:35	13		Brown Clay (CL) Sandy Clay, medium plasticity.
13.0	SPT	4	6	6	G		0.25					
		7	6	6	G					14		
										15		
		6	6	4	F				09:43			Brown (CL) Sandy Clay, medium plasticity, small percent sand (Fine)
15.5	SPT	7	6	6	G		1.25			16		
		8	6	6	G							
										17		
										18		
										19		
								150	10:00	20		
20.0	Shelby				P							Brown Clay (SC) Sand-clay mixture, medium plasticity, small percent sand (Fine)
					P					21		
					F							
					G							
					G		0.25	250		22		
34 5 23.0												
										23		
										24		
		9	6	6	G				10:12	25		Brown clay (SC) Sand-clay mixture, medium plasticity, small percent sand, (fine)
5.5	SPT	17	6	6	G		2.5					
		17	6	6	G					26		
										27		
										28		
										29		
		4	6	6	G				10:28	30		Brown Clay (SC) Sand - clay mixture.

FB

HARDING LAWSON ASSOCIATES

FIELD LOG OF BORING (CONTINUED)

SHEET 3 OF 6

PROJECT: Russell City AWT | NO 53483 | BORING NO CB-4

DEPTH	TYPE	BLOWS	DRIVEN	REC'V'D	COND.	D.RATE	Pen (T/ft²)	Pressure (PSI)	Time	DEPTH	GRAPHIC LOG	
30.5	SPT	6	6	6	6		1.25			31	X	medium plasticity, small percent sand.
		10	6	6	6						X	(fine)
										32		
										33		
										34		
		10	6	6	6				10:46	35	X	Brown Clay (SC) Sand - clay mixture,
35.5	SPT	14	6	6	6		2.00			36	X	medium plasticity, small percent sand.
		17	6	6	6						X	(fine)
										37		
										38		
										39		
		4	6	6	6				10:52	40	X	Greyish Brown Clay (CL), Silty Clay,
40.5	SPT	5	6	6	6		0.75	J.H. ~~0.75~~		41	X	high plasticity.
		9	6	6	6						X	
										42		
										43		
										44		
45.0												
	Grouting				6			150	11:12	45	X	Greyish Brown Clay (CL) Silty Clay,
					6						X	high plasticity.
					6					46	X	
					6						X	
					6		J.H. ~~0.05~~ 0.50	250		47	X	
										48		
										49		
		0	6	6	6				11:34	50	X	Grey Clay (CL) high plasticity, very little

FIELD LOG OF BORING (CONTINUED)

SHEET 4 OF 6

PROJECT: Russell City AWT | NO 53483 | BORING NO. CB-4

DEPTH	TYPE	BLOWS	DRIVEN	REC'V'D	COND.	D.RATE	Pen (T/ft²)	Pressure (PSI)	Time	DEPTH	GRAPHIC LOG	
50.5	SPT	9	6	6	6		1.0			51		silt.
		11	6	6	6							
										52		
										53		
										54		
		7	6	6	6				11:56	55		Brown (SC) Sandy Clay, large percentage of fine sands, low plasticity
55.5	SPT	10	6	6	6		1.75			56		
		15	6	6	6							
										57		
										58		
										59		
		7	6	6	6				12:12	60		Greyish brown (SC) Sandy Clay, lower percent of fine sands, low plasticity.
60.5	SPT	9	6	6	6		1.25			61		
		15	6	6	6							
										62		
										63		
										64		
65.5	Shelby				F		1.0	200	12:35	65		Greyish brown (SC) Sandy clay, large percentage of coarser grained sands, low plasticity.
					6							
					6					66		
					6							
1.5					6			250		67		
										68		
										69		
		8	6	6	6				12:56	70		Grey Clay (CL) high plasticity, very little

FIELD LOG OF BORING (CONTINUED)

SHEET 5 OF 6

PROJECT: Russell City Auto | NO 53483 | BORING NO CB-4

DEPTH	TYPE	BLOWS	DRIVEN	REC'V'D	COND.	D.RATE	Pen (T/ft²)	Pressure (Psi)	Time	DEPTH	GRAPHIC LOG	
70.5	SPT	11	6	6	6		1.0		13:25	71	X	silt.
		14	6	6	6						X	
										72		
										73		
										74		
		7	6	6	6				13:50	75	X	
75.5	SPT	12	6	6	6		1.0			76	X	Grey Clay (CL) high plasticity, very little silt.
		18	6	6	6						X	
										77		
										78		
										79		
		8	6	6	6				14:10	80	X	
80.5	SPT	13	6	6	6		1.25			81	X	Grey Clay (CL) high plasticity, very little silt.
		21	6	6	6						X	
										82		
										83		
										84		
		9	6	6	6				14:31	85	X	
85	SPT	14	6	6	6		1.50			86	X	Olive Grey Clay (CL) some red specs. small percentage of silt, high plasticity.
		20	6	6	6						X	
										87		
										88		
										89		
		8	6	4	F				15:00	90	X	Olive Grey Clay (CL) some red specs

FIELD LOG OF BORING (CONTINUED)

SHEET 6 OF 6

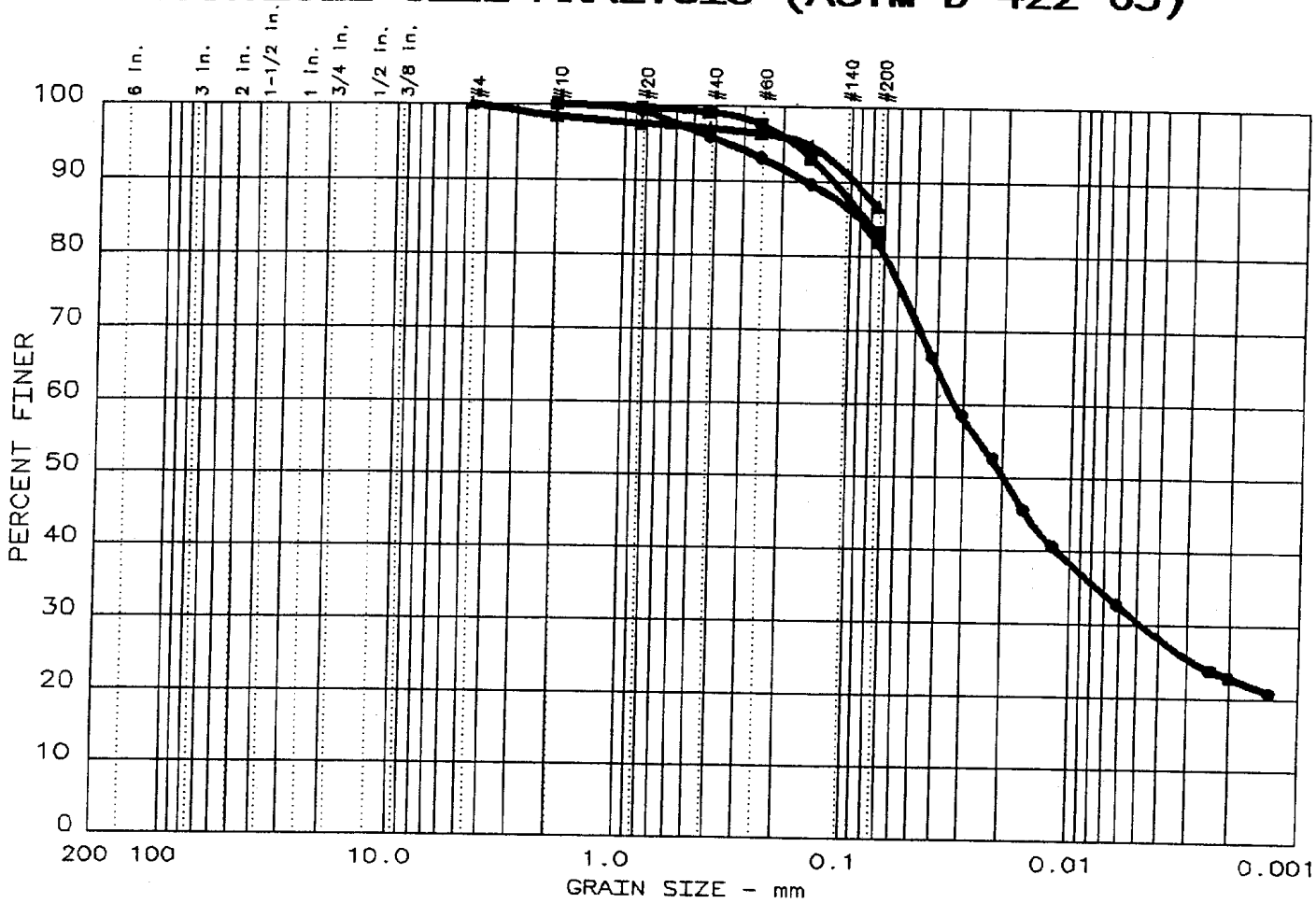
PROJECT Russell City AWT | NO 53483 | BORING NO. CB-4

DEPTH	TYPE	BLOWS	DRIVEN	REC'V'D	COND.	D.RATE	Pen (T/FT²)	Pressure (PSI)	Time	DEPTH	GRAPHIC LOG	
90.5	SPT	14	6	6	G		2.0			91		small percentage of silt.
		19	6	4	P							
										92		
										93		
										94		
		5	6	6	G				15:25	95		
95.5	SPT	9	6	6	6		2.0					Olive Grey Clay (CL) highly plasticity,
		15	6	6	6					96		very little silt.
										97		
										98		
										99		
		8	6	6	6				15:45	100		
20.5	SPT	14	6	6	6		2.25					Olive Grey Clay (CL) high plasticity,
		19	6	6	6					101		very little silt.
										102		Bottom of Boring
										103		Backfilled w/ neat grout
										104		
										105		
										106		
										107		
										108		
										109		
										110		

APPENDIX B

LABORATORY TEST RESULTS

PARTICLE SIZE ANALYSIS (ASTM D 422-63)



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PI
●	0.0	0.0	18.2	59.0	22.8	CL		
▲	0.0	0.0	13.4	86.6		CL		
■	0.0	0.0	16.9	83.1		CL		

SIEVE inches size	PERCENT FINER ●	▲	■
GRAIN SIZE			
D_{60}	0.03		
D_{30}	0.005		
D_{10}			
COEFFICIENTS			
C_c			
C_u			

SIEVE number size	PERCENT FINER ●	▲	■
4		100.0	
10	100.0	98.4	100.0
20	99.2	97.5	99.6
40	95.8	96.9	99.1
60	93.0	96.2	97.5
100	89.6	94.6	93.0
200	81.8	86.6	83.1

Sample information:

● CB-1 10.5'
Dark gray silty CLAY.

▲ CB-1 30.5'
Dark brn. silty CLAY
w/caliche inclusions.

■ CB-1 45.5'
Dark gray silty CLAY.

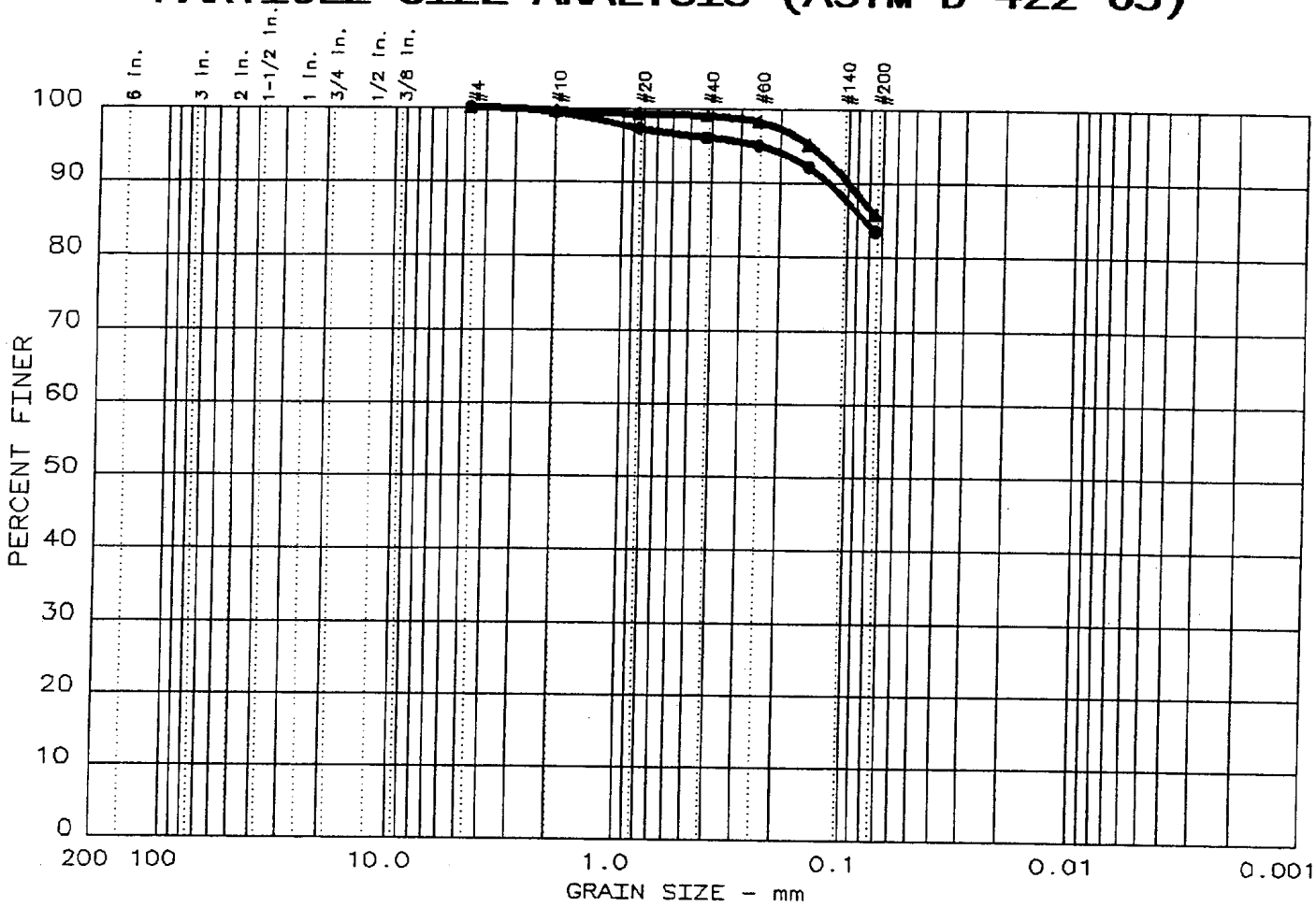
Remarks:

Soil Mechanics Lab

Project No.: 53483.007
Project: Russell City AWT

Date: 11-24-01 Data Sheet No. ____

PARTICLE SIZE ANALYSIS (ASTM D 422-63)



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PI
●	0.0	0.0	16.6	83.4		CL		
▲	0.0	0.0	14.3	85.7		CL		

SIEVE inches size	PERCENT FINER ●	▲	
GRAIN SIZE			
D_{60}			
D_{30}			
D_{10}			
COEFFICIENTS			
C_c			
C_u			

SIEVE number size	PERCENT FINER ●	▲	
4	100.0	100.0	
10	99.4	99.6	
20	97.3	99.2	
40	96.0	99.0	
60	95.0	98.2	
100	92.1	95.2	
200	83.4	85.7	

Sample information:

● CB-2 11.0'
V.dk.gray sandy CLAY.

▲ CB-2 13.5'
Dk.olive brn. silty CLAY w/sand.

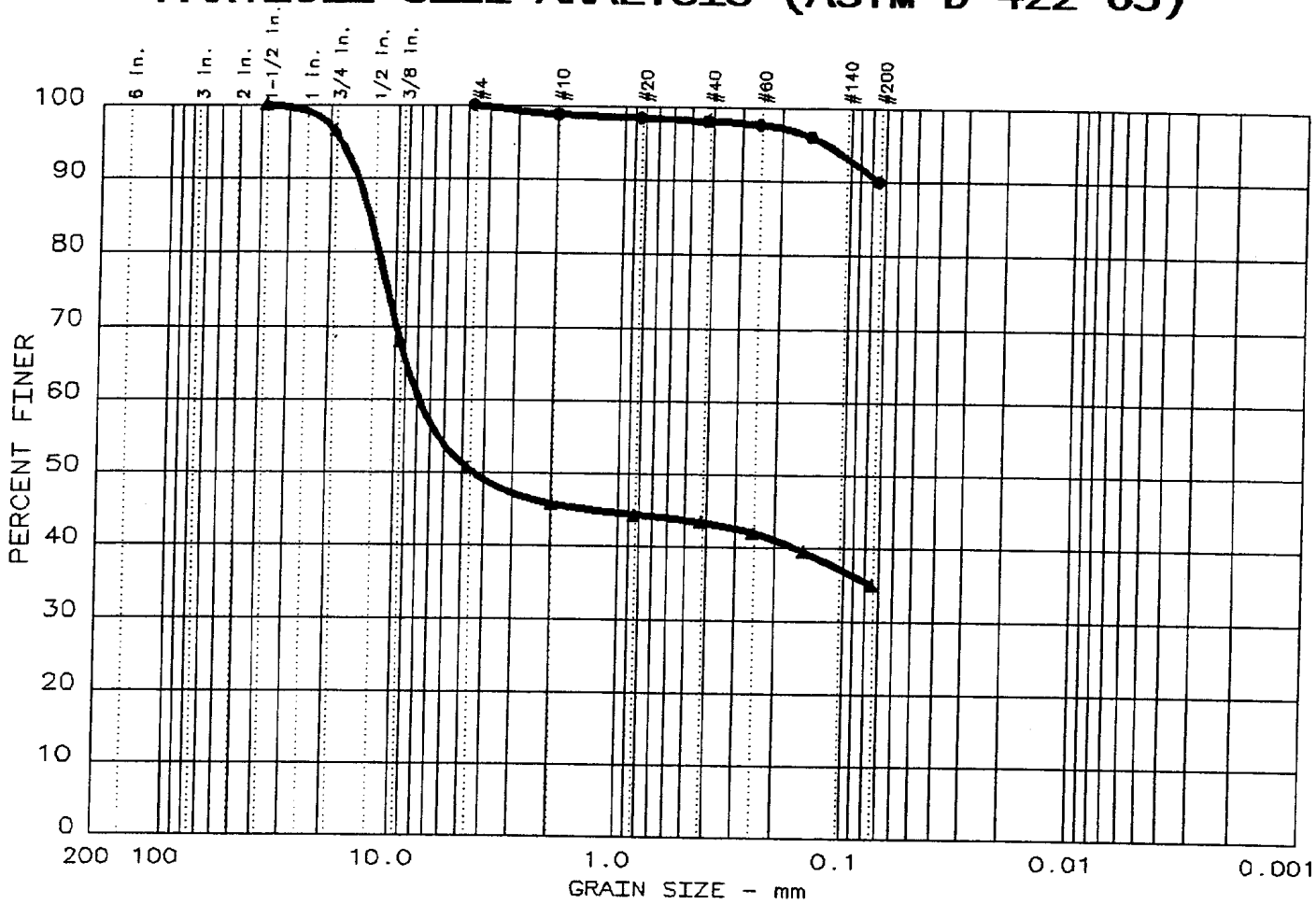
Remarks:

Soil Mechanics Lab

Project No.: 53483.007
Project: Russell City AWT

Date: 11-24-01 Data Sheet No. ____

PARTICLE SIZE ANALYSIS (ASTM D 422-63)



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PI
●	0.0	0.0	10.1	89.9		CL		
▲	0.0	49.4	15.5	35.1		GC		

SIEVE inches size	PERCENT FINER ●	▲	
1.5		100.0	
0.75		96.6	
0.375		68.0	
GRAIN SIZE			
D_{60}		7.74	
D_{30}			
D_{10}			
COEFFICIENTS			
C_c			
C_u			

SIEVE number size	PERCENT FINER ●	▲	
4	100.0	50.6	
10	98.8	45.7	
20	98.4	44.3	
40	98.0	43.3	
60	97.6	41.9	
100	96.0	39.4	
200	89.9	35.0	

Sample information:

● CB-2 25.5'
Dark gray silty CLAY w/sand.

▲ CB-2 49.5'
Dark gray clayey f-c GRAVEL w/sand.

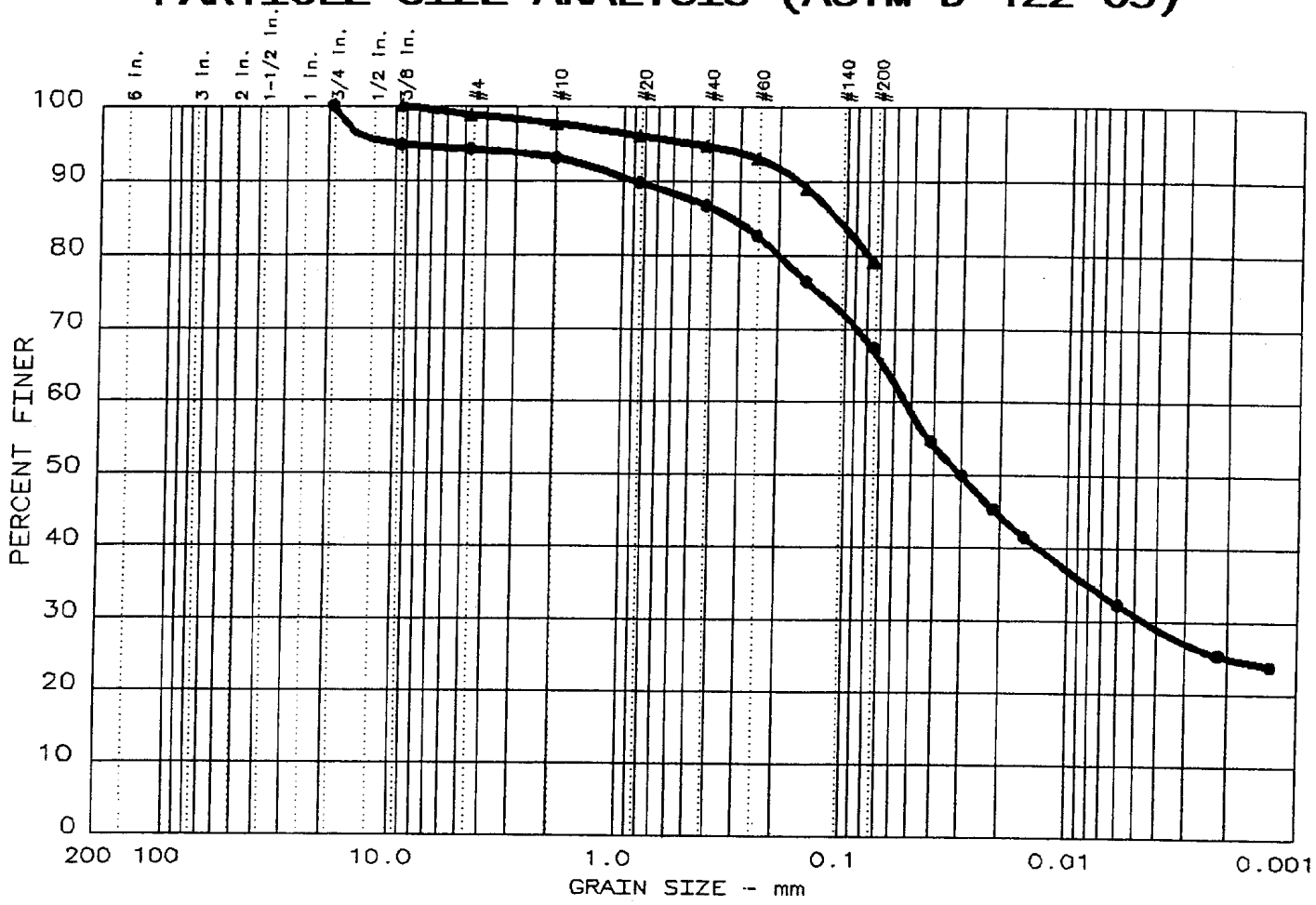
Remarks:

Soil Mechanics Lab

Project No.: 53483.007
Project: Russell City AWT

Date: 11-24-01 Data Sheet No. ____

PARTICLE SIZE ANALYSIS (ASTM D 422-63)



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PI
●	0.0	5.8	26.8	42.4	25.0	CL		
▲	0.0	1.2	19.6	79.2		CL		

SIEVE inches size	PERCENT FINER ●	▲	
0.75	100.0		
0.375	94.7	100.0	
GRAIN SIZE			
D_{60}	0.05		
D_{30}	0.005		
D_{10}			
COEFFICIENTS			
C_c			
C_u			

SIEVE number size	PERCENT FINER ●	▲	
4	94.2	98.8	
10	93.0	97.6	
20	89.7	96.0	
40	86.6	94.6	
60	82.6	93.0	
100	76.4	89.0	
200	67.4	79.2	

Sample information:

● CB-3 5.5'
Grayish blk.sandy CLAY.
Tr.f-gravel.

▲ CB-3 10.5'
Dk.gray sandy CLAY
w/caliche inclusions.

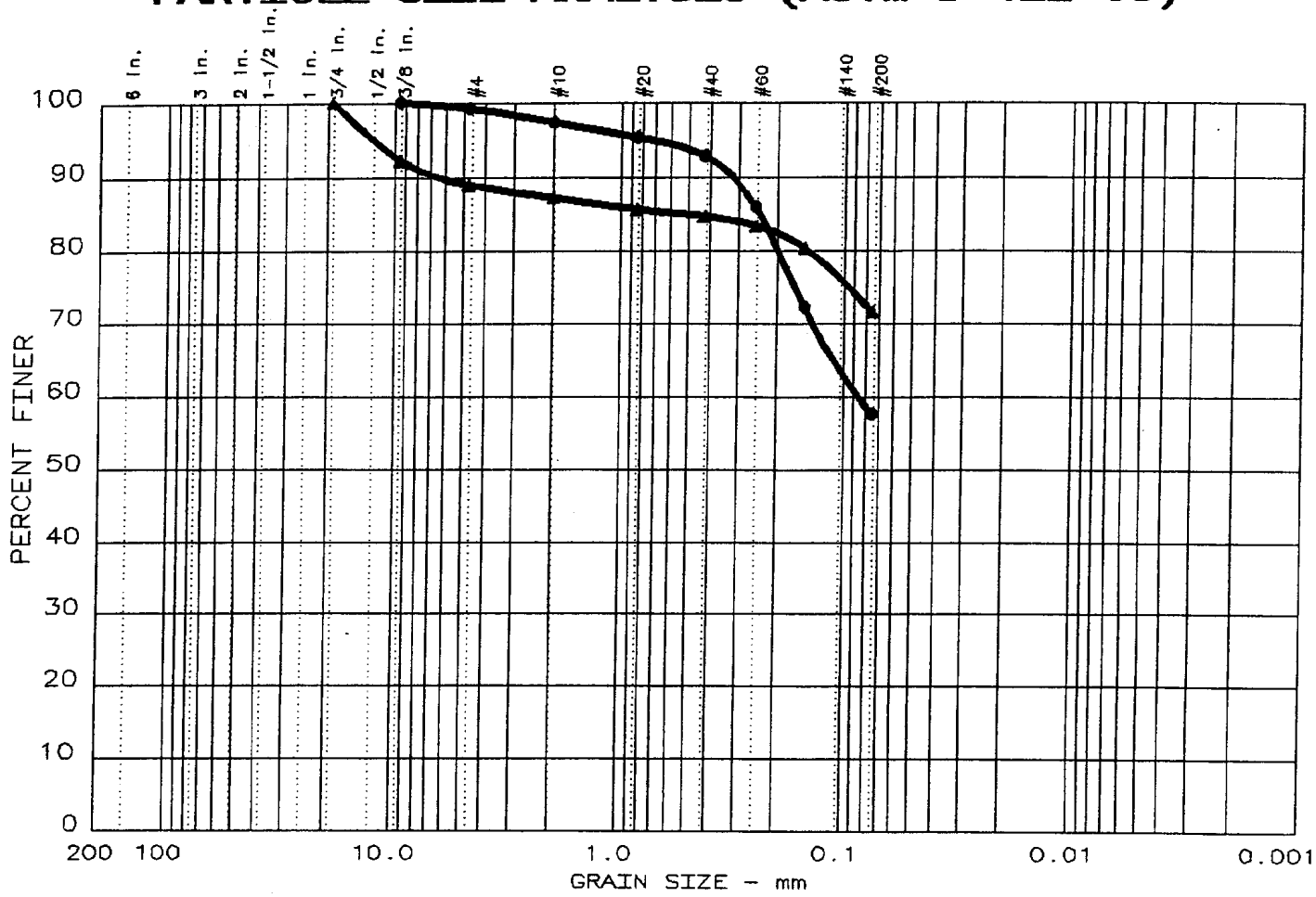
Remarks:

Soil Mechanics Lab

Project No.: 53483.007
Project: Russell City AWT

Date: 11-24-01 Data Sheet No. ____

PARTICLE SIZE ANALYSIS (ASTM D 422-63)



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PI
●	0.0	0.8	41.6	57.6		CL		
▲	0.0	11.0	17.4	71.6		CL		

SIEVE inches size	PERCENT FINER ●	▲	
0.75		100.0	
0.375	100.0	92.3	
GRAIN SIZE			
D_{60}	0.09		
D_{30}			
D_{10}			
COEFFICIENTS			
C_c			
C_u			

SIEVE number size	PERCENT FINER ●	▲	
4	99.2	89.0	
10	97.3	87.2	
20	95.3	85.7	
40	92.8	84.7	
60	86.0	83.4	
100	72.2	80.3	
200	57.6	71.6	

Sample information:

● CB-3 20.5'
Dk.brown sandy CLAY

▲ CB-3 27.5'
Olive brown silty CLAY.

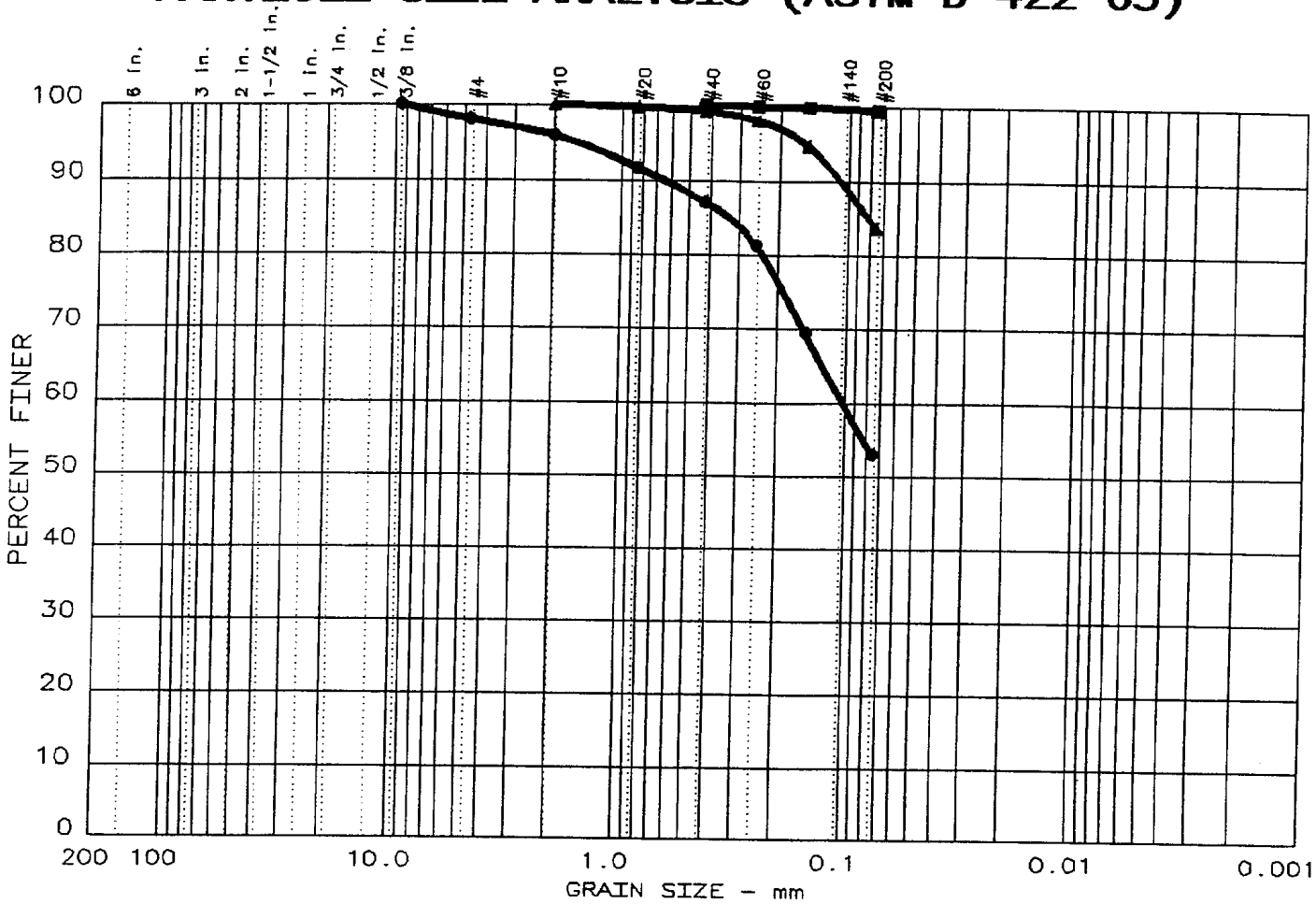
Remarks:

Soil Mechanics Lab

Project No.: 53483.007
Project: Russell City AWT

Date: 11-24-01 Data Sheet No. ____

PARTICLE SIZE ANALYSIS (ASTM D 422-63)



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PI
●	0.0	1.9	45.0	53.1		CL		
▲	0.0	0.0	16.4	83.6		CL		
■	0.0	0.0	0.6	99.4		CL		

SIEVE inches size	PERCENT FINER ●	▲	■
0.375	100.0		
GRAIN SIZE			
D_{60}	0.10		
D_{30}			
D_{10}			
COEFFICIENTS			
C_c			
C_u			

SIEVE number size	PERCENT FINER ●	▲	■
4	98.1		
10	95.9	100.0	
20	91.6	99.7	
40	87.1	99.2	100.0
60	81.3	98.0	99.9
100	69.4	94.6	99.8
200	53.0	83.6	99.4

Sample information:

● CB-4 8.0'
V.dk. gray sandy CLAY.

▲ CB-4 20.5'
Dark,olive brn. silty CLAY.

■ CB-4 65.5'
Dark gray silty CLAY.

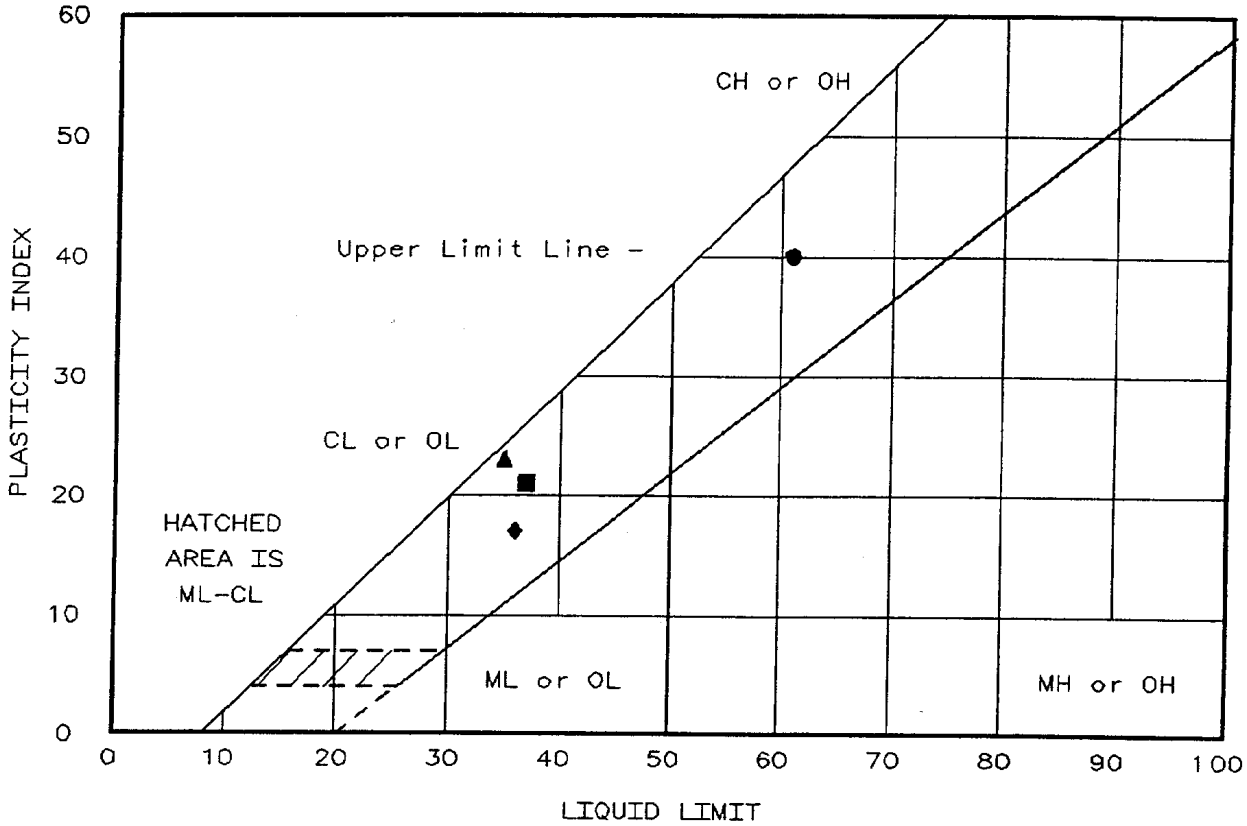
Remarks:

Soil Mechanics Lab

Project No.: 53483.007
Project: Russell City AWT

Date: 11-24-01 Data Sheet No. ____

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	ASTM D 2487-90
●	CB-1 @ 5.5':Dk. gray FAT CLAY(CL)	61	21	40		
▲	CB-1 @ 10.5':Dk. gray silty CLAY(CL) w/sand.	35	12	23	81.8	CL, Lean clay with sand
■	CB-1 @ 15.5':Brown silty CLAY(CL)	37	16	21		
◆	CB-1 @ 20.5':Brown silty CLAY(CL)	36	19	17		

Project No.: 53483.007
Project: Russell City AWT

Client: Harding ESE
Location:

Date: 11-21-01

Remarks:

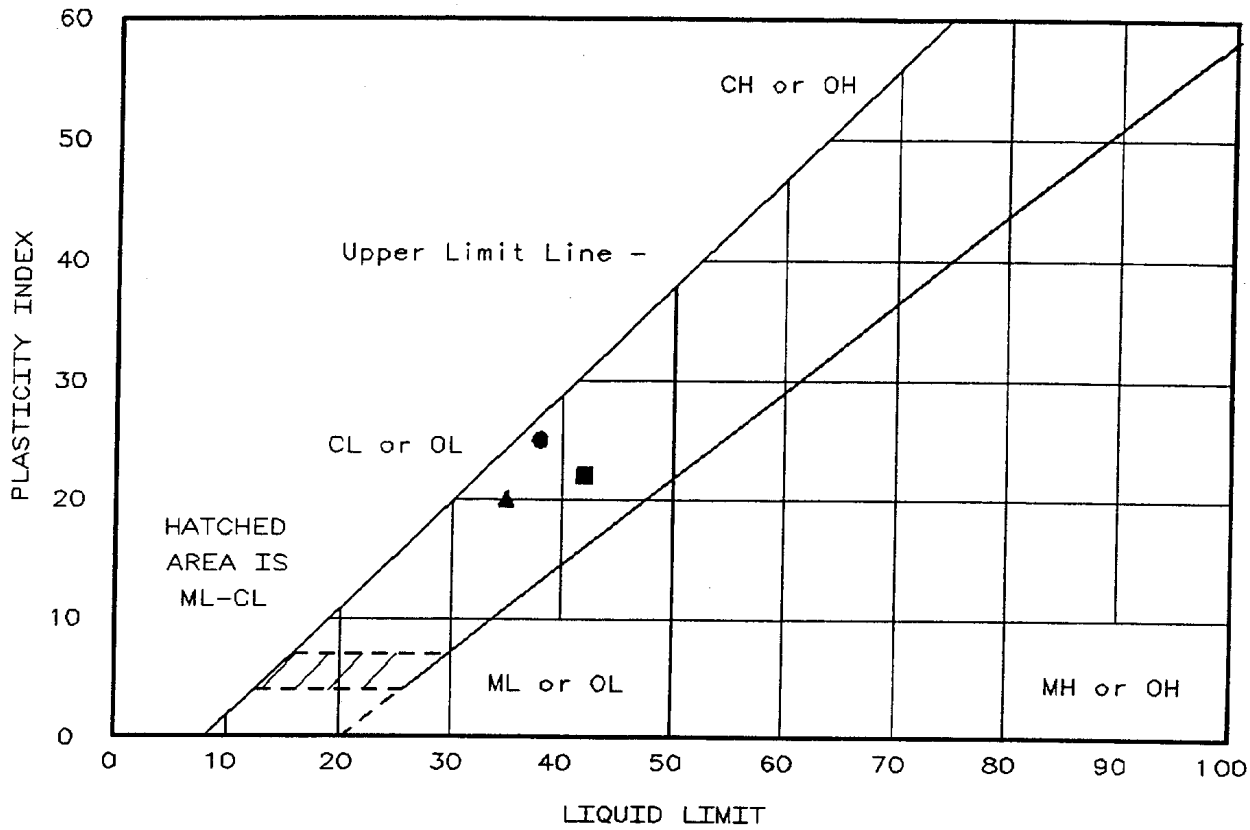
ASTM D 4318

LIQUID AND PLASTIC LIMITS TEST REPORT

Soil Mechanics Lab

Fig. No. _____

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	ASTM D 2487-90
●	CB-1 @ 30.5':Dk.brn.silty CLAY(CL)w/caliche.	38	13	25	86.6	CL, Lean clay
▲	CB-1 @ 45.5':Dk. gr.silty CLAY(CL)	35	15	20	83.1	CL, Lean clay with sand
■	CB-1 @ 67.5':Dk.gr. silty CLAY(CL)	42	20	22		

Project No.: 53483.007
Project: Russell City AWT

Client: Harding ESE
Location:

Date: 11-21-01

Remarks:

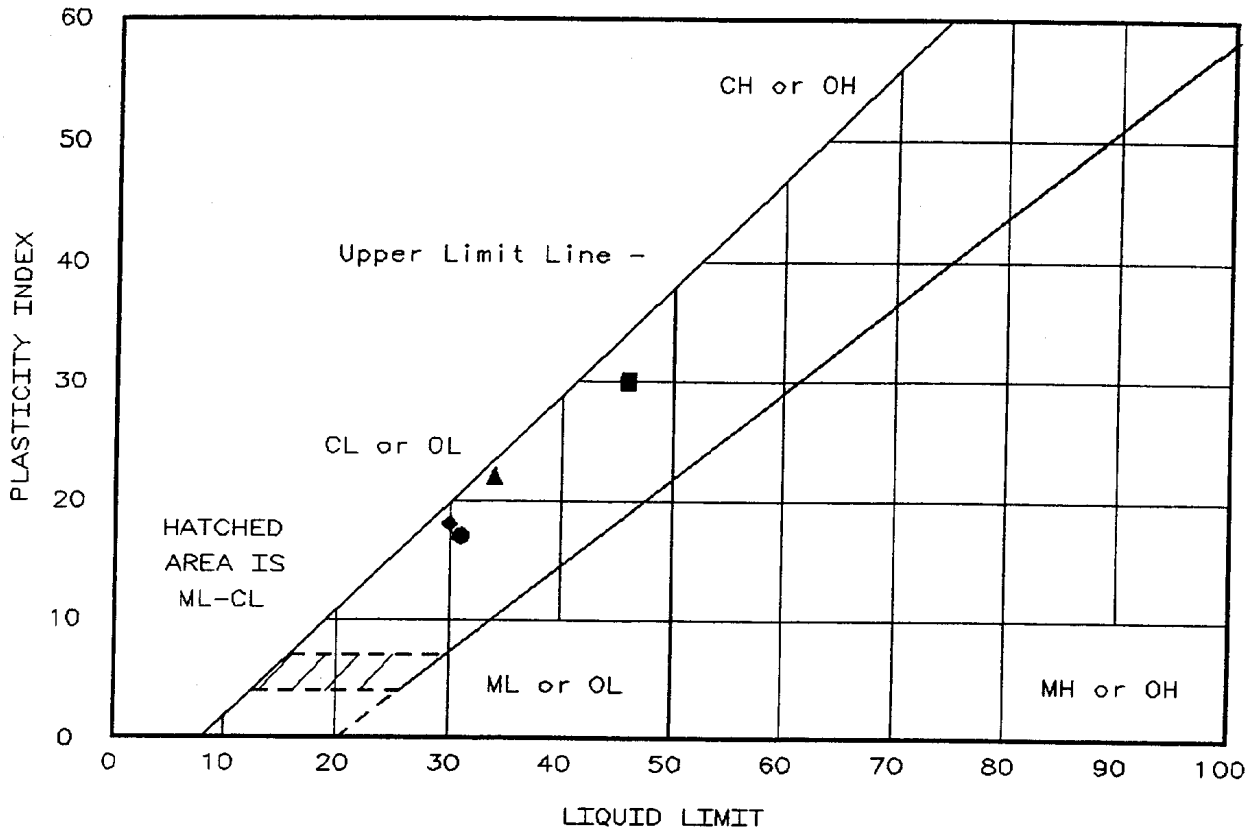
ASTM D 4318

LIQUID AND PLASTIC LIMITS TEST REPORT

Soil Mechanics Lab

Fig. No. _____

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	ASTM D 2487-90
●	CB-2 @ 11.0':V.dark gray sandy CLAY(CL) Wn=21%	31	14	17	83.4	CL, Lean clay with sand
▲	CB-2 @ 13.5':Dk.olv. brn. silty CLAY(CL)w/sand.	34	12	22	85.7	CL, Lean clay
■	CB-2 @ 25.5':Dk. gr.silty CLAY(CL)w/sand. Wn=21%	46	16	30	89.9	CL, Lean clay
◆	CB-2 @ 32':Olive brown sandy CLAY(CL)	30	12	18		

Project No.: 53483.007
Project: Russell City AWT

Client: Harding ESE
Location:

Date: 11-21-01

Remarks:

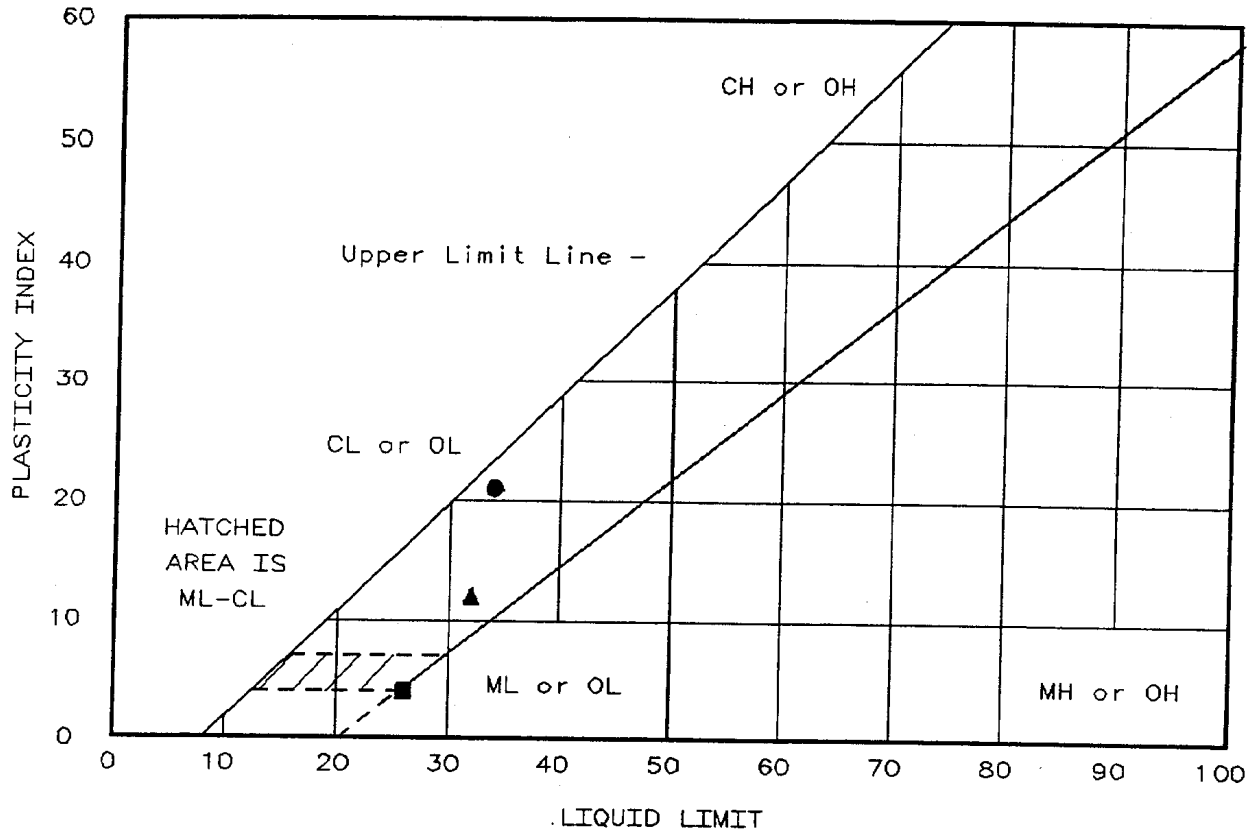
ASTM D 4318

LIQUID AND PLASTIC LIMITS TEST REPORT

Soil Mechanics Lab

Fig. No. _____

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	ASTM D 2487-90
●	CB-2 @ 49.5':Dk. gray clayey GRAVEL(GC)w/sand.	34	13	21	35.0	GC, Clayey gravel with sand
▲	CB-2 @ 71':Dk. olive gr. silty CLAY(CL)	32	20	12		
■	CB-2 @ 90.5':Dk. gray clayey SILT(ML)w/sand.	26	22	4		

Project No.: 53483.007
Project: Russell City AWT

Client: Harding ESE
Location:

Date: 11-21-01

Remarks:

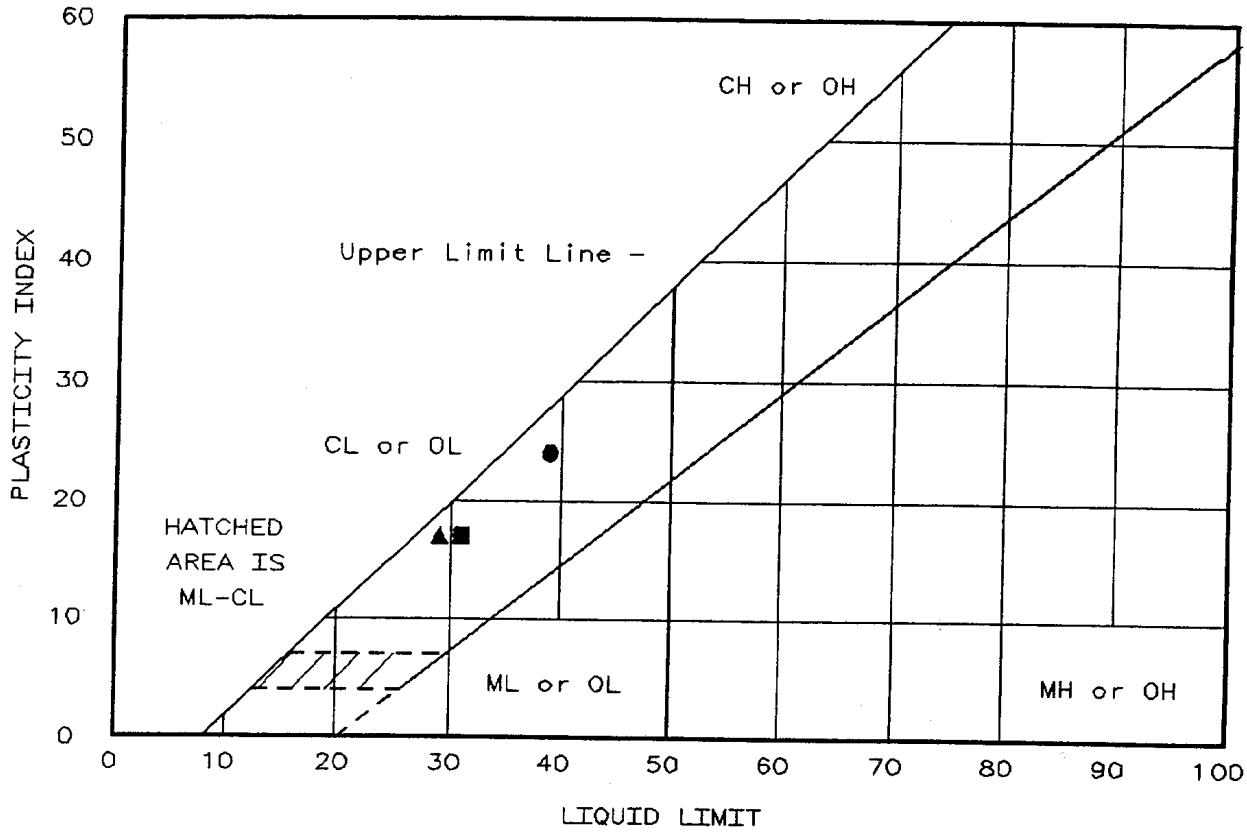
ASTM D 4318

LIQUID AND PLASTIC LIMITS TEST REPORT

Soil Mechanics Lab

Fig. No. _____

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	ASTM D 2487-90
●	CB-3 @ 5.5':Grayish black sandy CLAY(CL) 8%	39	15	24	67.4	CL, Sandy lean clay
▲	CB-3 @ 10.5':Dk. gray sandy CLAY(CL)	29	12	17	79.2	CL, Lean clay with sand
■	CB-3 @ 20.5':Dk. brown sandy CLAY(CL) Wn=19%	31	14	17	57.6	CL, Sandy lean clay

Project No.: 53483.007
Project: Russell City AWT

Client: Harding ESE
Location:

Date: 11-21-01

Remarks:

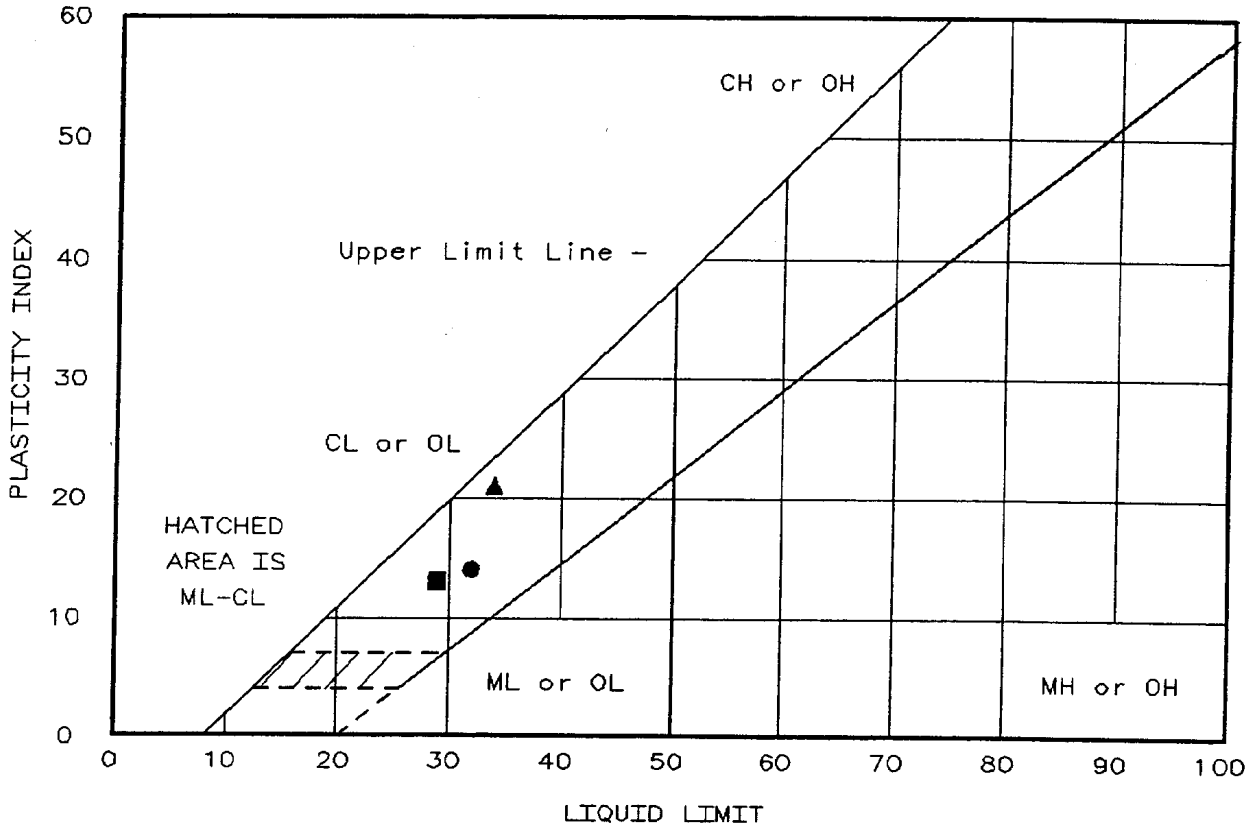
ASTM D 4318

LIQUID AND PLASTIC LIMITS TEST REPORT

Soil Mechanics Lab

Fig. No. _____

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	ASTM D 2487-90
●	CB-3 @ 27.5':Olive brown silty CLAY(CL)	32	18	14	71.6	CL, Lean clay with sand
▲	CB-3 @ 48':Dk. gr. silty CLAY(CL)	34	13	21		
■	CB-3 @ 73.5':Dk.gr. silty CLAY(CL)w/silt seams.	29	16	13		

Project No.: 53483.007
Project: Russell City AWT

Client: Harding ESE
Location:

Date: 11-21-01

Remarks:

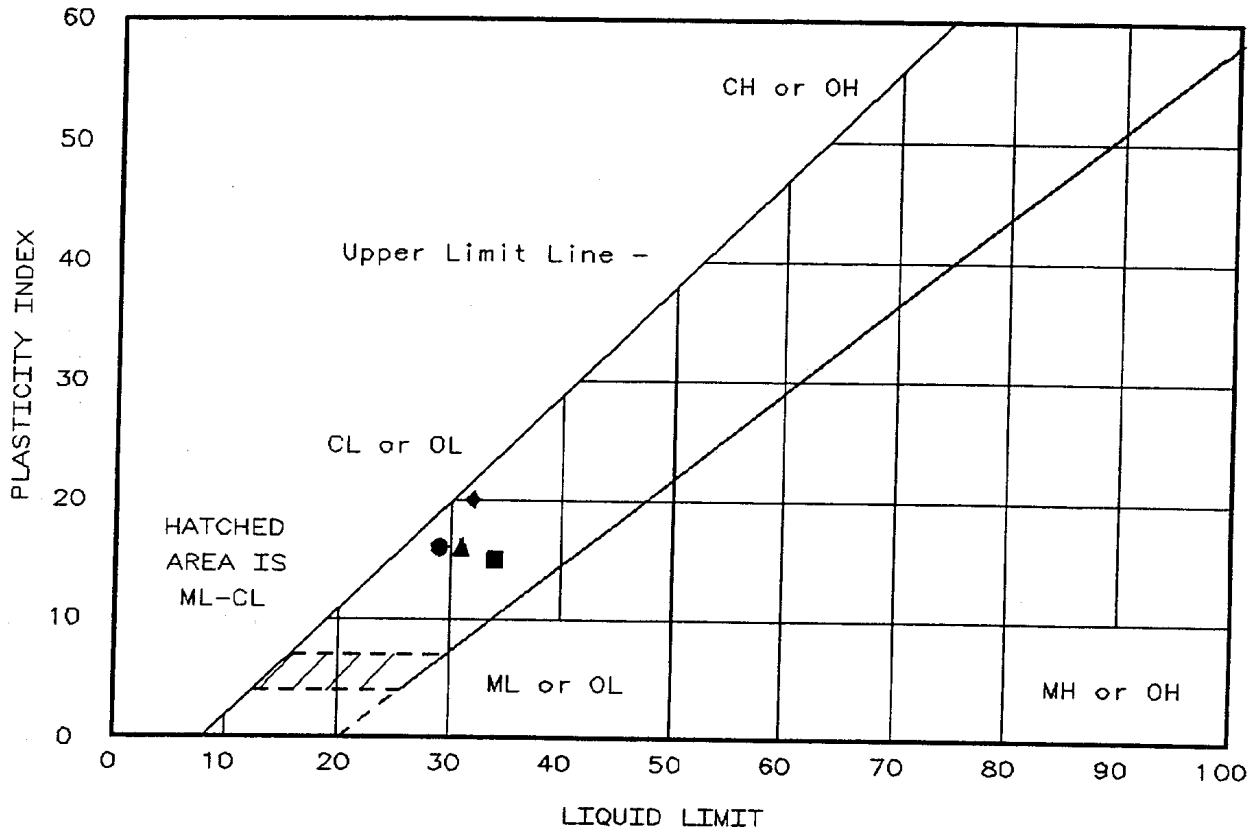
ASTM D 4318

LIQUID AND PLASTIC LIMITS TEST REPORT

Soil Mechanics Lab

Fig. No. _____

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	ASTM D 2487-90
●	CB-4 @ 6.5':Dk. gr. sandy CLAY(CL)	29	13	16		
▲	CB-4 @ 8':V. dk. gray sandy CLAY(CL) Wn=19%	31	15	16	53	CL, Sandy lean clay
■	CB-4 @ 15.5':Olive brown silty CLAY(CL)w/sand.	34	19	15		
◆	CB-4 @ 20.5':Dk. olv. brn silty CLAY(CL)	32	12	20	83.6	CL, Lean clay with sand

Project No.: 53483.007
Project: Russell City AWT

Client: Harding ESE
Location:

Date: 11-21-01

Remarks:

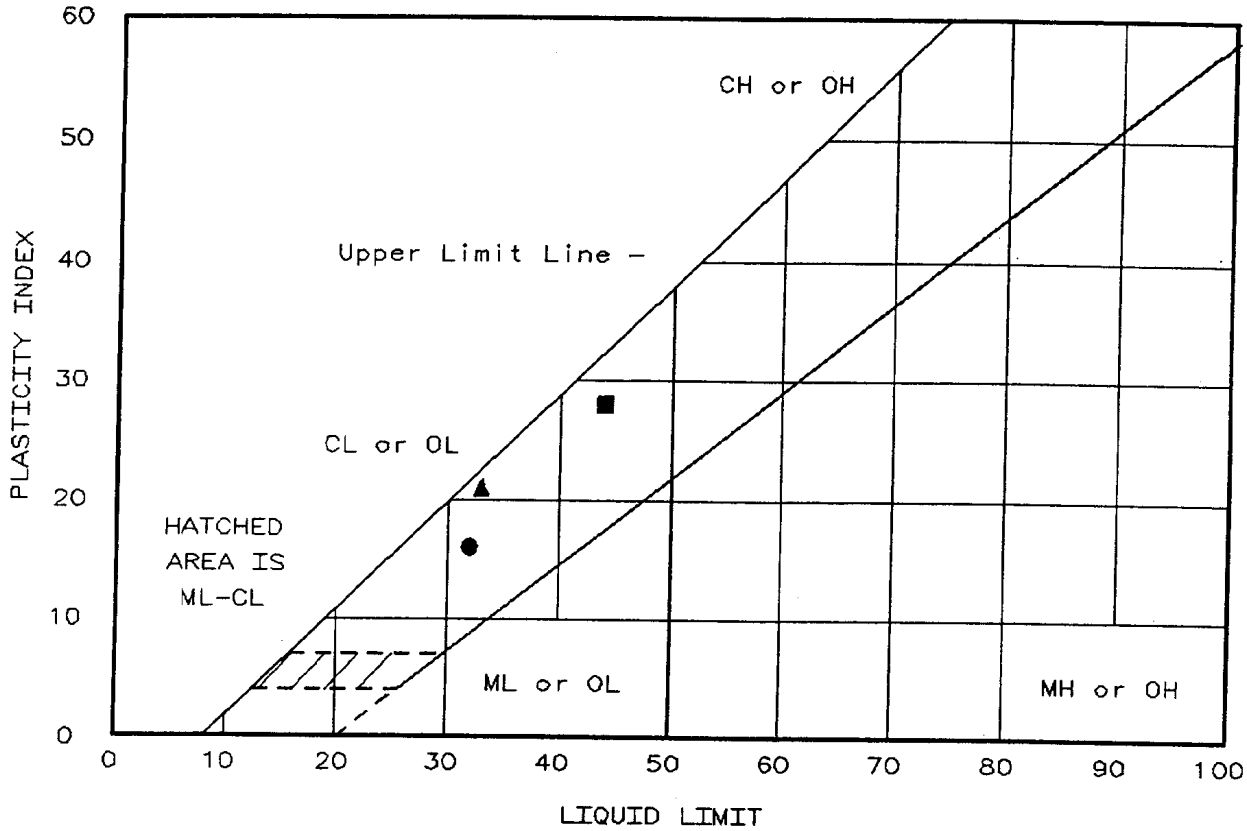
ASTM D 4318

LIQUID AND PLASTIC LIMITS TEST REPORT

Soil Mechanics Lab

Fig. No. _____

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	ASTM D 2487-90
●	CB-4 @ 30.5':Olive brown silty CLAY(CL)w/sand.	32	16	16		
▲	CB-4 @ 45.5':Olive brown silty CLAY(CL)	33	12	21		
■	CB-4 @ 65.5':Dk. gray silty CLAY(CL)	44	16	28	99.4	CL, Lean clay

Project No.: 53483.007
Project: Russell City AWT

Client: Harding ESE
Location:

Date: 11-21-01

Remarks:

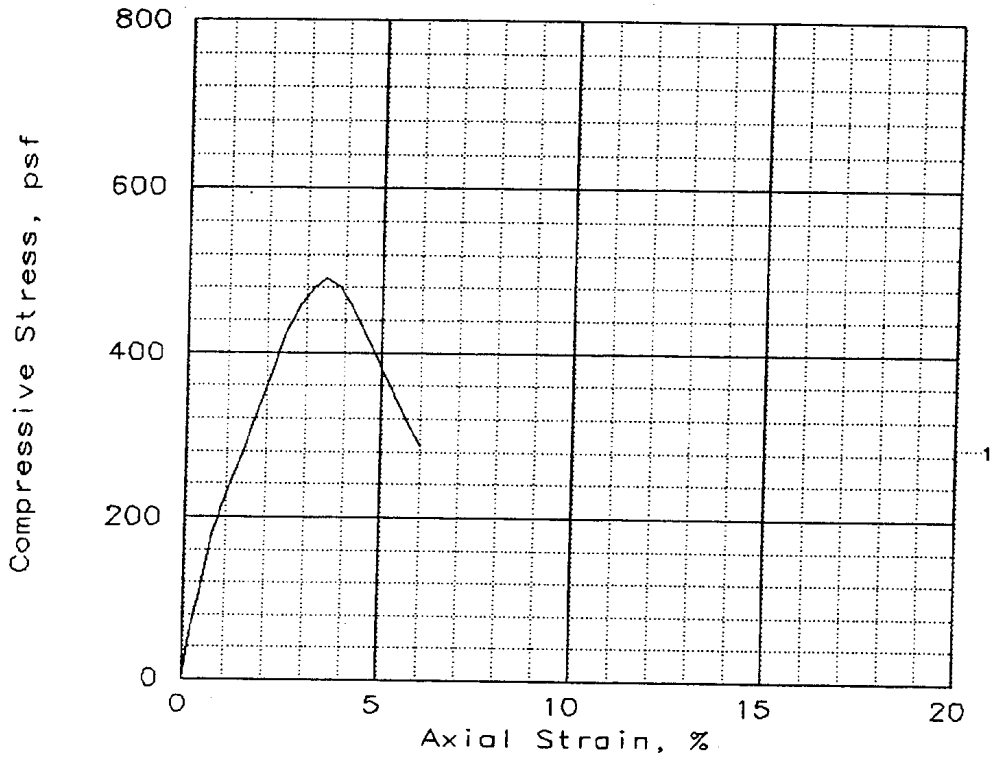
ASTM D 4318

LIQUID AND PLASTIC LIMITS TEST REPORT

Soil Mechanics Lab

Fig. No. _____

UNCONFINED COMPRESSION TEST



SAMPLE NO.:	1			
Unconfined strength, psf	491			
Undrained shear strength, psf	245			
Failure strain, %	3.5			
Strain rate, in/min	0.0750			
Water content, %	22.6			
Wet density, pcf	127.4			
Dry density, pcf	103.9			
Saturation, %	98.2			
Void ratio	0.6224			
Specimen diameter, in	2.86			
Specimen height, in	5.64			
Height/diameter ratio	1.97			

1) Description: Dk. gray silty CLAY(CL)w/sand.
2) Description:
3) Description:
4) Description:

			GS= 2.7	Type: Shelby

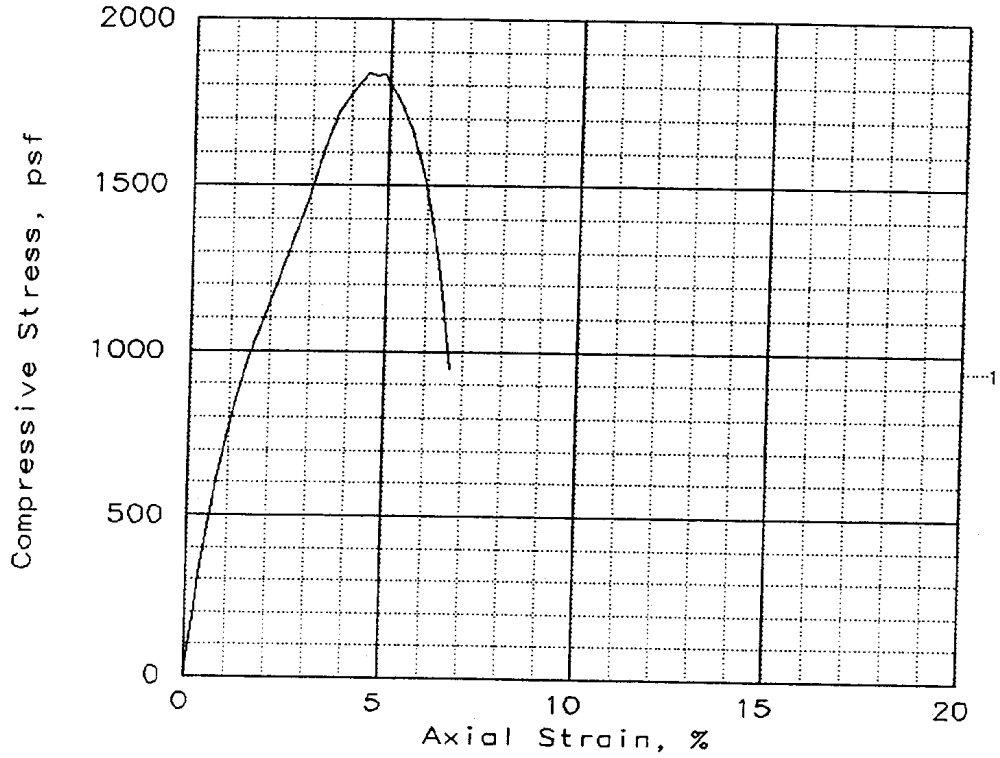
Project No.: 53483.007
Date: 11-26-01
Remarks:

Client: Harding ESE
Project: Russell City AWT
Location: CB-1 10.5'

UNCONFINED COMPRESSION TEST
Soil Mechanics Lab

Fig. No.: ——

UNCONFINED COMPRESSION TEST



SAMPLE NO.:	1			
Unconfined strength, psf	1837			
Undrained shear strength, psf	919			
Failure strain, %	4.5			
Strain rate, in/min	0.0750			
Water content, %	18.5			
Wet density, pcf	130.1			
Dry density, pcf	109.8			
Saturation, %	93.1			
Void ratio	0.5353			
Specimen diameter, in	2.86			
Specimen height, in	5.36			
Height/diameter ratio	1.87			

1) Description: Dk. brown silty CLAY(CL)w/caliche inclusions.
2) Description:
3) Description:
4) Description:

			GS= 2.7	Type: Shelby

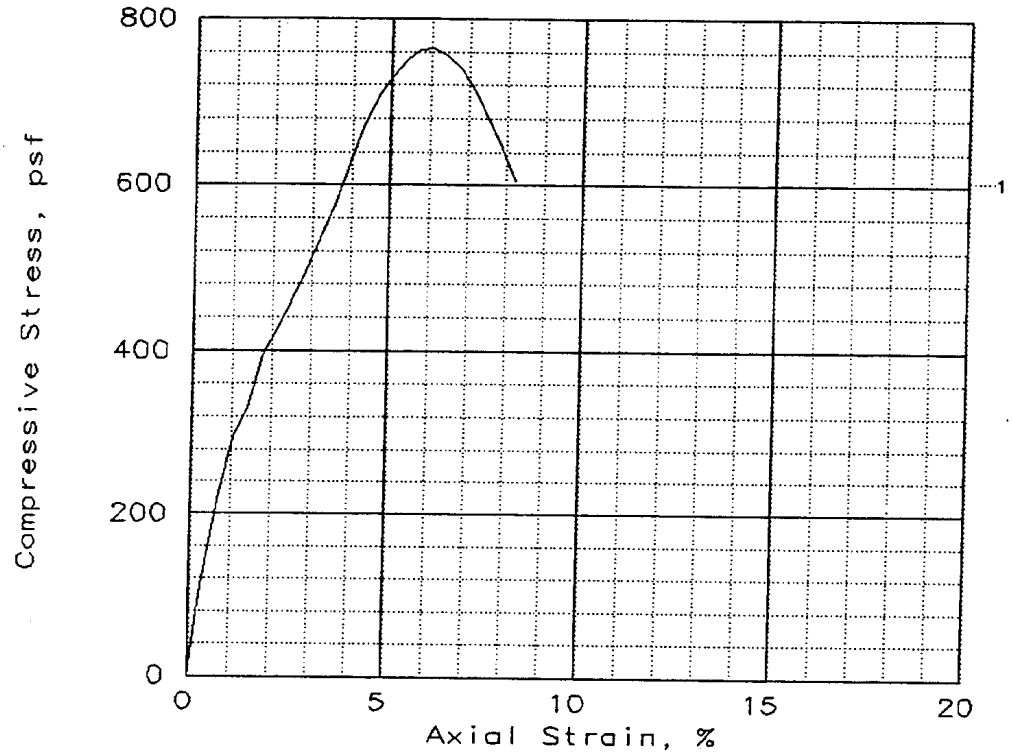
Project No.: 53483.007
Date: 11-26-01
Remarks:

Client: Harding ESE
Project: Russell City AWT
Location: CB-1 30.5'

UNCONFINED COMPRESSION TEST
Soil Mechanics Lab

Fig. No.: ——

UNCONFINED COMPRESSION TEST



SAMPLE NO.:	1			
Unconfined strength, psf	764			
Undrained shear strength, psf	382			
Failure strain, %	6.1			
Strain rate, in/min	0.0750			
Water content, %	21.9			
Wet density, pcf	126.3			
Dry density, pcf	103.6			
Saturation, %	94.2			
Void ratio	0.6263			
Specimen diameter, in	2.86			
Specimen height, in	5.57			
Height/diameter ratio	1.95			

1) Description: Dk. gray silty CLAY(CL)
2) Description:
3) Description:
4) Description:

			GS= 2.7	Type: Shelby

Project No.: 53483.007
Date: 11-26-01
Remarks:

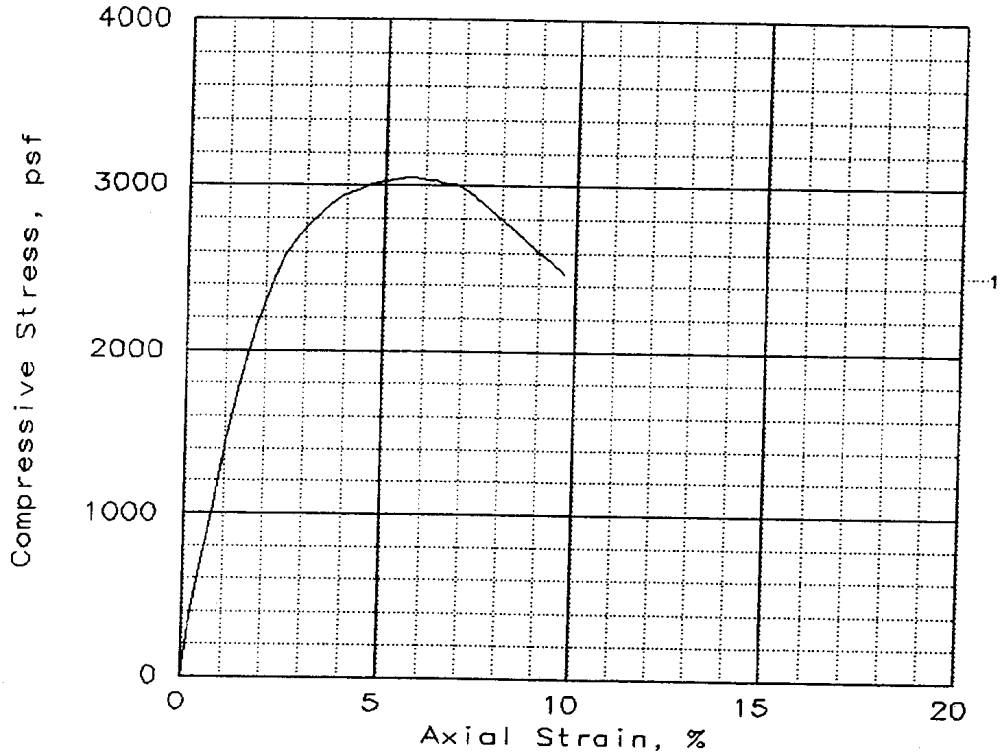
Client: Harding ESE
Project: Russell City AWT
Location: CB-1 45.5'

UNCONFINED COMPRESSION TEST

Fig. No.: ——

Soil Mechanics Lab

UNCONFINED COMPRESSION TEST



SAMPLE NO.:	1			
Unconfined strength, psf	3049			
Undrained shear strength, psf	1524			
Failure strain, %	5.7			
Strain rate, in/min	0.0750			
Water content, %	27.5			
Wet density, pcf	126.9			
Dry density, pcf	99.5			
Saturation, %	107.0			
Void ratio	0.6943			
Specimen diameter, in	2.86			
Specimen height, in	5.57			
Height/diameter ratio	1.95			

1) Description: Dk. gray silty CLAY(CL)

2) Description:

3) Description:

4) Description:

			GS= 2.7	Type: Shelby

Project No.: 53483.007

Date: 11-26-01

Remarks:

Client: Harding ESE

Project: Russell City AWT

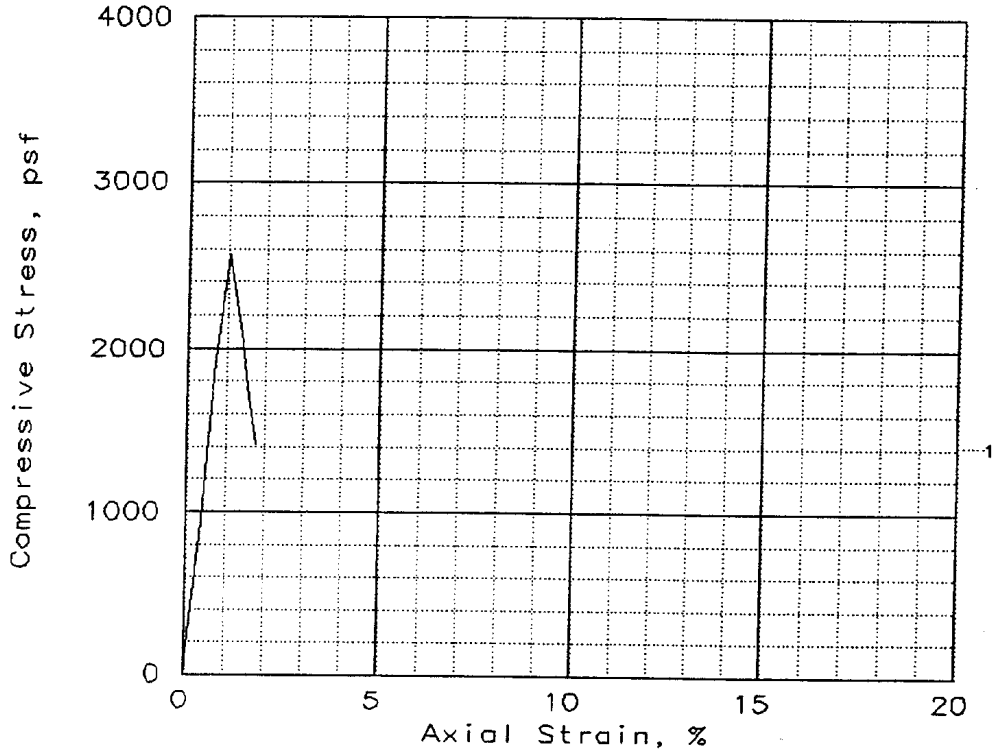
Location: CB-1 67.5'

UNCONFINED COMPRESSION TEST

Soil Mechanics Lab

Fig. No.: ____

UNCONFINED COMPRESSION TEST



SAMPLE NO.:	1			
Unconfined strength, psf	2568			
Undrained shear strength, psf	1284			
Failure strain, %	1.1			
Strain rate, in/min	0.0750			
Water content, %	20.1			
Wet density, pcf	129.8			
Dry density, pcf	108.0			
Saturation, %	97.0			
Void ratio	0.5601			
Specimen diameter, in	2.86			
Specimen height, in	5.57			
Height/diameter ratio	1.95			

1) Description: Dk. olive brown silty CLAY(CL)

2) Description:

3) Description:

4) Description:

			GS= 2.7	Type: Shelby

Project No.: 53483.007

Date: 11-26-01

Remarks:

Client: Harding ESE

Project: Russell City AWT

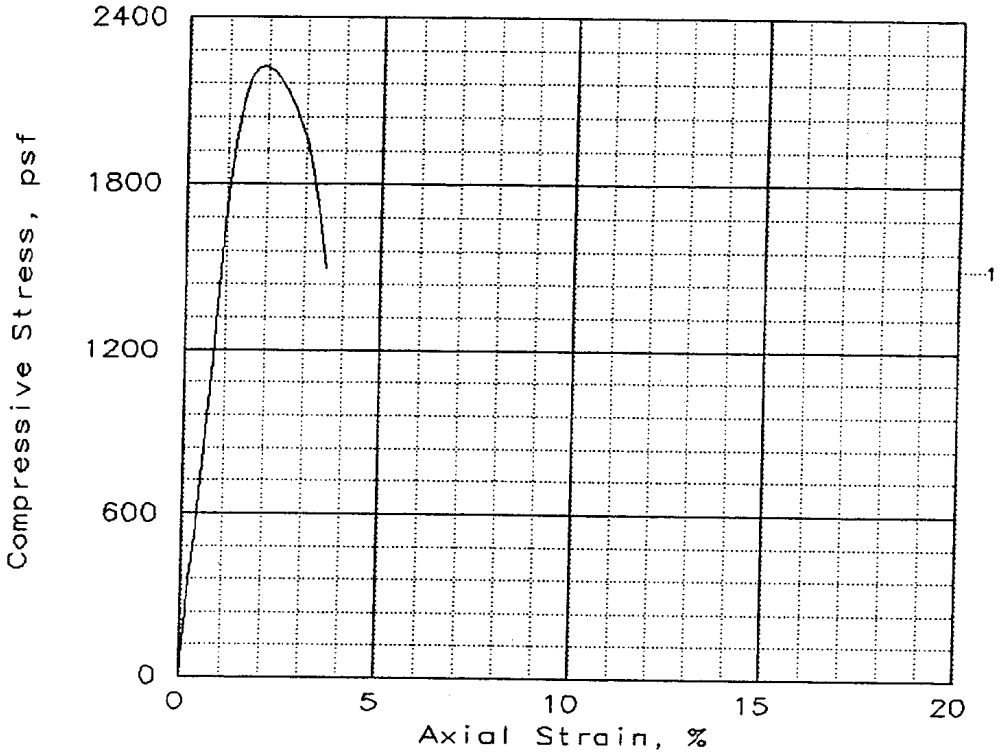
Location: CB-2 13.5'

UNCONFINED COMPRESSION TEST

Soil Mechanics Lab

Fig. No.: ____

UNCONFINED COMPRESSION TEST



SAMPLE NO.:	1			
Unconfined strength, psf	2224			
Undrained shear strength, psf	1112			
Failure strain, %	2.0			
Strain rate, in/min	0.0750			
Water content, %	19.4			
Wet density, pcf	131.4			
Dry density, pcf	110.0			
Saturation, %	98.7			
Void ratio	0.5321			
Specimen diameter, in	2.86			
Specimen height, in	5.57			
Height/diameter ratio	1.95			

1) Description: Olive brown sandy CLAY(CL)

2) Description:

3) Description:

4) Description:

			GS= 2.7	Type: Shelby

Project No.: 53483.007

Date: 11-26-01

Remarks:

Fig. No.: ——

Client: Harding ESE

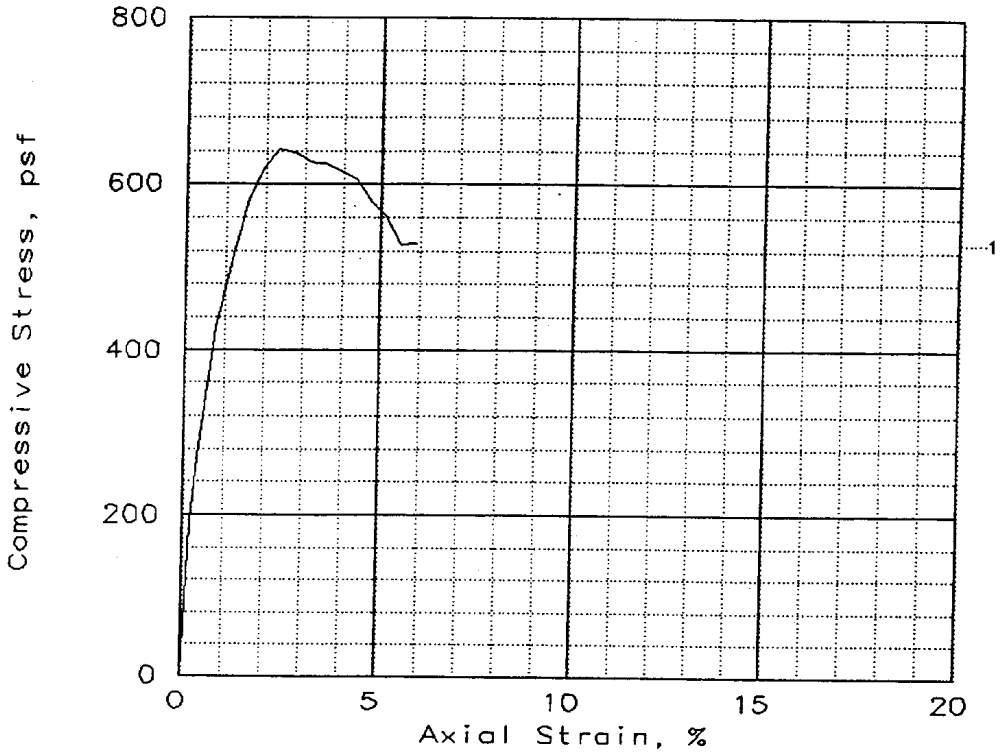
Project: Russell City AWT

Location: CB-2 32.0'

UNCONFINED COMPRESSION TEST

Soil Mechanics Lab

UNCONFINED COMPRESSION TEST



SAMPLE NO.:	1			
Unconfined strength, psf	643			
Undrained shear strength, psf	322			
Failure strain, %	2.4			
Strain rate, in/min	0.0750			
Water content, %	21.8			
Wet density, pcf	135.8			
Dry density, pcf	111.5			
Saturation, %	115.1			
Void ratio	0.5113			
Specimen diameter, in	2.86			
Specimen height, in	5.05			
Height/diameter ratio	1.77			

1) Description: Dark gray clayey GRAVEL(GC)w/sand.
2) Description:
3) Description:
4) Description:

			GS= 2.7	Type: Shelby

Project No.: 53483.007
Date: 11-26-01
Remarks:
*Specimen probably disturbed due to 3/8" gravel "drag" during sampling.

Fig. No.: ——

Client: Harding ESE

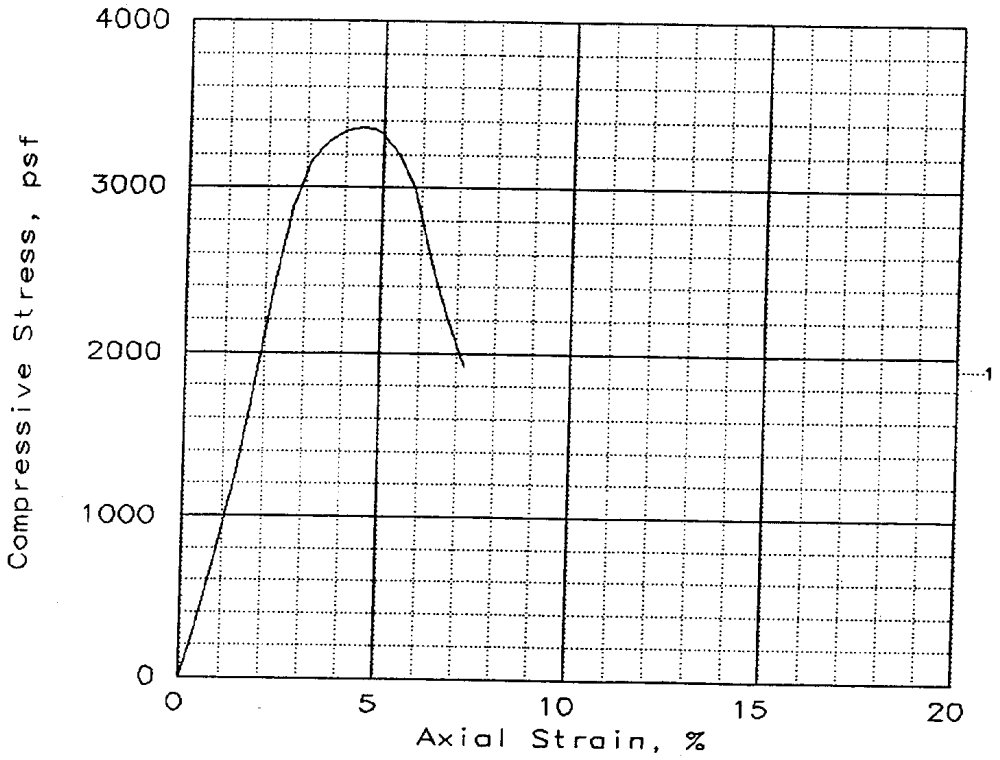
Project: Russell City AWT

Location: CB-2 49.5'

UNCONFINED COMPRESSION TEST

Soil Mechanics Lab

UNCONFINED COMPRESSION TEST



SAMPLE NO.:	1			
Unconfined strength, psf	3358			
Undrained shear strength, psf	1679			
Failure strain, %	4.5			
Strain rate, in/min	0.0750			
Water content, %	24.6			
Wet density, pcf	128.1			
Dry density, pcf	102.8			
Saturation, %	104.0			
Void ratio	0.6395			
Specimen diameter, in	2.86			
Specimen height, in	4.43			
Height/diameter ratio	1.55			

1) Description: Dk. olive gray silty CLAY(CL)

2) Description:

3) Description:

4) Description:

			GS= 2.7	Type: Shelby

Project No.: 53483.007

Date: 11-26-01

Remarks:

Client: Harding ESE

Project: Russell City AWT

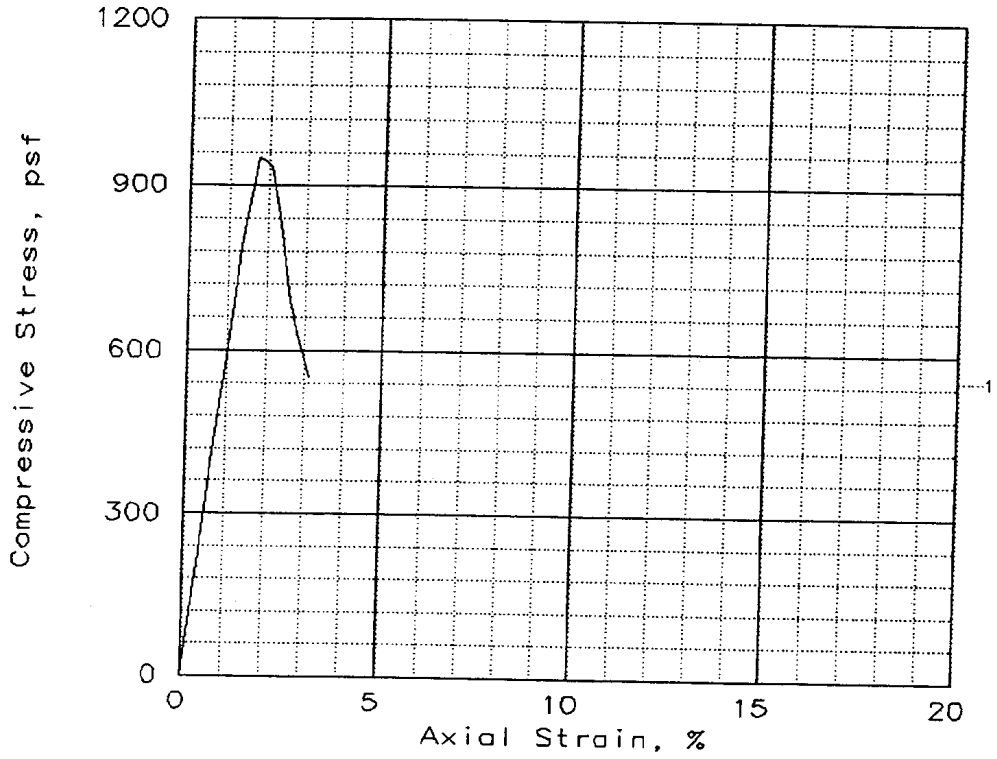
Location: CB-2 71'

UNCONFINED COMPRESSION TEST

Soil Mechanics Lab

Fig. No.: ——

UNCONFINED COMPRESSION TEST



SAMPLE NO.:	1			
Unconfined strength, psf	949			
Undrained shear strength, psf	475			
Failure strain, %	1.8			
Strain rate, in/min	0.0750			
Water content, %	25.1			
Wet density, pcf	121.7			
Dry density, pcf	97.2			
Saturation, %	92.5			
Void ratio	0.7337			
Specimen diameter, in	2.86			
Specimen height, in	5.68			
Height/diameter ratio	1.99			

1) Description: Dk. gray sandy CLAY(CL)

2) Description:

3) Description:

4) Description:

			GS= 2.7	Type: Shelby

Project No.: 53483.007

Date: 11-26-01

Remarks:

Client: Harding ESE

Project: Russell City AWT

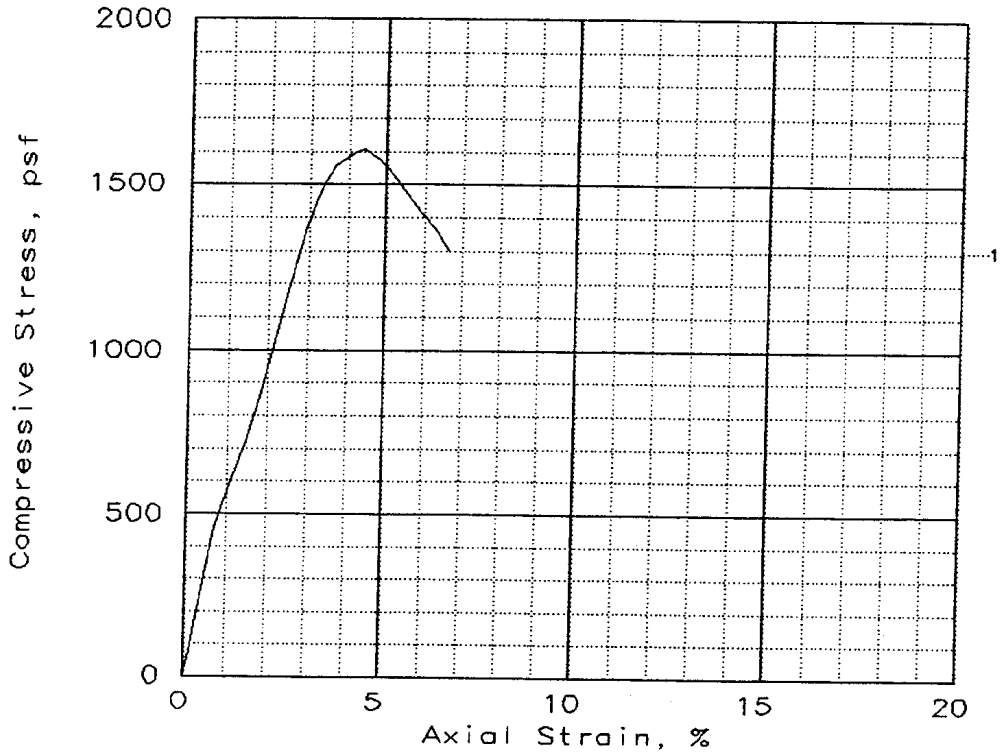
Location: CB-3 10.5'

UNCONFINED COMPRESSION TEST

Fig. No.: ——

Soil Mechanics Lab

UNCONFINED COMPRESSION TEST



SAMPLE NO.:	1			
Unconfined strength, psf	1606			
Undrained shear strength, psf	803			
Failure strain, %	4.5			
Strain rate, in/min	0.0750			
Water content, %	20.5			
Wet density, pcf	132.0			
Dry density, pcf	109.5			
Saturation, %	102.6			
Void ratio	0.5390			
Specimen diameter, in	2.86			
Specimen height, in	5.39			
Height/diameter ratio	1.88			

1) Description: Olive brown silty CLAY(CL)

2) Description:

3) Description:

4) Description:

			GS= 2.7	Type: Shelby

Project No.: 53483.007

Date: 11-26-01

Remarks:

Client: Harding ESE

Project: Russell City AWT

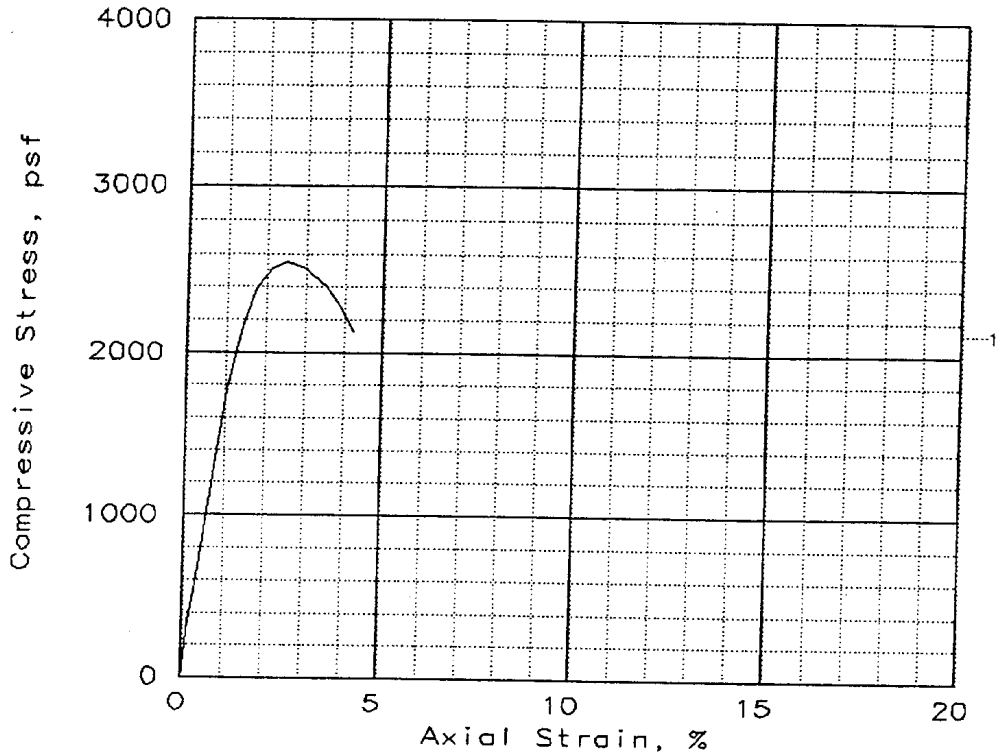
Location: CB-3 27.5'

UNCONFINED COMPRESSION TEST

Soil Mechanics Lab

Fig. No.: ____

UNCONFINED COMPRESSION TEST



SAMPLE NO.:	1			
Unconfined strength, psf	2551			
Undrained shear strength, psf	1275			
Failure strain, %	2.5			
Strain rate, in/min	0.0750			
Water content, %	20.9			
Wet density, pcf	130.4			
Dry density, pcf	107.9			
Saturation, %	100.2			
Void ratio	0.5621			
Specimen diameter, in	2.86			
Specimen height, in	5.62			
Height/diameter ratio	1.97			

1) Description: Dk. gray silty CLAY(CL)
2) Description:
3) Description:
4) Description:

			GS= 2.7	Type: Shelby

Project No.: 53483.007
Date: 11-26-01
Remarks:

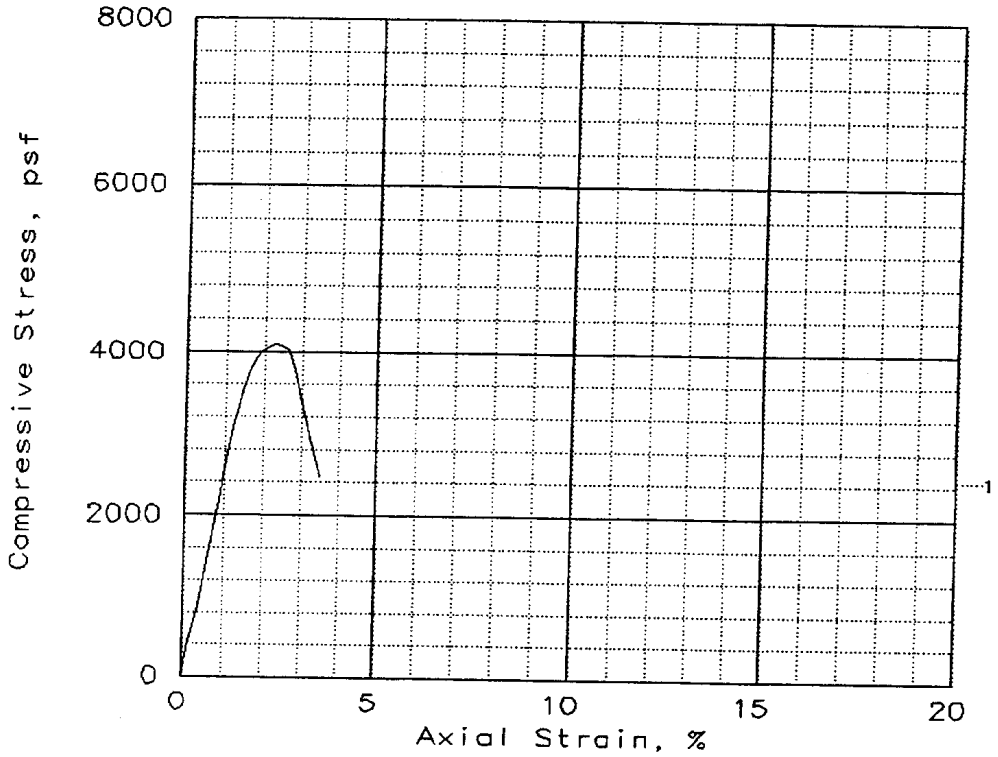
Client: Harding ESE
Project: Russell City AWT
Location: CB-3 48'

UNCONFINED COMPRESSION TEST

Fig. No.: ——

Soil Mechanics Lab

UNCONFINED COMPRESSION TEST



SAMPLE NO.:	1			
Unconfined strength, psf	4080			
Undrained shear strength, psf	2040			
Failure strain, %	2.3			
Strain rate, in/min	0.0750			
Water content, %	20.8			
Wet density, pcf	127.6			
Dry density, pcf	105.7			
Saturation, %	94.2			
Void ratio	0.5953			
Specimen diameter, in	2.86			
Specimen height, in	5.64			
Height/diameter ratio	1.97			

1) Description: Dk. gray silty CLAY(CL)w/silt seams.
2) Description:
3) Description:
4) Description:

			GS= 2.7	Type: Shelby

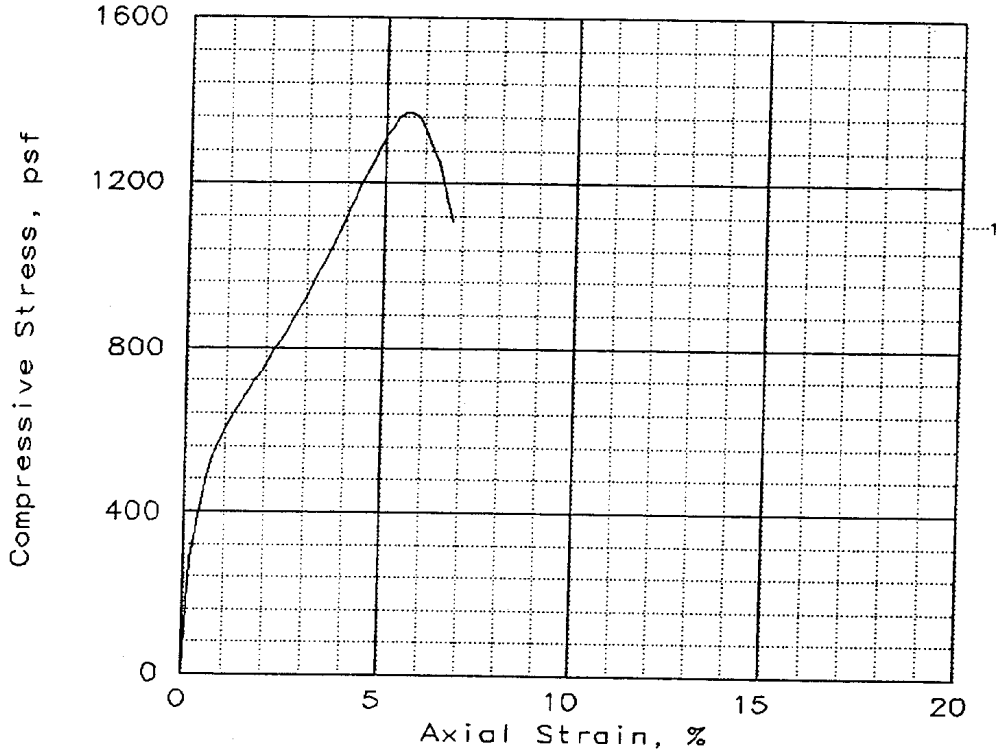
Project No.: 53483.007
Date: 11-26-01
Remarks:

Client: Harding ESE
Project: Russell City AWT
Location: CB-3 73.0'

UNCONFINED COMPRESSION TEST
Soil Mechanics Lab

Fig. No.: ____

UNCONFINED COMPRESSION TEST



SAMPLE NO.:	1			
Unconfined strength, psf	1370			
Undrained shear strength, psf	685			
Failure strain, %	5.5			
Strain rate, in/min	0.0750			
Water content, %	17.3			
Wet density, pcf	122.9			
Dry density, pcf	104.7			
Saturation, %	76.8			
Void ratio	0.6094			
Specimen diameter, in	2.86			
Specimen height, in	5.62			
Height/diameter ratio	1.97			

1) Description: Dk. gray sandy CLAY(CL)

2) Description:

3) Description:

4) Description:

			GS= 2.7	Type: Shelby

Project No.: 53483.007

Date: 11-26-01

Remarks:

Client: Harding ESE

Project: Russell City AWT

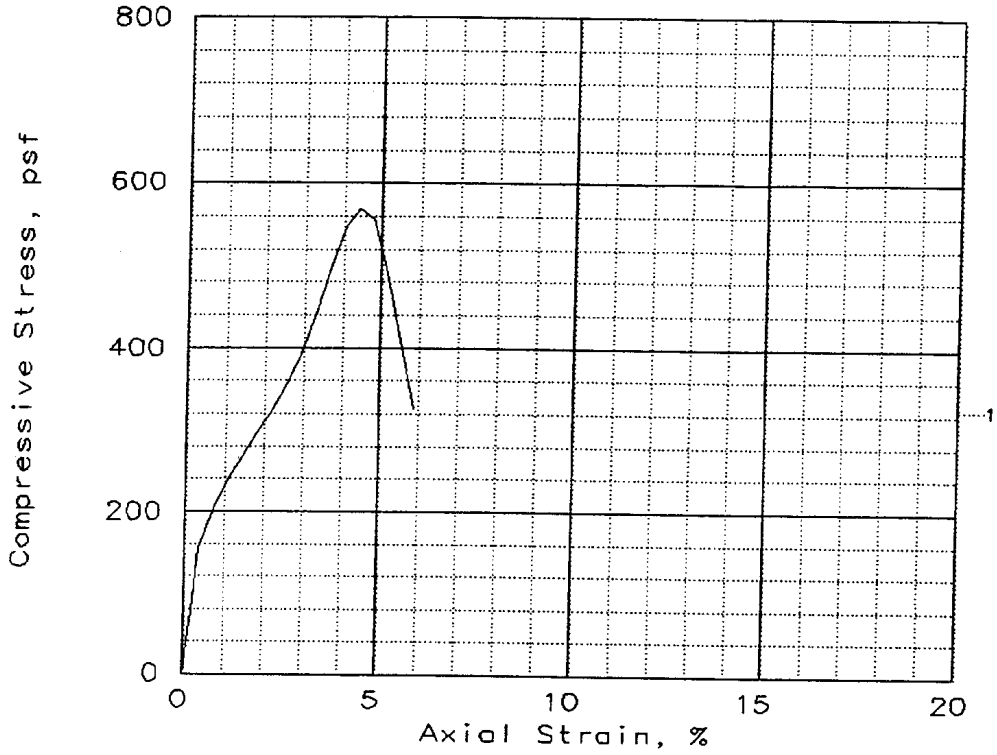
Location: CB-4 7.0'

UNCONFINED COMPRESSION TEST

Fig. No.: ____

Soil Mechanics Lab

UNCONFINED COMPRESSION TEST



SAMPLE NO.:	1			
Unconfined strength, psf	570			
Undrained shear strength, psf	285			
Failure strain, %	4.4			
Strain rate, in/min	0.0750			
Water content, %	24.1			
Wet density, pcf	126.9			
Dry density, pcf	102.3			
Saturation, %	100.2			
Void ratio	0.6482			
Specimen diameter, in	2.86			
Specimen height, in	5.41			
Height/diameter ratio	1.89			

1) Description: Dk. olive brown silty CLAY(CL)
2) Description:
3) Description:
4) Description:

			GS= 2.7	Type: Shelby

Project No.: 53483.007
Date: 11-26-01
Remarks:

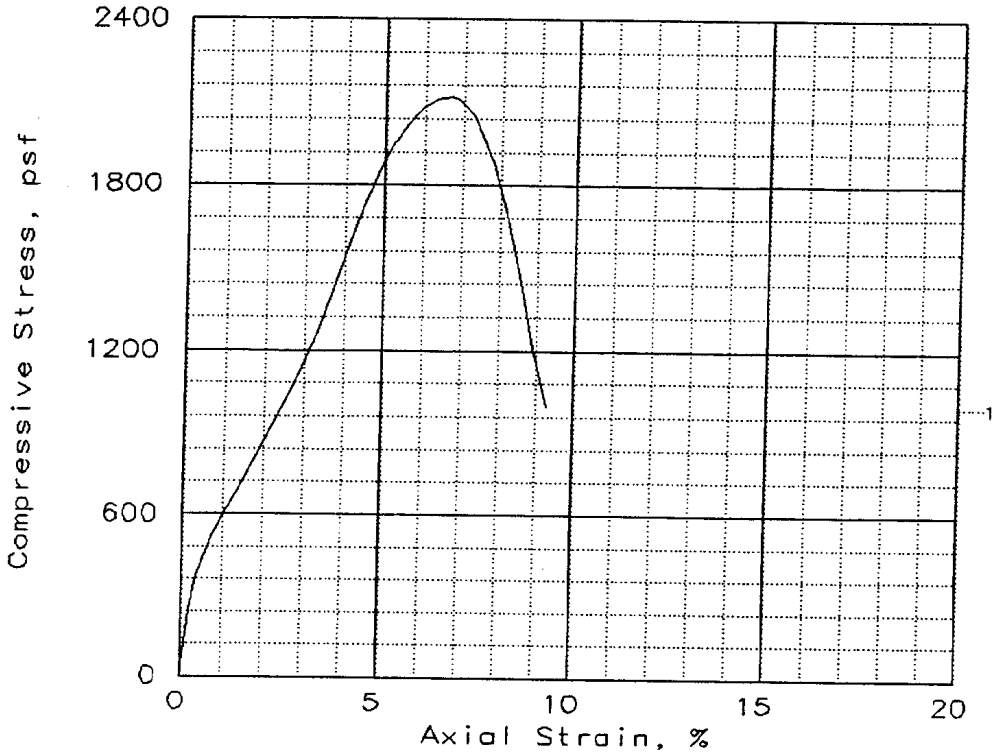
Client: Harding ESE
Project: Russell City AWT
Location: CB-4 20.5'

UNCONFINED COMPRESSION TEST

Fig. No.: ——

Soil Mechanics Lab

UNCONFINED COMPRESSION TEST



SAMPLE NO.:	1			
Unconfined strength, psf	2118			
Undrained shear strength, psf	1059			
Failure strain, %	6.7			
Strain rate, in/min	0.0750			
Water content, %	18.7			
Wet density, pcf	132.9			
Dry density, pcf	111.9			
Saturation, %	99.8			
Void ratio	0.5059			
Specimen diameter, in	2.86			
Specimen height, in	5.37			
Height/diameter ratio	1.88			

1) Description: Olive brown silty CLAY(CL)

2) Description:

3) Description:

4) Description:

			GS= 2.7	Type: Shelby

Project No.: 53483.007

Date: 11-26-01

Remarks:

Client: Harding ESE

Project: Russell City AWT

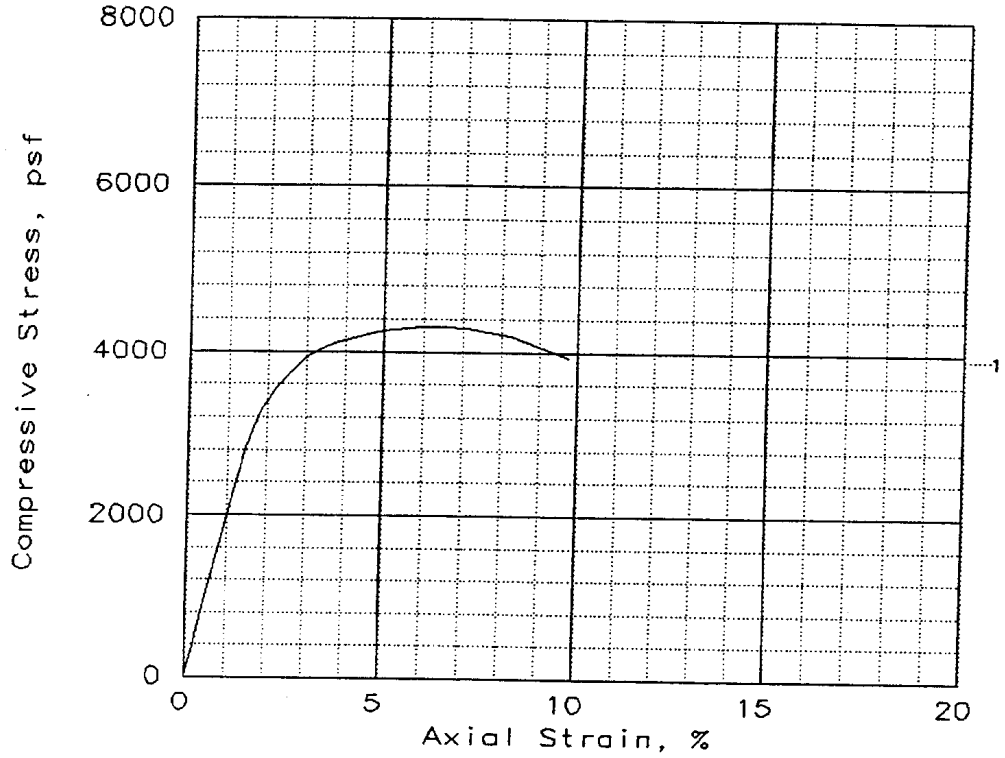
Location: CB-4 45.5'

UNCONFINED COMPRESSION TEST

Soil Mechanics Lab

Fig. No.: ——

UNCONFINED COMPRESSION TEST



SAMPLE NO.:	1			
Unconfined strength, psf	4312			
Undrained shear strength, psf	2156			
Failure strain, %	6.4			
Strain rate, in/min	0.0750			
Water content, %	26.9			
Wet density, pcf	125.2			
Dry density, pcf	98.6			
Saturation, %	102.5			
Void ratio	0.7089			
Specimen diameter, in	2.86			
Specimen height, in	5.33			
Height/diameter ratio	1.86			

1) Description: Dk. gray silty CLAY(CL)
2) Description:
3) Description:
4) Description:

			GS= 2.7	Type: Shelby

Project No.: 53483.007
Date: 11-26-01
Remarks:

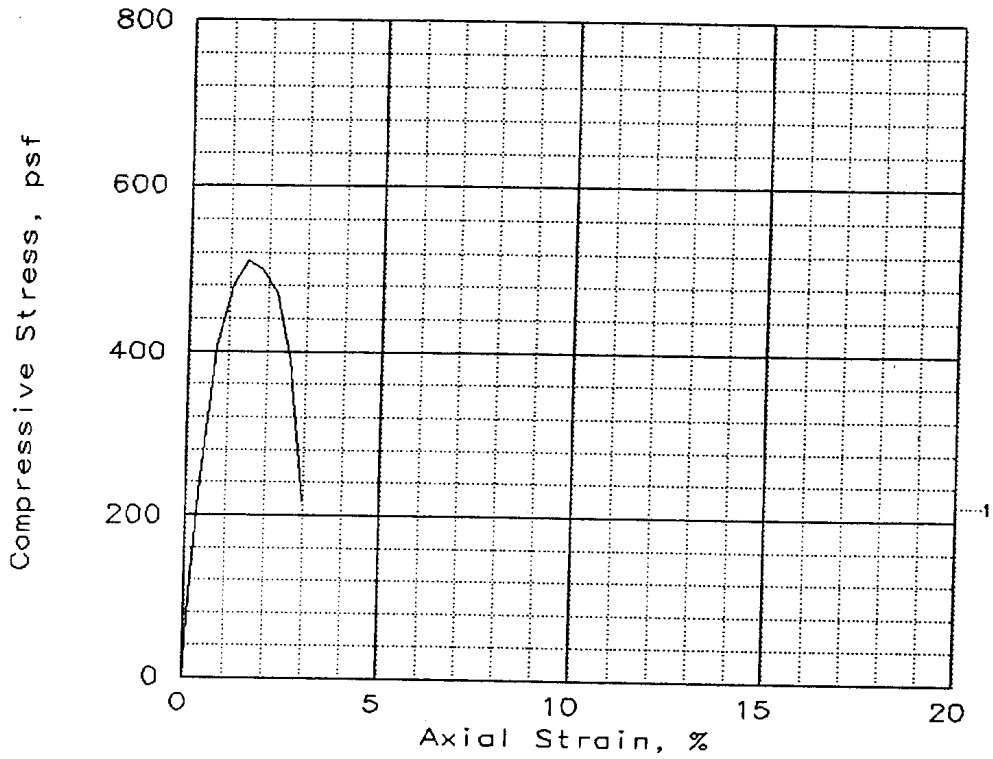
Client: Harding ESE
Project: Russell City AWT
Location: CB-4 65.5'

UNCONFINED COMPRESSION TEST

Fig. No.: ——

Soil Mechanics Lab

UNCONFINED COMPRESSION TEST



SAMPLE NO.:	1			
Unconfined strength, psf	510			
Undrained shear strength, psf	255			
Failure strain, %	1.5			
Strain rate, in/min	0.0750			
Water content, %	24.3			
Wet density, pcf	128.3			
Dry density, pcf	103.2			
Saturation, %	103.8			
Void ratio	0.6328			
Specimen diameter, in	2.86			
Specimen height, in	5.33			
Height/diameter ratio	1.86			

1) Description: Dk. gray silty SAND(SM)*

2) Description:

3) Description:

4) Description:

			GS= 2.7	Type: Shelby

Project No.: 53483.007

Date: 11-26-01

Remarks:

*Becoming silty CLAY at bott. of tube.

Client: Harding ESE

Project: Russell City AWT

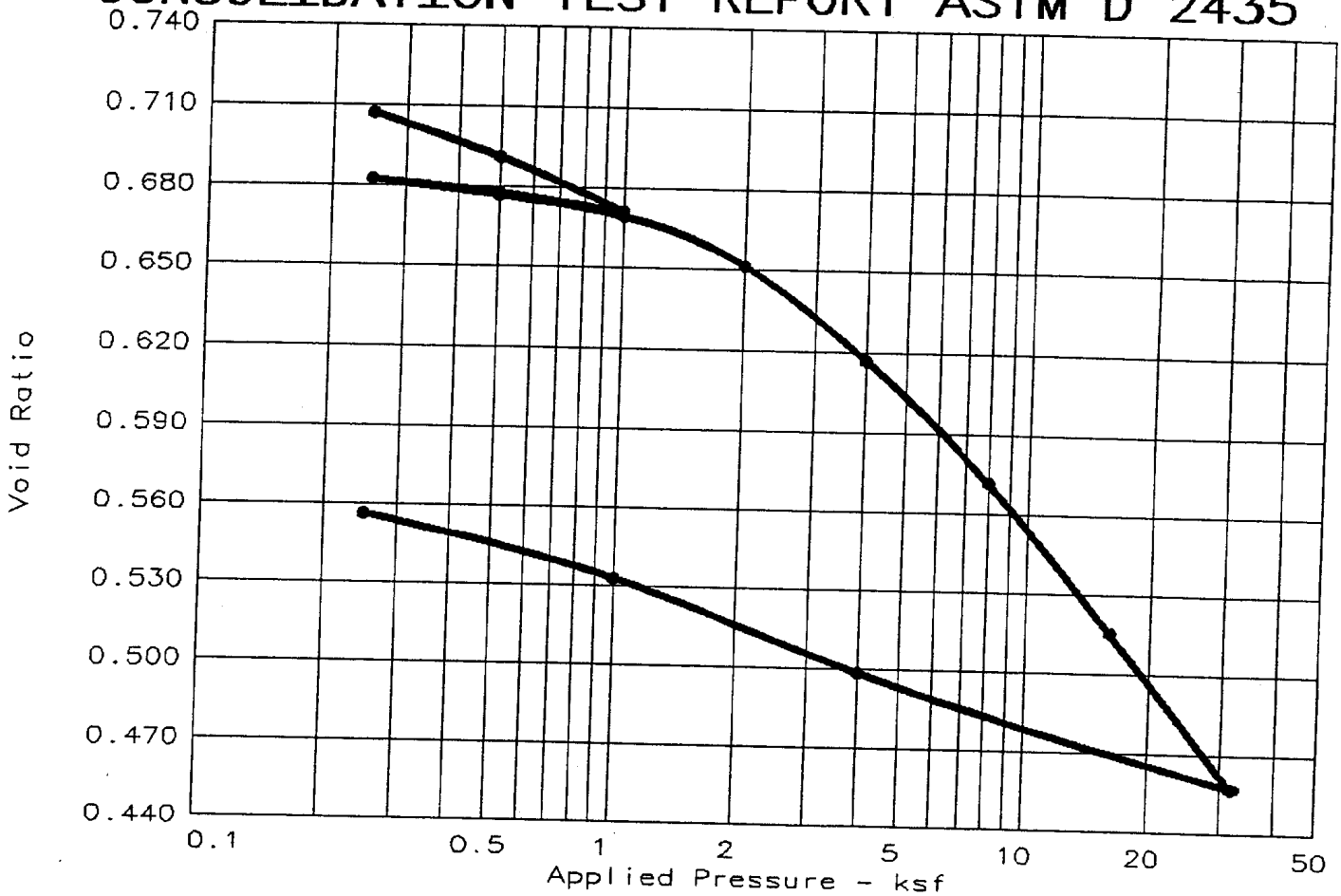
Location: CB-3 131'

UNCONFINED COMPRESSION TEST

Soil Mechanics Lab

Fig. No.: ____

CONSOLIDATION TEST REPORT ASTM D 2435



Coeffs. of Consolidation (sq. ft./day) & Secondary Consolidation											
No.	Load	Cv	Cα	No.	Load	Cv	Cα	No.	Load	Cv	Cα
9	4.00	0.59									
10	8.00	0.87									

Natural Saturation	Natural Moisture	Dry Dens. (pcf)	LL	PI	Sp.Gr.	Precons. (ksf)	C_c	e_o
96.9 %	25.5 %	98.5	35	23	2.700	3.16	0.19	0.7107

TEST RESULTS

Compression Index = 0.19

MATERIAL DESCRIPTION

Olive brown silty CLAY.

Class: CL

Remarks:

Project No.: 53483.007
Project: Russell City AWT
Location: CB-1 11.0'

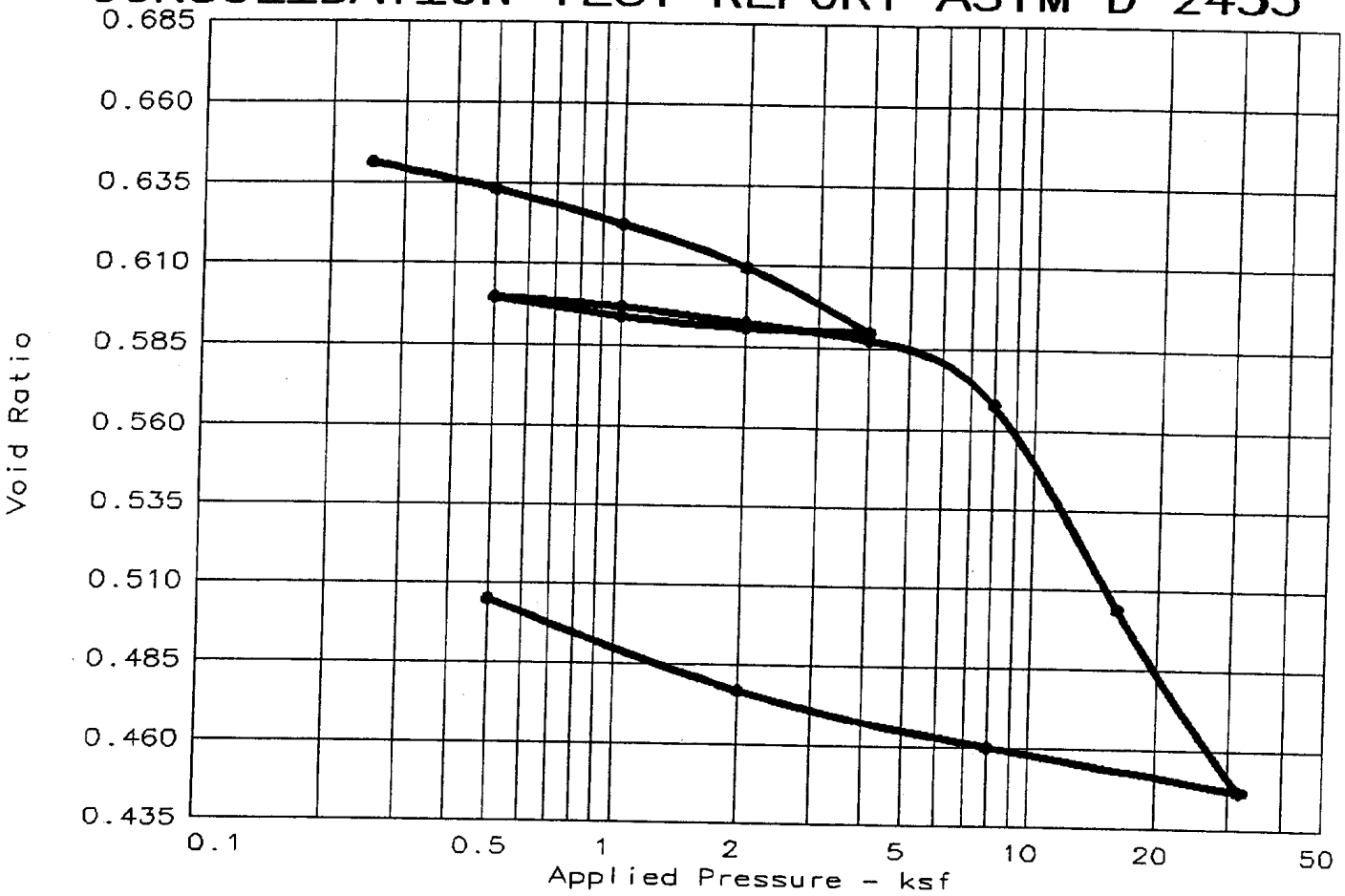
Date: 11-16-01

CONSOLIDATION TEST REPORT ASTM D 2435

Soil Mechanics Lab

Fig. No. _____

CONSOLIDATION TEST REPORT ASTM D 2435



Coeffs. of Consolidation (sq. ft./day) & Secondary Consolidation											
No.	Load	Cv	Cα	No.	Load	Cv	Cα	No.	Load	Cv	Cα
11	4.00	1.50									
12	8.00	0.88									

Natural Saturation	Natural Moisture	Dry Dens. (pcf)	LL	PI	Sp.Gr.	Precons. (ksf)	C_c	e_o
93.8 %	22.8 %	101.8	35	20	2.700	7.32	0.22	0.6562

TEST RESULTS

Compression Index = 0.22

Project No.: 53483.007
Project: Russell City AWT
Location: CB-1 46.0'

Date: 11-26-01

CONSOLIDATION TEST REPORT ASTM D 2435

Soil Mechanics Lab

MATERIAL DESCRIPTION

Dark gray silty CLAY.

Class: CL

Remarks:

Cc is btwn. 9 & 20ksf.

Fig. No. _____

CONSOLIDATION TEST REPORT ASTM D 2435

Coeffs. of Consolidation (sq. ft./day) & Secondary Consolidation											
No.	Load	Cv	Cα	No.	Load	Cv	Cα	No.	Load	Cv	Cα
9	4.00	1.68									
10	8.00	0.93									

Natural Saturation	Natural Moisture	Dry Dens. (pcf)	LL	PI	Sp.Gr.	Precons. (ksf)	C_c	e_o
91.6 %	21.2 %	103.8	42	22	2.700	9.46	0.22	0.6246

TEST RESULTS

Compression Index = 0.22

MATERIAL DESCRIPTION

Dark gray silty CLAY.
Trace sand seams.

Class: CL

Project No.: 53483.007
Project: Russell City AWT
Location: CB-1 68.0'

Date: 11-26-01

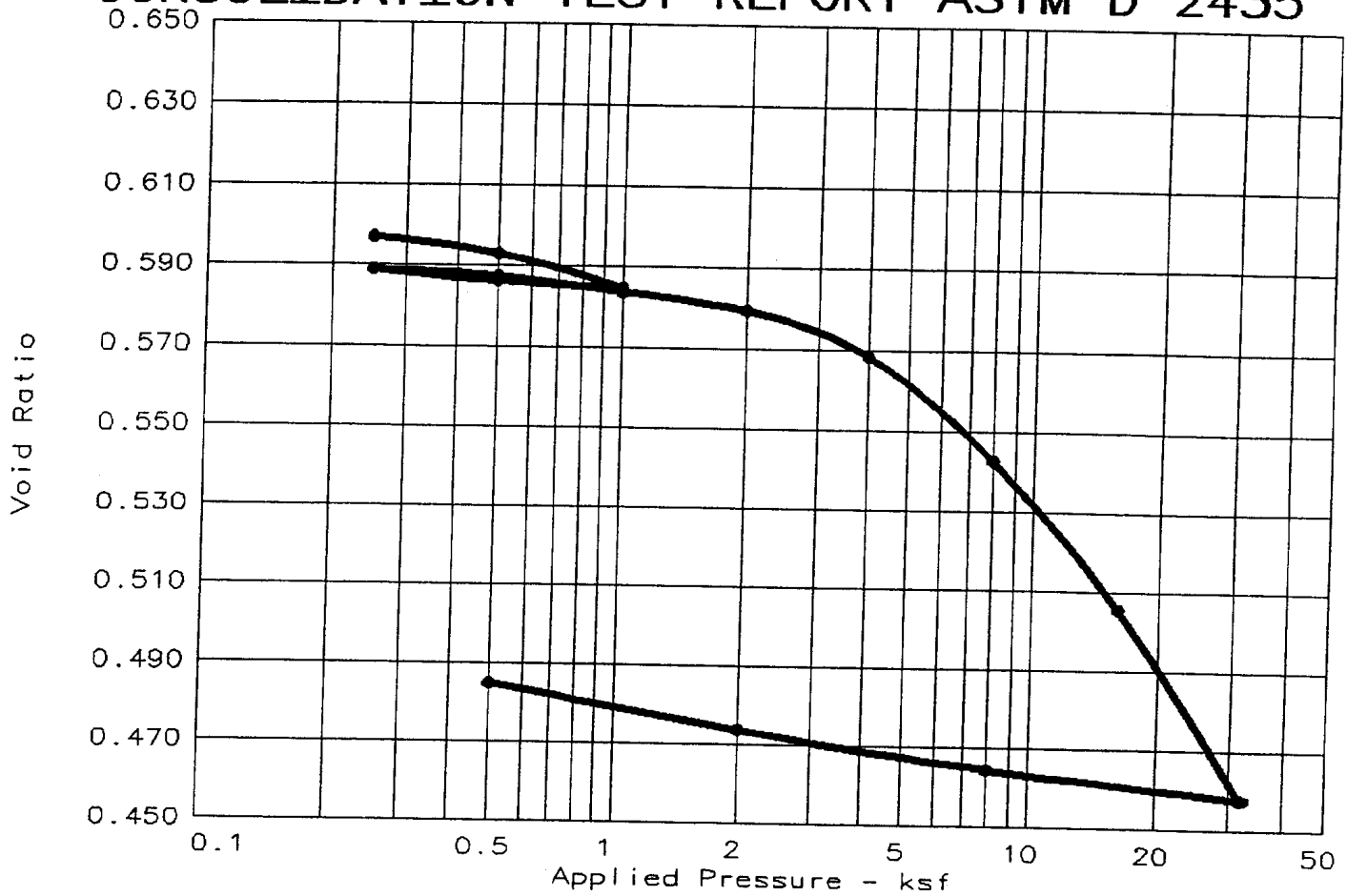
Remarks:

CONSOLIDATION TEST REPORT ASTM D 2435

Soil Mechanics Lab

Fig. No. _____

CONSOLIDATION TEST REPORT ASTM D 2435



Coeffs. of Consolidation (sq. ft./day) & Secondary Consolidation											
No.	Load	Cv	Cα	No.	Load	Cv	Cα	No.	Load	Cv	Cα
10	8.00	1.62									
11	16.00	0.90									

Natural Saturation	Natural Moisture	Dry Dens. (pcf)	LL	PI	Sp.Gr.	Precons. (ksf)	C_c	e_o
88.9 %	19.7 %	105.4	34	22	2.700	6.69	0.16	0.5985

TEST RESULTS

Compression Index = 0.16

MATERIAL DESCRIPTION

Dark gray silty CLAY.

Class: CL

Remarks:

Project No.: 53483.007
Project: Russell City AWT
Location: CB-2 14.0'

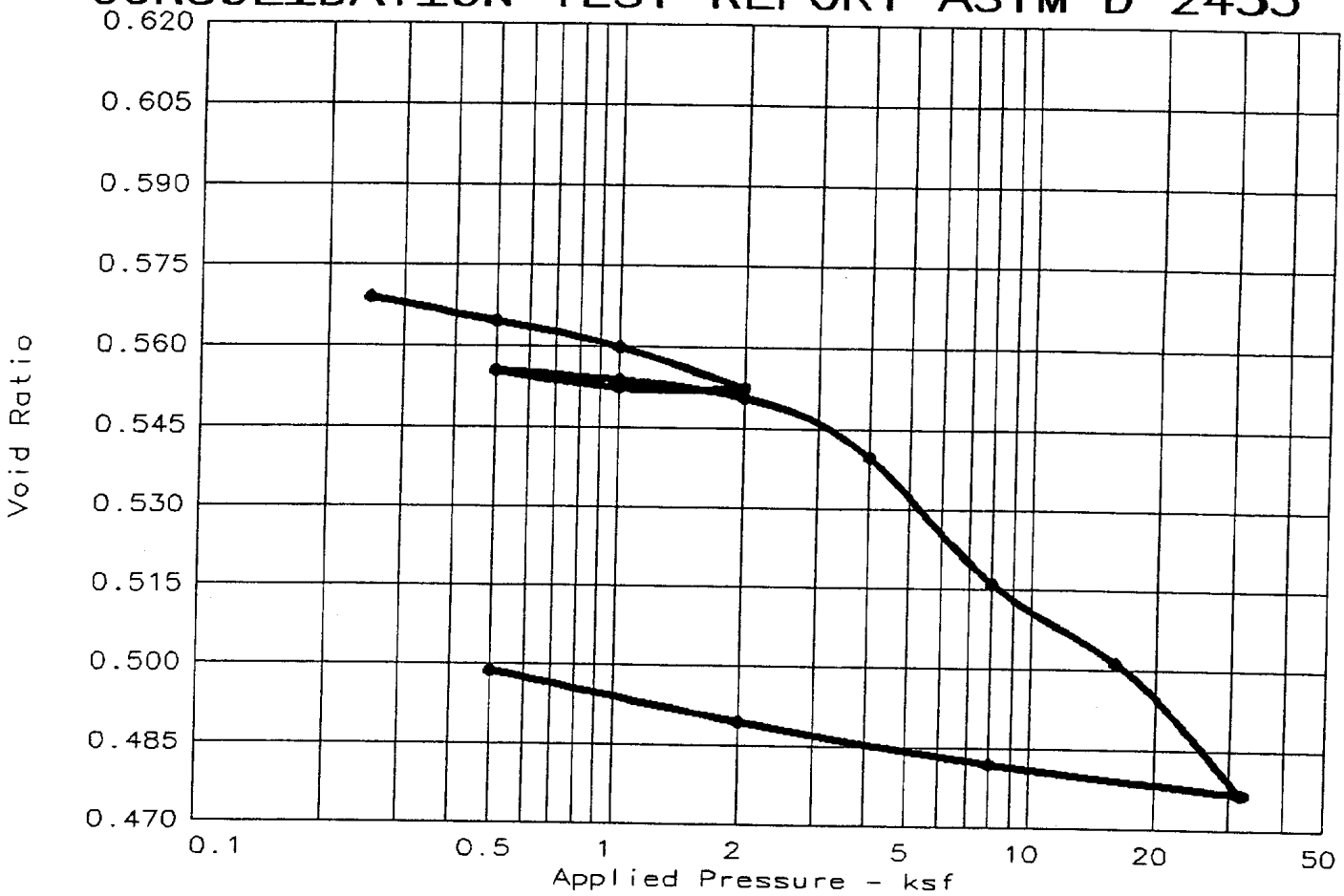
Date: 11-26-01

CONSOLIDATION TEST REPORT ASTM D 2435

Soil Mechanics Lab

Fig. No. _____

CONSOLIDATION TEST REPORT ASTM D 2435



Coeffs. of Consolidation (sq. ft./day) & Secondary Consolidation											
No.	Load	Cv	Cα	No.	Load	Cv	Cα	No.	Load	Cv	Cα
10	8.00	1.47									
11	16.00	1.78									

Natural Saturation	Natural Moisture	Dry Dens. (pcf)	LL	PI	Sp.Gr.	Initial void ratio
83.4 %	17.7 %	107.2	30	18	2.700	0.5727

TEST RESULTS

MATERIAL DESCRIPTION

Olive brown silty CLAY w/caliche inclusions.*

Class: CL

Project No.: 53483.007
Project: Russell City AWT
Location: CB-2 32.5'

Date: 11-26-01

Remarks:

*Pc & Cc unreliable due to #4 to 3/8" gravel size caliche inclusins. Based on PI, Cc prob'ly 0.22 or above.

Fig. No. _____

CONSOLIDATION TEST REPORT ASTM D 2435

Soil Mechanics Lab

CONSOLIDATION TEST REPORT ASTM D 2435

Coeffs. of Consolidation (sq. ft./day) & Secondary Consolidation											
No.	Load	Cv	Cα	No.	Load	Cv	Cα	No.	Load	Cv	Cα
9	4.00	1.64									
10	8.00	1.12									

Natural Saturation	Natural Moisture	Dry Dens. (pcf)	LL	PI	Sp.Gr.	Precons. (ksf)	C_c	e_o
91.2 %	22.4 %	101.3	29	17	2.700	5.00	0.28	0.6631

TEST RESULTS

Compression Index = 0.28

Project No.: 53483.007
Project: Russell City AWT
Location: CB-3 11.0'

Date: 11-26-01

CONSOLIDATION TEST REPORT ASTM D 2435

Soil Mechanics Lab

MATERIAL DESCRIPTION

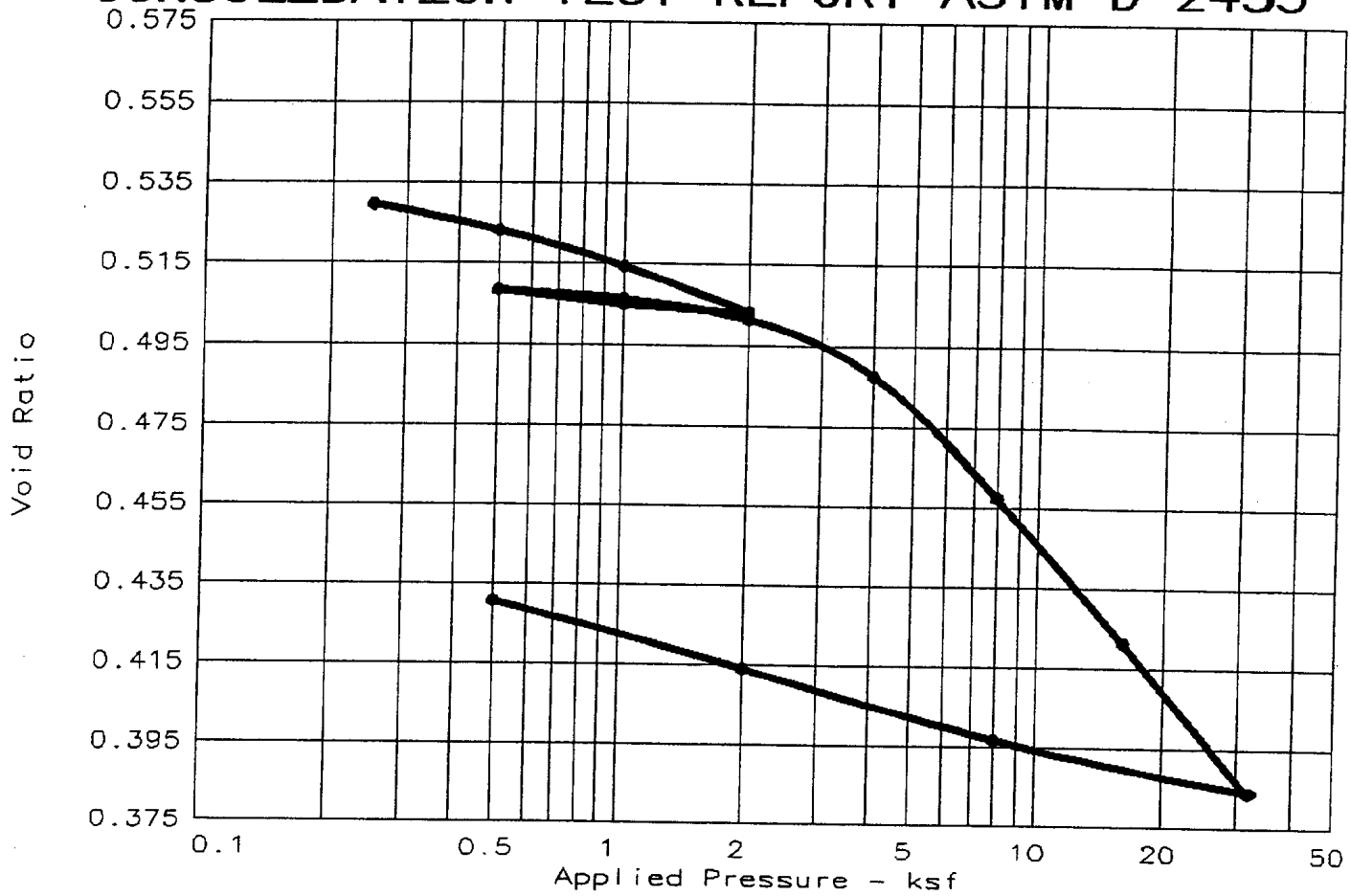
Dark gray silty CLAY.

Class: CL

Remarks:

Fig. No. _____

CONSOLIDATION TEST REPORT ASTM D 2435



Coeffs. of Consolidation (sq. ft./day) & Secondary Consolidation											
No.	Load	Cv	Cα	No.	Load	Cv	Cα	No.	Load	Cv	Cα
10	8.00	1.84									
11	16.00	1.26									

Natural Saturation	Natural Moisture	Dry Dens. (pcf)	LL	PI	Sp.Gr.	Precons. (ksf)	C_c	e_o
85.9 %	16.9 %	110.1	32	14	2.700	4.28	0.12	0.5311

TEST RESULTS

Compression Index = 0.12

Project No.: 53483.007
Project: Russell City AWT
Location: CB-3 28.0'

Date: 11-26-01

CONSOLIDATION TEST REPORT ASTM D 2435

Soil Mechanics Lab

MATERIAL DESCRIPTION

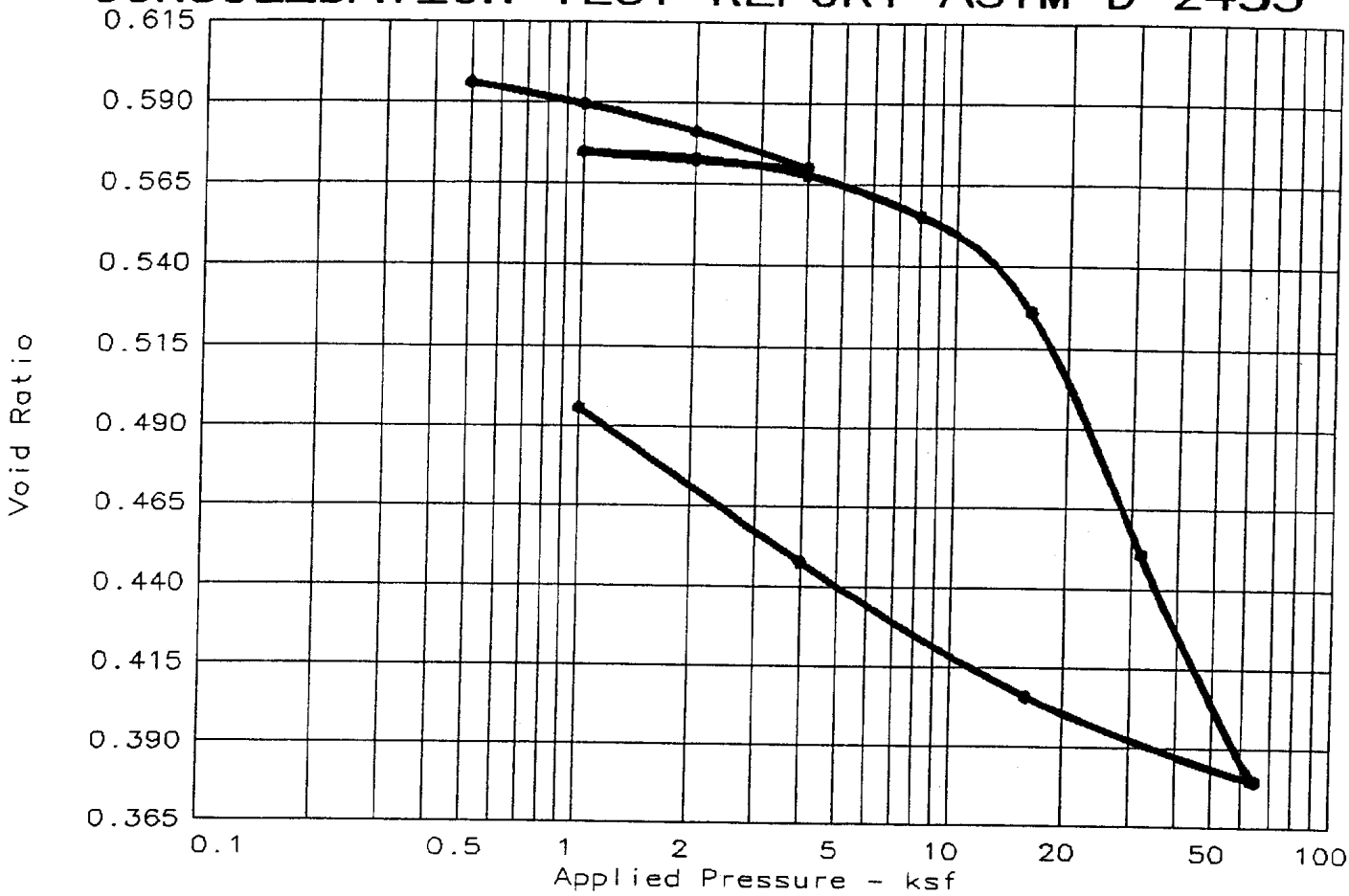
Olive brown sandy CLAY w/caliche inclusions.

Class: CL

Remarks:

Fig. No. _____

CONSOLIDATION TEST REPORT ASTM D 2435



Coeffs. of Consolidation (sq. ft./day) & Secondary Consolidation

No.	Load	Cv	Cα	No.	Load	Cv	Cα	No.	Load	Cv	Cα
9	8.00	1.02									
10	16.00	0.16									

Natural Saturation	Natural Moisture	Dry Dens. (pcf)	LL	PI	Sp.Gr.	Precons. (ksf)	C_c	e_o
95.3 %	21.2 %	105.3	29	13	2.700	14.98	0.26	0.6006

TEST RESULTS

Compression Index = 0.26

MATERIAL DESCRIPTION

Dark gray silty CLAY

Class: CL

Remarks:

Project No.: 53483.007
Project: Russell City AWT
Location: CB-3 73.0'

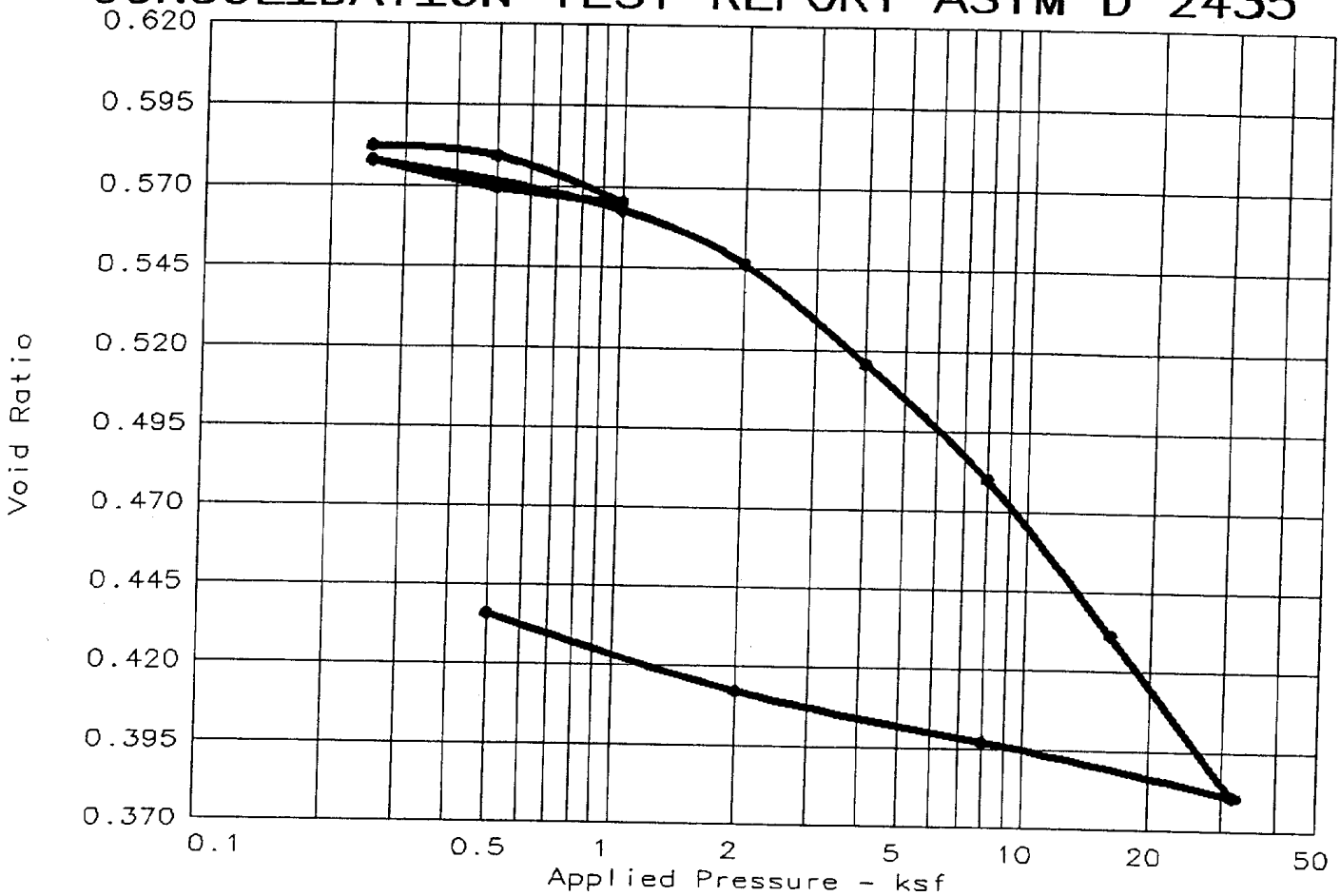
Date: 11-26-01

CONSOLIDATION TEST REPORT ASTM D 2435

Soil Mechanics Lab

Fig. No. _____

CONSOLIDATION TEST REPORT ASTM D 2435



Coeffs. of Consolidation (sq. ft./day) & Secondary Consolidation											
No.	Load	Cv	Cα	No.	Load	Cv	Cα	No.	Load	Cv	Cα
8	4.00	1.05									
9	8.00	1.56									

Natural Saturation	Natural Moisture	Dry Dens. (pcf)	LL	PI	Sp.Gr.	Precons. (ksf)	C_c	e_o
79.2 %	17.1 %	106.5	29	16	2.700	3.11	0.17	0.5825

TEST RESULTS

Compression Index = 0.17

Project No.: 53483.007
Project: Russell City AWT
Location: CB-4A 6.5'

Date: 11-16-01

CONSOLIDATION TEST REPORT ASTM D 2435

Soil Mechanics Lab

MATERIAL DESCRIPTION

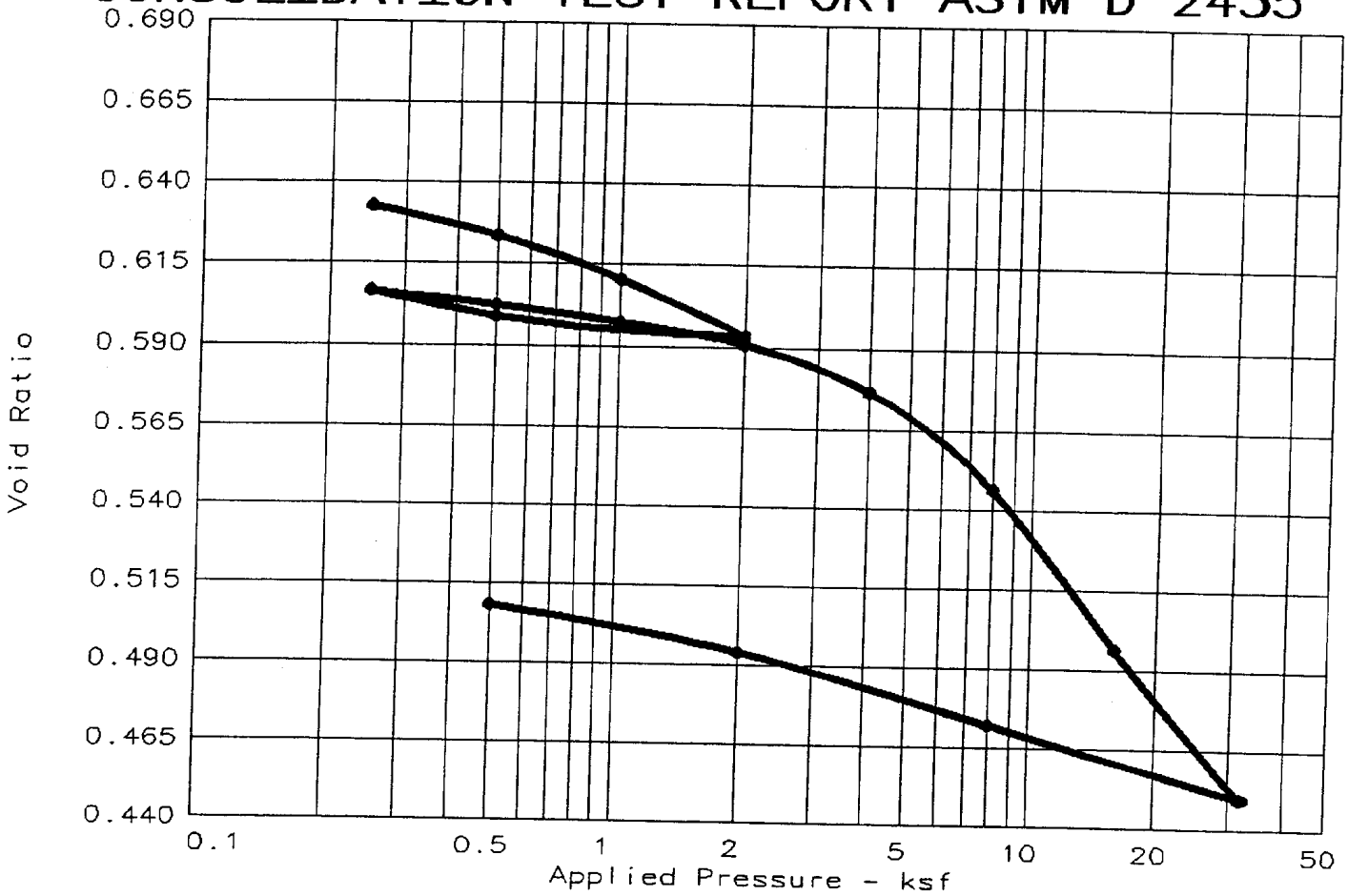
Dk. gray sandy CLAY.

Class: CL

Remarks:

Fig. No. _____

CONSOLIDATION TEST REPORT ASTM D 2435



Coeffs. of Consolidation (sq. ft./day) & Secondary Consolidation											
No.	Load	Cv	Cα	No.	Load	Cv	Cα	No.	Load	Cv	Cα
10	4.00	0.55									
11	8.00	0.62									

Natural Saturation	Natural Moisture	Dry Dens. (pcf)	LL	PI	Sp.Gr.	Precons. (ksf)	C_c	e_o
93.5 %	22.0 %	103.1	32	20	2.700	5.50	0.17	0.6356

TEST RESULTS

Compression Index = 0.17

MATERIAL DESCRIPTION

dK.OLIVE brn. silty CLAY.

Class: CL

Project No.: 53483.007
Project: Russell City AWT
Location: CB-4 21.0'

Date: 11-26-01

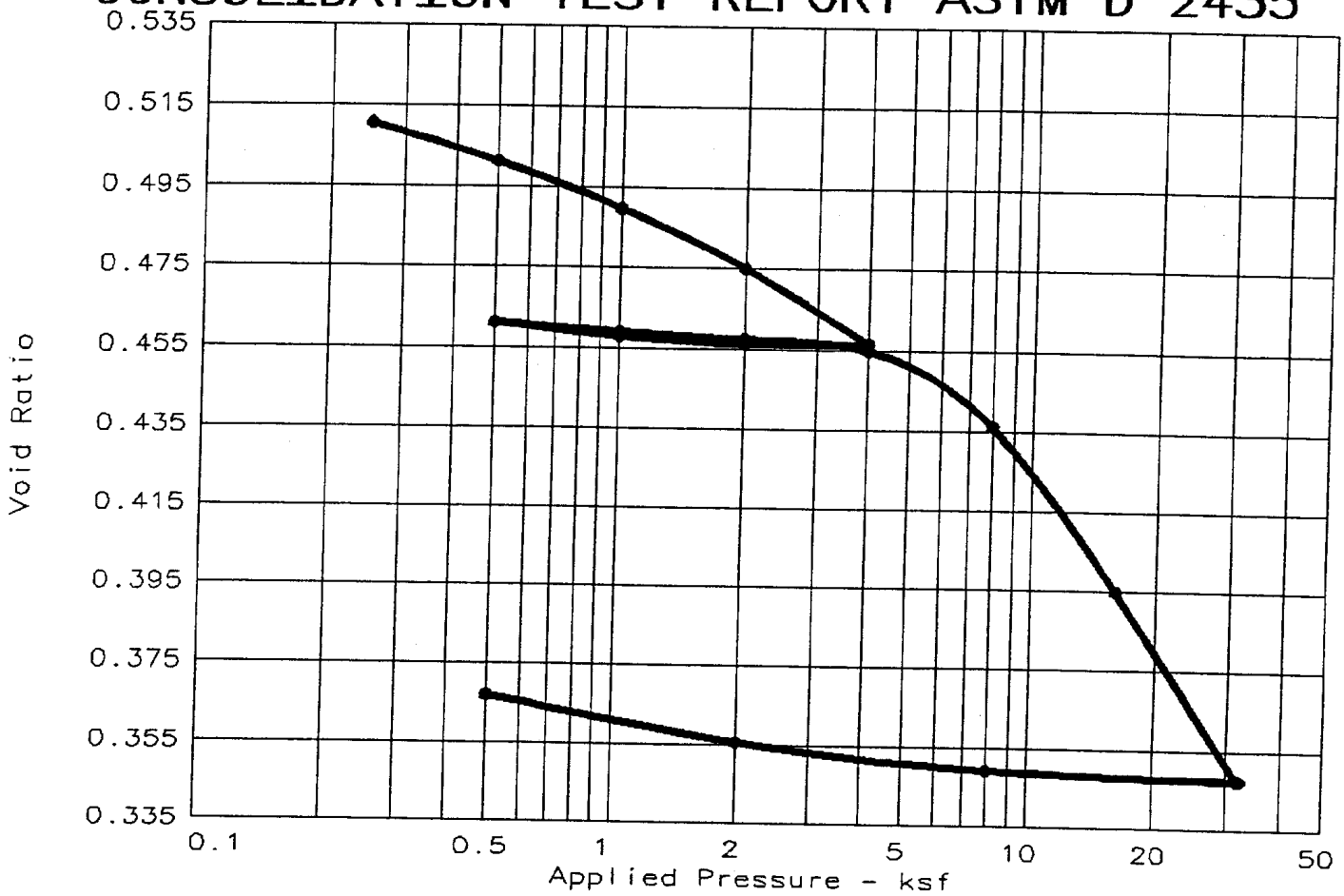
Remarks:

CONSOLIDATION TEST REPORT ASTM D 2435

Soil Mechanics Lab

Fig. No. _____

CONSOLIDATION TEST REPORT ASTM D 2435



Coeffs. of Consolidation (sq. ft./day) & Secondary Consolidation

No.	Load	Cv	Cα	No.	Load	Cv	Cα	No.	Load	Cv	Cα
11	4.00	1.66									
12	8.00	1.44									

Natural Saturation	Natural Moisture	Dry Dens. (pcf)	LL	PI	Sp.Gr.	Precons. (ksf)	C_c	e_o
79.3 %	15.2 %	111.0	33	21	2.700	7.00	0.16	0.5190

TEST RESULTS

Compression Index = 0.16

MATERIAL DESCRIPTION

Olive gray/brn. sandy CLAY.

Class: CL

Project No.: 53483.007
Project: Russell City AWT
Location: CB-4 46.0'

Date: 11-26-01

Remarks:

CONSOLIDATION TEST REPORT ASTM D 2435

Soil Mechanics Lab

Fig. No. _____

CERCO Analytical, Inc.

3942-A Valley Avenue, Pleasanton, CA 94566-4715 (925) 462-2771 Fax (925) 462-2775

FINAL RESULTS

Client: Soil & Mechanics Lab
Client's Project No.: 53483.007
Client's Project Name: Russell City
Authorization: Signed Chain of Custody

Date Sampled: Not Indicated
Date Received: 14-Nov-2001
Date of Report: 29-Nov-2001
Matrix: Soil

Job/Sample No.	Sample I.D.	Redox (mV)	pH	Conductivity (umhos/cm)*	Resistivity (100% Saturation) (ohms-cm)	Sulfide (mg/kg)*	Chloride (mg/kg)*	Sulfate (mg/kg)*
0111126-001	CB1 @ 5.5'	-	8.1	-	300	-	640	230
0111126-002	CB1 @ 15.5'	-	7.8	-	550	-	420	110
0111126-003	CB2 @ 14.5'	-	8.1	-	1,400	-	24	73
0111126-004	CB3 @ 11.5'	-	8.1	-	2,200	-	N.D.	28
0111126-005	CB-4A @ 7.0'	-	8.2	-	1,100	-	100	150
0111126-006	CB-4 @ 21.5'	-	8.1	-	1,800	-	N.D.	24

Method:	ASTM D1498	ASTM D4972	ASTM D1125M	ASTM G57	ASTM D4658M	ASTM D4327	ASTM D4327
Detection Limit:	-	-	10	-	50	15	15
Date Analyzed:	-	26-Nov-2001	-	27-Nov-2001	-	26-Nov-2001	26-Nov-2001

Cheryl McMillen
Laboratory Director

* Results Reported on "As Received" Basis
N.D. - None Detected

Quality Control Summary - All laboratory quality control parameters were found to be within established limits

DISTRIBUTION

Geotechnical Data Report
Subsurface Investigation
Advanced Water Treatment System
Russell City Energy Center
Hayward, California

December 7, 2001

Copy No. 5

Copies 1 - 5:	Mr. Peter Mason Calpine/Bechtel Joint Development 4160 Dublin Boulevard, Second Floor Dublin, California 94568-3139
Copies 6 - 9:	Project Files
Copy 10:	Harding ESE Corporate Records

MHW/WHG:gj/GJ58106-Geotech

Harding ESE
A MACTEC COMPANY

Land Use

Data Responses 29-37

Land Use (29-37)

Legal Description of Properties

29. *Please provide a complete legal description of all properties contained within the proposed project site boundaries, as they currently exist. Include a site map, drawn to scale, indicating existing parcel boundaries, assessors parcel numbers (APNs), and approximate acreage for each parcel (or portion of a parcel). Indicate any proposed boundary changes or land divisions. Note current city or county jurisdiction.*

Response: A site map indicating existing parcel boundaries, APNs, city or county jurisdiction, and acreage for each parcel is provided as Figure DR29-1. The project site consists of four parcels as identified in Table 2.1-1 of the Amendment. The legal description for each of the parcels is as follows:

APN 439-0070-009 (Eash Parcel #1)

Beginning at a point in the southern line of County Road No. 2853 said point being the northeastern corner of that certain tract of land described in the deed from Edward H. Clawiter to J.N. Rodrigues, dated August 29, 1923 and recorded October 1, 1923, in Book 534 of Official Records of Alameda County, at page 183; and running thence along the eastern line of said tract of land south 11°23′ east, distant 1,070 feet to the southeastern corner thereof; thence along the southern line of said tract of land south 89°03′ west distant 754.5 feet to a fence corner which marks the southwestern corner of said tract of land; thence along the western line of said tract of land; thence along the western of said tract of land north 11°47′ west distant 496.4 feet to a post; thence leaving said western line north 85°21′ east distant 730.8 feet to a stake; thence north 11°23′ west distant 525 feet to a stake in the said southern line of County Road No. 5853; thence along said line of said road north 85°20′ east distant 20 feet to the point of beginning.

Being a portion of that certain piece or parcel of land conveyed by deed from Edward H. Clawiter, also known as E.H. Clawiter, et al., to J.N. Rodrigues, dated August 29, 1923 and recorded in Book 534 of Official Records of Alameda County, at page 183.

Excepting therefrom the following described portion thereof:

Beginning at the northwestern corner of that certain 9.13 acre tract of land described in deed from J.N. and Margaret Rodrigues to Emma C. Stone dated October 1, 1929 and recorded October 11, 1929, in Book 2207, Official Records of Alameda County, at page 346; and running thence south 11°47′ east along the western line of said 9.13 acre tract 495.68 feet to an existing concrete monument at the northwestern corner of that certain 65.85 acre tract of land described in deed from Henrietta Johnson to William Johnson and Caroline A. Johnson dated March 3, 1934 and recorded April 28, 1934, in Book 3055, Official Records of Alameda County, at page 85, thence north 89°02′45″ east along the northern line of the 65.85 acre tract of land described in deed secondly above referred to 64.07 feet to a point; thence north

21°29′05″ west a distance of 195.41 feet to a point on a line drawn parallel to and distant northeasterly at right angles 30.00 feet from the aforementioned western line of the 9.13 acre tract of land described in deed first above referred to, thence north 11°47′ west along last mentioned line 311.27 feet to a point on the northern line of the 9.13 acre tract of land described in deed first above referred to; thence south 85°19′ west along last mentioned line 30.23 feet to the point of beginning.

Being a portion of the certain 9.13 acre tract of land described in deed first above referred to and containing 0.41 acres, as granted to City of Hayward by instrument dated September 3, 1953 and recorded December 13, 1954, in Book 7507 of Official Records, page 129.

APN 439-0070-008-06 (Aladdin Parcel)

The land described herein is situated in the state of California, county of Alameda, unincorporated area, and is described as follows:

Beginning at the intersection of the eastern line of that parcel of land conveyed to Ada M. Freeland by deed recorded June 5, 1936, Book 3297, Official Records, page 297, Alameda County Records, with southern line of County Road No. 2853 known as Depot Road, as said county road existed October 3 1984; thence along said southern line of Depot Road south 85°16′21″ west, 70.00 feet; thence south 10°49′43″ east, 75.00 feet; thence south 85°16′21″ west parallel with said southern line of Depot Road, 5.00 feet; thence south 10°44′21″ east, 567.42 feet; thence south 82°15′13″ west, 127.25 feet to a point on the eastern line of that parcel of land conveyed to J.M. Rodrigues by deed recorded October 1 1923, in Book 534 of Official Records, page 183, Alameda County Records; thence along said eastern line south 12°07′32″ east, 421.46 feet to the northern boundary line of land now or formerly owned by August Johnson; thence along last said line, north 88°55′37″ east, 189.73 feet to the intersection thereof with the first said eastern line; thence along last said line north 10°30′38″ west, 1,081.13 feet to the point of beginning.

Excepting that portion conveyed in the deed to the City of Hayward by instrument dated August 21, 1985, recorded October 22, 1985, Series No. 85-226615, Alameda County records.

APN 439-0070-012-02 (Eash Parcel #2)

A portion of Parcel 3, Parcel Map No. 2702, filed April 17, 1979, in Book 109 of parcel maps, at page 65 and 66, records of Alameda County, California, described as follows:

Commencing at point in the southern line of County Road No. 2702, commonly known as Depot Road, said point being the northern corner of Parcel 2, Parcel Map No. 2702; thence easterly along the southern line of the County Road No. 2853, north 85°16′21″ east, 60.82 feet to the actual point of beginning; thence continuing along the southern line of County Road No. 2853, north 85°16′21″ east, 147.28 feet to the northeastern corner of Parcel 3, as shown on said Parcel Map 2702; thence southeasterly along eastern line of said Parcel 3; south 12°07′32″ east, 526.84 feet to

the southeastern corner said Parcel 3, south 84°14′09″ west, 154.18 feet; thence north 11°22′433″ west, 526.09 to the actual point of beginning;

APN 439-0099-002 (City of Hayward, partial)

The land described herein is situated in the State of California, County of Alameda, City of Hayward, and is described as follows:

Being a portion of that certain parcel of land described in the deed from Johnson to Johnson, recorded April 28, 1934, in Book 3055 of deeds at page 85, County Recorder of Alameda County, further described as follows:

Beginning at a point that bears north 88°59′54″ east, 154.45 feet along the northerly line of said Johnson parcel (3055 D 85) from the northwest corner thereof; thence from said point of beginning, north 88°59′54″ east, 739.07 feet along last said northerly line; thence at a right angle to last said line south 01°00′06″ east, 380.79 feet; thence along a line parallel with said northerly line of said Johnson parcel south 88°59′54″ west, 506.88 feet; thence north 32°22′27″ west, 446.00 feet to the point of beginning.

Project Site Parcel Map

30. *Please provide a copy of the recorded Final Map(s), lot line adjustment, or Certificate of Compliance creating the parcels that make up the project site. Copy must be legible and at least 11″ X 17″ hard copy or in electronic PDF format.*

Response: The Final Map, lot line adjustment, and Certificate of Compliance creating the new project parcel have not yet been prepared. These documents are typically prepared after the project is certified by the CEC. Russell City Energy Company will file these documents with the CEC when they are completed.

Parcel Map and Legal Description

31. *Please provide the tentative parcel map and legal description of any proposed new legal parcel(s).*

Response: The tentative parcel map and legal description of the new legal parcel have not yet been prepared. These documents are typically prepared after the project is certified by the CEC. Russell City Energy Company will file these documents with the CEC when they are completed.

Adjoining Properties

32. *Please identify the APN, location in reference to the project site, zoning and land use designation, and existing use for each parcel that abuts the project site, including those properties separated by a road or easement. This information may be included on the site map requested in Land Use Item 29 above. Reference location of Open Space areas to project site boundaries.*

Response: The APN, zoning and land use designation, and existing uses for all adjoining parcels are shown on Figure DR29-1.

Consistency with Area Plans

33. *Please discuss the consistency of the new project site with the policies and provisions of the San Francisco Bay Plan and Hayward Area Shoreline Plan, with particular emphasis on raising the site elevation above the surrounding FEMA flood plain and the placement of fill immediately adjacent to the Baylands area.*

Response: As discussed in the RCEC AFC, Section 8.6.1.2, "Other Applicable Land Use Plans," the San Francisco Bay Plan includes new development within 100 feet of the shoreline. The marshlands to the immediate southwest of the project site are not within the Bay shoreline zone, because they are not tidally influenced. They are instead freshwater marshlands fed by runoff, treated wastewater from the Union Sanitary District, and periodic infusions of Bay water intentionally released into the area to create a brackish marsh. To the west, the actual Bay shoreline is approximately one mile west of the RCEC site on the western side of the City of Hayward's wastewater treatment plant's former sludge drying ponds. Therefore, the project site does not fall under the San Francisco Bay Plan, or the jurisdiction of the San Francisco Bay Conservation and Development Commission.

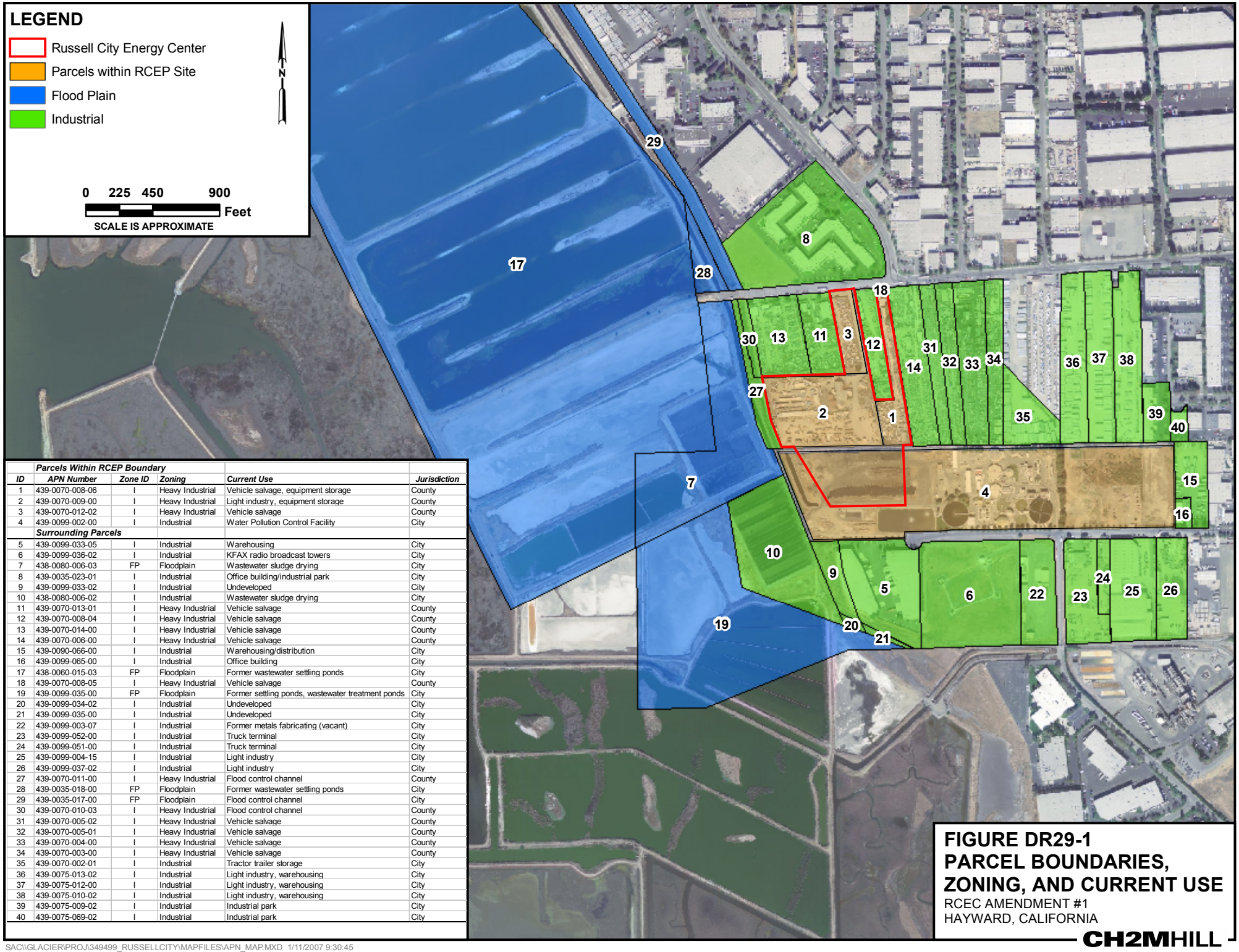
In addition, in AFC Section 8.6.1.2, the Hayward Area Shoreline Plan is also discussed. The RCEC is located within an area that the Hayward Area Shoreline Planning Agency (HASPA) refers to as the City of Hayward Industrial Corridor. One of the key program objectives of HASPA is to "Promote industrial in-fill development in areas designated for industrial and public utilities." The RCEC lies within the area designated in the Hayward Area Shoreline Plan maps as "Industrial/Public Facilities." Therefore, the RCEC is consistent with the Hayward Area Shoreline Plan.

In addition, because the RCEC will use standard Best Management Practices (BMPs) and will comply with all permits and ordinances that govern drainage and erosion control, the project will not cause an increase in offsite flooding potential or sedimentation during the construction phase and will meet all local, state, and federal regulatory requirements associated with the protection of water quality and soil resources.

Natural Gas Line Easement

34. *Please describe any easements necessary for the construction and operation of the natural gas supply line for the RCEC facilities. Discuss the actual location within the Depot Road right-of-way, whether the supply line would be located within an existing easement or if a new or expanded easement will be required, any co-located or adjacent facilities within the easement, ownership of the easement (if it currently exists), and process for acquiring access or ownership.*

Response: PG&E will acquire the easements in Depot Road needed for routing the RCEC's natural gas supply pipeline in accordance with their franchise agreements with the City of Hayward and Alameda County. Final acquisition of the easements and final pipeline design will be done by PG&E during the gas pipeline's final construction planning phase.



ID	APN Number	Zone ID	Zoning	Current Use	Jurisdiction
	Parcels Within RCEP Boundary				
1	439-0070-008-06	I	Heavy Industrial	Vehicle salvage, equipment storage	County
2	439-0070-009-00	I	Heavy Industrial	Light industry, equipment storage	County
3	439-0070-012-02	I	Heavy Industrial	Vehicle salvage	County
4	439-0099-002-00	I	Industrial	Water Pollution Control Facility	City
	Surrounding Parcels				
5	439-0099-033-05	I	Industrial	Warehousing	City
6	439-0099-036-02	I	Industrial	KFAX radio broadcast towers	City
7	438-0080-006-03	FP	Floodplain	Wastewater sludge drying	City
8	439-0035-023-01	I	Industrial	Office building/industrial park	City
9	439-0099-033-02	I	Industrial	Undeveloped	City
10	438-0080-006-02	I	Industrial	Wastewater sludge drying	City
11	439-0070-013-01	I	Heavy Industrial	Vehicle salvage	County
12	439-0070-008-04	I	Heavy Industrial	Vehicle salvage	County
13	439-0070-014-00	I	Heavy Industrial	Vehicle salvage	County
14	439-0070-006-00	I	Heavy Industrial	Vehicle salvage	County
15	439-0090-066-00	I	Industrial	Warehousing/distribution	City
16	439-0099-065-00	I	Industrial	Office building	City
17	438-0060-015-03	FP	Floodplain	Former wastewater settling ponds	City
18	439-0070-008-05	I	Heavy Industrial	Vehicle salvage	County
19	439-0099-035-00	FP	Floodplain	Former settling ponds, wastewater treatment ponds	City
20	439-0099-034-02	I	Industrial	Undeveloped	City
21	439-0099-035-00	I	Industrial	Undeveloped	City
22	439-0099-003-07	I	Industrial	Former metals fabricating (vacant)	City
23	439-0099-052-00	I	Industrial	Truck terminal	City
24	439-0099-051-00	I	Industrial	Truck terminal	City
25	439-0099-004-15	I	Industrial	Light industry	City
26	439-0099-037-02	I	Industrial	Light industry	City
27	439-0070-011-00	I	Heavy Industrial	Flood control channel	County
28	439-0035-018-00	FP	Floodplain	Former wastewater settling ponds	City
29	439-0035-017-00	FP	Floodplain	Flood control channel	City
30	439-0070-010-03	I	Heavy Industrial	Flood control channel	County
31	439-0070-005-02	I	Heavy Industrial	Vehicle salvage	County
32	439-0070-005-01	I	Heavy Industrial	Vehicle salvage	County
33	439-0070-004-00	I	Heavy Industrial	Vehicle salvage	County
34	439-0070-003-00	I	Heavy Industrial	Vehicle salvage	County
35	439-0070-002-01	I	Industrial	Tractor trailer storage	City
36	439-0075-013-02	I	Industrial	Light industry, warehousing	City
37	439-0075-012-00	I	Industrial	Light industry, warehousing	City
38	439-0075-010-02	I	Industrial	Light industry, warehousing	City
39	439-0075-009-02	I	Industrial	Industrial park	City
40	439-0075-069-02	I	Industrial	Industrial park	City

FIGURE DR29-1
PARCEL BOUNDARIES, ZONING, AND CURRENT USE
RCEC AMENDMENT #1
HAYWARD, CALIFORNIA

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SAC\\GLACIER\PROJ\349499_RUSSELLCITY\MAPFILES\APN_MAP.MXD 1/11/2007 9:30:45

Transmission Line Easements

35. *Please describe any existing or new easement(s) that will be used or created for the transmission line routing from the RCEC property to the Grant-Eastshore connection Include information concerning current ownership of existing easement(s), actions proposed within the easement(s), and process for acquiring access approval or ownership.*

Response: Under the transmission Interconnection Agreement between PG&E and Russell City Energy Company, PG&E is responsible for obtaining all necessary transmission easements. Most of the RCEC transmission line will run in an existing easement (Grant-Eastshore corridor). PG&E will acquire the new easements necessary for the transmission line route between the RCEC and the Grant-Eastshore corridor.

Parking Map for Facility

36. *Please provide a scaled site map indicating the location and number of parking spaces for employees and visitors (including handicapped), off-street loading space(s), internal roads/driveways servicing these areas, emergency vehicle turnaround areas, and security gate parking stall and turn around(s), in compliance with the City of Hayward zoning requirements [Chapter 10, Article 1, Section 1.1645(o, u), Article 2, and Article 14]. Identify type of surfacing. Discuss method of determining the number of parking spaces proposed and justify any variation from minimum requirements. Design may be included as part of the requested landscaping plan (see **Visual**) or site map referenced in Land Use Item 1 above.*

Response: A full-size version of Figure 2.1-2 is provided as Attachment DR36-1. As noted in the background section preceding this data request, the site layout currently shows a total of ten parking spaces, with one of the ten spaces designated as a space for persons with physical disabilities. A review of parking needs at several of Calpine's existing northern California plants indicates that ten spaces will not be adequate, thus the project owner proposes that ten additional parking spaces be included, for a total of twenty spaces. With a maximum daytime staff of fifteen, this allows for five spaces for visitors. Five of the additional ten spaces will be located north and adjacent to the parking spaces currently shown. The remaining five additional parking spaces will be located on the opposite side of the road immediately north of the administration/control/BOP electrical building. The parking spaces shown are 10 feet wide x 24 feet long, and are thus greater than the minimum dimensions of 9 feet wide by 19 feet long indicated for standard parking spaces in Section 10-1.1645(o) of the City of Hayward Municipal Code. Also, Figure 2.1-2 incorrectly shows the access aisle for the space designated for persons with physical disabilities on the driver's side, whereas Section 10-2.720 of the Municipal Code requires the aisle on the passenger side.

There are four off-street loading spaces: (1) adjacent to the cooling tower chemical feed pavilion for use in offloading bulk cooling tower chemicals and totes, (2) adjacent to the Title 22 chemical storage area for use in offloading bulk Title 22 chemicals and totes, (3) adjacent to the ammonia storage tank for use in offloading ammonia, and (4) south of the HRSG chemical feed pavilion for offloading HRSG chemical totes. In the case of the first three areas, the main plant loop road is widened in the unloading area to allow a tanker truck to offload while still allowing traffic in both directions on the main plant loop road. In the case of the fourth area, the delivery truck would be backed into the short spur road, thus leaving the plant loop road clear.

The main entrance to the RCEC will be from the south, off of Enterprise Avenue and across City of Hayward property following an alignment that makes use of portions of existing rights-of-way (storm sewer and East Bay Dischargers Authority pipeline). A secondary plant entrance on the north side of the RCEC, off Depot Road, will normally only be used for emergency purposes. Traffic flow within the RCEC can be in either direction on the plant loop road depending on the point of delivery. For instance, deliveries to the Title 22 chemical feed area and cooling tower chemical feed pavilion would travel in the counterclockwise direction, whereas ammonia deliveries would travel in the clockwise direction.

All plant roads will be asphalt paved as shown in the Site Surfacing Plan, included in Appendix 2C of the Amendment No. 1 petition. Chemical delivery containment areas and areas where cranes will be located for maintenance purposes will have concrete surfaces. The Roadway and Fence Location Plan, also included in Appendix 2C, shows the dimensions of the parking spaces, dimensions of plant roads, coordinates of intersections, and radius of each turn. The plant entrance roads and main loop road are 20 feet wide. Various one-way driveways vary in width from 12 to 15 feet. A typical road section can be found in the Grading Details, also included in Appendix 2C.

The access road from the end of Enterprise Avenue to the RCEC security gate will allow sufficient space for multiple vehicles to remain clear of the public street while awaiting clearance to enter the RCEC site. The design does not currently include a "turnaround stall" to turn around vehicles that are denied entry. Attachment DR36-2 shows an existing easement that the Union Sanitary District (USD) has with the City of Hayward for the purpose of turning around sodium bisulfite delivery trucks making deliveries to the Hayward Marsh dechlorination facility. The project owner intends to work with the City of Hayward and USD to make adjustments to this easement to tie-in with the RCEC entrance lane and also allow this easement to be used as the RCEC turnaround stall.

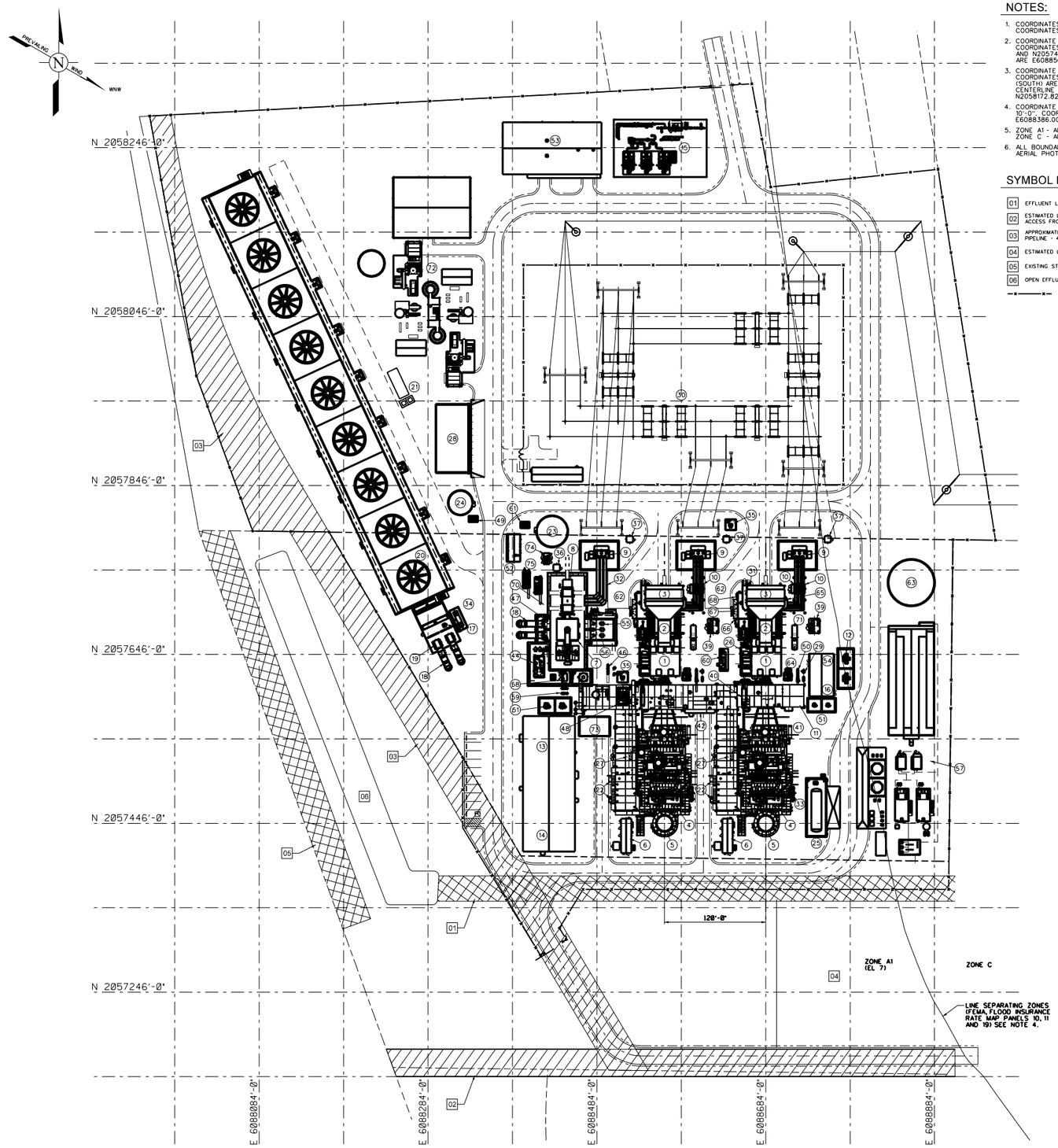
Non-regulatory Signage

37. *Please identify the type, location (including height from ground), size, and design of any non-regulatory signage proposed for the facility. Indicate if the signs will be illuminated.*

Response: City of Hayward's Municipal Code Article 7 of Chapter 10 appears to be intended for signs visible to the public, assuring that such signs are attractive, preserve and improve the appearance of the City, and safeguard and enhance property values. Most of the signs within the fence line of the RCEC would be considered "regulatory" signs, required to notify personnel of fire hazards, safety hazards, hazardous materials, protective equipment requirements, confined spaces, traffic restrictions, etc. Other signs are used for equipment and building identification purposes. These signs are generally small and unobtrusive and will not typically be visible from the public right-of-way (i.e., the end of Enterprise Road). The RCEC will likely include a facility identification sign located adjacent to the main entrance gate. This sign has not yet been designed, but will be a free standing sign meeting the dimensional requirements of Section 10-7.403 (j) of the City of Hayward Municipal Code. If the sign is illuminated by means other than the street lighting at the entrance gate, the design of such illumination will comply with Section 10-7.308 of the City of Hayward Municipal Code.

Attachment DR36-1

General Arrangement Drawing



NOTES:

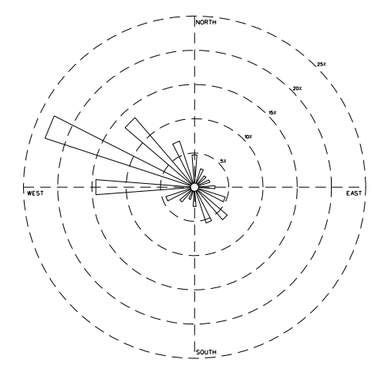
1. COORDINATES LISTED ARE STATE PLANE NAD83, CALIFORNIA, ZONE 3 COORDINATES.
2. COORDINATE FOR TOP OF HRSG FOUNDATION ELEVATION IS 10'-0". COORDINATES FOR CENTERLINE OF HRSG #1 STACK ARE E6088684.000' AND N2057446.000'. COORDINATES FOR CENTERLINE OF HRSG #2 STACK ARE E6088564.000' AND N2057446.000'.
3. COORDINATE FOR TOP OF COOLING TOWER FAN ELEVATION IS 67.177'. COORDINATES FOR CENTERLINE OF COOLING TOWER FAN #1 (SOUTH) ARE E6088266.960' AND N2057737.794'. COORDINATES FOR CENTERLINE OF COOLING TOWER FAN #9 (NORTH) ARE E6088064.103' AND N2058172.822'.
4. COORDINATE FOR TOP OF FIRE PUMP HOUSE FOUNDATION ELEVATION IS 10'-0". COORDINATES FOR CENTERLINE OF FIRE PUMP HOUSE ARE E6088386.000' AND N2057772.500'.
5. ZONE A1 - AREAS OF 100-YR FLOOD, BASE FLOOD ELEVATION OF 7 FT. ZONE C - AREAS OF MINIMAL FLOODING.
6. ALL BOUNDARY INFORMATION IS APPROXIMATE BASED ON PARCEL MAPS, AERIAL PHOTOS AND FIELD WORK.

SYMBOL LEGEND:

- 01 EFFLUENT LINE - 30' WIDE.
- 02 ESTIMATED LOCATION AND WIDTH EASEMENT FOR CITY ACCESS FROM ENTERPRISE AVE TO SLUDGE BEDS - 30' WIDE
- 03 APPROXIMATE LOCATION FOR 60" EBDA EFFLUENT PIPELINE - 40' WIDE
- 04 ESTIMATED LOCATION OF EXISTING EQUALIZATION BASIN
- 05 EXISTING STORM CHANNEL TO REMAIN AN OPEN DITCH 35' WIDE
- 06 OPEN EFFLUENT DITCH
- FENCE

EQUIPMENT LEGEND:

1. COMBUSTION TURBINE
2. CT GENERATOR
3. CT AIR INLET SYSTEM
4. HRSG
5. HRSG STACK
6. CEM/HRSG POWER DISTRIBUTION CENTER
7. STEAM TURBINE
8. ST GENERATOR
9. GENERATOR STEPUP TRANSFORMER
10. GENERATOR BREAKER
11. PIPE RACK
12. UNIT AUXILIARY TRANSFORMERS
13. BOP ELECTRICAL CONTROL BLDG
14. ADMIN/CONTROL ROOM BLDG
15. FUEL GAS METERING & COMPRESSORS
16. AUX POWER DISTRIBUTION CENTER
17. AUXILIARY COOLING WATER PUMP
18. CIRCULATING WATER LINES
19. CIRCULATING WATER PUMPS
20. COOLING TOWER
21. AUXILIARY TRANSFORMERS & COOLING TOWER PDC
22. BOILER FEED PUMPS
23. SERVICE / FIRE WATER STORAGE TANK
24. DEMIN. WATER STORAGE TANK
25. AMMONIA STORAGE TANK, PUMPS & VAPORIZER
26. CT HYDRAULIC UNIT
27. BLOWDOWN TANK AND SUMP
28. COOLING TOWER CHEM FEED PAVILION
29. FUEL GAS KNOCKOUT DRUM/ DRAIN TANK
30. SWITCHYARD
31. WATER WASH SKID
32. ISO PHASE BUS DUCT
33. AMMONIA INJECTION SKID
34. OIL/WATER SEPARATOR (ABOVE GROUND)
35. OIL/WATER SUMP AND PUMPS
36. ST EQUIP DELUGE VALVE STATION
37. TRANSFORMER/FIRE PROTECTION DELUGE VALVE HOUSE
38. NOT USED
39. INLET FOGGING SKID
40. ROTOR AIR COOLER
41. DUCT BURNER SKID
42. SAMPLE PANEL & WATER LAB
43. NOT USED
44. STG LUBE OIL SKID
45. GLAND STEAM SKID (NOT SHOWN)
46. GLAND STEAM CONDENSER
47. CONDENSER
48. AIR COMPRESSORS (UNDER PIPE BRIDGE)
49. DEMIN. WATER PUMPS
50. FUEL GAS PERFORMANCE HEATER
51. SUS TRANSFORMERS
52. FIRE PUMP SKID ENCLOSURE
53. WAREHOUSE
54. DC AND UPS SYSTEM
55. CONDENSATE PUMPS
56. CONDENSATE STRAINERS
57. TITLE 22 AREA
58. STG EHC SKID
59. CLOSED COOLING WATER PUMPS & HEAT EXHCANGERS
60. FUEL GAS DEWPOINT HEATER
61. SERVICE WATER PUMPS
62. CRANE AREA / MAINTENANCE
63. RECYCLED WATER STORAGE TANK
64. MAIN & PILOT FUEL GAS FILTER SEPARATOR
65. VT & SURGE CUBICLE
66. CT MECHANICAL PACKAGE
67. CT ELECTRICAL PACKAGE
68. CT STARTING PACKAGE
69. ST SEAL OIL SKID (NOT SHOWN)
70. BULK HYDROGEN & CO2 STORAGE (TRAILER MOUNT)
71. WATER WASH TANK (UNDERGROUND)
72. ZERO LIQUID DISCHARE (ZLD) AREA
73. HRSG CYCLE CHEM FEED PAVILION
74. THY/FCB CUBICLES
75. NON CONDENSABLE GAS REMOVAL SKIDS



60 0 60 120 180

SCALE: 1" = 60'

SOURCE: WorleyParsons, 2006

VHL: Thu Jun 09 14:23:05 2005

FIGURE 2.1-2
GENERAL ARRANGEMENT
RCEC AMENDMENT #1
HAYWARD, CALIFORNIA

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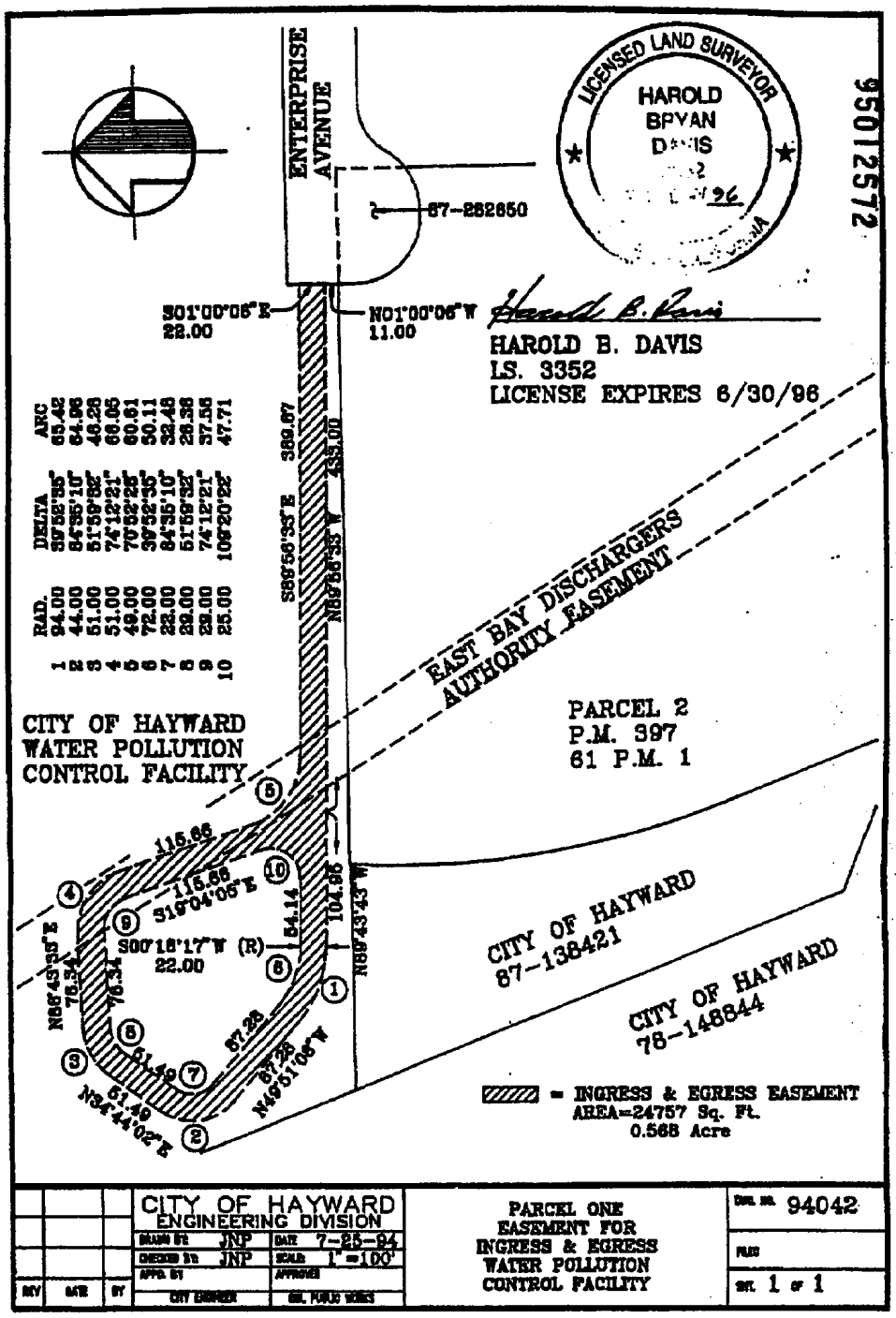
Attachment DR36-2

EBDA Access Easement


ENTERPRISE AVENUE
87-282850
LICENSED LAND SURVEYOR
HAROLD BRYAN DAVIS
S01°00'06"E 22.00
N01°00'06"W 11.00
HAROLD B. DAVIS
LS. 3352
LICENSE EXPIRES 6/30/96
ARC
DELTA
RAD.
1 65.42 39°58'35" 94.00
2 64.96 84°35'10" 44.00
3 46.26 51°59'32" 51.00
4 66.05 74°12'21" 51.00
5 60.61 70°52'25" 49.00
6 50.11 39°52'35" 72.00
7 32.48 84°35'10" 22.00
8 26.38 51°59'32" 29.00
9 57.56 74°12'21" 29.00
10 47.71 109°20'22" 25.00
389.67
S89°56'35"E
N89°56'35"W
235.00
EAST BAY DISCHARGERS AUTHORITY EASEMENT
CITY OF HAYWARD WATER POLLUTION CONTROL FACILITY
PARCEL 2
P.M. 397
61 P.M. 1
115.66
S19°04'06"E
S00°18'17"W (R) 22.00
54.14
104.86
N89°43'43"W
N66°43'35"E
76.34
67.28
N49°51'06"W
51.49
N34°44'02"E
CITY OF HAYWARD 87-138421
CITY OF HAYWARD 78-148844
= INGRESS & EGRESS EASEMENT
AREA=24757 Sq. Ft.
0.568 Acre
CITY OF HAYWARD
ENGINEERING DIVISION
DRAWN BY JNP
DATE 7-25-94
CHECKED BY JNP
SCALE 1" =100'
APPR. BY
APPROVED
CITY ENGINEER
DIR. PUBLIC WORKS
REV DATE BY
PARCEL ONE
EASEMENT FOR
INGRESS & EGRESS
WATER POLLUTION
CONTROL FACILITY
DWG. NO. 94042
FILE
SHT. 1 OF 1

95012572

Soil and Water Resources

Data Responses 38-42

Soil and Water Resources (38-42)

Title 22 Engineering Report

38. *Please provide a draft engineering report per the provisions of Title 22 Code of Regulations Section 60323 that identifies:*

    a. *all agencies or entities that will be involved in the design, treatment, distribution, construction, operation and maintenance of the recycle facilities;*

    b. *a description of any legal arrangements outlining authorities and responsibilities between the agencies with respect to treatments; and*

    c. *a description of arrangements for coordinating all reuse-related activities between the City of Hayward and the project owner.*

Response: The project owner is in the process of preparing the Engineering Report for the recycled water facility. A draft of this report should be available by mid- to late-February 2007. In the meantime, the following responses address the three items specifically identified in the data request:

a. The project owner will be responsible for the preliminary design, treatment, distribution, and operation and maintenance of the recycled water facilities. The project owner intends to include the detailed design and construction of the recycled water facilities in the engineer/procure/construct contract under which the remainder of the RCEC will be designed and constructed. The City of Hayward will remain responsible for the operation and maintenance of their existing Water Pollution Control Facility (WPCF) and the production of the secondary effluent that will be the influent flow to the RCEC recycled water facility.

b. The City of Hayward and the project owner have an existing agreement that obligates the parties to enter into a definitive agreement wherein: (1) the City will be responsible for making available up to 4.1 mgd of secondary effluent, on a first priority basis, for use as influent to the RCEC recycled water facility, (2) the City will accept clarifier sludge from the recycled water facility, and (3) the City will accept filter backwash water from the recycled water facility. Since this agreement was executed, the project owner has decided to return the filter backwash to the front end of the recycled water facility versus discharging it to the City's WPCF. The definitive agreement will address responsibilities of the City with respect to treatment.

c. The project owner and City of Hayward will develop a communications protocol that will outline the flow of information between the City and the RCEC. For instance, this protocol will require that the City notify the RCEC whenever they are producing secondary effluent that does not meet the discharge requirements of the East Bay Discharger Authority's NPDES permit (excluding disinfection requirements).

Tertiary Treatment Train

39. *Provide a full description and schematic of the tertiary treatment train for the Title 22 RWF system; a discussion of its reliability record including the provisions for multiple RWF units to ensure reliable delivery of tertiary treated recycled water; and a discussion of all previous experience in producing tertiary treated recycled water.*

Response: A full description of the RCEC Recycled Water Facility (RWF) will be included in the Engineering Report. In the mean time, the following abbreviated description is provided in response to this data request.

The RWF will be designed to produce disinfected tertiary treated recycled water suitable for makeup to an industrial cooling tower in accordance with Title 22, Chapter 4 of the California Code of Regulations. The RWF will be sized for a net recycled water production rate of 3,000 gpm (4.3 mgd), thus providing a margin of approximately 7.4 percent on the projected RCEC peak demand of 2,793 gpm. Attachment 39-1 is a process flow diagram showing the major components and processes of the RWF. Attachment 39-2 is a scale drawing showing the general arrangement of the RWF.

The RWF will contain the following major elements and unit processes:

- **Secondary Effluent Diversion**—Secondary effluent will be diverted to the RWF from the City of Hayward's existing 48-inch secondary effluent pipeline which runs along the south edge of the RCEC.
- **Influent Pumping**—The influent pump station will include three 50% capacity, variable-speed, vertical turbine pumps installed in a conventional wet well. The pump station will be used to pump secondary effluent to the ACTIFLO systems providing the head necessary for the remainder of the treatment processes.
- **ACTIFLO Systems**—Two 100% capacity Krüger ACTIFLO systems will be provided to coagulate, flocculate, settle, and remove solids from the secondary effluent. The ACTIFLO system utilizes ballasted sedimentation (sand is added to the process) to provide rapid settling of suspended solids, thereby minimizing the footprint required for the flocculation and clarification processes. Each ACTIFLO train will include the following components:
  - One coagulation tank with constant-speed vertical shaft mixer.
  - One injection tank with constant-speed vertical shaft mixer.
  - One maturation tank with variable-speed vertical shaft mixer (variable-speed is required to optimize floc formation and chemical consumption).
  - One settling tank (clarifier) with variable-speed sludge scraper mechanism and Lamella plate settlers.
  - Two 100% capacity constant-speed sand/sludge pumps to recirculate the sand/sludge mixture back to the hydrocyclones.

- Two 100% capacity hydrocyclones to separate the sand from the settled solids. The sand will be recovered and recycled to the injection tank. The settled solids will be discharged the sludge tank.

The following facilities will be shared by the two ACTIFLOW trains:

- One sludge tank for collection of the solids discharged from the ACTIFLO process.
- Two 100% capacity constant-speed sludge pumps to pump sludge from the sludge tank to the City of Hayward WPCF.
- One sand hopper for storage of the sand used to replace that which is lost in the ACTIFLO process.
- One eductor and booster pump for periodic transfer of make-up sand from the sand hopper to the ACTIFLO injection tanks.

- **Chemical Storage and Feed**—Facilities will be provided to store and feed a coagulant aid (e.g., ferric chloride or alum), flocculent aid (various polymers), and sodium hypochlorite. An 8,000-gallon coagulant storage tank will provide approximately 15 days of storage at the design process flow and a dosage of 60 mg/L. Two 100% capacity chemical metering pumps will be provided for feeding coagulant to a common feed location upstream of the ACTIFLO process. Polymer will be delivered and stored in two 200-gallon totes, providing approximately 39 days of storage at the design process flow and a dosage of 2 mg/L. Three 100% capacity polymer-blending units (two service units and one common spare) will be provided for feeding polymer to the two ACTIFLO trains. The spare polymer-blending unit will also be capable of pumping a "filter aid" polymer directly to a common feed location, located immediately upstream of the filters. Space will be provided for a third tote bin containing filter aid polymer. An 8,000-gallon sodium hypochlorite storage tank will provide approximately 17 days of storage at the design process flow and a dosage of 15 mg/L. Two 100% capacity chemical metering pumps will be provided for feeding sodium hypochlorite to a common feed location at the inlet to the chlorine contact basins. A third auxiliary chemical metering pump will be used to periodically feed sodium hypochlorite to the front end of the RWF for algae control. All metering pumps will be variable-speed with manually adjustable stroke.

- **Filtration**—Two 100% capacity packaged cloth media disc filter systems will be provided to remove additional solids not previously removed in the ACTIFLO process. The filters will be sized to provide a loading rate not exceeding 6 gpm/sf at the maximum recycled water flow rate of 4.3 mgd, with one filter out of service. Each filter will include a dedicated backwash pump. Backwash wastewater will be recycled to the influent pump station. The filters provided will be one of the following:

  - Aqua-Aerobic Systems, AquaDISK
  - U.S. Filter-Krüger Products, Hydrotech Discfilter

  Both of these products are listed in the Department of Health Services' January 2007 Treatment Technology Report for Recycled Water as being "acceptable" for compliance with the treatment requirements of the California Recycled Water Criteria.

- **Disinfection**—Two 50% capacity chlorine contact basins will be included to provide 90 minutes (modal) chlorine contact time as required by Title 22 regulations. Each basin will have a serpentine flow path with extensive baffling in order to approach plug flow conditions. Upstream of the chlorine contact basins, two mixers, installed in series, will be used to thoroughly mix sodium hypochlorite with filtered water.
- **Recycled Water Pumping**—Three 50% capacity, variable speed, horizontal end suction centrifugal pumps will be used to pump recycled water from the outlet of the chlorine contact basins to the recycled water storage tank. In the event that the recycled water storage tank is out of service, these pumps will also be able to pump directly to the cooling tower basin.
- **Recycled Water Storage**—A nominal 700,000-gallon storage tank will provide approximately four hours of operational storage at the maximum recycled water demand of 2,793 gpm.
- **RWF Power Distribution Center**—A dedicated power distribution center (PDC) will contain the motor control center, power distribution panels, and controls for the RWF. Power will be fed to PDC at the 480-volt level from the RCEC auxiliary power distribution center.

In the unlikely event that secondary effluent is not available from the City of Hayward WPCF, or the quality of the secondary effluent is such that treatment to Title 22 standards is not feasible, or there is a failure within the RWF that does not allow the facility to meet the recycled water demand, City of Hayward potable water will be used to supplement or replace recycled water. The potable water will be fed to the chlorein contact basin effluent channel and protected with an air gap.

The RWF will include complete redundancy for each unit process such that the facility can operate at design capacity with one unit in each process (i.e., one influent pump, one ACTIFLO train, one filter, one chlorine mixer, and one recycled water pump) out of service. The exception to this is the chlorine contact basins, which have no moving parts, and where two 50% capacity basins are proposed. The project owner's previous recycled water experience is addressed in the response to Data Request 41.

Rationale for Using Potable Water

40. *Please provide the rationale and economic and/or environmental justification for not using an alternative nonpotable or fresh water source for the RCEC's backup water supply which is consistent with State Water Policy and SWRCB Resolution 75-58.*

Response: The RCEC will use recycled water for steam production and for cooling. As certified by the CEC, in the unlikely event that supply from the WPCF is interrupted and the treated storage is exhausted, domestic water supply from the City of Hayward will be used for temporary makeup to the RCEC.

The CEC decision granting certification of the RCEC with a backup domestic water supply from the City of Hayward concluded that "the project will not cause any significant adverse direct, indirect, or cumulative impacts to soil or water resources, and will comply with all applicable laws, ordinances, regulations, and standards" (RCEC Decision, p. 160).

The RCEC project, as amended, continues to propose to receive process water supply from the City of Hayward WPCF and to use domestic water for domestic uses, fire fighting, service water, and as an emergency backup supply. While the inclusion of the zero-liquid discharge system, the addition of the Title 22 Recycled Water Facility, and removal of the Advanced Wastewater Treatment plant will involve some redesign of the water treatment systems, the sources of water for the project remain the same and the quantities of water used will remain nearly the same as under the approved design. Therefore, neither the approved project nor the project as amended will cause any significant adverse direct, indirect, or cumulative impacts to soil or water resources, and will comply with all applicable LORS.

Data Request 40 implies that the project, as amended, does not comply with State Water Policy and SWRCB Resolution 75-58 because the emergency backup supply would use domestic water supply from the City of Hayward. Resolution 75-58 was adopted by the State Water Resources Control Board in 1975, more than 31 years ago and, to our knowledge, the policy has never been updated or revised. Portions of the Resolution have been characterized as "outdated" by the CEC Staff.[1] Nevertheless, to the extent that the Resolution provides relevant policy guidance, the RCEC project, as licensed by the CEC and as amended, fully complies with that policy. The policy states:

> …the Board's position that from a water quantity and quality standpoint the source of power plant cooling water should come from the following sources in this order of priority depending on site specifics such as environmental, technical and economic feasibility consideration:
> (1) wastewater being discharged to the ocean, (2) ocean, (3) brackish water from natural sources or irrigation return flow, (4) inland wastewaters of low TDS, and (5) other inland waters."

That is precisely what this project does. The source of cooling water is the source listed as the highest priority: "wastewater being discharged to the ocean." And the source of water listed as the lowest priority, "other inland waters," is to be used for cooling purposes only in an emergency and only on a temporary basis, when there is an infrequent failure in the wastewater treatment facilities.

It is not necessary to conduct a detailed economic or environmental analysis of the feasibility of using wastewater from another wastewater treatment facility as backup to RCEC. All of the other wastewater facilities in Alameda County are such a great distance from the RCEC that the enormous cost of constructing a pipeline from these facilities to RCEC solely for the purpose of providing a backup supply of water in the unlikely event of a failure the primary system would far outweigh the benefits of potentially displacing a small quantity of domestic water.[2]

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[1] Docket No. 02-IEP-1, STAFF COMMENTS - State Water Policy Background and Recommendation for Implementation September 2, 2003, footnote 1

[2] The other wastewater facilities in Alameda County are City of Livermore, which provides service within the Livermore city limits; Ruby Hills in Pleasanton; Lawrence Livermore and Sandia National Laboratories; City of San Leandro, Environmental Services Division, which serves zip code areas 94577, 94578, and 94579; Dublin San Ramon Services District, which serves the cities of Pleasanton and Dublin; East Bay Municipal Utility District, which serves the cities of Oakland, Emeryville, Alameda, Piedmont, Berkeley, and Albany; Oro Loma Sanitary District, which serves San Lorenzo, Ashland, Cherryland, Fairview, and portions of Castro Valley, San Leandro, and Hayward; and Union Sanitary District, which serves the cities of Fremont, Newark, and Union City.

Annual Consumption of Potable Water

41. *If it is determined that all other nonpotable or fresh water sources are economically infeasible or environmentally undesirable as a backup water supply, please provide an estimate of the annual consumption of potable water that would be needed for backup cooling and process water needs based on:*

    a. *previous recycled water production experience or*

    b. *the process redundancy and/or reliability of the proposed Title 22 Recycled Water Facility system.*

Response: Condition of Certification SOIL & WATER 4 presently allows the use of potable water as a backup water supply for the RCEC in the event of "an unavoidable interruption of the AWT Plant supply, but not to exceed 45 days (1,080 hours) in any one calendar year." The Condition additionally allows potable water to be used for "cooling and process purposes in excess of 45 days per calendar year if an unavoidable interruption of the AWT supply is due to an Act of God, a natural disaster, an unforeseen emergency or other unforeseen circumstances outside the control of the project owner." The amendments to this condition as proposed by the project owner are simply to replace the references to the "AWT" and "AWT supply" with "onsite Title 22 facility" so as to reflect the current water and wastewater treatment configuration. The project owner is not proposing any revisions to the use of potable water as a backup supply or the circumstances under which it may be used.

During normal operation, no potable water will be used for process or cooling purposes at the RCEC. The RCEC will include a recycled water storage tank of sufficient capacity to meet the peak demand of the RCEC for a period of up to 4 hours. The volume in this tank should be sufficient to cover the most likely unavoidable interruptions in the supply of recycled water to the RCEC. These would include such things as temporary loss of chemical feed, failure of analyzers, controls failures, or brief power failures. During most years, the RCEC is not expected to use any potable water for backup of the recycled water supply. The rare instances where the RCEC would anticipate needing potable water are such things as extended utility power outages at the 230 kV level, extended upsets of the City of Hayward's WPCF where the secondary effluent quality is not suitable for treatment to disinfected, tertiary treatment standards. Such events would be expected to be very infrequent and last only a matter of days.

In response to the specifics of this data request, the project owner offers the following:

a. The project owner's previous recycled water production experience involves the following projects:

    - Delta Diablo Sanitation District (DDSD) Recycled Water Facility—This project is a 12.8-mgd facility for which Calpine oversaw the engineering, construction, and startup of a tertiary treatment plant providing recycled water to Calpine's Delta Energy Center, Los Medanos Energy Center, and several community parks and landscaped areas. The plant is owned and operated by DDSD and has been operating successfully since 2001. The plant includes an influent pump station, ACTIFLO ballasted sedimentation process, continuous backwash sand filters, chlorine contact basins, recycled water storage tank and pump stations, and

associated chemical feed systems. The facilities proposed for the RCEC will be very similar, although the RCEC recycled water facility will be smaller in capacity and will use a different technology for filtration.

- City of Mankato Water Reclamation Facility—This project is a 6-mgd facility for which Calpine oversaw the engineering, construction, and startup of a tertiary treatment plant providing recycled water to Calpine's Mankato Energy Center. The plant is owned and operated by the City of Mankato and has been operating successfully since 2006. Because of the cold climate, the majority of this facility is located indoors. In addition, the ACTIFLO process at this facility is designed with a capacity of 12 mgd to provide phosphorus removal to the entire effluent stream from the City's secondary treatment facilities. The plant includes an influent pump station, ACTIFLO ballasted sedimentation process, disk filters, chlorine contact basin, recycled water pump station, and associated chemical feed systems. Again, the facilities proposed for the RCEC will be very similar; although the RCEC recycled water facility will be located outdoors.

b. The RCEC recycled water facility will be designed to meet or exceed the reliability requirements of Sections 60349 through 60355 of Title 22. Specifically, the following redundancy will be provided in order to assure a high level of reliability:

- Three 50% capacity influent pumps
- Two 100% capacity ACTIFLO trains
- Two 100% capacity disc filters
- Two 100% capacity chlorine mixers
- Two 50% capacity chlorine contact basins
- Three 50% capacity recycled water pumps
- Two 100% capacity coagulant pumps
- Three 100% capacity polymer feed systems (one per ACTIFLO train plus a common spare)
- Three 100% capacity sodium hypochlorite feed pumps (Two for the disinfection proceed plus a third pump for use in feeding sodium hypochlorite to alternate locations, i.e., plant influent)

This level of redundancy exceeds that of the DDSD facility which has two 50% capacity ACTIFLO trains and four 25% capacity filters. The DDSD facility has been operating since April 2001 with only occasional planned outages for maintenance purposes and a few unplanned outages because of utility power failures. The planned outages have been scheduled so as to not interrupt the flow of recycled water to the Delta Energy Center and Los Medanos Energy Center. The utility power failures have generally been short in duration. Although the DDSD facility includes a backup water supply (Contra Costa Water District raw water), the backup supply has never been used to supplement or replace the recycled water provided by the facility. The RCEC RWF is expected to be even more reliable than the DDSD facility given the higher level of redundancy and more reliable power source.

DESCP

42. *Please provide a draft DESCP containing elements A through I below outlining site management activities and erosion/sediment control BMPs to be implemented during site mobilization, excavation, construction, and post-construction activities. Within the draft DESCP, please provide a discussion of those additional requirements of SFBRWQCB Order No. 2003-0021 as they relate to construction and post-construction BMPs as well as a discussion of brownfield cleanup requirements and which state or local agency has lead agency jurisdiction. The level of detail in the draft DESCP should be commensurate with the current level of planning for site cleanup and corresponding site grading and drainage. Please provide all conceptual erosion control information for those phases of construction and post-construction that have been developed or provide a statement when such information will be available.*

    A. ***Vicinity Map*** *– A map(s) at a minimum scale 1″=100′ will be provided indicating the location of all project elements with depictions of all significant geographic features including swales, storm drains, and sensitive areas.*

    B. ***Site Delineation*** *– All areas subject to soil disturbance for the RCEC (project site, lay down areas, all linear facilities, landscaping areas, and any other project elements) shall be delineated showing boundary lines of all construction areas and the location of all existing and proposed structures, pipelines, roads, and drainage facilities.*

    C. ***Watercourses and Critical Areas*** *– The DESCP shall show the location of all nearby watercourses including swales, storm drains, and drainage ditches. Indicate the proximity of those features to the project construction, lay down, and landscape areas and all transmission and pipeline construction corridors.*

    D. ***Drainage Map*** *– The DESCP shall provide a topographic site map(s) at a minimum scale 1″=100′ showing all existing, interim and proposed drainage systems and drainage area boundaries. On the map, spot elevations are required where relatively flat conditions exist. The spot elevations and contours shall be extended off-site for a minimum distance of 100 feet in flat terrain.*

    E. ***Drainage of Project Site Narrative*** *– The DESCP shall include a narrative of the drainage measures to be taken to protect the site and downstream facilities. The narrative should include the summary pages from the hydraulic analysis prepared by a professional engineer/erosion control specialist. The narrative shall state the watershed size(s) in acres that was used in the calculation of drainage measures. The hydraulic analysis should be used to support the selection of BMPs and structural controls to divert off-site and on-site drainage around or through the project construction and laydown areas.*

    F. ***Clearing and Grading Plans*** *– The DESCP shall provide a delineation of all areas to be cleared of vegetation and areas to be preserved. The plan shall provide elevations, slopes, locations, and extent of all proposed grading as shown by contours, cross sections or other means. The locations of any disposal areas, fills, or other special features will also be shown. Illustrate existing and proposed topography tying in proposed contours with existing topography.*

    G. ***Clearing and Grading Narrative*** *– The DESCP shall include a table with the quantities of material excavated or filled for the site and all project elements of the RCEC (project site, lay down areas, transmission corridors, and pipeline corridors). The table*

shall distinguish whether such excavations or fill are temporary or permanent and the amount of material to be imported or exported.

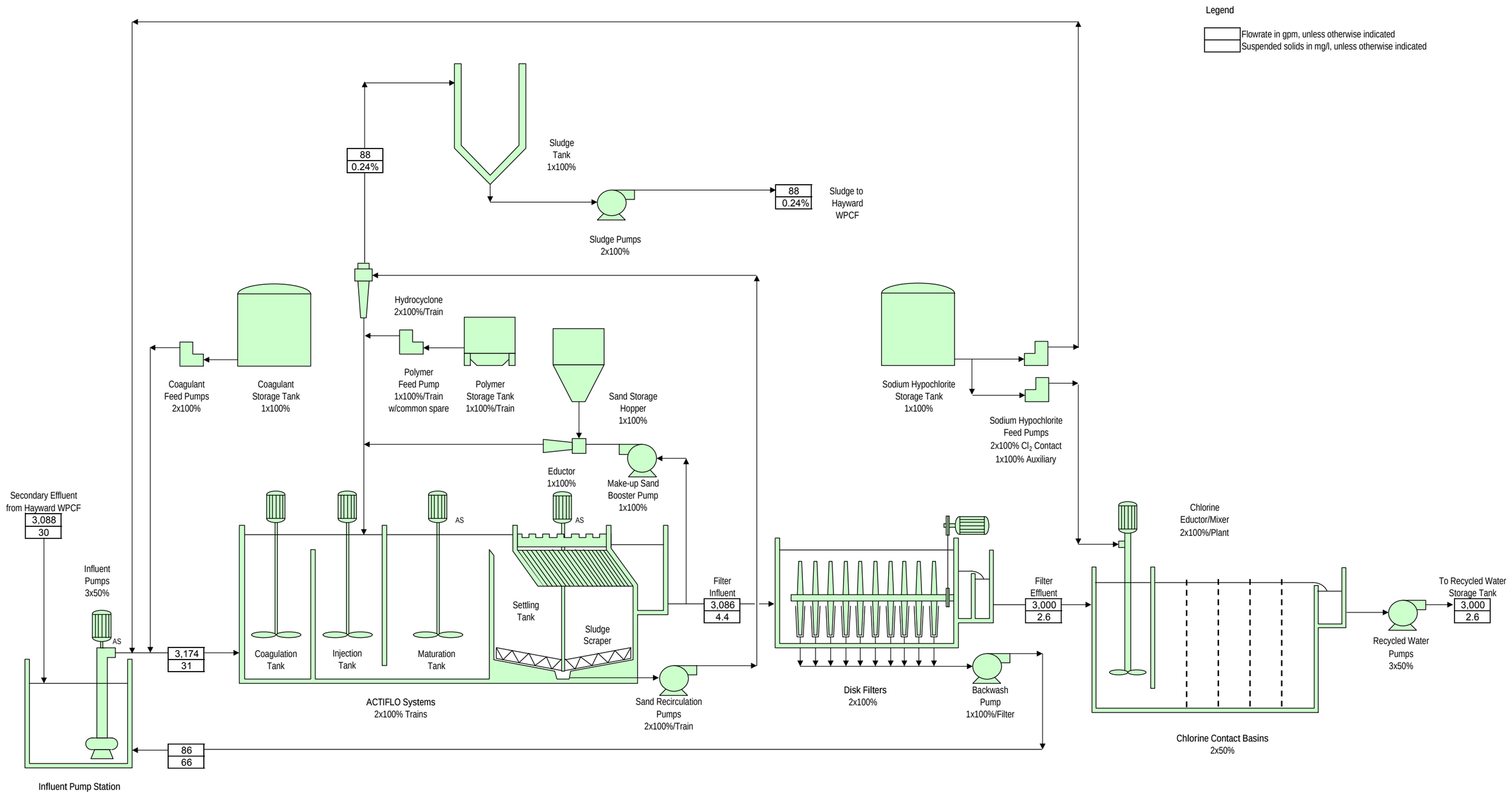
H. ***Best Management Practices Plan*** *– The DESCP shall identify on the topographic site map(s) the location of the site specific BMPs to be employed during each phase of construction (initial grading, project element excavation and construction, and final grading/stabilization). BMPs shall include measures designed to prevent wind and water erosion in areas with existing soil contamination. Treatment control BMPs used during construction should enable testing of groundwater and/or stormwater runoff prior to discharge to San Francisco Bay.*

I. ***Best Management Practices Narrative*** *– The DESCP shall show the location (as identified in H above), timing, and maintenance schedule of all erosion and sediment control BMPs to be used prior to initial grading, during project element excavation and construction, final grading/stabilization, and post-construction. Separate BMP implementation schedules shall be provided for each project element for each phase of construction. The maintenance schedule should include post-construction maintenance of structural control BMPs, or a statement provided when such information will be available.*

Response: A Draft DESCP is provided as Attachment DR42-1. Due to the size of the document, 5 copies have been provided to the CEC. Additional copies will be provided to the CEC Staff or other interested parties upon request.

Attachment DR39-1

RWF Process Flow Diagram



Rev.	Description	By	Date
0	For response to CEC Staff Data Request 39	JBM	01/15/06

Design Case: Design

Configuration:	2 x 1	MPD
Site Altitude:	7.5	ft
Dry Bulb Temp.:	88	deg. F
Wet Bulb Temp.:	68	deg. F
Duct Firing:	Yes	

CALPINE

Russell City Energy Center

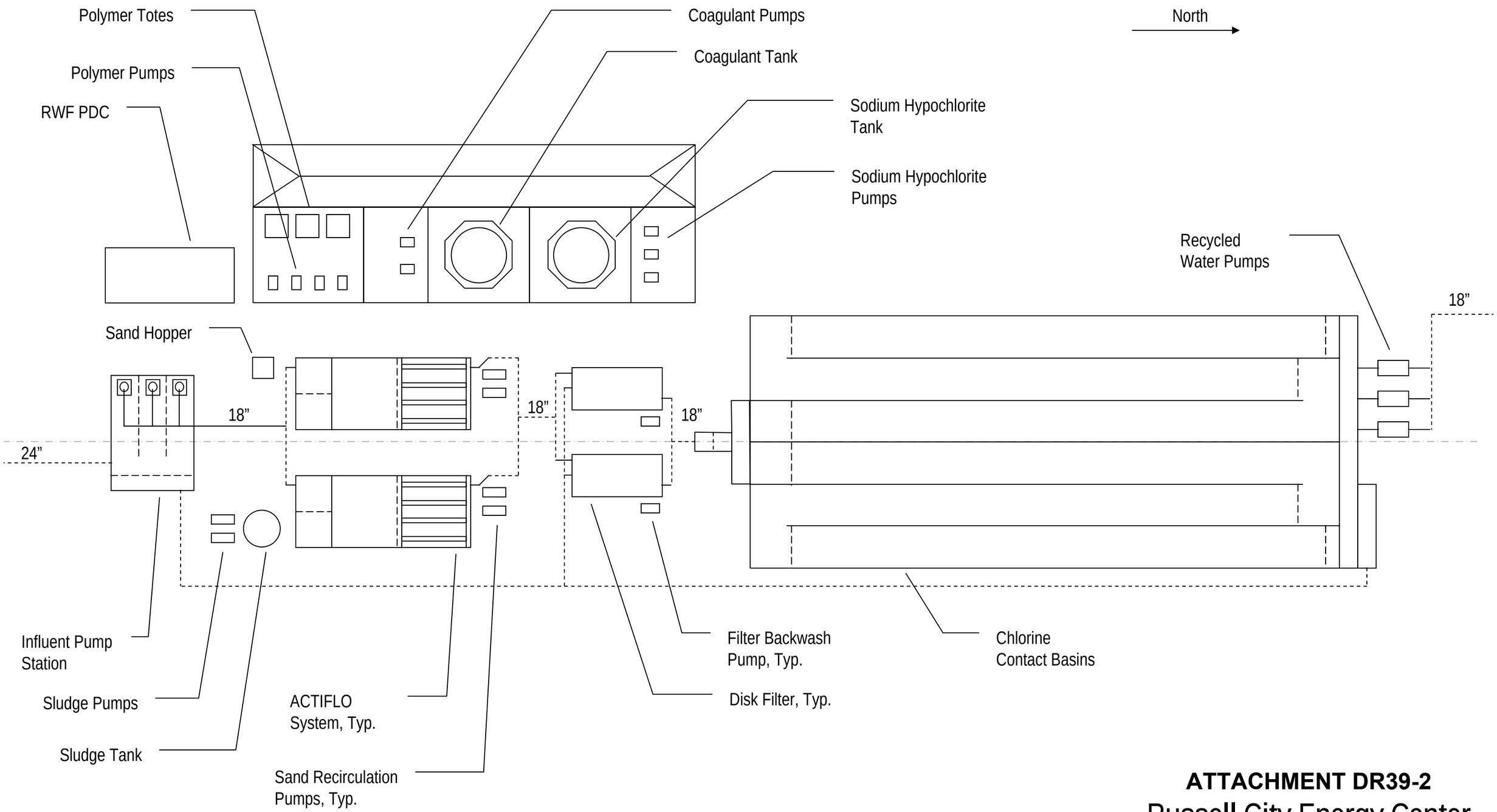
RWF Process Flow Diagram

ATTACHMENT DR39-1

Rev. 0

Attachment DR39-2

Recycled Water Facility



ATTACHMENT DR39-2

Russell City Energy Center

Recycled Water Facility

Scale – 1” = 20’

Attachment DR42-1

Draft Erosion Sediment Control Plan

Preliminary Draft Plan

Drainage, Erosion, and Sediment Control Plan

Russell City Energy Center

Hayward, California

(01-AFC-07, Amendment No. 1)

Submitted to the

California Energy Commission

Submitted by

Russell City Energy Company, LLC

With Technical Assistance by:

CH2MHILL

Sacramento, CA

January 2007

Contents

Section **Page**

1. Introduction **1-1**
1.1 Drainage, Erosion, and Sediment Control Plan Elements 1-1
1.2 Regulatory Background 1-2
1.2.1 San Francisco Bay RWQCB Order No. 2003-0021 1-2
1.2.2 Brownfield Cleanup 1-2
1.3 Project Overview 1-3
1.4 Watercourses and Other Critical Areas 1-4
1.4.1 Watercourses 1-4
1.4.2 Other Critical Areas 1-4
1.5 Project Ownership 1-4

2. Drainage **2-1**
2.1 Precipitation 2-1
2.2 Floodplain 2-1
2.3 Drainage 2-1

3. Clearing and Grading **3-1**
3.1 Areas to be Cleared and Graded 3-1
3.1.1 RCEC Site 3-1
3.1.2 Linear Facilities 3-1
3.2 Location of Disposal Areas, Fills or Other Special Areas 3-1
3.3 Existing and Proposed Topography 3-2
3.4 Volumes of Cut and Fill 3-2

4. Project Schedule **4-1**

5. Best Management Practices **5-1**
5.1 General Erosion Control Measures 5-1
5.1.1 Access Road, Entrance and Parking, and Laydown Areas 5-2
5.1.2 RCEC Site and Linear Facilities 5-3
5.1.3 Foundations 5-4
5.1.4 Site Stabilization and Demobilization 5-4
5.2 Other Controls 5-4
5.2.1 Material Handling and Storage 5-5
5.2.2 Solid and Hazardous Waste Management 5-6
5.2.3 Potential Contaminated Soil 5-7
5.2.4 Groundwater/Dewatering Controls 5-8
5.2.5 Offsite Vehicle Tracking 5-8
5.2.6 Dust Suppression and Control 5-8

Appendixes

1 Figures
2A Stormwater Management Plan
2B Erosion and Sediment Control Plan
2C Final Site Grading and Drainage Plan
3 BMP Fact Sheets

Tables

1 Summary of Cut and Fill Volumes for the RCEC 3-2
2 Project Schedule Major Milestones 4-1
3 Proposed Construction Laydown and Worker Parking Areas 5-3
4 Quantities of Nonhazardous Waste Generated During Construction 5-6

Figures

1 Project Vicinity
2 Project Location
3 General Arrangement
4 Surface Water Features
5 FEMA Flood Zones
6 Grading and Drainage Plan
7 Construction Parking and Worker Laydown Areas
8 Supplemental BMP Map

SECTION 1

Introduction

This Preliminary Draft Drainage, Erosion, and Sediment Control Plan (DESCP) has been prepared in anticipation of the California Energy Commission's (CEC) approval of the proposed Russell City Energy Center (RCEC) (01-AFC-07, Amendment #1). The RCEC will be a natural gas-fired, combined-cycle electric generating facility rated at a nominal gross generating capacity of 600 megawatts (MW). It will be located within the City of Hayward. This preliminary draft DESCP, prepared in response to CEC Staff Data Request #42, demonstrates that the Project will not cause an increase in off-site flooding potential (due to an increase in stormwater runoff from the post-development site conditions) or sedimentation during the construction phase by using standard best management practices (BMPs), and it will meet all local, state, and federal regulatory requirements associated with the protection of water quality and soil resources. In addition, this DESCP discusses the requirements of the San Francisco Bay Regional Water Quality Control Board (RWQCB) as they relate to construction and post-construction BMPs and also those requirements associated with the clean-up of sites designated as brownfields.

This draft DESCP is preliminary because it is prepared in advance of the final phase of construction planning and engineering design, during which the details regarding construction schedule and certain aspects of erosion control design will be finalized. This will take place after licensing and will be included in a future draft of the DESCP. This document contains placeholders for some of these future items (i.e., detailed schedule and supplemental BMP map).

1.1 Drainage, Erosion, and Sediment Control Plan Elements

Staff Data Request #42 requests a draft DESCP "outlining site management activities to be implemented during site mobilization, excavation, and construction." This draft DESCP includes the following elements:

- **Vicinity Map –** The project location map (Figure 2) indicates the location of all project elements with depiction of significant geographic features to include watercourses, swales, storm drains, and sensitive areas.
- **Site Delineation –** The RCEC site and all project elements are delineated on a map showing all areas subject to soil disturbance and the location of all existing and proposed structures, pipelines, roads, and drainage facilities.
- **Watercourses and Critical Areas –** The DESCP shows the location of watercourses and critical areas such as creeks, rivers, wetlands and other environmentally sensitive areas.
- **Drainage –** The DESCP provides a topographic site map showing existing, interim and proposed drainage systems; drainage area boundaries; watershed size in acres; and the hydraulic analysis to support the selection of BMPs to divert off-site drainage around

and through the plant and laydown areas. A narrative also is provided to support the map.

- **Clearing and Grading –** The DESCP provides clearing and grading plans to show elevations, slope, location, and extent of proposed grading. A narrative also is included with a table of the quantities of material excavated or filled for the site.
- **Best Management Practices –** The DESCP describes the location, timing, and maintenance schedule of BMPs to be used. Final design and placement of the BMPs will take place during the final phase of construction planning after licensing.

1.2 Regulatory Background

The Project will comply with all local, state, and federal regulatory requirements associated with the protection of water quality and soil resources, as indicated in the original Application for Certification (AFC) and AFC Amendment Petition No. 1 for the RCEC. The following paragraphs discuss the requirements of the San Francisco Bay RWQCB and also those requirements associated with the cleanup of sites designated as brownfields.

1.2.1 San Francisco Bay RWQCB Order No. 2003-0021

The City of Hayward is a co-permittee of the Alameda County Clean Water Program, which is a coordinated effort by local governments in Alameda County to improve water quality in San Francisco Bay. In February of 2003, the San Francisco Bay RWQCB approved a new Municipal Stormwater Permit (Order No. 2003-0021) for Alameda County, which requires more stringent best management practices (BMPs) prior to stormwater discharge from new development or redevelopment.

Permittees must submit a Stormwater Quality Management Plan (SQMP) in order to reduce the discharge of pollutants in stormwater to the maximum extent practicable (MEP) and to effectively prohibit non-stormwater discharges into municipal storm drain systems and watercourses within the Permittees' jurisdictions. The SQMP serves as the framework for identification, assignment, and implementation of BMPs. The SQMP also contains performance standards that address the following program components: public information and participation, municipal maintenance, new development and significant redevelopment, construction site controls, illicit discharge controls, and industrial and commercial discharge controls. Performance standards are defined as the level of implementation necessary to demonstrate the control of pollutants in stormwater to the MEP. Permittees are required to implement the SQMP, demonstrate its effectiveness, and provide for necessary and appropriate revisions, modifications, and improvements to reduce pollutants in stormwater discharges to the MEP.

1.2.2 Brownfield Cleanup

Assembly Bill 1876 (Statutes 1995, Chapter 820), established the Private Site Management Program (Program) to provide the private sector with an incentive to cleanup low-threat sites, including brownfields. The project location will involve industrial renovation of "brownfield" property in an area that is zoned for industrial and heavy industrial uses. The Program addresses the need for an appropriate level of environmental oversight at

certain types of brownfields and other low-risk sites. It authorizes private site managers to conduct environmental assessments, site investigations, and removal or remedial actions at low-risk sites with limited Department of Toxic Substances Control (DTSC) oversight. The Program Performance Standards Regulations were adopted by DTSC in February 2003 and are available for review on DTSC's website at http://www.dtsc.ca.gov/LawsRegsPolicies/Title22/OEARA_REG_Title22_Ch51.cfm.

1.3 Project Overview

Russell City Energy Company, LLC proposes to construct, own, and operate a merchant energy generating facility in the Industrial Corridor of the City of Hayward, Alameda County, California. The generating facility is to be known as the Russell City Energy Center (RCEC). The RCEC will be a natural gas-fired, combined-cycle electric generating facility rated at a nominal gross generating capacity of 600 megawatts (MW). The RCEC property will be approximately 18.8 acres, consisting of a fenced-in area of 16.5 acres, which includes the East Bay Dischargers Authority (EBDA) easement. The fenced area will accommodate the generation facilities, including the storage tank areas, parking area, control/administration building, water treatment building, emission control equipment, generation equipment, and the on-site switchyard. The site location is shown in Figures 1 and 2 (all figures are located in Appendix 1). The power plant facilities are shown in the general arrangement drawing in Figure 3.

The proposed energy center will consist of the following:

- A 600-megawatt (MW) nominal, natural gas-fired, combined cycle generating facility consisting of two "F-Class" combustion turbine–generators (CTGs), two multi-pressure, supplementary-fired heat recovery steam generators (HSRGs), a single 3-pressure, reheat, condensing steam turbine–generator (STG), and a hybrid, wet/dry plume-abated mechanical draft cooling tower.
- A 230-kilovolt (kV) on-site switchyard and a 230-kV, double-circuit overhead transmission line connecting the RCEC switchyard to the existing Pacific Gas and Electric (PG&E) Eastshore Substation via PG&E's existing Eastshore to Grant 115-kV transmission corridor. The transmission line will be constructed by PG&E; construction of the transmission line is not covered by this DESCP.
- A new natural gas line. Natural gas will be delivered via a new gas line from Pacific Gas and Electric Company's (PG&E) line 153 located along the Union Pacific Railroad easement to the east of the project. The gas line will run east from the project site, along Depot Road to the easement for a distance of approximately 3,800 feet (0.7 mile) (see Figure 2). The natural gas line will be constructed by PG&E; construction of the natural gas line is not covered by this DESCP.
- A new connection from the southern boundary of the project site to the exiting, City of Hayward, 12-inch potable water line that runs along Enterprise Avenue (see Figure 2). This connection will provide water required for domestic uses and fire fighting. A new sanitary sewer line will parallel the potable water line connection.

The temporary disturbance area for the project will be 45.37 acres. This acreage includes construction of all of the linear facilities. Construction of the transmission line and natural gas line will be constructed by PG&E. Therefore, they are not covered in this DESCP. Stormwater management during construction of the transmission line and natural gas line will be addressed by regulatory requirements (i.e., State Water Resources Control Board) through PG&E. The temporary disturbance area will be approximately 29 acres for the project, less the disturbance area for the transmission line and natural gas line.

1.4 Watercourses and Other Critical Areas

1.4.1 Watercourses

The RCEC site is located within the San Lorenzo Cone drainage basin. This basin drains an area of west Hayward comprising approximately 9,700 acres. Old Alameda Creek and the Ward-Zeile Creek systems convey most of the precipitation runoff in this area (Figure 4). Surface waters flow into South San Francisco Bay. The watershed of the project area lies in the Arroyo de Alameda between Sulphur Creek and Mt. Eden Creek, the largest streams in the RCEC vicinity. Sulphur Creek (approximately 1.7 miles to the northwest) and Mt. Eden Creek (approximately 1 mile to the south) also flow into South San Francisco Bay. Most of the streams and arroyos in the vicinity of the site are ephemeral in nature. Storm-flow runoff is managed by the Alameda County Public Works Agency-Flood Control and Water Conservation District to mitigate flooding impacts and to help recharge groundwater.

1.4.2 Other Critical Areas

No jurisdictional wetlands or waters of the U.S. are present within the project site or the construction parking and laydown area. Small, isolated seasonal wetlands are located south of the RCEC site. Large areas south of the isolated wetlands and to the west are brackish or saltwater marshes in various stages of restoration. These areas include several areas that were formerly salt evaporation ponds that are currently open water; areas formerly salt evaporation ponds, but that have returned to natural wetland vegetation (pickleweed dominant); a large area called the HARD Marsh that is a managed and created wetland fed by runoff as well as by secondary treated effluent from USD/EBDA, mixed periodically with bay water; and the Cogswell Marsh, a tidally influenced salt marsh to the northwest of the project area. These wetland areas are shown on Figure 4.

An excavated drainage ditch, which is a part of the Alameda County Flood Control and Water Conservation District's storm water system, is present approximately 15 feet west of the project area; the drainage is approximately 15 to 20 feet wide and conveys storm water runoff to the north.

1.5 Project Ownership

Russell City Energy Company, LLC, a wholly owned subsidiary of Calpine Corporation (Calpine) and GE Energy Financial Services (GE), is the project owner.

SECTION 2

Drainage

2.1 Precipitation

The climate in the project area is Mediterranean with moderate year-round temperatures and a winter rainy season. The closest long-term precipitation gauge to the RCEC is Station 62, located on the Hayward Corporation Yard, at an elevation of 55 feet above mean sea level. Between 1957 and 1992, the annual rainfall at that location averaged 17.9 inches per year. The project site falls in an area that receives, on average, approximately 17 inches of rain per year. Most of this precipitation occurs during the months of October through April, while summers are relatively dry.

2.2 Floodplain

Portions of the project site, construction laydown area, and parking sites are located within the revised Federal Emergency Management Agency (FEMA) 100-year floodplain, as shown in Figure 5. The project site grade elevation will be raised, as necessary, to ensure the minimization of flooding risk to the plant structures and to confirm compliance with FEMA, City (Chapter 9, Article 4, Section 9.4.110 of the City of Hayward Municipal Code), and County (Article 3 of the Alameda County General Ordinance Code) policies, which require that the energy center be above the 100-year flood level, base flood elevation of 7 feet.

2.3 Drainage

The grading and drainage plan for the RCEC is shown in Figure 6. During operations, off-site stormwater runoff will be diverted around the improved facilities using a combination of berms and swales, generally draining from the east to the west, into an existing Alameda County Flood Control and Water Conservation District (ACFCWCD) stormwater drainage channel running along the western boundary of the project site. On-site stormwater runoff from non-contained areas will be diverted to a series of catch basins and ultimately discharged to the same location as the off-site runoff (the ACFCWCD stormwater drainage channel). On-site stormwater runoff from within the contained generating and industrial areas of the site will be collected in the plant process drain system and routed through an oil-water separator. The oil-water separator will remove floating oil, grease, and other hydrocarbons. The clean water from the separator will be sent to the sanitary sewer.

During construction, stormwater will be processed as described above (diverted to catch basins and ultimately discharged to the ACFCWCD stormwater drainage channel). The initial construction activity will be to construct diversion channels and Channel A around the site perimeter (Figure 6). Next, catch basins and pipes will be installed prior to active construction in project areas. This will occur in the switchyard area first, followed by the

power block area, and then the cooling tower area). Inlet protection BMPs will be used until construction is complete. See Appendix 2B for more details.

A drainage plan for the construction parking and laydown areas and for construction of the water lines is not currently available. A temporary drainage system will be designed and added to the Final DESCP for control of stormwater during construction.

A Stormwater Management Plan (with complete analysis methods and calculations) is provided in Appendix 2A. An Erosion and Sediment Control Plan is provided in Appendix 2B for the RCEC site and one of the construction laydown areas (the majority of this plan is summarized in this DESCP in Section 5, Best Management Practices). Stormwater drawings identifying drainage and grading details are provided in Appendix 2C.

SECTION 3

Clearing and Grading

3.1 Areas to be Cleared and Graded

3.1.1 RCEC Site

The grading plan for the RCEC is shown in Figure 6. The topography of the site is essentially flat, with a mean elevation of approximately 10 feet above mean sea level. Construction of the RCEC will require grading and earthwork to bring the base elevation to above the 100-year floodplain elevation. Graded areas will be smooth, compact, free from irregular surface changes, and sloped to drain toward the natural drainage system.

Any areas to be backfilled will be prepared by removing unsuitable material and rocks. The bottom of any excavation will be examined for loose or soft areas. Such areas will be fully excavated and backfilled with compacted fill in layers of uniform, specified thickness. Structural fill supporting foundations, roads, parking areas, etc., will be compacted in accordance with ASTM standards.

The surficial soils at the RCEC site are predominantly clay (Reyes clay, drained). Clearing of vegetative cover and the subsequent soil disturbance for grading activities will likely result in short-term increases in water and wind erosion rates. The proposed project design will include measures to stabilize fill areas and cut slopes and to control drainage and erosion. These design measures are expected to minimize erosion and sedimentation to acceptable levels.

3.1.2 Linear Facilities

The potable water and sanitary sewer connections will be accomplished through trenching. Trenching will consist of digging a 3- to 7-foot-wide trench. Trench width will depend on the type of soils encountered and underground obstructions. Trench depth will be sufficient to meet the requirements of the governing agencies. The excavated soil will be piled on one side of the trench and used for backfilling after the pipes are installed in each trench.

3.2 Location of Disposal Areas, Fills or Other Special Areas

It is anticipated that any excavated soil will be used onsite for grading and leveling purposes. In the event that some of the excavated soil will not be reused onsite, classification of the soil for disposal would be made on the basis of sampling. Sampling would be completed once the soil is excavated and stockpiled. Soil that is determined to be non-hazardous could be suitable for reuse at a construction site or disposal at a regional disposal facility, depending on the chemical quality. Soil that is determined to be hazardous would be disposed of properly.

3.3 Existing and Proposed Topography

Existing and proposed topography for the RCEC site is illustrated on Figure 6. Existing topography also is shown on Drawing RC-GEN-DE-C1-0009 in Appendix 2C.

Topography maps for the construction parking and laydown areas and the water lines are not available at this time. This information will be incorporated into the Final DESCP.

3.4 Volumes of Cut and Fill

The grading of the site to design elevations will require the following: a cut volume of ___[1] cubic yards and fill of ____ cubic yards for a net fill of ___ cubic yards. Topsoil removal (hauled away from site) will total approximately ___ cubic yards. Cut and fill volumes for each project element are described in Table 1, below. Trenches excavated for the linear facilities will be entirely refilled. No surplus soil is expected.

TABLE 1
Summary of Cut and Fill Volumes for the RCEC

Project Element	Quantity of Material Excavated	Quantity of Material Filled	Temporary (T) / Permanent (P)
General Site Grading	TBD	TBD	TBD
Raising of Base Flood Elevation	TBD	TBD	TBD
Total			**NA**

[1] Cut and fill volumes will be determined during final construction planning and will be included in the Final DESCP.

SECTION 4

Project Schedule

Construction of the RCEC from site preparation and grading to commercial operation is expected to take place from the spring of 2008 to the summer of 2010, a total of 25 months. The actual construction duration from the start of construction to substantial completion is estimated to be 23 months. Major milestones are listed in Table 2. A more detailed project schedule will be provided in a future draft after final construction design is completed.

TABLE 2
Project Schedule Major Milestones

Activity	Date
Begin Construction	Second Quarter 2008
Begin Startup and Testing	Fourth Quarter 2009
Construction Substantially Complete	Second Quarter 2010
Commercial Operation	Second Quarter 2010

SECTION 5

Best Management Practices

The temporary disturbance area for construction of the facility will be approximately 29 acres. The permanent disturbance area will be approximately 18.8 acres. The project has been designed to impact as small an area as possible at any given time, thereby limiting the amount of exposed soil. Construction is expected to proceed as expediently and efficiently as possible, thereby ensuring that as little soil is exposed for as short a time as possible. The following sections present standard construction best management practices (BMPs), most of which are described in the *California Storm Water Best Management Practice Handbook* (CASQA, 2003) and the *Caltrans Storm Water Quality Handbook* (2003). These resource handbooks provide comprehensive details on BMP implementation and will be obtained and reviewed by managers for all construction contractors that may have an impact on implementation of the DESCP. Appendix 3 contains the CASQA BMP fact sheets for BMPs to be used at the project site. These fact sheets include detailed descriptions of the BMPs discussed in the following sections. The fact sheets also include the maintenance practices for each BMP. Drawing RC-GEN-DE-C1-0007 in Appendix 2B shows the location of erosion and sediment control BMPs to be used at the 18.8-acre RCEC site. A supplemental BMP map for the construction parking and laydown areas and water lines will be prepared at a later date. This supplemental BMP map will be included in the Final DESCP as Figure 8.

The following sections present the recommended construction BMPs for stormwater pollution prevention at the RCEC construction laydown areas, plant site, and water lines. Each section provides information on BMP implementation as it relates to the activity being performed. BMPs that may have an impact on implementation of the DESCP will be reviewed by managers and construction contractors. While performing the work, the contractors may implement additional control measures if necessary.

5.1 General Erosion Control Measures

The project has been designed to impact as small an area as possible at any given time, thereby limiting the amount of exposed soil. BMPs will be used to help maintain water quality, protect property from erosion damage, and prevent accelerated soil erosion or dust generation. Temporary erosion control measures would be implemented before construction begins and they would be evaluated and maintained during construction. These measures typically include revegetation, mulching, physical stabilization, dust suppression, berms, ditches, and sediment barriers. These measures would be removed from the site after the completion of construction.

A mitigation monitoring plan also will be developed in conjunction with CEC Staff to set performance standards and monitor the effectiveness of BMPs. This plan will address the timing and methods of such measures, as well as reporting and response requirements. Personnel will receive training to conduct their jobs properly and recognize and report abnormal/adverse situations so that they can be quickly corrected.

The following general control measures may be used during various phases of the project:

- Proper scheduling and sequencing of activities (EC-1)
- Preservation of existing vegetation (EC-2)
- Silt fences and fiber rolls (SE-1 and SE-5)
- Drainage swales (EC-9)
- Straw mulch (EC-6)
- Placement of geotextiles, plastic covers, & erosion control blankets/mats (EC-7)
- Placement of hydro seeding (EC-4), mulching (EC-8), or geotextile/erosion control blankets (EC-7) on slopes
- Gravel bag berm (SE-6)
- Street sweeping (SE-7)
- Sandbag barrier (SE-8)
- Storm drain inlet protection (SE-10)
- Stockpile management (WM-3)
- Wind erosion control (WE-1)
- Solid and hazardous waste management (WM-5 and WM-6)
- Sanitary/septic waste management (WM-9)
- Vehicle and equipment maintenance (NS-10)
- Vehicle and equipment fueling (NS-9)
- Spill prevention and control (WM-4)
- Employee and contractor training

5.1.1 Access Road, Entrance and Parking, and Laydown Areas

Figure 7 shows the construction laydown and parking areas. Construction parking and laydown will be located at several parcels as listed in Table 3. Note to reader: Drawing RCEC-024-DC-0002 in Appendix 2B is outdated as it shows a "finger" parcel being used for construction laydown. This "finger" parcel has been replaced with the 4.1-acre L-shaped parcel (McLucas, 2006).

All construction-phase parking will be accessed from Enterprise Avenue. The entrance will be maintained to limit sediment tracking and creation of dust. The parking and laydown areas will be stabilized with coarse gravel. All surfaces will be regularly watered to reduce generation of dust, but will not be excessively watered so as to generate runoff. Silt fencing may be used at edges of these areas, as necessary to minimize sediment discharging into swales or ditches.

TABLE 3
Proposed Construction Laydown and Worker Parking Areas

APN	Parcel Name	Street Frontage	Acres
439009900307	Runnels Industries	Whitesell Street and Enterprise Avenue	3.9
439009900200	City of Hayward (portion)	Enterprise Avenue	4.1
439009900200	City of Hayward (portion)	Enterprise Avenue	1.7
Total			**9.7**

All construction equipment will be maintained to control leaks and spills, and fueling will only be conducted within contained areas. Any contaminated soils resulting from spills will be dug up as quickly as possible, and then removed from the site for proper disposal.

The following BMPs are recommended for construction access areas:

- Silt fencing (SE-1)
- Stabilizing entrances and surfaces with coarse aggregate (TR-1 and TR-2)
- Compacting access road surfaces (TR-2)
- Proper scheduling and sequencing of activities (EC-1)
- Street sweeping and vacuuming (SE-7)
- Placement of hydro seeding (EC-4), mulching (EC-8), or geotextile/erosion control blankets (EC-7).
- Wind erosion control (WE-1)
- Earth dikes and drainage swales (EC-9)
- Vehicle and equipment cleaning (NS-8)
- Establishing vehicle and equipment fueling (NS-9) and maintenance areas (NS-10)

5.1.2 RCEC Site and Linear Facilities

The site will be constructed on relatively level ground; therefore, it is not considered necessary to place barriers around the property boundary. However, some barriers would be placed in locations where offsite drainage could occur to prevent sediment from leaving the site and all drains on surface streets surrounding the site will be protected with gravel bags and/or silt sacks. If used, sediment barriers would be properly installed, then removed or used as mulch after construction. Runoff detention basins, drainage diversions, and other large-scale sediment traps are not considered necessary due to the level topography. Any soil stockpiles, including sediment barriers around the base of the stockpiles, would be stabilized and covered.

The project linear facilities include a new connection from the southern boundary of the project site to the exiting 12-inch potable water line that runs along Enterprise Avenue and a new connection to the existing sanitary sewer line. The sanitary sewer line parallels the potable water line, as shown in Figure 2. BMPs to be considered during construction of the site and linear facilities are listed below (the RCEC site BMPs also are described in the Erosion and Sediment Control Plan in Appendix 2B):

- Silt Fence (SE-1)
- Check Dam (SE-4).
- Street Sweeping and Vacuuming (SE-7)
- Storm Drain Inlet Protection (SE-10)
- Stabilized Construction Entrance (TR-1)
- Stabilized Construction Roadway (TR-2)
- Entrance/Outlet Tire Wash (TR-3)
- Straw Mulch (EC-6)
- Geotextiles and Mats (EC-7)

5.1.3 Foundations

During construction of the foundations, a concrete washout area will be required. Dumping of excess concrete and washing out of delivery vehicles will be prohibited at other locations on site. Notices will be posted to inform all drivers.

The following BMPs will be considered during the construction of foundations:

- Solid waste management (WM-5)
- Concrete waste management (WM-8)

5.1.4 Site Stabilization and Demobilization

As construction nears completion, areas used for linear facilities' construction, parking, and storage and laydown will be cleared and stabilized. Areas that will continue to be used for parking or storage will have permanent storm water collection and conveyance structures provided.

5.2 Other Controls

The RCEC will use hazardous materials both during construction and project operation. Most of the hazardous materials that will be used for the project are required for backup emergency fuel, facility maintenance and lubrication of equipment or will be contained within transformers and electrical switches. The project will comply with good engineering practices, applicable laws and regulations for the storage of these materials to minimize the potential for a release of hazardous materials, and will conduct emergency response planning to address public health concerns regarding hazardous materials use and storage. The Hazardous Materials Business Plan is discussed below in Section 5.2.1.

5.2.1 Material Handling and Storage

There will be a variety of chemicals stored and used during both facility construction and operation. All hazardous materials will be handled and stored in accordance with applicable codes and regulations. In addition, a Hazardous Materials Business Plan is required by CCR Title 19 and the Health and Safety Code (Section 25504). In accordance with these regulations, the Hazardous Materials Business Plan will include an inventory and location map of hazardous materials onsite and an emergency response plan for hazardous materials incidents. Specific topics to be covered in the plan include:

- Facility identification
- Emergency contacts
- Chemical inventory information (for every hazardous material above threshold limits)
- Site map
- Emergency notification data
- Procedures to control actual or threatened releases
- Emergency response procedures
- Training procedures
- Certification

The Hazardous Materials Business Plan will be prepared for approval by the CEC CPM and the City of Hayward Fire Department, which is the local CUPA.

Hazardous materials used during construction of the RCEC and associated linear facilities will include gasoline, diesel fuel, motor oil, hydraulic fluid, certain solvents, cleaners, sealants, welding flux, various lubricants, paint, and paint thinner. No acutely hazardous materials will be used or stored on-site during construction. There are no feasible alternatives to motor fuels and oils for operating construction equipment. The types of paint required are dictated by the types of equipment and structures that must be coated and the manufacturer's requirements for coating.

The most likely incidents involving these hazardous materials would be associated with minor spills or drips. Impacts from such incidents will be mitigated by thoroughly cleaning up minor spills as soon as they occur. In the case of a large spill of hazardous material, any contaminated soil will be excavated and stored in drums or roll-off bins for off-site disposal as a hazardous waste.

The following BMPs will be considered for material handling and storage during construction:

- Solid Waste Management (WM-5)
- Vehicle and Equipment Refueling (NS-9)
- Vehicle and Equipment Maintenance (NS-10)
- Material Delivery and Storage (WM-1)
- Material Use (WM-2)
- Concrete Waste Management (WM-8)

5.2.2 Solid and Hazardous Waste Management

Waste will be generated at the RCEC site during facility construction. Types of waste will include wastewater, solid nonhazardous waste, and liquid and solid hazardous waste. The project will also generate solid nonhazardous waste during construction of the electric transmission line, natural gas supply line, and water supply interconnects to the existing site service feeders. The estimates for the amount of waste to be produced are presented in Table 4.

TABLE 4
Quantities of Nonhazardous Waste Generated During Construction

Type of Construction Waste	Revised Estimate for Amendment
Paper, Wood, Glass, and Plastics	35 tons
Metal	38 tons
Concrete (from demolition of buildings)	1,000 tons*

* 50 percent of the concrete will be disposed at the beginning of the project, and the remaining 50 percent will be disposed of towards the end of construction.

5.2.2.1 Nonhazardous Waste Disposal Facilities

Currently, the City of Hayward has a franchise agreement with Waste Management, Inc. for collection and disposal of solid waste generated within its jurisdiction, in effect through May 2007. Waste Management, Inc. also provides collection services directly for commercial and industrial facilities in the project site area. Nonhazardous waste, collected by the City of Hayward, is brought to the Altamont Landfill disposal facility, which is owned by Waste Management, Inc. It is located in the eastern part of the county. The estimated closure date of the facility is 2024. There are two other disposal sites located in Alameda County: the Vasco Road Landfill (Vasco) and the Tri-Cities Landfill (Tri-Cities). Located in the eastern portion of the county, Vasco is owned by Republic Industries, Inc. and has a closure date of 2015. The Tri-Cities Landfill accepts waste from Fremont, Newark, and Union City only (i.e., would not take waste from the RCEC facility).

5.2.2.2 Hazardous Waste Disposal Facilities

According to the California Department of Toxic Substances Control (DTSC), there are 64 facilities in California that can accept hazardous waste for treatment and recycling (DTSC, 2005). For ultimate disposal, California has three hazardous waste (Class I) landfills. The closest disposal facility to RCEC is Clean Harbors' Buttonwillow Landfill, Kern County.

The following BMPs will be considered at the designated storage locations:

- Cover or store hazardous materials indoors, if possible (WM-6)
- Material delivery and storage (WM-1)
- Material use (WM-2)
- Spill prevention and control (WM-4)
- Solid waste management (WM-5)
- Hazardous waste management (WM-6)
- Use of covered dumpsters and containers for waste (WM-5)

5.2.3 Potential Contaminated Soil

The RCEC site is a designated brownfields site. The RCEC facility is composed of four parcels, identified as the small and large Eash parcels, the City of Hayward parcel, and the Aladdin parcel. The following paragraphs summarize the current conditions at each parcel.

The Eash parcels are located at 3862 and 3878 Depot Road in Hayward, California. The parcel at 3862 Depot Road (large Eash parcel) was used as a fertilizer plant prior to the mid 1940s, and then was used for a variety of light industrial uses such as a machine shop, wooden pallet fabrication shop and storage yard, lumber yard, and a wrought iron fabrication shop. All four of these activities are currently onsite. The parcel at 3878 Depot Road (small Eash parcel) was occupied by an uncultivated pasture with a single-family residence prior to 1947. The structure was removed from the parcel between 1959 and 1969 and an automobile salvage yard was developed on the lot. The salvage yard remains in operation.

The City of Hayward parcel consists of two parcels located at 3700 Enterprise Avenue. One of the parcels is the western portion of the 39.86-acre property addressed as 3700 Enterprise Avenue, and the other is a 1.67 acre unaddressed parcel that adjoins the western portion to the south. The site has been the location of the City of Hayward wastewater treatment plant since the early 1950s. Prior to that time the site was undeveloped. The unaddressed parcel may have been used for farming, but is currently undeveloped. No buildings are located on the site, and the ground surface consists of bare soil. The site is currently used as a biosolids drying area.

The Aladdin parcel consists of one parcel located at 3810 Depot Road. The parcel is approximately 2.96 acres, and is divided into the northern and southern portion. The northern portion of the site is occupied by 4000 Auto Wreckers, Inc., an auto wrecking facility. The southern portion of the property is used for storage by the property owners, as well as St. Francis Electric Company, Bay Area Framers, and D&S Trucking. An inactive greenhouse is located along the southern site border.

In September 2006, a limited subsurface investigation was conducted at the site to address potential contamination at the site. Results of the field investigation are summarized in Section 3.13, Waste Management, in the AFC Amendment.

Cleanup of contaminated soils at the site will be completed by the project owner. Areas of potential soil contamination will be sampled, excavated and disposed of as necessary. Soil contamination is anticipated to be limited to petroleum spot contamination. All soil sampling and excavation will be completed in accordance with the Private Site Management Program as described in Section 1.2.2.

All contaminated soil will be excavated before construction of the project site begins. As such, it is unlikely that contaminated soil will be encountered during construction. However, operators and construction personnel will be asked to report unusual conditions to the appropriate personnel and the area and/or material will be properly contained during investigative actions. If soils require temporary stockpiling, piles will be covered with plastic sheeting or tarps that are secured safely with sand bags and bermed with hay bales or silt fencing to prevent runoff from leaving the area. If required, samples will be collected and sent to a certified analytical laboratory for characterization. If contamination is detected, the waste will be handled and properly disposed of in an authorized waste management facility.

5.2.4 Groundwater/Dewatering Controls

The construction phase of RCEC is not anticipated to require any groundwater removal. If dewatering is required, dewatering will be done with dewatering pumps. The dewatering pumps will discharge into the permanent diversion channels to be conveyed to Channel A (Channel A is shown on Figure 6). In the event that groundwater or dewatering controls were required and if any contamination were detected via odors or visible sheens, the collected water will be handled and properly disposed in a manner consistent with federal, state, and local regulations. The following control methods will be considered for groundwater/dewatering controls, as necessary:

- Dewatering operations (NS-2)
- Hazardous waste management (WM-6)

5.2.5 Offsite Vehicle Tracking

Because sediment reaching public roads generally has a clear path to wetlands and water bodies, controls will be in place to minimize or eliminate soils from being tracked off the project site from vehicles. The site entrance will be maintained to limit sediment tracking and creation of dust. The parking and laydown areas will be stabilized with coarse gravel. During construction of the linear facilities, sediment tracking BMPs will be used as necessary. All surfaces will be regularly watered to reduce generation of dust, but will not be excessively watered so as to generate runoff. Silt fencing may be used at edges of these areas, as necessary to minimize sediment discharging into swales or ditches.

The following control methods will be considered for offsite vehicle tracking, as necessary:

- Stabilized construction entrance/exit (TR-1)
- Stabilized construction roadway (TR-2)
- Entrance/exit tire wash (TR-3)

5.2.6 Dust Suppression and Control

During construction of the project and the related linear facilities, dust erosion control measures would be implemented to minimize the wind-blown loss of soil. Water of a quality equal to or better than existing surface runoff would be sprayed on the soil in construction areas to control dust during revegetation.

The following control method will be considered for dust suppression, as necessary:

- Wind erosion control (WE-1)

APPENDIX 1

Figures

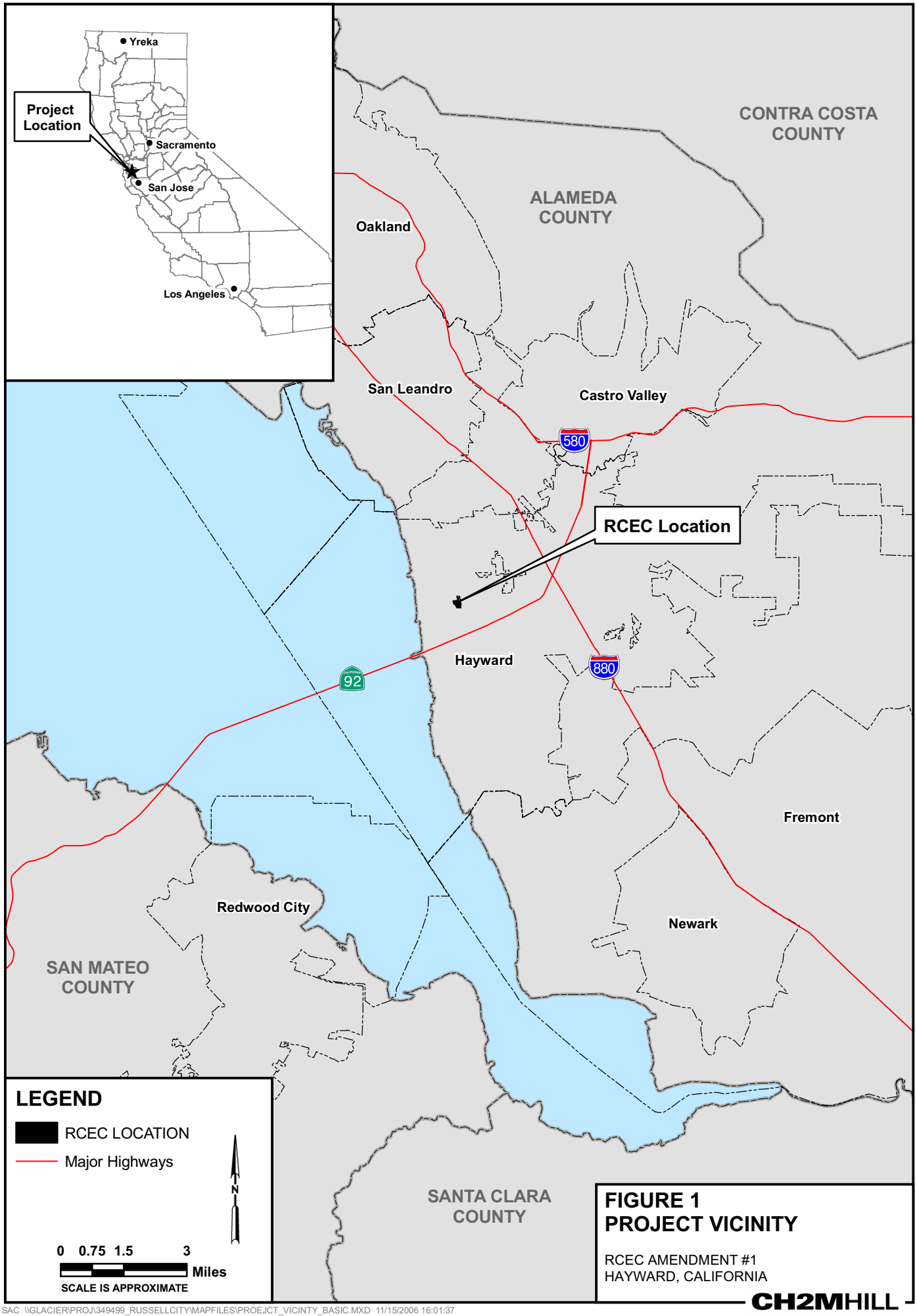


FIGURE 1
PROJECT VICINITY

RCEC AMENDMENT #1
HAYWARD, CALIFORNIA

CH2MHILL

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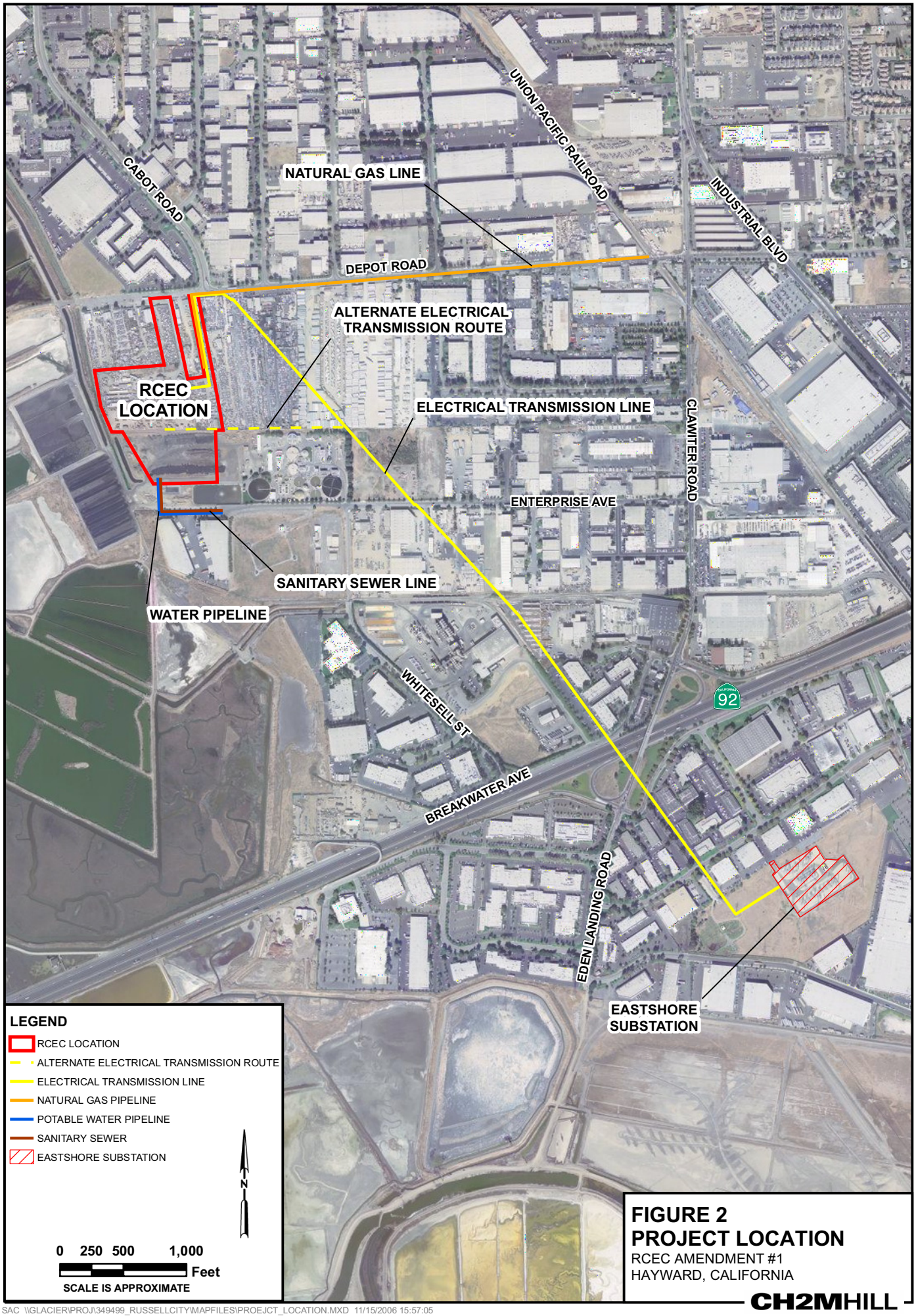

FIGURE 2
PROJECT LOCATION
RCEC AMENDMENT #1
HAYWARD, CALIFORNIA

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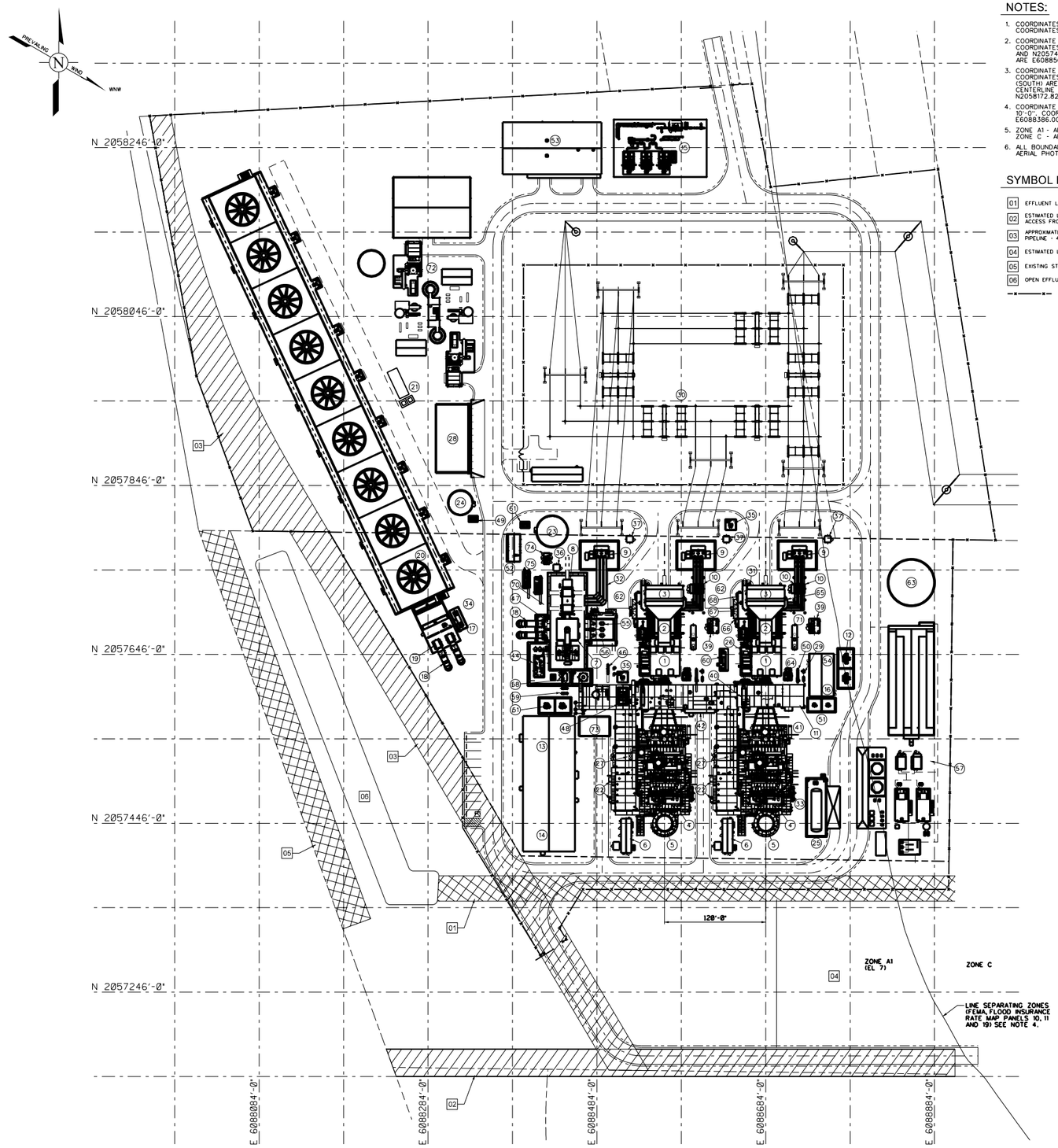


NOTES:

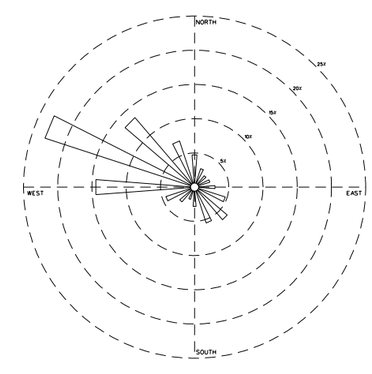
1. COORDINATES LISTED ARE STATE PLANE NAD83, CALIFORNIA, ZONE 3 COORDINATES.
2. COORDINATE FOR TOP OF HRSG FOUNDATION ELEVATION IS 10'-0". COORDINATES FOR CENTERLINE OF HRSG #1 STACK ARE E6088684.000' AND N2057446.000'. COORDINATES FOR CENTERLINE OF HRSG #2 STACK ARE E6088564.000' AND N2057446.000'.
3. COORDINATE FOR TOP OF COOLING TOWER FAN ELEVATION IS 67.177'. COORDINATES FOR CENTERLINE OF COOLING TOWER FAN #1 (SOUTH) ARE E6088266.960' AND N2057737.794'. COORDINATES FOR CENTERLINE OF COOLING TOWER FAN #9 (NORTH) ARE E6088064.103' AND N2058172.822'.
4. COORDINATE FOR TOP OF FIRE PUMP HOUSE FOUNDATION ELEVATION IS 10'-0". COORDINATES FOR CENTERLINE OF FIRE PUMP HOUSE ARE E6088386.000' AND N2057772.500'.
5. ZONE A1 - AREAS OF 100-YR FLOOD, BASE FLOOD ELEVATION OF 7 FT. ZONE C - AREAS OF MINIMAL FLOODING.
6. ALL BOUNDARY INFORMATION IS APPROXIMATE BASED ON PARCEL MAPS, AERIAL PHOTOS AND FIELD WORK.

SYMBOL LEGEND:

- 01 EFFLUENT LINE - 30' WIDE.
- 02 ESTIMATED LOCATION AND WIDTH EASEMENT FOR CITY ACCESS FROM ENTERPRISE AVE TO SLUDGE BEDS - 30' WIDE
- 03 APPROXIMATE LOCATION FOR 60" EBDA EFFLUENT PIPELINE - 40' WIDE
- 04 ESTIMATED LOCATION OF EXISTING EQUALIZATION BASIN
- 05 EXISTING STORM CHANNEL TO REMAIN AN OPEN DITCH 35' WIDE
- 06 OPEN EFFLUENT DITCH
- FENCE

EQUIPMENT LEGEND:

1. COMBUSTION TURBINE
2. CT GENERATOR
3. CT AIR INLET SYSTEM
4. HRSG
5. HRSG STACK
6. CEM/HRSG POWER DISTRIBUTION CENTER
7. STEAM TURBINE
8. ST GENERATOR
9. GENERATOR STEPUP TRANSFORMER
10. GENERATOR BREAKER
11. PIPE RACK
12. UNIT AUXILIARY TRANSFORMERS
13. BOP ELECTRICAL CONTROL BLDG
14. ADMIN/CONTROL ROOM BLDG
15. FUEL GAS METERING & COMPRESSORS
16. AUX POWER DISTRIBUTION CENTER
17. AUXILIARY COOLING WATER PUMP
18. CIRCULATING WATER LINES
19. CIRCULATING WATER PUMPS
20. COOLING TOWER
21. AUXILIARY TRANSFORMERS & COOLING TOWER PDC
22. BOILER FEED PUMPS
23. SERVICE / FIRE WATER STORAGE TANK
24. DEMIN. WATER STORAGE TANK
25. AMMONIA STORAGE TANK, PUMPS & VAPORIZER
26. CT HYDRAULIC UNIT
27. BLOWDOWN TANK AND SUMP
28. COOLING TOWER CHEM FEED PAVILION
29. FUEL GAS KNOCKOUT DRUM/ DRAIN TANK
30. SWITCHYARD
31. WATER WASH SKID
32. ISO PHASE BUS DUCT
33. AMMONIA INJECTION SKID
34. OIL/WATER SEPARATOR (ABOVE GROUND)
35. OIL/WATER SUMP AND PUMPS
36. ST EQUIP DELUGE VALVE STATION
37. TRANSFORMER/FIRE PROTECTION DELUGE VALVE HOUSE
38. NOT USED
39. INLET FOGGING SKID
40. ROTOR AIR COOLER
41. DUCT BURNER SKID
42. SAMPLE PANEL & WATER LAB
43. NOT USED
44. STG LUBE OIL SKID
45. GLAND STEAM SKID (NOT SHOWN)
46. GLAND STEAM CONDENSER
47. CONDENSER
48. AIR COMPRESSORS (UNDER PIPE BRIDGE)
49. DEMIN. WATER PUMPS
50. FUEL GAS PERFORMANCE HEATER
51. SUS TRANSFORMERS
52. FIRE PUMP SKID ENCLOSURE
53. WAREHOUSE
54. DC AND UPS SYSTEM
55. CONDENSATE PUMPS
56. CONDENSATE STRAINERS
57. TITLE 22 AREA
58. STG EHC SKID
59. CLOSED COOLING WATER PUMPS & HEAT EXHCANGERS
60. FUEL GAS DEWPOINT HEATER
61. SERVICE WATER PUMPS
62. CRANE AREA / MAINTENANCE
63. RECYCLED WATER STORAGE TANK
64. MAIN & PILOT FUEL GAS FILTER SEPARATOR
65. VT & SURGE CUBICLE
66. CT MECHANICAL PACKAGE
67. CT ELECTRICAL PACKAGE
68. CT STARTING PACKAGE
69. ST SEAL OIL SKID (NOT SHOWN)
70. BULK HYDROGEN & CO2 STORAGE (TRAILER MOUNT)
71. WATER WASH TANK (UNDERGROUND)
72. ZERO LIQUID DISCHARE (ZLD) AREA
73. HRSG CYCLE CHEM FEED PAVILION
74. THY/FCB CUBICLES
75. NON CONDENSABLE GAS REMOVAL SKIDS



60 0 60 120 180

SCALE: 1" = 60'

SOURCE: WorleyParsons, 2006

VHL: Thu Jun 09 14:23:05 2005

FIGURE 3
GENERAL ARRANGEMENT
RCEC AMENDMENT #1
HAYWARD, CALIFORNIA

CH2MHILL

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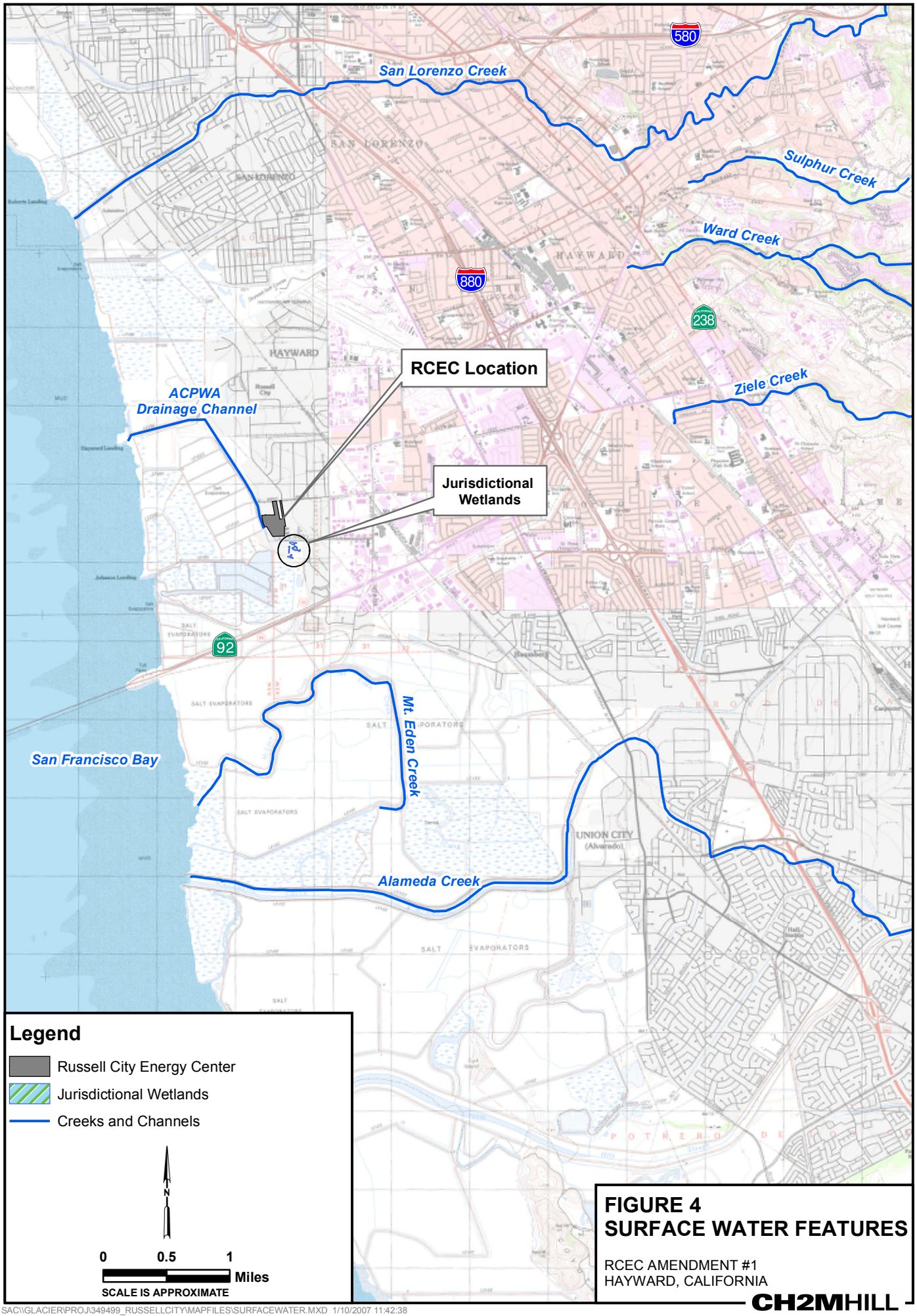

FIGURE 4
SURFACE WATER FEATURES

RCEC AMENDMENT #1
HAYWARD, CALIFORNIA

CH2MHILL

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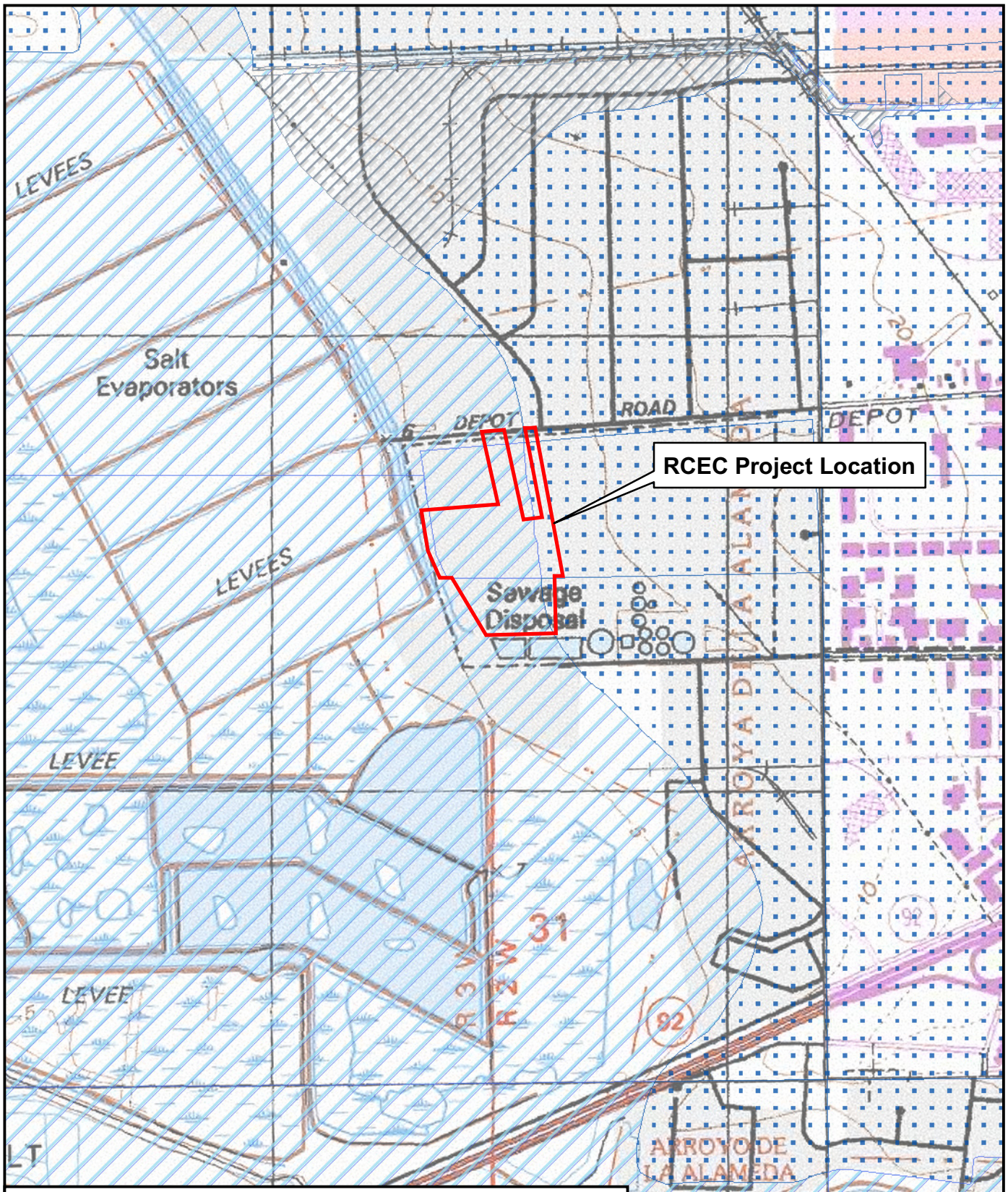

LEGEND

RCEC LOCATION

FEMA Zones

- Zone A - Subject to 100-year flood
- Zone X - Areas outside the 500-year flood plain
- Zone X500 - Areas between the limits of the 100-year and 500-year flood plain

0 250 500 1,000 Feet

SCALE IS APPROXIMATE

N

FIGURE 5
FEMA FLOOD ZONES

RCEC AMENDMENT #1
HAYWARD, CALIFORNIA

CH2MHILL

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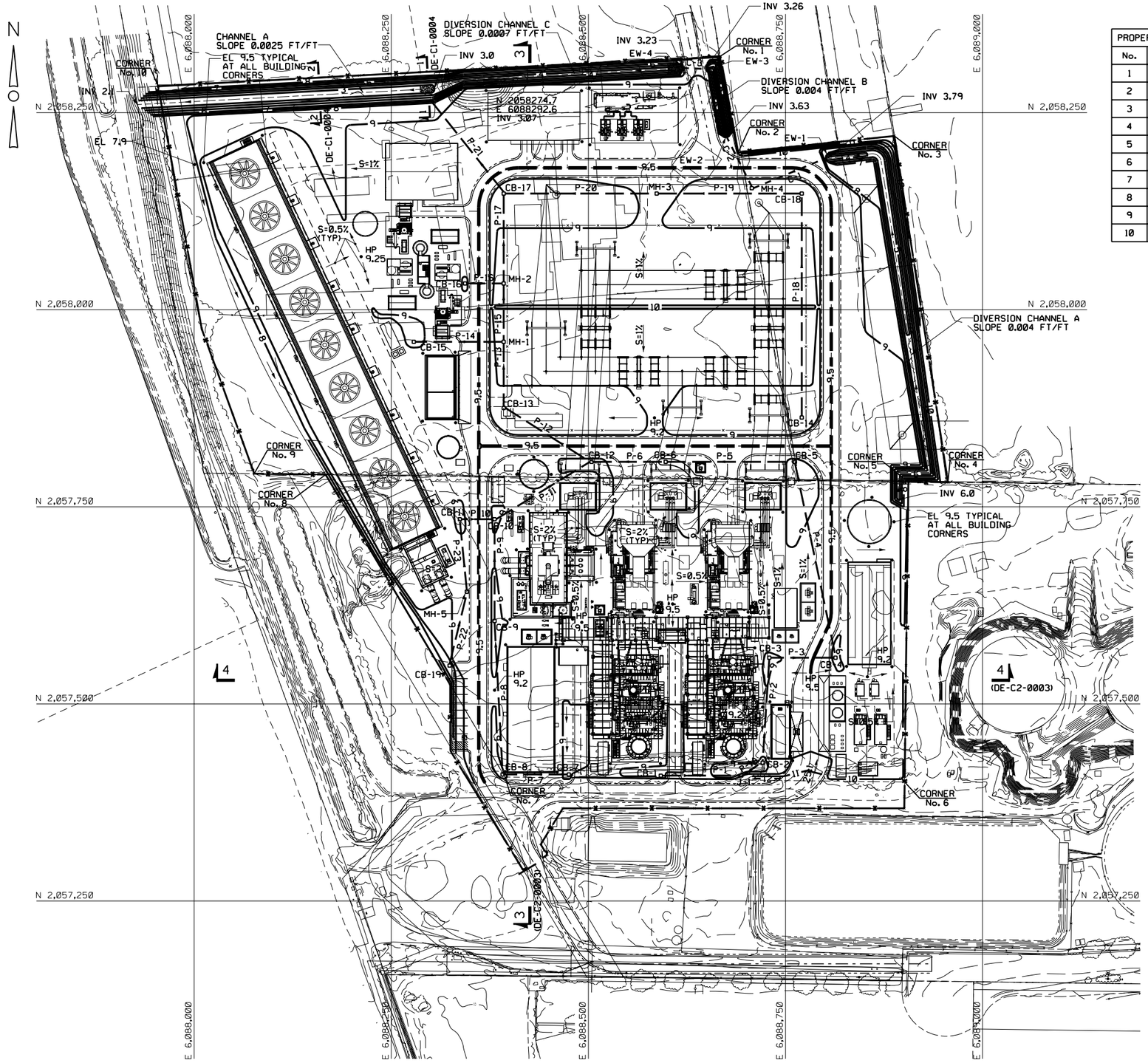

PROPERTY CORNER COORDINATE SCHEDULE		
No.	NORTH	EAST
1	2058321.5	6088667.5
2	2058199.4	6088690.1
3	2058220.4	6088888.1
4	2057781.1	6088956.2
5	2057781.8	6088905.8
6	2057401.0	6088901.2
7	2057407.2	6088394.3
8	2057790.8	6088166.8
9	2057791.9	6088076.5
10	2058283.4	6087954.3

LEGEND

- EXISTING GRADE CONTOUR
- FINAL GRADE CONTOUR
- FINAL GRADE SPOT ELEVATION
- PROPOSED FENCE
- PROPOSED STORM DRAIN
- PROPOSED CULVERT
- PROPOSED STORM CATCH BASIN
- PROPOSED ENDWALL
- PROPOSED DRAINAGE CHANNEL
- DIRECTION OF FLOW

NOTES:

1. COORDINATES LISTED ARE STATE PLANE NAD83, CALIFORNIA ZONE 3.
2. DRAIN INSERTS SHALL BE USED FOR ALL CATCH BASINS AND SHALL BE ACCORDING TO ULTRA DRAIN GUARD, OIL AND SEDIMENT MODEL, PART #9225, OR EQUAL.

REFERENCES:

DC-G1-0001	GENERAL ARRANGEMENT SITE PLAN
DE-C1-0002	SITE SURFACING PLAN
DE-C1-0004	GRADING DETAILS
DE-C2-0002	DRAINAGE STRUCTURES
DE-C2-0001	CATCH BASIN AND PIPE SCHEDULE
DE-C2-0003	SECTIONS

60 0 60 120 180

SCALE IN FEET

SOURCE: WorleyParsons, 2006

FIGURE 6
GRADING AND DRAINAGE PLAN
RCEC AMENDMENT #1
HAYWARD, CALIFORNIA

CH2MHILL

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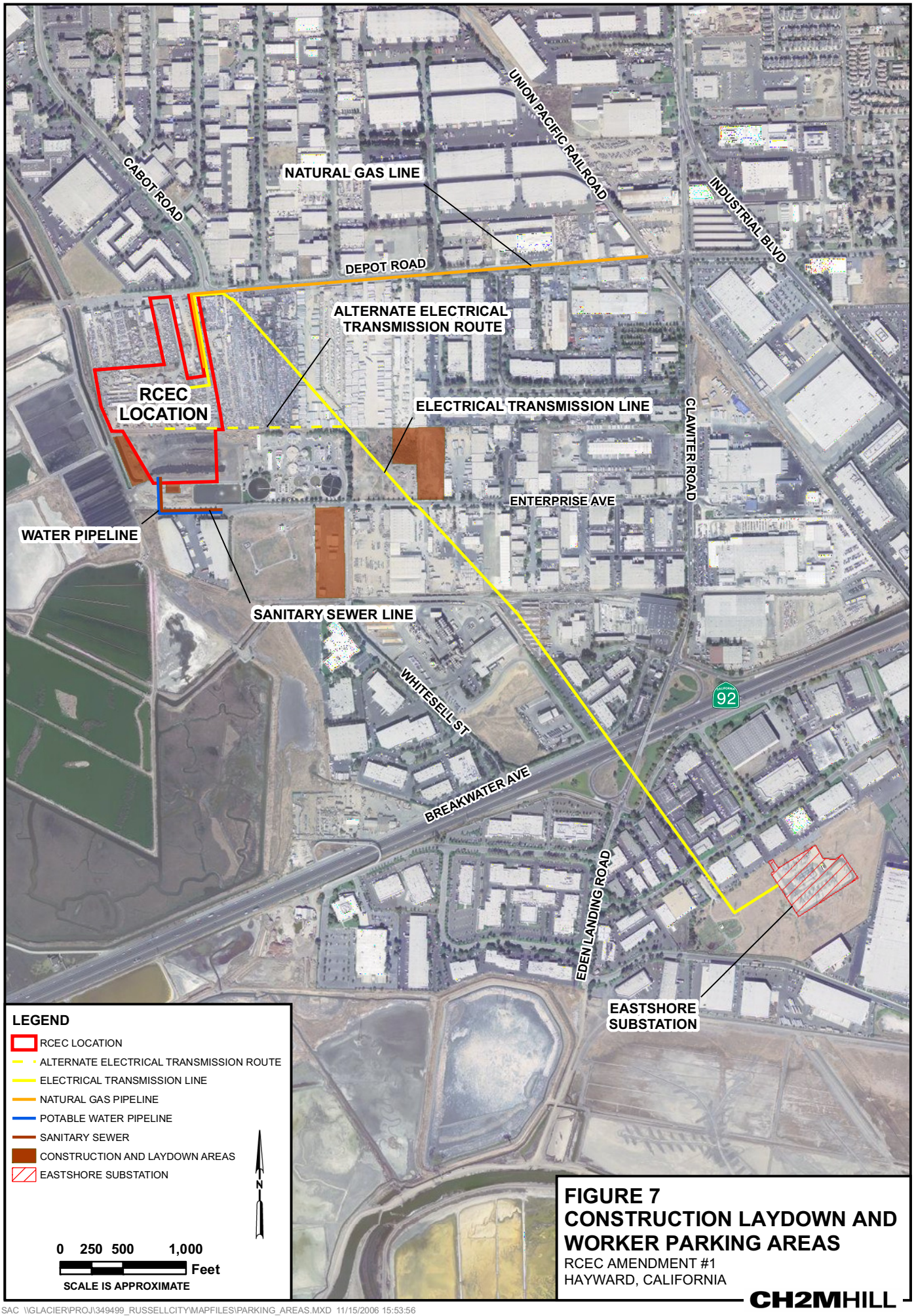

FIGURE 7
CONSTRUCTION LAYDOWN AND WORKER PARKING AREAS
RCEC AMENDMENT #1
HAYWARD, CALIFORNIA

CH2MHILL

SAC \\GLACIER\PROJ\349499_RUSSELLCITY\MAPFILES\PARKING_AREAS.MXD 11/15/2006 15:53:56

APPENDIX 2A

Stormwater Management Plan

WorleyParsons
resources & energy

CALCULATION COVER SHEET

CLIENT	Calpine
PROJECT	Russell City Energy Center, Alameda County, California
SUBJECT	Stormwater Management
JOB NUMBER	53794801
WBS NUMBER	024
CALCULATION NO.:	RCEC-024-DC-0001
PAGE 1 OF	15

DESCRIPTION/PURPOSE

Design stormwater system to collect site runoff and convey the runoff to an existing drainage channel (Line E) located west of the project site. The stormwater system will consist of inlet and pipe systems and open channels and will be designed in accordance with the requirements of the Alameda County, California, the Alameda County Flood Control and Water Conservation District Hydrology and Hydraulics Criteria Summary Manual and Alameda Countywide Clean Water Program (ACCWP), Provision C.3 Stormwater Technical Guidance.

METHOD OF ANALYSIS

Use the Modified Rational Method as implemented by the ACFC&WCD Hydrology Manual to estimate peak runoff for the collection system design. Use Haestad methods, "StormCAD", "Culvertmaster", and "Flowmaster" to design the storm drain and culvert system.

CODES AND STANDARDS

None applicable.

REGISTERED PROFESSIONAL ENGINEER
PRADIP KUMAR KHAN
No. 54262
Exp. 12-31-07
CIVIL
STATE OF CALIFORNIA

See electronic signature for date and time

REV	DATE	DESCRIPTION	PAGES REVISED	PAGES ADDED	PAGES DELETED	BY/DATE	REV/DATE	LDE/DATE
D								
C								
B								
A	11-1-06	ORIGINAL ISSUE	NA	NA	NA	D. Sheth 11-1-06	K. Giffin 11-3-06	Pradip Khan 11/14/06

WorleyParsons
resources & energy

CALCULATION COVER SHEET

CLIENT	Calpine		
PROJECT	Russell City Energy Center, Alameda County, California		
SUBJECT	Stormwater Management		
JOB NUMBER	53794801	WBS NUMBER	024
CALCULATION NO.:	RCEC-024-DC-0001	PAGE 2 OF	15

INFORMATION SOURCES

1. Federal Emergency Management Agency (FEMA), National Flood Insurance Program, Flood Boundary and Floodway Map, Flood Insurance Rate Maps (FIRM), Panels 10 and 18 of 29, February 9, 2000.
2. Federal Emergency Management Agency (FEMA), National Flood Insurance Program, Flood Boundary and Floodway Map, Map Index, Community Panel Numbers 065033 0001-0029 February 9, 2000.
3. Federal Emergency Management Agency (FEMA), National Flood Insurance Program, Flood Insurance Study, City of Hayward, California, Alameda County, February 9, 2000.
4. City of Hayward, Hayward Municipal Code, 2006.
5. Alameda County General Ordinance Code, Matthew Bender & Company, Inc., 2006.
6. Alameda County Flood Control and Water Conservation District, Alameda County Hydrology and Hydraulics Criteria Summary Manual, 1989.
7. Alameda Countywide Clean Water Program (ACCWP), Provision C.3 Stormwater Technical Guidance.
8. MK-GEN-DB-003, Mankato Energy Center, Project Design Guidelines for Combined Cycle Plant with a 1x1x1 Configuration.
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10. McCuen, Richard, "Hydrologic Analysis and Design", 2nd Edition.
11. Bentley Systems, "Flowmaster", Service Pack 3.
12. FHWA, HEC-15, April 1983, pgs. 17, 36 and 37.
13. Bentley Systems, "Culvertmaster", Service Pack 1.
14. Bentley Systems, "StormCAD", Service Pack 2.
15. National Stone Association (NSA), Suggested Riprap Stone Sizes.
16. Commonwealth of Pennsylvania, Department of Environmental Protection, Erosion and Sediment Control Manual, 2000.

ASSUMPTIONS

Contained in body of calculation.

CONCLUSIONS AND RESULTS

The storm water management system for the site meets the requirements of Alameda County Flood Control and Water Conservation District Hydrology Manual and the Alameda Countywide Clean Water Program (ACCWP), Provision C.3 Stormwater Technical Guidance.

TABLE OF CONTENTS

TITLE	PAGE
PROJECT DESIGN CRITERIA FOR STORM WATER MANAGEMENT	5
1. Flood Control	5
2. Storm Water Management	5
STORMWATER DRAINAGE CALCULATION	7
1. Location	7
2. General Approach	7
3. Site Soils	7
4. Drainage Areas	7
5. Modified Rational Runoff Coefficients, C'	7
6. Time of Concentration	8
7. Rainfall Intensity	8
8. Peak Runoff Rate	8
STORM DRAIN SYSTEM CALCULATIONS	8
1. Storm Drain System	8
2. Permanent Channel Design	10
A. Diversion Channels	10
B. Channel A	12
3. Culvert Design	14
4. Riprap Outlet Protection	14
CONCLUSIONS	15

LIST OF ATTACHMENTS

A. Final Site Grading and Drainage Plan (RC-GEN-DE-C1-0001)
B. Documents Received from Alameda County
C. Surfacing Plan (RC-GEN-DE-C1-0002)
D. Site Soils Map
E. Tributary Drainage Areas
F. Runoff Coefficient C Calculation
G. Peak Flow Q Calculation by the Modified Rational Method
H. StormCAD Summary Reports
I. Storm Drainage System Catch Basin and Pipe Schedule
J. Mitigation of Excess Runoff
K. Permanent Channel Design Calculations
L. Culvert Design Calculation Reports
M. East Bay Dischargers Association Easement Information
N. Riprap Outlet Protection Calculations

PROJECT DESIGN CRITERIA FOR STORM WATER MANAGEMENT

1. Flood Control:

   A. According to the FIRM maps, (Reference 1), the southwest portion of the site falls within a flood zone, Zone A1. The base flood elevation (also called the 100-yr flood) is seven (7) feet above mean sea level (MSL) in the vicinity of the project site. From Reference 4, Chapter 9, Article 4, Flood Plain Management, Section 9.-4.110, for Zone A, the lowest floor shall be elevated to a level at or above the base flood elevation. From Reference 5, Article III, Permit Standards for Floodplain Management, the lowest floor shall be at least one foot above the base flood elevation.

   The finished floor for all structures shall be set at elevation +10.0 ft. and the site will be graded at a minimum slope of 0.5%, where appropriate.

2. Storm Water Management:

   A. The storm water drainage system for the Russell City Energy Center will be designed consistent with the requirements of Alameda County, California, the Alameda County Hydrology and Hydraulics Manual (Reference 6). All the runoff from the project site will drain to the Hayward Outfall Channel (Line E) mainly by the proposed stormwater facilities (Attachment B, District Drawing H-12). This is a primary facility as designated by the District located in Zone 4 (Attachment B).

   For primary facilities, the following guidelines for the design storm shall be followed as required by the District (Reference 6):

   - No outflow: All zones. All lines subject to tidal backwater effects and covered by the FEMA study.
   - 5-Year Storm: All zones. All lines near the bay subject to tidal backwater effects.
   - 15-Year Storm: All zones except zone 12. For all drainage areas up to ten square miles.
   - FEMA 100-Year Storm: All zones. For all reached of the flood control system covered by the FEMA flood insurance study. The flows to be used in design are found in the Flood Insurance Study for the particular line.

   B. The 'Modified Rational Method', as implemented by the District, is the recommended method for determining peak discharge from drainage areas of less than 640 acres.

   C. A detention facility may be required to limit the augmented discharge from the project site. The discharge shall be controlled by the outlet works such that the predetermined discharge rate (pre-existing conditions) from the detention facility and the peak flow in the receiving facility are not exceeded. Several types of detention facilities are acceptable to the District for controlling on-site augmented storm discharge such as parking lot detention, conduit storage, channel storage, and multi-purpose facilities. Due to the lack of space to construct a detention pond for the Russell City site, the excess post-development stormwater discharge will be controlled by conduit and channel storage.

   D. Culverts/Channels:

- Minimum velocities:

  Earth Channels: 2.0 ft/sec
  Concrete Lined Channels: 2.0 ft/sec
  Closed Conduits: 3.0 ft/sec

- Maximum Velocities:

  Earth Channels: 6.0 ft/sec
  Concrete Lined Channels: 14.0 ft/sec
  Closed Conduits: 14.0 ft/sec

- Minimum Slope:

  Earth Channels: 0.0007 ft/ft
  Concrete Lined Channels: 0.0007 ft/ft
  Closed Conduits: 0.0007 ft/ft

- Minimum pipe size shall be 12 inches in diameter.
- Minimum bottom width for open channels and boxes shall be four (4) feet for earth sections and six feet for concrete sections whenever possible.
- Maximum EGL elevation shall be below the top of bank in channels and below ground in closed conduit systems wherever possible.
- Manhole spacing for underground conduits shall not exceed 400 feet on center.
- The ratio of side slope for earth channels shall be no steeper than two and one half (2 1/2) horizontal units to one (1) vertical unit.

F. Freeboard Requirements:

Facility	Freeboard	From Design HGL up to:
Closed Conduits	1.25 ft	Top of Curb
Non-Leveed Channels		
District Design Storm	1.00 ft	Top of Bank
FEMA Q(100)	0.00 ft	Top of Bank
Retention/Detention Pond	1.00 ft	Top of Ground

G. From Reference 6, a modified runoff coefficient, C' is to be used in the design of the project site.

H. Time of concentration (Tc) is calculated using methods from Reference 6 based on the length and slope of the flow path and the land cover of the area. The time of concentration will be calculated using Equation 1-2 for *undeveloped watersheds* given in Reference 6.

$Tc = L / 60 V$ where,

Tc = Time of concentration in minutes

L = Overland flow length in feet

V = Overland flow velocity in feet per second, from Figure 4, page 28 (Ref. 6).

A five (5) minute minimum time of concentration is used.

The urbanized watershed figures will not be used to calculate the Tc since this does not apply to the project site.

STORMWATER DRAINAGE CALCULATION

1. Location

   The site for the proposed Russell City Energy Center is located in Alameda County, California, north of State Highway 92 between Depot Road and Enterprise Road on various parcels. The proposed plant facilities will envelop approximately 15.5 acres. A general arrangement of the proposed plant area is shown in Attachment A.

2. General Approach

   Design the site grading to have a minimum slope of 0.5% in the paved areas and a minimum slope of 1% in the unpaved areas in accordance with Reference 4, Section 10-8.33e(3). The Calpine design guidelines (Reference 8) state that site grading will comply with applicable land development regulations. Using the grading as shown on Attachment A, determine the tributary area to each inlet. The tributary areas are shown on Attachment E. Design the storm sewer to have a minimum pipe slope of 0.0007 ft/ft (Reference 6) to minimize the trench depth.

3. Site Soils

   According to Soil Survey of Western Alameda County, California, (Reference 9), the soils within the limits of the project property are described as Reyes Clay (Map Unit Symbol 139) and the hydrologic soil group (HSG) as given in Reference 9 for this soil series is classified as HSG D. A site soils map and the hydrologic group table are given in Attachment D.

4. Drainage Areas

   Measure drainage area tributary to individual storm drain system components (see Attachment E).

5. Modified Rational Runoff Coefficients, C'

   In Reference 6, a formula is given for the calculation of runoff coefficients, which incorporates the slope and the rainfall intensity factor. However, the modified C' will never exceed 0.80 when calculations are based on land use rather than type of surface. Therefore, runoff coefficients for the project site were taken from Reference 10, Table 7-10. This table is given in Attachment F.

   <u>Impervious (pavement, roof, and concrete):</u> C = 0.95
   Table 7-10, upper end of Pavement

   <u>Gravel:</u> C = 0.65
   Table 7-10, average for Industrial – Light

Grass: C = 0.20
Table 7-10, upper end for Lawns

The composite runoff coefficient for each tributary area is calculated and presented in Attachment F.

6. Time of Concentration

A minimum Time of Concentration, Tc = 5 minutes, is used for all sub-areas for all drainage structures except for catch basin # 19, the diversion channel(s) and Channel A. The time of concentration is 11.35 minutes, 29 minutes, and 47 minutes for catch basin # 19, the diversion channel(s), and Channel A, respectively.

7. Rainfall Intensity

The 15- and 100-year Intensity-Duration-Frequency curves from Reference 6 were entered in StormCAD as shown in Attachment H.

The average mean annual precipitation (MAP) is 17 inches for the watershed from the isohyetal map (Reference 6).

Example, for Tc = 5 minutes:

$Ix = I_{15} = 0.15\ h^{-1}$ (from Reference 6, Unit Frequency-Duration Curves)

$Ix = I_{100} = 0.20\ h^{-1}$ (from Reference 6, Unit Frequency-Duration Curves)

$i_{15} = I_{15} \times MAP = 0.15 \times 17\ in = 2.55\ in$

$i_{100} = I_{100} \times MAP = 0.20 \times 17\ in = 3.40\ in$

8. Peak Runoff Rate

Utilize the Modified Rational formula to compute peak storm runoff rate, where

$$Q_p = C'IA$$

The peak flows, which are collected into catch basins in the sub-drainage areas, are calculated and shown in Attachment G.

STORM DRAIN SYSTEM CALCULATION

1. Storm Drain System

Haestad Methods "StormCAD" (Reference 11) is used to calculate pipe capacities. StormCAD Summary Reports and profiles for the storm drainage pipes are presented in Attachment H, which provides additional pertinent computed hydraulic data. The average velocities in the pipes at design flow are less than 14 feet per second for the 15-year and 100-yr design storm. The head difference between the site grades and the base flood elevation is very low; therefore, the average velocities are less than the preferred 3 ft/s. More maintenance will be required if the sediment builds up in the pipes over time.

The capacity of the storm drain system is adequate for both the design storm (15-year) and check storm (100-year) peak flows given in Attachment H. The pipe and catch basin schedule is given in Attachment I.

Using information received from the Alameda County Public Works department (Attachment B), the flow for the 15-yr discharge in the Hayward Outfall Channel is 100 cfs at the end of Line E-3 (end of Enterprise Road) and 112 cfs at the end of Line E-2 (end of Depot Road). By interpolation, a flow of 107 cfs is assumed in calculating the tailwater for the stormwater system. The normal depth in this channel is calculated as 2.35 ft assuming a channel slope of 0.01 ft/ft and a roughness coefficient of 0.05 assuming vegetative growth. Using the gradually varied flow method, the tailwater elevation for the storm water system is 4.70' by adding the depth calculated at the upstream end of Channel A of 1.70' and the contour interval of 3'. (Attachment H). The same process is used for the 100-yr analysis and the tailwater elevation is 4.85'.

The Alameda County Flood Control and Water Conservation District also requires that the augmented storm runoff has to be mitigated if the development associated with a higher runoff coefficient is proposed.

Composite C (pre) = 0.60 (Attachment B)

Composite C (post) = 0.70 (Attachment J)

100-yr 24 hour storm, Px = P_{100} = 0.24 (from Reference 6, Figure 11)

0.24 x 17 in = 4.08 in

Volume(pre) = 4.08 in x 1 ft/12 in x 0.60 x 15.5 acres = 3.16 acre-ft

Volume(post) = 4.08 in x 1 ft/12 in x 0.70 x 15.5 acres = 3.69 acre-ft

Retain the post: Difference = post – pre = 3.69 – 3.16 acre-ft = 0.53 acre-ft = 23,087 ft^3

Volume in pipes = 7,931 ft^3 (Attachment J)

Volume stored in channel (Channel A):

Bottom width = 10'

Top width = 28' (3H:1V side slopes and a height of 3')

10'+28' / 2 = 19' x 3' = 57 ft^2

SAY Length = 321' 57 ft^2 x 321' = 18,297 ft^3

Length is measured from the east boundary of the EBDA easement and the junction of Diversion Channel C and Channel A.

Total Volume = 18,297 ft^3 + 7,931 ft^3 = 26,228 ft^3

There is sufficient volume in the storm system and the open channel to contain the 100-yr, 24-hr storm.

2. Permanent Channel Design

All channels are designed using Flowmaster (Reference 12) and the calculations are given in Attachments K.

In accordance with Reference 6, all channels should be designed to carry the peak flow from the 15-yr and the 100-yr storm. For the 15-yr, the freeboard required is one (1) foot and for the 100-yr storm it is zero feet from the design hydraulic grade line (HGL) up to the bank. The design velocities for channels should not exceed the permissible velocity and the permissible unit shear stress for the type of lining used. According to Reference 6, the Manning's "n" for all earth (smooth geometric) channels is 0.030 minimum. Erosion-control blankets (such as jute matting) will be required to protect new-growth vegetation so it will not be removed by storm flows before the vegetation can become established. From Reference 6, the Manning "n" for these linings will be determined according to manufacturer's specifications, however, they are taken directly from the material library in the Flowmaster software. The permissible unit shear stress is taken from Reference 12 and is also given in Attachment K.

A. Diversion Channels

Diversion Channel (A)

A channel will be required to divert the existing run-on onto the project site. After reviewing the adjacent topography, a watershed area of approximately 35 acres is draining to the project site. The total runoff is calculated using a time of concentration of 29 minutes and a rational runoff coefficient of 0.8 (heavy industrial). The designated watershed map is given in Attachment K.

Time of Concentration Calculation:

Tc = L/60V

Tc =Time of Concentration in minutes	28.3
L = Overland Flow Length in feet	2461
V =Overland Flow Velocity in feet per second, Reference 6, Figure 4, page 28	1.45

SAY 29 minutes

Additionally, part of the project site will also drain to this channel. The watershed area is approximately 1.20 and 0.39 acres for the north and south channel, respectively, with the sub-areas as following:

	North	South
Impervious, C = 0.95:	0.140	0.155 acres
Gravel, C = 0.65:	0 acres	0.235 acres
Grass, C = 0.20:	1.06 acres	0 acres
Watershed, C = 0.80:	35 acres	35 acres
Composite C:	0.78	0.80

Peak Flow (T_C = 29 minutes)

$I_{15} = 0.065h^{-1}$ Q_{15}: 31.2 cfs **31.3 cfs**

$I_{100} = 0.085h^{-1}$ Q_{100}: 40.8 cfs **40.9 cfs**

Since the peak flows for the north and south sections are very close in value, use the maximum flows for simplicity.

Assume a trapezoidal shape:

Slope:	0.004 ft/ft
Side slopes:	2.5H:1V
Bottom Width (min):	4.0 feet
Lining:	grass cover with jute matting (n = 0.022)
Manning "n":	0.03, normal depth(15) = 1.41 ft normal depth (100) = 1.61 ft
	0.05, normal depth(15) = 1.81 ft normal depth (100) = 2.06 ft
Freeboard Required:	15-yr storm – 1 ft 100-yr storm – 0 ft

Design as a grass-lined trapezoidal channel with b = 4', d = 3' and 2.5:1 slopes. Use jute net for the temporary lining.

Diversion Channel (B)

The diversion channel will run along the eastern and northern boundary of the project site and the channel cross-section will be consistent throughout. However, for a small channel run for about 100 feet along the eastern boundary of the "Eash" parcel, the channel section width is reduced two feet and the side slopes are 2H:1V due to limitation on the space in this area.

Assume a trapezoidal shape:

Slope:	0.004 ft/ft
Side slopes:	2H:1V
Bottom Width (min):	2.0 feet
Lining:	grass cover with jute matting (n = 0.022)
Manning "n":	0.03, normal depth(15) = 1.79 ft normal depth (100) = 2.02 ft
	0.05, normal depth(15) = 2.25 ft normal depth (100) = 2.53 ft
Freeboard Required:	15-yr storm – 1 ft 100-yr storm – 0 ft

Design as a grass-lined trapezoidal channel with b = 2', d = 3.5' and 2:1 slopes. Use jute net for the temporary lining.

Diversion Channel (C)

The diversion channel will continue along northern boundary of the project site into Channel B. The slope for this part of the channel will be the minimum required 0.0007 ft/ft due to invert

constraints. The minimum velocity requirement is not met and maintenance will be needed to provide adequate depth for the channel. Due to the low velocities, a temporary lining will not be required, however it is recommended to use a lining before vegetation is established.

Assume a trapezoidal shape:

Slope:	0.0007 ft/ft
Side slopes:	2.5H:1V
Bottom Width (min):	4.0 feet
Lining:	grass cover with jute matting (n = 0.022)
Manning "n":	0.03, normal depth(15) = 2.15 ft normal depth (100) = 2.43 ft
	0.05, normal depth(15) = 2.72 ft normal depth (100) = 3.07 ft
Freeboard Required:	15-yr storm – 1 ft 100-yr storm – 0 ft

Design as a grass-lined trapezoidal channel with b = 4', d = 3.7' and 2.5:1 slopes. Use jute net for the temporary lining.

B. Channel A

A channel will be located on the northern end of the RCEC site. This channel will drain all the water from the entire site, including the flow from the stormwater system and the flow from the diversion channels into the Hayward Outfall Channel.

The total area that the channel will drain is:

Watershed, C = 0.80:	35 acres
Site, C = 0.70:	15.5 acres (see Attachment J, Post-Development)
Composite C:	0.77

Time of Concentration Calculation:

The time of concentration is 29 minutes for the diversion channels. Additionally, the time to get around the channel system is calculated as follows:

Tc = L/60V

Tc =Time of Concentration in minutes	17.9	Say 18 minutes
L = Overland Flow Length in feet	1131	
V =Overland Flow Velocity in feet per second, Grassed Waterway, Reference 6, Figure 4, page 28	1.05	

Total Tc = 29 + 18 = <u>47 minutes</u>

Peak Flow (T_C = 47 min)

$Ix = I_{15} = 0.049\ h^{-1}$ (from Reference 6, Unit Frequency-Duration Curves)

$Ix = I_{100} = 0.065\ h^{-1}$ (from Reference 6, Unit Frequency-Duration Curves)

$i_{15} = I_{15} \times MAP = 0.049\ h^{-1} \times 17\ in = 0.84\ in/hr$

$i_{100} = I_{100} \times MAP = 0.065\ h^{-1} \times 17\ in = 1.11\ in/hr$

Q_{15} = 50.5 acres x 0.84 in/hr x 0.77 = **32.67 cfs**

Q_{100} = 50.5 acres x 1.11 in/hr x 0.77 = **43.17 cfs**

This channel is designed as a vegetated swale according to the requirements of the ACCWP Section 6.1 (Reference 7). This channel is designed to treat the runoff through sedimentation filtering by the vegetation in the channel, filtering through a subsoil matrix, or infiltration into the underlying soils as approved by the ACCWP. The runoff from the impervious area of the site is required to be treated.

In the requirements, it is stated that a single swale cannot treat areas greater than 10 acres. The total area that is draining to the diversion channels is about 36.6 acres; however the diversion channel will have vegetation, which will treat the runoff before it reaches Channel A. The total area from the site (excluding the off-site run-on) draining to Channel A is about 13.9 acres. Although, the maximum area of 10 acres is exceeded, part of the water will travel over gravel and grass surfaced areas before reaching the catch basins and will also be treated.

The swale is to have a treatment size of at least 4% of the impervious surface area of the site. The impervious site area is 6.03 acres (see Attachment J, Post-Development) and 4% of this is equal to 0.24 ac (10,507 ft^2). The area of the channel at the maximum water treatment depth of 4" is approximately 3,210 ft^2.

However, during the plant operation, the day-to-day activities will be managed by the operational SWPPP. The vehicular traffic on the site will be minimal and the oil leaked from cars will be minimal (see limited parking spaces shown in Attachment A). There will be containment for oil onsite. Additionally, each inlet will have a drain insert to reduce any trash or sediment from traveling through the storm water system. The site does not have high oil and grease concentrations as other sites may have. Therefore, maximizing the treatment size to accommodate the entire impervious area may be unnecessary.

Slope:	0.0025 ft/ft
Side slopes:	3H:1V
Bottom Width (min):	10.0 feet
Lining:	grass cover with jute matting (n = 0.022)
Manning "n":	0.03, normal depth(15) = 1.10 ft normal depth (100) = 1.28 ft
	0.05, normal depth(15) = 1.45 ft normal depth (100) = 1.68 ft
Freeboard Required:	15-yr storm – 1 ft 100-yr storm – 0 ft

Design as a grass-lined trapezoidal channel with b = 10', d = 3' and 3:1 slopes. Use jute net for the temporary lining.

There is an easement for a 60" Force Main that runs through the project site, which is controlled by the East Bay Dischargers Authority. Channel A will intersect this easement at the north-west end of the site where it discharges into the Hayward Outfall Channel. From Drawing 5, 'Force Main between Hayward and Alvarado', the top of the pipe is at approximate elevation 100'. This elevation is based on mean sea level datum 1929 (adj.) plus 100 feet. According to Reference 6, Figure 12, the mean sea level is 0.00 (Attachment M). The invert of the channel is at least 3' above the pipe and therefore is not a design concern.

3. Culvert Design

Culverts will be required to carry the flow from the diversion channels to Channel A. Haestad Methods "Culvertmaster" (Reference 14) Calculation Reports are presented in Attachment L, which give additional pertinent computed hydraulic data. Based on the culvert analysis, the headwater elevations are less than maximum allowable elevations, hence the proposed culverts have adequate capacities to discharge the design flows without overtopping the roadways. The velocities at the design flows for the culverts exceed 3 fps. See Table 1 for dimensions.

Table 1 – Culvert Data (15-yr)

Culvert	Size (in)	# of Sections	Material	Upstream Invert (ft)	Downstream Invert (ft)	Length (ft)	Allowable HW (ft)	Computed HW (ft)	Discharge (cfs)	Velocity (fps)
C-1	36	1	SLPE	3.79	3.70	100	9.0	7.35	31.3	4.43
C-2	36	1	SLPE	3.70	3.63	70	8.0	6.71	31.3	5.50
C-3	36	1	SLPE	3.26	3.23	30	8.0	6.50	31.3	4.65

4. Riprap Outlet Protection

Riprap outlet protection will be required at the downstream end of pipe P-21 (outfall into Channel A) and the downstream ends of culverts C-2 and C-3. The required stone size and thickness are given in Table 2 below. The riprap stone sizes are taken from Reference 15 (Attachment N) and the thickness is calculated as 1.5 times the maximum rock diameter. The dimensions of the apron are determined from Reference 16, Figure 22 (Attachment N). All pipe diameters (d_0) are 36 inches (3 ft).

Table 2

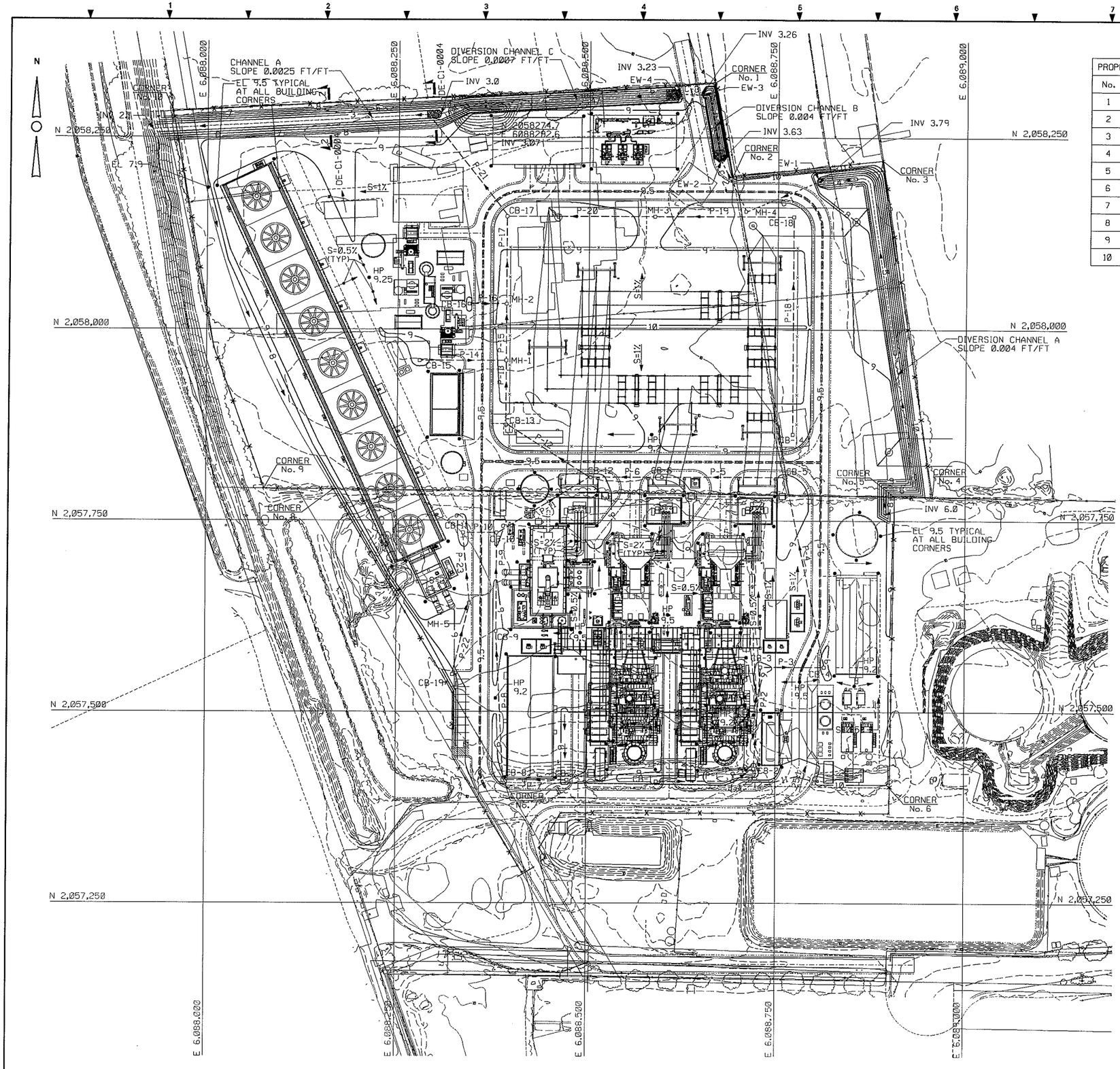
Culvert / Pipe	Discharge 15-yr (cfs)	Velocity 15-yr (fps)	Width (ft)	*Length (La) (ft)	Required Riprap Stone (NSA No.)	Thickness (in)
P-21	15.11	4.39	14.2	13'	R-3	9
C-2	31.3	5.50	14.2	13'	R-3	9
C-3	31.3	4.65	14.2	13'	R-3	9

*Apron Length is based on discharge (see Attachment N)

CONCLUSIONS AND RESULTS

The storm water management system for the site meets the requirements of Alameda County Flood Control and Water Conservation District Hydrology Manual and the Alameda Countywide Clean Water Program (ACCWP), Provision C.3 Stormwater Technical Guidance.

ATTACHMENT A



PROPERTY CORNER COORDINATE SCHEDULE		
No.	NORTH	EAST
1	2058321.5	6088667.5
2	2058199.4	6088690.1
3	2058220.4	6088888.1
4	2057781.1	6088956.2
5	2057781.8	6088905.8
6	2057401.0	6088901.2
7	2057407.2	6088394.3
8	2057790.8	6088166.8
9	2057791.9	6088076.5
10	2058283.4	6087954.3

LEGEND

- EXISTING GRADE CONTOUR
- FINAL GRADE CONTOUR
- 9.5 FINAL GRADE SPOT ELEVATION
- PROPOSED FENCE
- PROPOSED STORM DRAIN
- PROPOSED CULVERT
- PROPOSED STORM CATCH BASIN
- PROPOSED ENDWALL
- PROPOSED DRAINAGE CHANNEL
- DIRECTION OF FLOW

NOTES:

1. COORDINATES LISTED ARE STATE PLANE NAD83, CALIFORNIA ZONE 3.
2. DRAIN INSERTS SHALL BE USED FOR ALL CATH BASINS AND SHALL BE ACCORDING TO ULTRA DRAIN GUARD, OIL AND SEDIMENT MODEL, PART # 9225, OR EQUAL.

REFERENCES:

DC-G1-0001	GENERAL ARRANGEMENT SITE PLAN
DE-C1-0002	SITE SURFACING PLAN
DE-C1-0004	GRADING DETAILS
DE-C2-0002	DRAINAGE STRUCTURES
DE-C2-0001	CATCH BASIN AND PIPE SCHEDULE

60 0 60 120 180
SCALE IN FEET

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENGINEER	PROJECT ENGINEER	PROJECT MANAGER
A	11- -06	ISSUED FOR CLIENT REVIEW	GU	AM	DS	PK	DE

DRAWN BY GJU DATE 11- -06
CHECKED BY ALM DATE 11- -06
ENGINEER D SHETH DATE 11- -06
PROJECT ENGINEER P KHAN DATE 11- -06
PROJECT MANAGER DR ERALI DATE 11- -06

PROFESSIONAL ENGINEER STAMP

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA.

PRINT NAME PRADIP KHAN
SIGNATURE
DATE
LICENSE # 54262

ORIGINALLY PREPARED UNDER THE RESPONSIBLE SUPERVISION OF
PE#
LIC. NO.:
STATE:
DATE:

WorleyParsons

CALPINE

RUSSELL CITY ENERGY CENTER
HAYWARD, CALIFORNIA

CIVIL
GEN-GENERAL
FINAL SITE GRADING
AND DRAINAGE PLAN

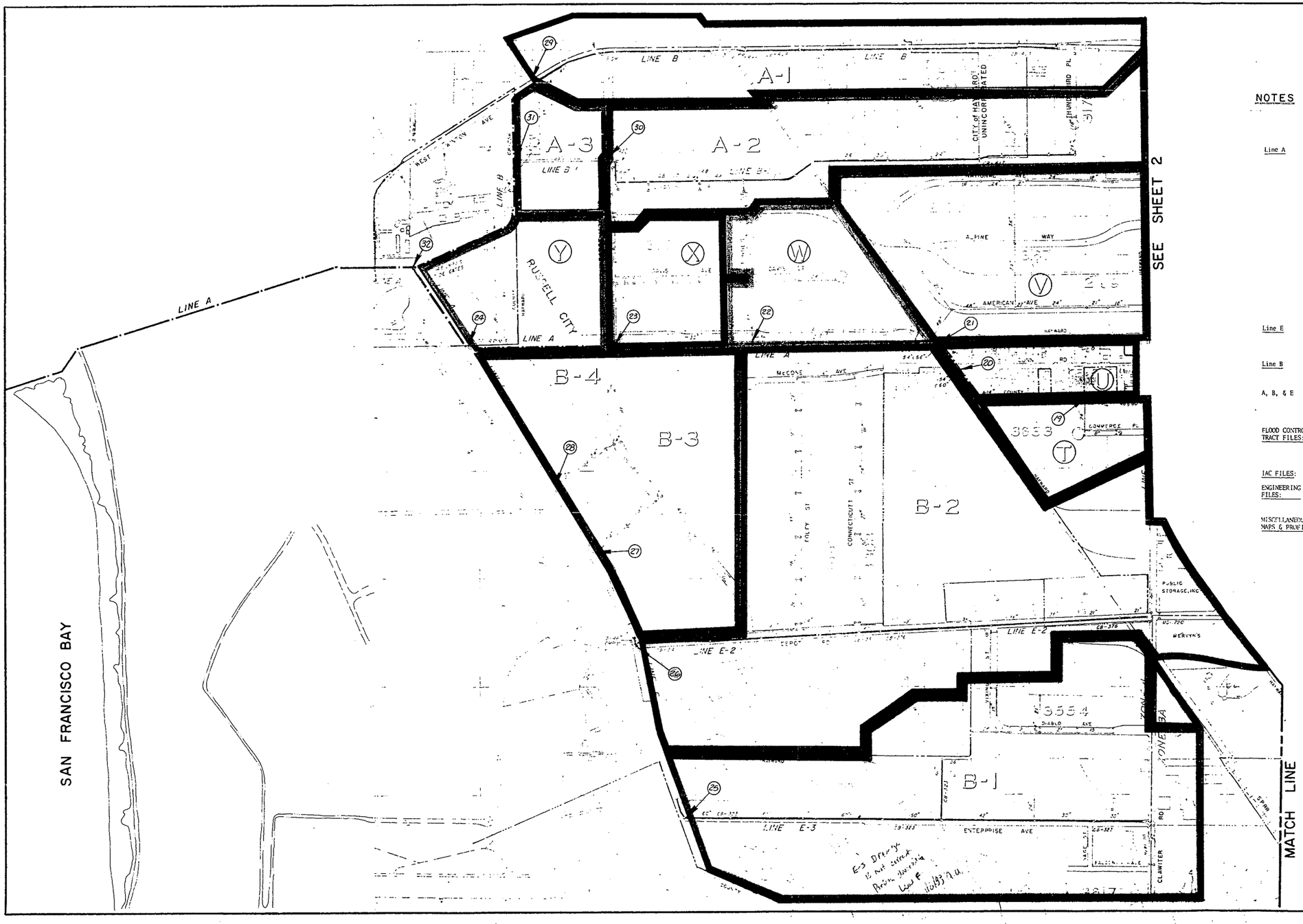
SCALE 1"=60'

DWG. NO. RC-GEN-DE-C1-0001 SHEET NO. 01 REVISION A

RCEC-024-DC-0001
A-1

FILE NAME:
PATH:
SERVER:
DWG-FILE: rc-gen-de-c1-0001.dgn
DWG-DATE: 01-Nov-06 10:38

ATTACHMENT B



NOTES

	Pt. of Conc.	C-Factor	Acres	Acres
Line A	1	.6	32.9	32.9
	2	.6	19.5	53.4
	3	.6	10.2	53.6
	4	.8	22.0	75.6
	5	.6	15.0	90.6
	6	.4	19.9	110.5
	7	.4	32.3	142.8
	8	.8	23.4	166.2
	9	.8	15.8	182.0
	10	.6	182.3	364.4
	11	.6	71.1	435.5
	12	.4	8.7	444.2
	13	.6	112.2	556.4
	14	.6	8.1	564.5
	15	.6	11.5	576.0
	16	.6	82.9	658.9
	17	.7	20.6	679.5
	18	.6	108.7	788.2
	19	.7	24.7	812.9
	20	.7	20.9	833.8
	21	.7	93.8	927.6
	22	.7	43.6	971.2
	23	.7	31.3	1002.5
	24	.7	40.3	1042.8
Line E	25	.6	196.3	196.3
	26	.6	285.5	481.8
	27	.6	77.3	559.1
	28	.6	25.0	584.1
Line B	29	.6	94.4	94.4
	30	.6	99.3	193.7
	31	.6	21.1	214.8
A, B, & E	32			1841.7

REFRENCES

	LINE A	LINE B	LINE E
FLOOD CONTROL TRACT FILES:	1407 2109 3110 3633 3640	3414	3308 3633
IAC FILES:	Chabot College		
ENGINEERING FILES:	E4-A.2 E4-A.3 E4-C.2	E4-B.2	
MISCELLANEOUS MAPS & PROFILES:	MB 250 MC 211, 231 MC 130 MC 80 P 382, 447, 503, 620, 507	P 462, 472	MC 211, 231 P 411 MC 1611

ALAMEDA COUNTY FLOOD CONTROL
AND
WATER CONSERVATION DISTRICT

ZONE NO. 4 PROJECT

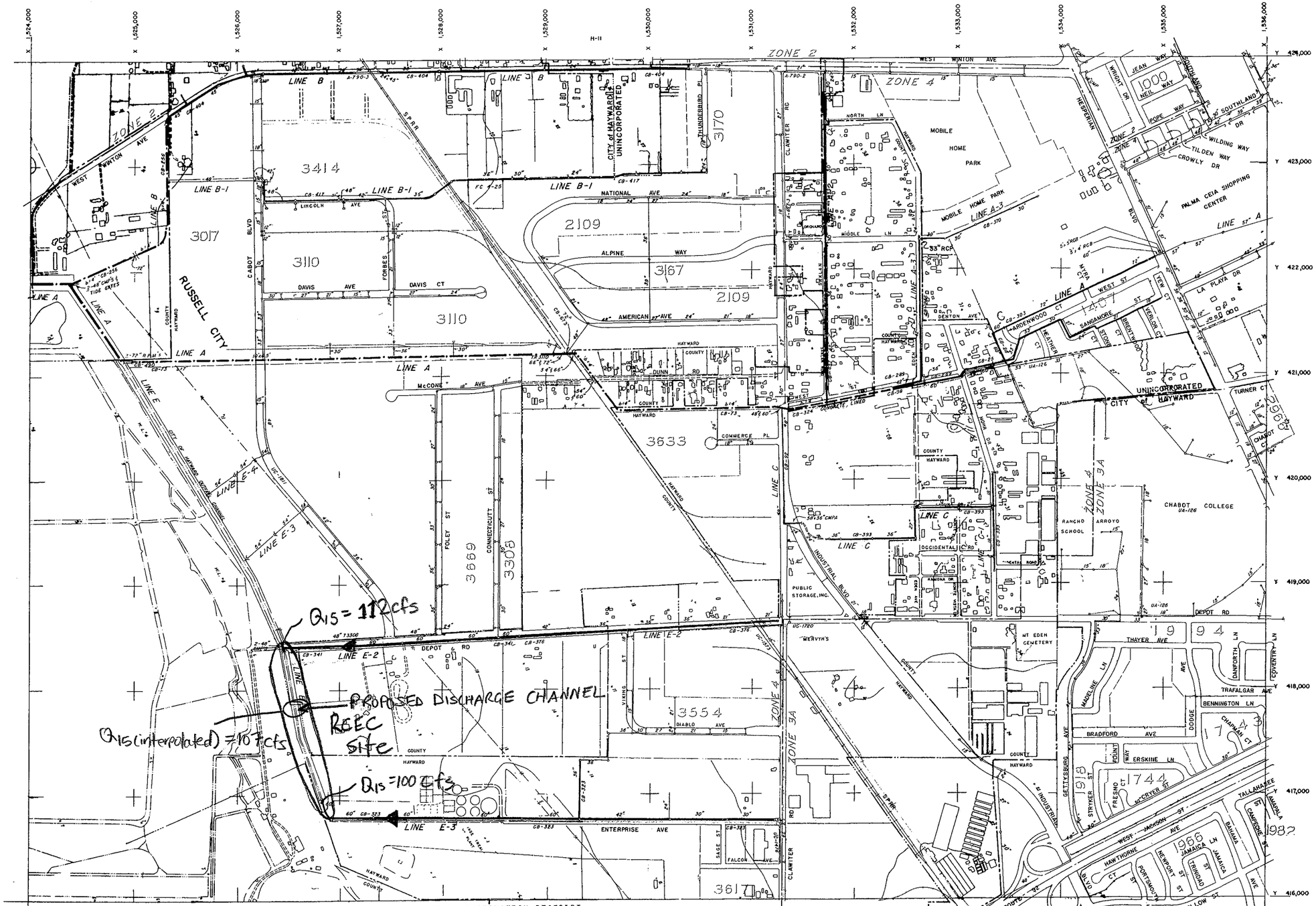
LINES A, B & E

DRAINAGE AREA MAP

DRAWN	DESIGNED	DATE	MARCH 1984
CHECKED		SCALE	1" = 400'
APVL. REC.		FILE NO.	MB-263
APPROVED		SHEET NO.	1 OF 2

RCEC-024-DC-0001

B-1



ALAMEDA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

This map has been prepared to show the general locations of various storm drainage and flood control facilities. The information shown on this drawing is compiled from limited data and this District assumes no responsibility or liability for the accuracy or completeness of the information shown hereon nor does this District assume responsibility for any use which is made of this map.

DISTRICT
- Conduit
- Open Conc Chan
- Open Earth Chan

OTHERS
- Conduit
- Open Conc Chan
- Open Earth Chan

RCEC-024-DC-0007
B-2

Dipti,

Thank you for your follow-up e-mail and thank you for your patience as well.

After our review of the contents of the Engineering file folder **FC4-18,** we did not find any drainage information that will be particularly useful and specifically relevant to your project site. Upon further research however, we would like to inform you that an Alameda County Flood Control District drainage area map drawing **MB-263** dated March 1984, were located that showed an adjusted runoff coefficient C-factor of 0.60 assigned to your project site.

In addition to the District **P-436** drawing dated January 1971, that was previously transmitted to you, which shows a 15-year design discharge of **112 CFS** for Line E-2 at the end of Depot Road, we would also like to inform you that as per District drawing **P-411** dated May 1969, a 15-year design discharge of **100 CFS** for Line E-3 at the end of Enterprise Avenue was calculated.

We trust that the above-mentioned hydrology information that were provided will be helpful in the storm drainage analysis and design of your project site. Please be reminded that if development associated with a higher runoff coefficient is to be proposed, the augmented storm runoff will have to be mitigated .

Should you have any questions or require any further clarification, you can either call or e-mail me.

Fernando B. Gonzales, P.E.
Associate Civil Engineer
Development Services Department
Alameda County Public Works Agency
Tel No. 510.670.5267
Fax No. 510.670.5269

From: Sheth, Dipti (Reading) [mailto:Dipti.Sheth@worleyparsons.com]
Sent: Wednesday, October 04, 2006 2:45 PM
To: Gonzales, Fernando
Subject: RE: Stormwater Management Information

Fernando,

Have you had any luck locating the FC4-18 record? Thanks.

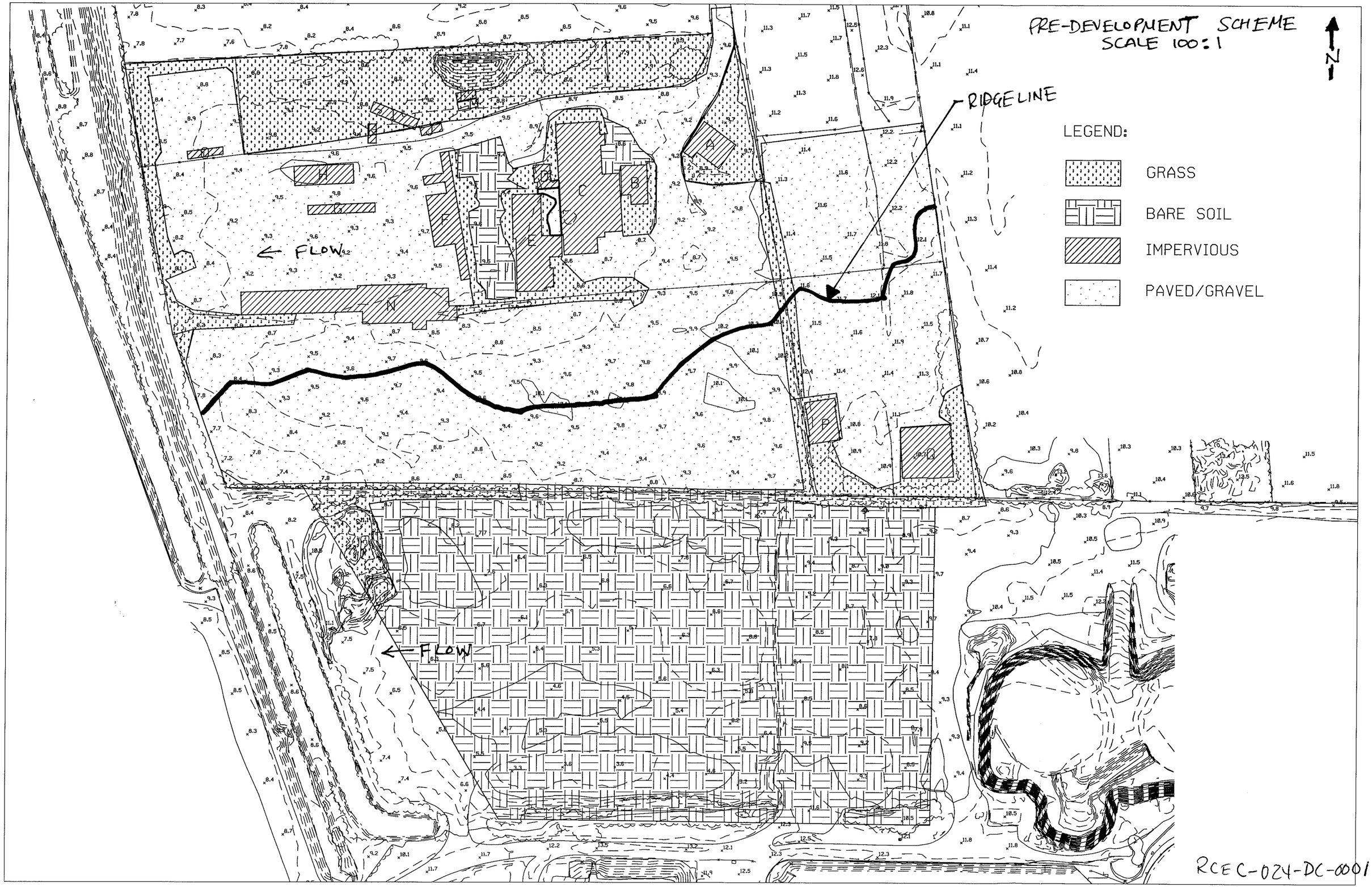
Dipti J. Sheth, E.I.T
Civil/Geotechnical Engineering
2675 Morgantown Road
Reading, PA 19607
Phone: 610-855-2781
Fax: 610-855-2727
Dipti.Sheth@WorleyParsons.com

From: Gonzales, Fernando [mailto:fernando@acpwa.org]
Sent: Monday, September 25, 2006 8:49 PM
To: Sheth, Dipti (Reading)
Cc: Aguiar, Gloria
Subject: RE: Stormwater Management Information

RCEC-024-DC-0001
B-3

Hi Dipti,

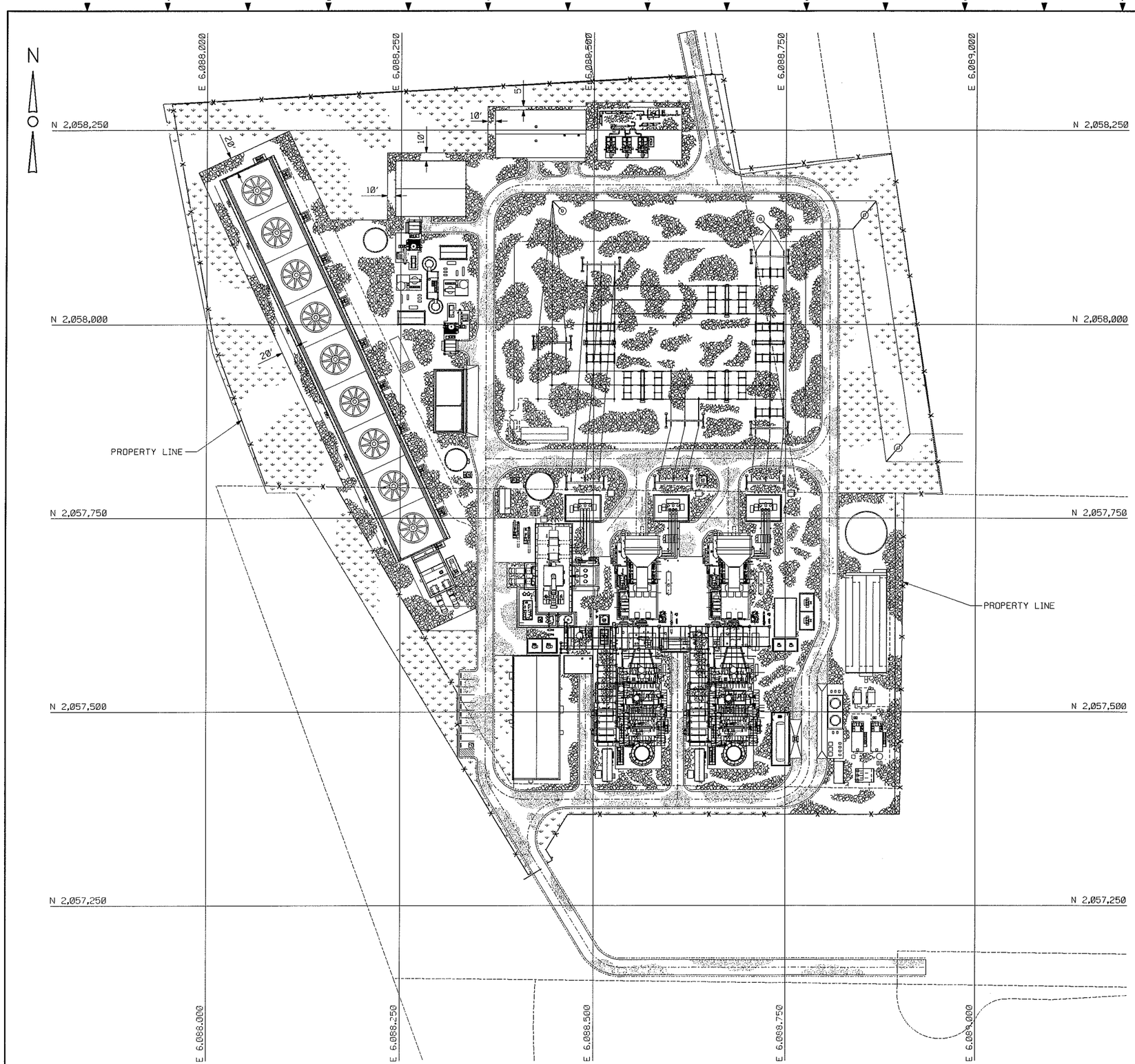
Enclosed please find for your information and reference, copy of the storm drainage **Base Map H-12** that shows the sizes and



RCEC-024-DC-0001

B-4

ATTACHMENT C



LEGEND

- AGGREGATE SURFACING
- CONCRETE SLAB
- BITUMINOUS PAVING
- GRASS

NOTES:

1. SURFACING IS BASED ON REVISION E OF THE GENERAL ARRANGEMENT DRAWING RC-GEN-DC-G1-0001.

REFERENCES:

DC-G1-0001	GENERAL ARRANGEMENT - SITE PLAN
DE-C1-0005	ROADWAY AND FENCE LOCATION - PLAN

60 0 60 120 180
SCALE IN FEET

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENGINEER	PROJECT ENGINEER	PROJECT MANAGER
A	11- -06	ISSUED FOR CLIENT REVIEW	GU	AM	DS	PK	DE

DRAWN BY GJU	DATE 11- -06
CHECKED BY ALM	DATE 11- -06
ENGINEER D SHETH	DATE 11- -06
PROJECT ENGINEER P KHAN	DATE 11- -06
PROJECT MANAGER DR ERALI	DATE 11- -06

PROFESSIONAL ENGINEER STAMP

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA.

PRINT NAME PRADIP KHAN
SIGNATURE
DATE
LICENSE # 54262

ORIGINALLY PREPARED UNDER THE RESPONSIBLE SUPERVISION OF
PE: STATE:
LIC. NO.: DATE:

WorleyParsons

CALPINE

RUSSELL CITY ENERGY CENTER
HAYWARD, CALIFORNIA

CIVIL
GEN-GENERAL
SITE SURFACING PLAN

SCALE 1"=60'

DWG. NO.	SHEET NO.	REVISION
RC-GEN-DE-C1-0002	01	A

FILE NAME:
PATH:
SERVER:

DWG-FILE: rc-gen-de-c1-0002.dgn
DWG-DATE: 01-Nov-06 07:10

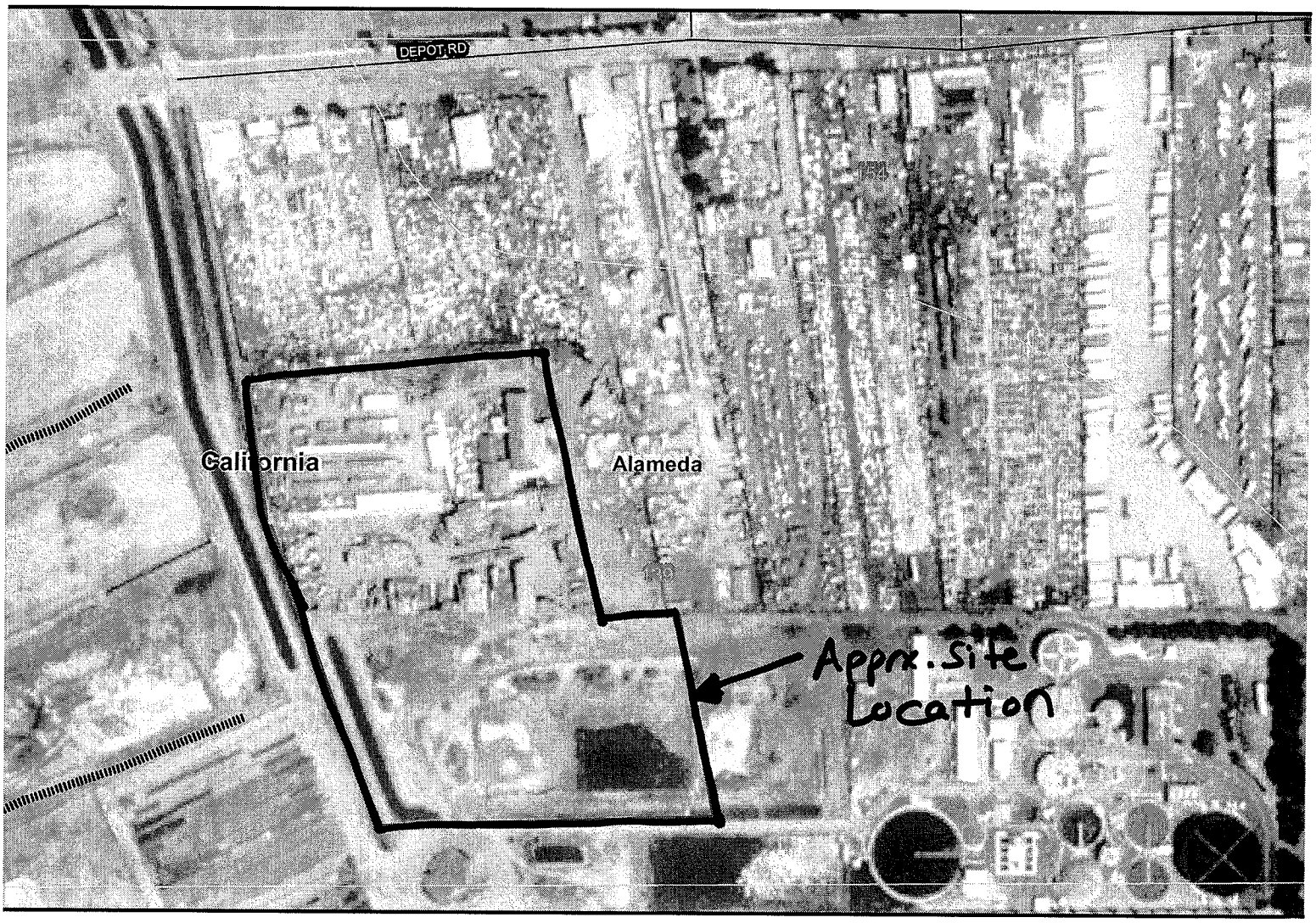
RCEC-024-DC-0001
C-1

VHL: Thu Jun 09 14:23:05 2005

ATTACHMENT D

SOIL SURVEY OF ALAMEDA COUNTY, CALIFORNIA, WESTERN PART

close-up russel city



Meters
0 40 80 160

Feet
0 100 200 400 600 800

Resources
tion Service

Web Soil Survey 1.1
National Cooperative Soil Survey

RCEC-024-DC-0001
D-1

SOIL SURVEY OF ALAMEDA COUNTY, CALIFORNIA, WESTERN PART

close-up russel city

MAP LEGEND

- Soil Map Units
- Cities
- Detailed Counties
- Detailed States
- Interstate Highways
- Roads
- Rails
- Water
- Hydrography
- Oceans
- Escarpment, bedrock
- Escarpment, non-bedrock
- Gulley
- Levee
- Slope
- Blowout
- Borrow Pit
- Clay Spot
- Depression, closed
- Eroded Spot
- Gravel Pit
- Gravelly Spot
- Gulley
- Lava Flow
- Landfill
- Marsh or Swamp
- Miscellaneous Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Slide or Slip
- Sinkhole
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Perennial Water
- Wet Spot

MAP INFORMATION

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov

Coordinate System: UTM Zone 10

Soil Survey Area: Alameda County, California, Western Part
Spatial Version of Data: 1
Soil Map Compilation Scale: 1:24000

Map comprised of aerial images photographed on these dates:
7/10/1993

The orthophoto or other base map on which the soil lines were compiled a digitized probably differs from the background imagery displayed on these As a result, some minor shifting of map unit boundaries may be evident.

RCEC-024-DC-0001
D-2

Map Unit Legend Summary

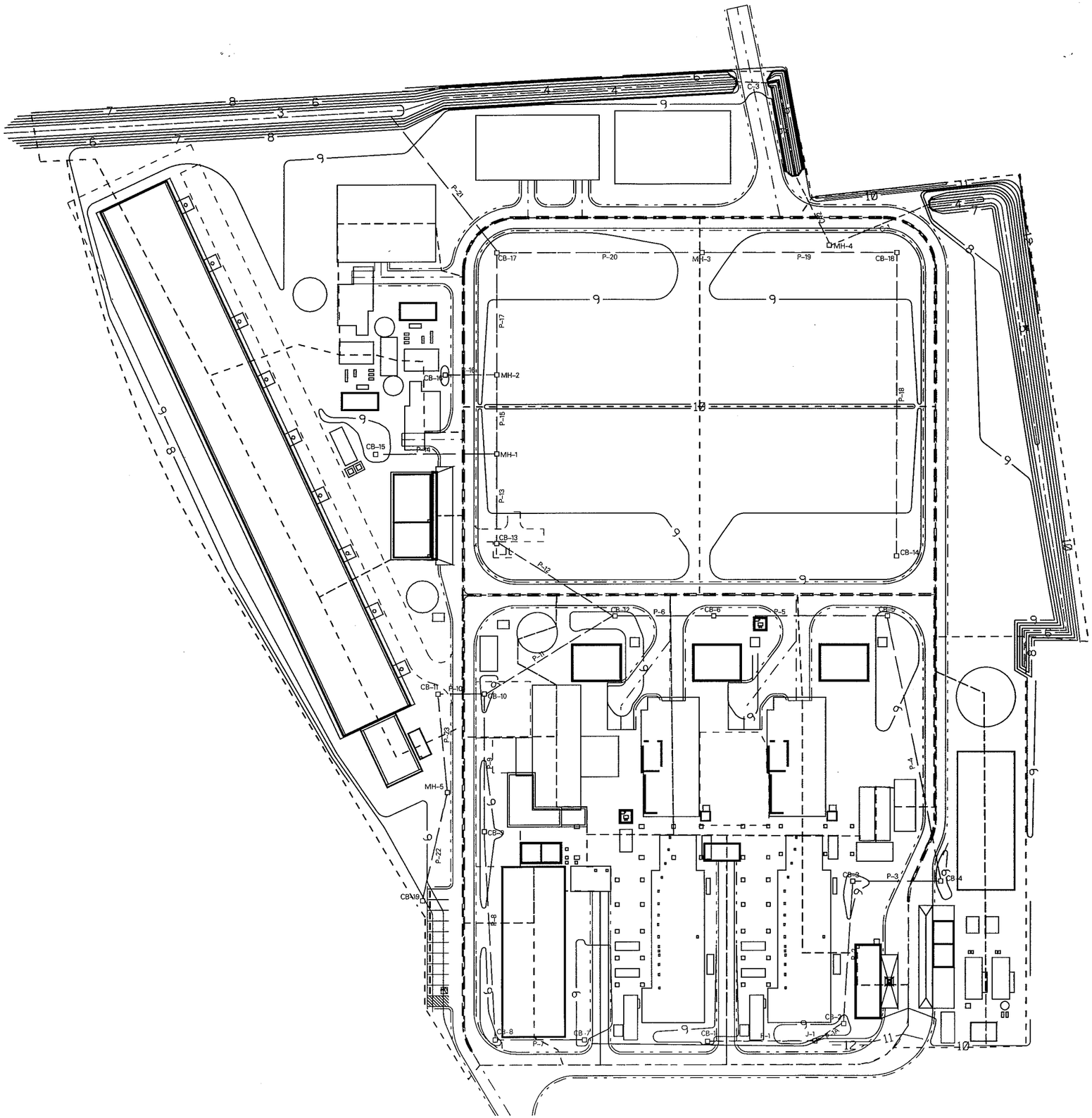
Alameda County, California, Western Part

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
139	Reyes clay, drained	74.0	76.1
154	Willows clay, drained	23.2	23.9

RCEC-024-DC-0001
D-3

ATTACHMENT E

TRIBUTARY AREAS
SCALE 100:1



RCEC-024-DC-0001
E-1

ATTACHMENT F

TABLE 7–10 Runoff Coefficients for the Rational Method

Description of Area	Range of Runoff Coefficients	Recommenc Value*
Business		
Downtown	0.70–0.95	0.85
Neighborhood	0.50–0.70	0.60
Residential		
Single-family	0.30–0.50	0.40
Multiunits, detached	0.40–0.60	0.50
Multiunits, attached	0.60–0.75	0.70
Residential (suburban)	0.25–0.40	0.35
Apartment	0.50–0.70	0.60
Industrial		
Light	0.50–0.80	0.65
Heavy	0.60–0.90	0.75
Parks, cemeteries	0.10–0.25	0.20
Playgrounds	0.20–0.35	0.30
Railroad yard	0.20–0.35	0.30
Unimproved	0.10–0.30	0.20

It is often desirable to develop a composite runoff coefficient based on the percentage of different types of surface in the drainage area. This procedure often is applied to typical "sample" block as a guide to selection of reasonable values of the coefficient for an entire area. Coefficients with respect to surface type currently in use are listed below.

Character of Surface	Range of Runoff Coefficients	Recommended Value*
Pavement		
Asphaltic and Concrete	0.70–0.95	0.85
Brick	0.75–0.85	0.80
Roofs	0.75–0.95	0.85
Lawns, sandy soil		
Flat, 2%	0.05–0.10	0.08
Average, 2 to 7%	0.10–0.15	0.13
Steep, 7%	0.15–0.20	0.18
Lawns, heavy soil		
Flat, 2%	0.13–0.17	0.15
Average, 2 to 7%	0.18–0.22	0.20
Steep, 7%	0.25–0.35	0.30

The coefficients in these two tabulations are applicable for storms of 5- to 10-year frequencies. Less frequent, higher intensity storms will require the use of higher coefficients because infiltration and other losses have a proportionally smaller effect on runoff. The coefficients are based on the assumption that the design storm does not occur when the ground surface is frozen.

*Recommended value not included in original source.

Source: Design and Construction of Sanitary and Storm Sewers, American Society of Civil Engineers, New York, p. 332, 1969.

RCEC-024-DC-0001
F-1

Project Russell City Energy Center
Job No. 53794801
Design Storm Frequency: 5-yr, 15-yr, and 100-yr

Date 10/17/2006
Computed DS
Reviewed KG

Runoff Coefficient C Calculation

Rational Runoff Coefficient (C) per the site cover condition:

Grass:	0.20
Gravel:	0.65
Impervious (Pavement, Roofs)	0.95

Sub-drainage No.	Areas							Composite C
	Total	Subtracted	Drainage		Impervious	Gravel	Grass	
	(SF)	(SF)	(SF)	(AC)	(SF)	(SF)	(SF)	
CB-1	26,010	0	26,010	0.597	15,233	10,778	0	0.83
CB-2	23,751	0	23,751	0.545	13,140	10,611	0	0.82
CB-3	14,679	0	14,679	0.337	8,708	5,972	0	0.83
CB-4	21,136	0	21,136	0.485	8,962	12,174	0	0.78
CB-5	26,883	0	26,883	0.617	10,599	16,285	0	0.77
CB-6	27,680	0	27,680	0.635	20,671	7,009	0	0.87
CB-7	10,417	0	10,417	0.239	6,680	3,737	0	0.84
CB-8	9,061	0	9,061	0.208	5,852	605	2,604	0.71
CB-9	16,794	0	16,794	0.386	13,094	3,700	0	0.88
CB-10	10,276	0	10,276	0.236	7,810	2,466	0	0.88
CB-11	18,488	0	18,488	0.424	10,150	8,338	0	0.81
CB-12	25,236	0	25,236	0.579	13,769	11,467	0	0.81
CB-13	38,916	0	38,916	0.893	5,448	33,468	0	0.69
CB-14	38,916	0	38,916	0.893	4,433	34,483	0	0.68
CB-15	35,696	0	35,696	0.819	18,857	16,839	0	0.81
CB-16	16,198	0	16,198	0.372	10,587	5,610	0	0.85
CB-17	38,916	0	38,916	0.893	4,433	34,483	0	0.68
CB-18	38,916	0	38,916	0.893	4,433	34,483	0	0.68
CB-19	68,609	0	68,609	1.575	27,209	23,584	17,816	0.65
SUM (A)			506,579	11.63	210,066	276,093	20,420	

RCEC-024-DC-0001
F-2

ATTACHMENT G

Project	Russell City Energy Center	Date	10/17/2006
Job No.	53794801	Computed	DS
Design Storm Frequency: 5, 15, 100-yr.		Reviewed	KG

Peak Flow Calculation by Rational Method

5 Minute Duration Rainfall Intensity per Storm Frequency:

Frequency	5-yr	15-yr	100-yr
Intensity	1.96	2.55	3.40

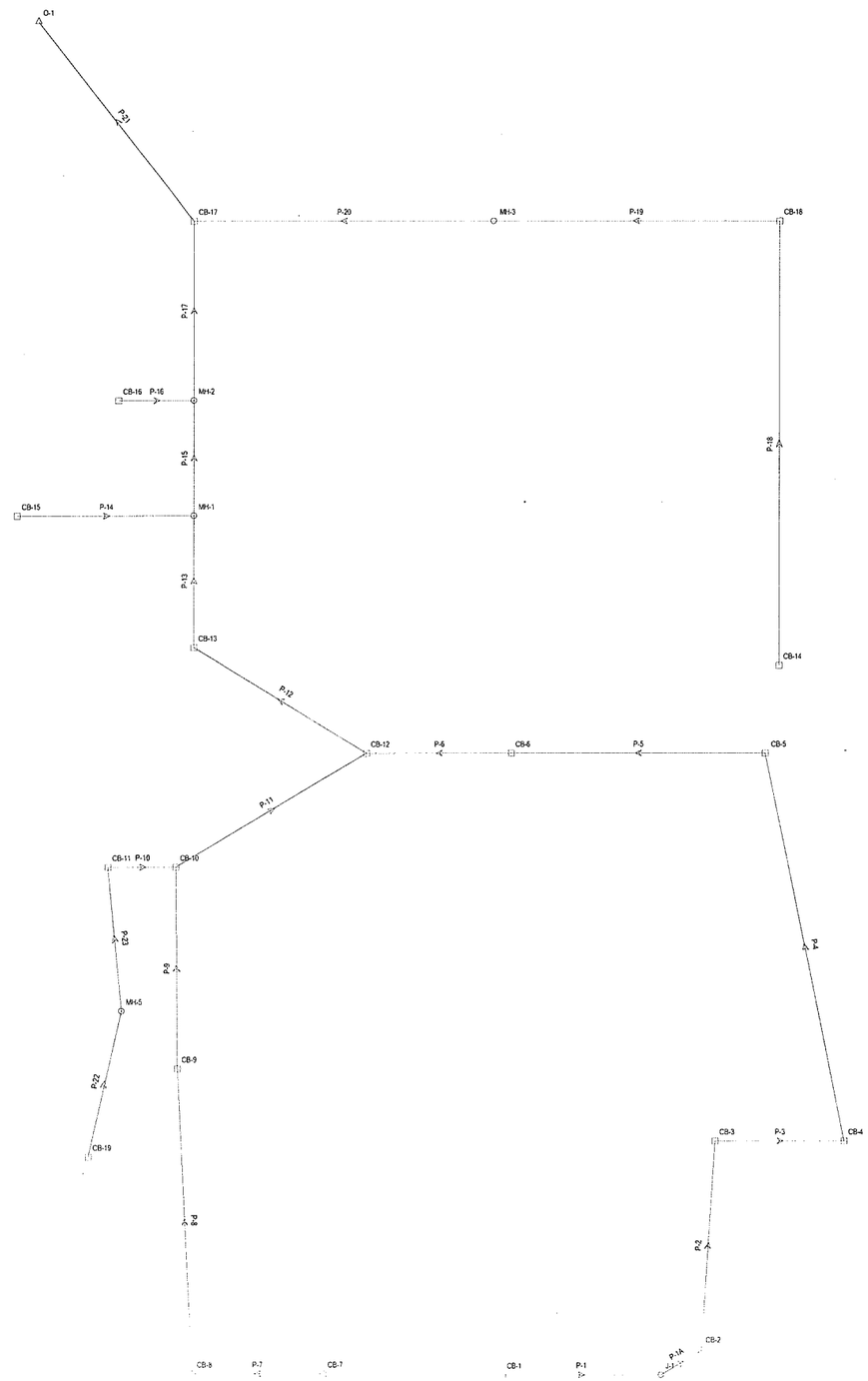
Sub-Area No.	Drainage Area	Composite C	Peak Flow			
			5-yr	15-yr	100-yr	
	(AC)		(CFS)	(CFS)	(CFS)	
CB-1	0.597	0.83	0.96	1.26	1.68	
CB-2	0.545	0.82	0.87	1.13	1.51	
CB-3	0.337	0.83	0.55	0.71	0.95	
CB-4	0.485	0.78	0.74	0.96	1.28	
CB-5	0.617	0.77	0.93	1.21	1.61	
CB-6	0.635	0.87	1.09	1.42	1.89	
CB-7	0.239	0.84	0.39	0.51	0.68	
CB-8	0.208	0.71	0.29	0.38	0.51	
CB-9	0.386	0.88	0.67	0.87	1.16	
CB-10	0.236	0.88	0.40	0.53	0.70	
CB-11	0.424	0.81	0.68	0.88	1.18	
CB-12	0.579	0.81	0.92	1.20	1.60	
CB-13	0.893	0.69	1.21	1.58	2.10	
CB-14	0.893	0.68	1.19	1.56	2.08	
CB-15	0.819	0.81	1.30	1.69	2.25	
CB-16	0.372	0.85	0.62	0.80	1.07	
CB-17	0.893	0.68	1.19	1.56	2.08	
CB-18	0.893	0.68	1.19	1.56	2.08	
*CB-19	1.575	0.65	1.40	1.75	2.44	Tc = 11.35 min

Note:
1) For CB-19, the minimum time of concentration is 11.35 minutes.

RCEC-024-DC-0001
9-1

ATTACHMENT H

Scenario: Base



RCEC-024-DC-0001
H-1

Title: Russell City Energy Center
r:\...\stormcad\stormsystem-15.stm
11/09/06 02:13:10 PM

© Bentley Systems, Inc. Haestad Methods Solution Center Watertown, CT 06795 USA +1-203-755-1666

Project Engineer: Dipti Sheth
StormCAD v5.6 [05.06.012.00]

Rainfall Table

Return Periods			
Durations	5 year	15 year	100 year
5 min	1.96	2.55	3.40
10 min	1.39	1.96	2.55
30 min	0.80	1.05	1.45
60 min	0.56	0.75	1.02

Rainfall Intensities are in (in/hr)

RCEC-024-DC-0001
H-2

Calculation Results Summary

15-YR

==========
Scenario: Base

>>>> Info: Subsurface Network Rooted by: O-1
>>>> Info: Subsurface Analysis iterations: 2
>>>> Info: Convergence was achieved.

CALCULATION SUMMARY FOR SURFACE NETWORKS

Label	Inlet Type	Inlet	Total Intercepted Flow (cfs)	Total Bypassed Flow (cfs)	Capture Efficiency (%)	Gutter Spread (ft)	Gutter Depth (ft)
CB-17	Generic Inlet	Generic Default 100%	1.56	0.00	100.0	0.00	0.00
CB-18	Generic Inlet	Generic Default 100%	1.56	0.00	100.0	0.00	0.00
CB-14	Generic Inlet	Generic Default 100%	1.56	0.00	100.0	0.00	0.00
CB-13	Generic Inlet	Generic Default 100%	1.58	0.00	100.0	0.00	0.00
CB-2	Generic Inlet	Generic Default 100%	1.15	0.00	100.0	0.00	0.00
CB-3	Generic Inlet	Generic Default 100%	0.72	0.00	100.0	0.00	0.00
CB-4	Generic Inlet	Generic Default 100%	0.97	0.00	100.0	0.00	0.00
CB-5	Generic Inlet	Generic Default 100%	1.22	0.00	100.0	0.00	0.00
CB-6	Generic Inlet	Generic Default 100%	1.42	0.00	100.0	0.00	0.00
CB-12	Generic Inlet	Generic Default 100%	1.21	0.00	100.0	0.00	0.00
CB-1	Generic Inlet	Generic Default 100%	1.27	0.00	100.0	0.00	0.00
CB-10	Generic Inlet	Generic Default 100%	0.53	0.00	100.0	0.00	0.00
CB-9	Generic Inlet	Generic Default 100%	0.87	0.00	100.0	0.00	0.00
CB-8	Generic Inlet	Generic Default 100%	0.38	0.00	100.0	0.00	0.00
CB-11	Generic Inlet	Generic Default 100%	0.88	0.00	100.0	0.00	0.00
CB-7	Generic Inlet	Generic Default 100%	0.52	0.00	100.0	0.00	0.00
CB-16	Generic Inlet	Generic Default 100%	0.81	0.00	100.0	0.00	0.00
CB-15	Generic Inlet	Generic Default 100%	1.71	0.00	100.0	0.00	0.00
CB-19	Generic Inlet	Generic Default 100%	1.95	0.00	100.0	0.00	0.00

CALCULATION SUMMARY FOR SUBSURFACE NETWORK WITH ROOT: O-1

Label	Number of Sections	Section Size	Section Shape	Length (ft)	Total System Flow (cfs)	Average Velocity (ft/s)	Hydraulic Grade Upstream (ft)	Hydraulic Grade Downstream (ft)
P-21	1	36 inch	Circular	162.00	15.17	4.39	4.90	4.70
P-20	1	24 inch	Circular	194.00	2.70	2.89	5.74	5.25
P-17	1	36 inch	Circular	114.00	12.16	4.25	5.11	5.04
P-19	1	24 inch	Circular	184.00	2.85	2.93	6.13	5.81
P-16	1	12 inch	Circular	49.00	0.81	2.16	6.47	6.28
P-15	1	30 inch	Circular	74.00	11.70	4.21	5.28	5.20
P-18	1	15 inch	Circular	284.00	1.56	2.55	6.62	6.19
P-14	1	15 inch	Circular	114.00	1.71	2.60	6.65	6.29
P-13	1	30 inch	Circular	84.00	10.62	4.12	5.45	5.39
P-12	1	30 inch	Circular	131.00	9.68	3.50	5.64	5.54
P-11	1	18 inch	Circular	143.00	4.14	4.29	5.86	5.71
P-6	1	24 inch	Circular	94.00	5.38	4.03	5.75	5.71
P-9	1	15 inch	Circular	129.00	1.63	3.33	5.98	5.92
P-10	1	18 inch	Circular	44.00	2.52	3.01	5.94	5.92
P-5	1	24 inch	Circular	164.00	4.45	3.31	5.88	5.80
P-8	1	15 inch	Circular	195.00	0.87	2.80	6.54	6.04
P-23	1	18 inch	Circular	93.00	1.92	2.13	5.99	5.96
P-4	1	18 inch	Circular	254.00	3.69	3.14	6.28	5.94
P-7	1	12 inch	Circular	84.00	0.52	2.46	6.81	6.60

RCEC-024-DC-0001
H-3

Calculation Results Summary

P-22	1	18 inch	Circular	96.00	1.95	2.11	6.04	6.01
P-3	1	18 inch	Circular	84.00	2.89	2.97	6.42	6.35
P-2	1	18 inch	Circular	133.00	2.32	2.81	6.56	6.47
P-1A	1	15 inch	Circular	31.00	1.23	2.40	6.61	6.60
P-1	1	12 inch	Circular	103.00	1.27	2.40	6.74	6.63

Label	Total System Flow (cfs)	Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
O-1	14.92	9.00	4.70	4.70
CB-17	15.17	8.50	5.04	4.90
MH-3	2.70	9.00	5.81	5.74
MH-2	12.16	9.70	5.20	5.11
CB-18	2.85	8.50	6.19	6.13
CB-16	0.81	8.50	6.51	6.47
MH-1	11.70	9.60	5.39	5.28
CB-14	1.56	8.50	6.67	6.62
CB-15	1.71	8.50	6.71	6.65
CB-13	10.62	8.50	5.54	5.45
CB-12	9.68	8.50	5.71	5.64
CB-10	4.14	8.50	5.92	5.86
CB-6	5.38	8.50	5.80	5.75
CB-9	1.63	8.50	6.04	5.98
CB-11	2.52	8.50	5.96	5.94
CB-5	4.45	8.50	5.94	5.88
CB-8	0.87	8.50	6.60	6.54
MH-5	1.92	9.00	6.01	5.99
CB-4	3.69	8.50	6.35	6.28
CB-7	0.52	8.60	6.86	6.81
CB-19	1.95	7.00	6.06	6.04
CB-3	2.89	8.50	6.47	6.42
CB-2	2.32	8.50	6.60	6.56
J-1	1.23	8.90	6.63	6.61
CB-1	1.27	8.50	6.77	6.74

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RCEC-024-DC-0001
H-4

Calculation Results Summary

100-YR

==========
Scenario: Base

>>>> Info: Subsurface Network Rooted by: O-1
>>>> Info: Subsurface Analysis iterations: 3
>>>> Info: Convergence was achieved.

CALCULATION SUMMARY FOR SURFACE NETWORKS

Label	Inlet Type	Inlet	Total Intercepted Flow (cfs)	Total Bypassed Flow (cfs)	Capture Efficiency (%)	Gutter Spread (ft)	Gutter Depth (ft)
CB-17	Generic Inlet	Generic Default 100%	2.08	0.00	100.0	0.00	0.00
CB-18	Generic Inlet	Generic Default 100%	2.08	0.00	100.0	0.00	0.00
CB-14	Generic Inlet	Generic Default 100%	2.08	0.00	100.0	0.00	0.00
CB-13	Generic Inlet	Generic Default 100%	2.11	0.00	100.0	0.00	0.00
CB-2	Generic Inlet	Generic Default 100%	1.53	0.00	100.0	0.00	0.00
CB-3	Generic Inlet	Generic Default 100%	0.96	0.00	100.0	0.00	0.00
CB-4	Generic Inlet	Generic Default 100%	1.30	0.00	100.0	0.00	0.00
CB-5	Generic Inlet	Generic Default 100%	1.63	0.00	100.0	0.00	0.00
CB-6	Generic Inlet	Generic Default 100%	1.89	0.00	100.0	0.00	0.00
CB-12	Generic Inlet	Generic Default 100%	1.61	0.00	100.0	0.00	0.00
CB-1	Generic Inlet	Generic Default 100%	1.70	0.00	100.0	0.00	0.00
CB-10	Generic Inlet	Generic Default 100%	0.71	0.00	100.0	0.00	0.00
CB-9	Generic Inlet	Generic Default 100%	1.16	0.00	100.0	0.00	0.00
CB-8	Generic Inlet	Generic Default 100%	0.51	0.00	100.0	0.00	0.00
CB-11	Generic Inlet	Generic Default 100%	1.18	0.00	100.0	0.00	0.00
CB-7	Generic Inlet	Generic Default 100%	0.69	0.00	100.0	0.00	0.00
CB-16	Generic Inlet	Generic Default 100%	1.08	0.00	100.0	0.00	0.00
CB-15	Generic Inlet	Generic Default 100%	2.27	0.00	100.0	0.00	0.00
CB-19	Generic Inlet	Generic Default 100%	2.55	0.00	100.0	0.00	0.00

CALCULATION SUMMARY FOR SUBSURFACE NETWORK WITH ROOT: O-1

Label	Number of Sections	Section Size	Section Shape	Length (ft)	Total System Flow (cfs)	Average Velocity (ft/s)	Hydraulic Grade Upstream (ft)	Hydraulic Grade Downstream (ft)
P-21	1	36 inch	Circular	162.00	19.45	4.67	5.11	4.85
P-20	1	24 inch	Circular	194.00	3.60	3.13	5.85	5.34
P-17	1	36 inch	Circular	114.00	15.58	4.53	5.35	5.28
P-19	1	24 inch	Circular	184.00	3.80	3.17	6.25	5.93
P-16	1	12 inch	Circular	49.00	1.08	2.32	6.55	6.34
P-15	1	30 inch	Circular	74.00	14.97	4.45	5.55	5.46
P-18	1	15 inch	Circular	284.00	2.08	2.73	6.75	6.32
P-14	1	15 inch	Circular	114.00	2.27	2.78	6.77	6.37
P-13	1	30 inch	Circular	84.00	13.58	4.36	5.75	5.67
P-12	1	30 inch	Circular	131.00	12.36	3.70	5.95	5.84
P-11	1	18 inch	Circular	143.00	5.32	3.01	6.34	6.03
P-6	1	24 inch	Circular	94.00	7.10	4.32	6.08	6.03
P-9	1	15 inch	Circular	129.00	2.17	3.59	6.53	6.41
P-10	1	18 inch	Circular	44.00	3.24	1.84	6.45	6.41
P-5	1	24 inch	Circular	164.00	5.88	3.55	6.22	6.14
P-8	1	15 inch	Circular	195.00	1.16	3.04	6.62	6.56
P-23	1	18 inch	Circular	93.00	2.49	1.41	6.52	6.47
P-4	1	18 inch	Circular	254.00	4.89	3.28	6.68	6.27
P-7	1	12 inch	Circular	84.00	0.69	2.67	6.86	6.69

RCEC-024-DC-0001
H-5

Calculation Results Summary

P-22	1	18 inch	Circular	96.00	2.55	1.45	6.58	6.53
P-3	1	18 inch	Circular	84.00	3.83	3.16	6.82	6.74
P-2	1	18 inch	Circular	133.00	3.07	3.01	6.94	6.86
P-1A	1	15 inch	Circular	31.00	1.63	2.58	6.98	6.97
P-1	1	12 inch	Circular	103.00	1.70	2.16	7.20	7.00

Label	Total System Flow (cfs)	Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
O-1	19.17	9.00	4.85	4.85
CB-17	19.45	8.50	5.28	5.11
MH-3	3.60	9.00	5.93	5.85
MH-2	15.58	9.70	5.46	5.35
CB-18	3.80	8.50	6.32	6.25
CB-16	1.08	8.50	6.60	6.55
MH-1	14.97	9.60	5.67	5.55
CB-14	2.08	8.50	6.81	6.75
CB-15	2.27	8.50	6.84	6.77
CB-13	13.58	8.50	5.84	5.75
CB-12	12.36	8.50	6.03	5.95
CB-10	5.32	8.50	6.41	6.34
CB-6	7.10	8.50	6.14	6.08
CB-9	2.17	8.50	6.56	6.53
CB-11	3.24	8.50	6.47	6.45
CB-5	5.88	8.50	6.27	6.22
CB-8	1.16	8.50	6.69	6.62
MH-5	2.49	9.00	6.53	6.52
CB-4	4.89	8.50	6.74	6.68
CB-7	0.69	8.60	6.92	6.86
CB-19	2.55	7.00	6.60	6.58
CB-3	3.83	8.50	6.86	6.82
CB-2	3.07	8.50	6.97	6.94
J-1	1.63	8.90	7.00	6.98
CB-1	1.70	8.50	7.23	7.20

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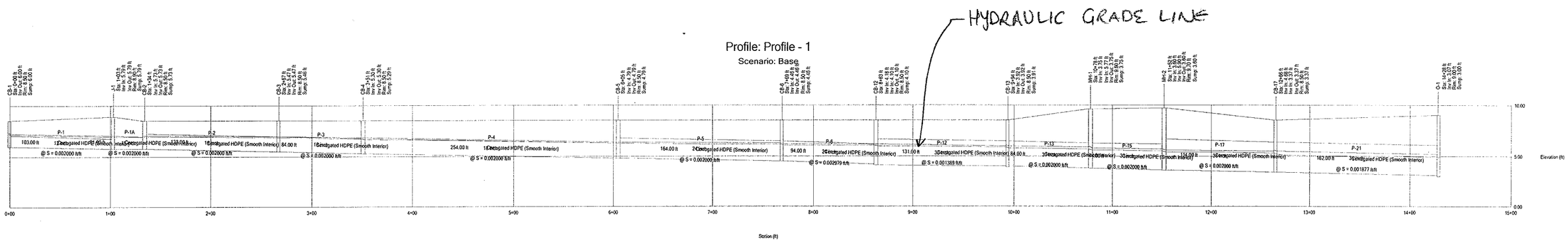
RCEC-024-DC-0001
H-6

Profile
Scenario: Base

100-YR

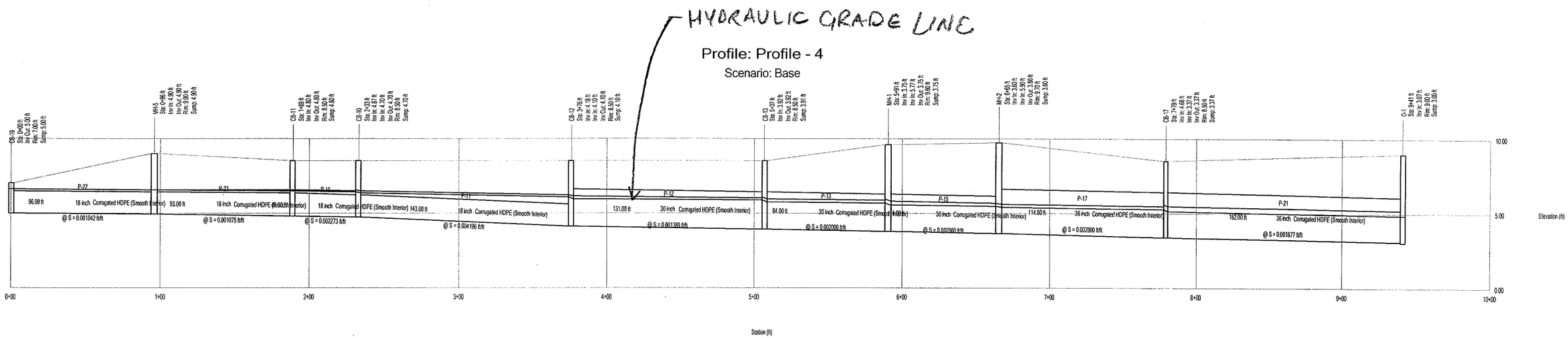
CB-1 TO O-1



RCEC-024-DC-0001
H-7

Profile
Scenario: Base

100-YR
CB-19 TO O-1

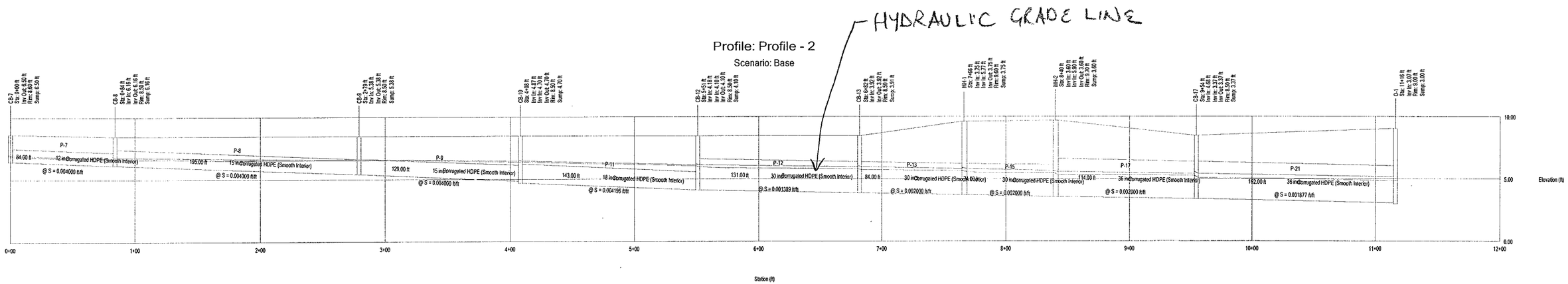


RCEC-024-DC-0001
H-9

Profile
Scenario: Base

100-YR

CB-7 TO O-1



RCEC-024-DC-0001
H-8

Worksheet for Hayward Outfall Channel

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050		→ assumed Rough channel w/ grass
Channel Slope	0.01000	ft/ft	→ see sketch
Left Side Slope	3.00	ft/ft (H:V)	Scaled off topography See sketch
Right Side Slope	3.00	ft/ft (H:V)	
Bottom Width	5.00	ft	
Discharge	107.00	ft³/s	→ 15-YR Flow (interpolated)

Results

Normal Depth	2.35	ft
Flow Area	28.39	ft²
Wetted Perimeter	19.89	ft
Top Width	19.12	ft
Critical Depth	1.73	ft
Critical Slope	0.03652	ft/ft
Velocity	3.77	ft/s
Velocity Head	0.22	ft
Specific Energy	2.57	ft
Froude Number	0.55	
Flow Type	Subcritical	

Used to calculate tailwater for storm system outlet

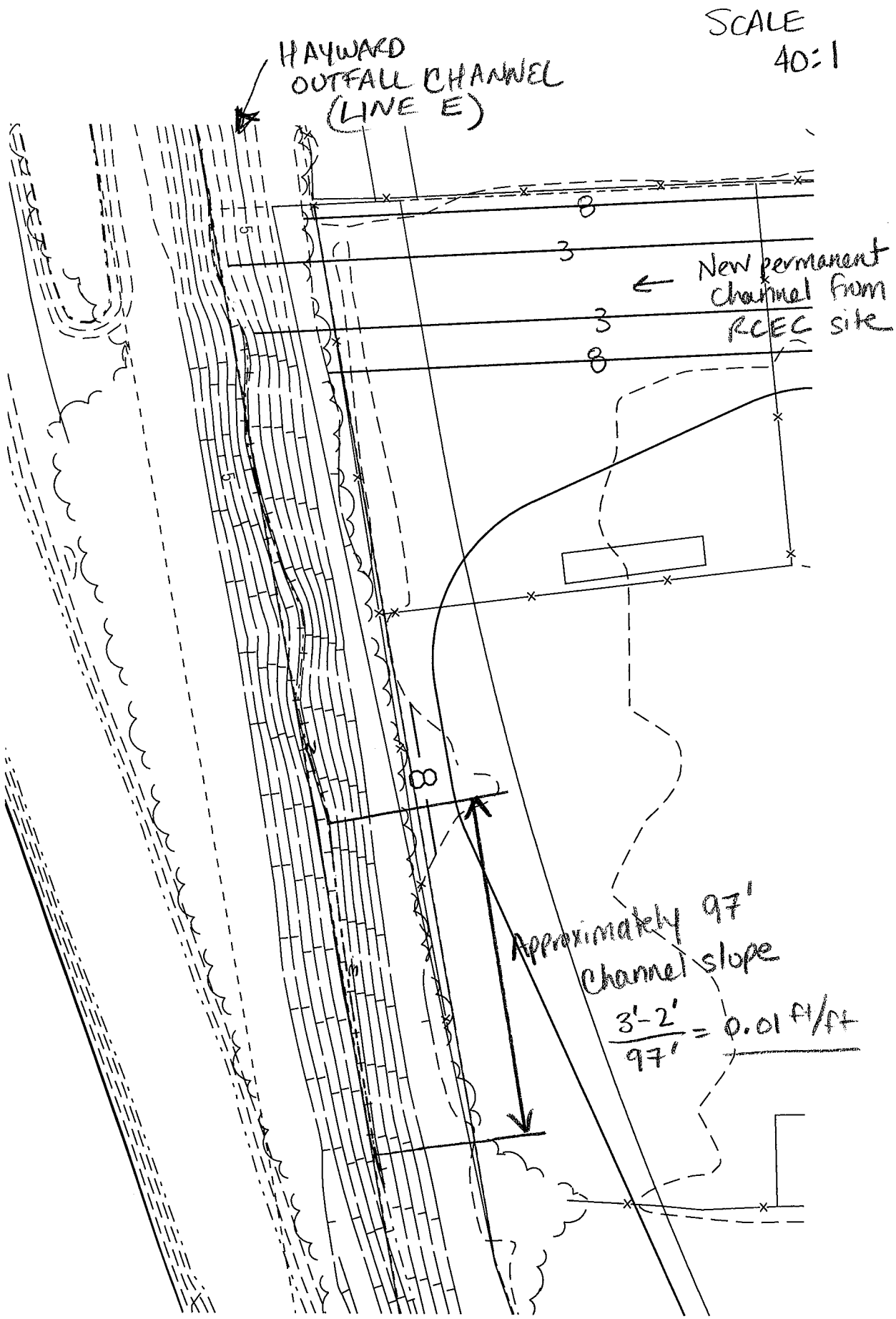
GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.35	ft
Critical Depth	1.73	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.03652	ft/ft

RCEC-024-DC-0001
H-10



RCEC-024-DC-0001
H-11

Channel A

Worksheet for 15-yr - 0.0025 ft/ft (Grass 0.05) - GVF

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.00250	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	32.67	ft^3/s ← 15-YR DISCHARGE

Results

Normal Depth	1.45	ft
Flow Area	20.81	ft^2
Wetted Perimeter	19.17	ft
Top Width	18.70	ft
Critical Depth	0.65	ft
Critical Slope	0.04519	ft/ft
Velocity	1.57	ft/s
Velocity Head	0.04	ft
Specific Energy	1.49	ft
Froude Number	0.26	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	2.35	ft ← DEPTH TAKEN FROM HAYWARD OUTFALL CHANNEL
Length	377.00	ft
Number Of Steps	10	

GVF Output Data

Upstream Depth	1.70	ft ← Calculated upstream depth used in Storm system calculation.
Profile Description	M1	
Profile Headloss	0.29	ft
Downstream Velocity	0.82	ft/s
Upstream Velocity	1.27	ft/s
Normal Depth	1.45	ft
Critical Depth	0.65	ft
Channel Slope	0.00250	ft/ft
Critical Slope	0.04519	ft/ft

RCEC-024-DC-0001
H-12

CHANNEL A

Worksheet for 100-yr - 0.0025 ft/ft (Grass 0.05) - GVF

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.00250	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	43.17	ft^3/s ← 100-YR Discharge

Results

Normal Depth	1.68	ft
Flow Area	25.34	ft^2
Wetted Perimeter	20.65	ft
Top Width	20.10	ft
Critical Depth	0.77	ft
Critical Slope	0.04307	ft/ft
Velocity	1.70	ft/s
Velocity Head	0.05	ft
Specific Energy	1.73	ft
Froude Number	0.27	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	2.35	ft ← Depth taken from Hayward outfall Channel
Length	377.00	ft
Number Of Steps	10	

GVF Output Data

Upstream Depth	1.85	ft ← Calculated upstream depth used in storm system Calculation
Profile Description	M1	
Profile Headloss	0.44	ft
Downstream Velocity	1.08	ft/s
Upstream Velocity	1.51	ft/s
Normal Depth	1.68	ft
Critical Depth	0.77	ft
Channel Slope	0.00250	ft/ft
Critical Slope	0.04307	ft/ft

RCEC-024-DC-0001
H-13

ATTACHMENT I

Scenario: Base

Inlet Report

Label	Northing (ft)	Easting (ft)	Ground Elevation (ft)	Set Rim Equal to Ground Elevation?	Rim Elevation (ft)	Sump Elevation (ft)	Area (acres)	Inlet C	Inlet CA (acres)	Time of Concentration (min)	External CA (acres)	External Time of Concentration (min)	Known Flow (cfs)	Inlet	Inlet Location	Local Rational Flow (cfs)	Intercepted Tc (min)
CB-1	,057,409.04	,088,591.83	8.50	true	8.50	6.00	0.60	0.83	0.50	5.00	0.00	0.00	0.00	Generic Default 1(	In Sag	1.27	5.00
CB-8	,057,410.55	,088,391.23	8.50	true	8.50	6.16	0.21	0.71	0.15	5.00	0.00	0.00	0.00	Generic Default 1(	In Sag	0.38	5.00
CB-7	,057,410.55	,088,475.23	8.60	true	8.60	6.50	0.24	0.84	0.20	5.00	0.00	0.00	0.00	Generic Default 1(	In Sag	0.52	5.00
CB-2	,057,425.37	,088,721.00	8.50	true	8.50	5.73	0.55	0.82	0.45	5.00	0.00	0.00	0.00	Generic Default 1(	In Sag	1.15	5.00
CB-19	,057,548.74	,088,324.05	7.00	true	7.00	5.00	1.57	0.65	1.02	11.35	0.00	0.00	0.00	Generic Default 1(	In Sag	1.95	11.35
CB-3	,057,558.58	,088,729.47	8.50	true	8.50	5.46	0.34	0.83	0.28	5.00	0.00	0.00	0.00	Generic Default 1(	In Sag	0.72	5.00
CB-4	,057,558.65	,088,813.46	8.50	true	8.50	5.29	0.49	0.78	0.38	5.00	0.00	0.00	0.00	Generic Default 1(	In Sag	0.97	5.00
CB-9	,057,605.08	,088,381.18	8.50	true	8.50	5.38	0.39	0.88	0.34	5.00	0.00	0.00	0.00	Generic Default 1(	In Sag	0.87	5.00
CB-11	,057,734.27	,088,337.00	8.50	true	8.50	4.80	0.42	0.81	0.34	5.00	0.00	0.00	0.00	Generic Default 1(	In Sag	0.88	5.00
CB-10	,057,734.39	,088,380.83	8.50	true	8.50	4.70	0.24	0.88	0.21	5.00	0.00	0.00	0.00	Generic Default 1(	In Sag	0.53	5.00
CB-12	,057,807.09	,088,504.10	8.50	true	8.50	4.10	0.58	0.81	0.47	5.00	0.00	0.00	0.00	Generic Default 1(	In Sag	1.21	5.00
CB-5	,057,807.09	,088,762.10	8.50	true	8.50	4.79	0.62	0.77	0.48	5.00	0.00	0.00	0.00	Generic Default 1(	In Sag	1.22	5.00
CB-6	,057,807.09	,088,598.10	8.50	true	8.50	4.46	0.64	0.87	0.55	5.00	0.00	0.00	0.00	Generic Default 1(	In Sag	1.42	5.00
CB-14	,057,863.31	,088,770.60	8.50	true	8.50	6.00	0.89	0.68	0.61	5.00	0.00	0.00	0.00	Generic Default 1(	In Sag	1.56	5.00
CB-13	,057,875.31	,088,392.60	8.50	true	8.50	3.91	0.89	0.69	0.62	5.00	0.00	0.00	0.00	Generic Default 1(	In Sag	1.58	5.00
CB-15	,057,959.31	,088,278.60	8.50	true	8.50	6.00	0.82	0.81	0.66	5.00	0.00	0.00	0.00	Generic Default 1(	In Sag	1.71	5.00
CB-16	,058,033.31	,088,343.60	8.50	true	8.50	6.00	0.37	0.85	0.32	5.00	0.00	0.00	0.00	Generic Default 1(	In Sag	0.81	5.00
CB-17	,058,147.31	,088,392.60	8.50	true	8.50	3.37	0.89	0.68	0.61	5.00	0.00	0.00	0.00	Generic Default 1(	In Sag	1.56	5.00
CB-18	,058,147.31	,088,770.60	8.50	true	8.50	5.43	0.89	0.68	0.61	5.00	0.00	0.00	0.00	Generic Default 1(	In Sag	1.56	5.00

RCEC-024-DC-0001
I-1

Scenario: Base

Pipe Report

Label	Downstream Node	Upstream Node	Upstream Inlet CA (acres)	Upstream Calculated System CA (acres)	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Full Capacity (cfs)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Cover (ft)	Downstream Cover (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
P-18	CB-18	CB-14	0.61	0.61	1.56	284.00	0.002000	15 inch	0.012	3.13	6.00	5.43	1.25	1.82	6.62	6.19
P-19	MH-3	CB-18	0.61	1.21	2.85	184.00	0.002000	24 inch	0.012	10.96	5.43	5.06	1.07	1.94	6.13	5.81
P-20	CB-17	MH-3	N/A	1.21	2.70	194.00	0.002000	24 inch	0.012	10.96	5.06	4.68	1.94	1.82	5.74	5.25
P-21	O-1	CB-17	0.61	8.78	15.17	162.00	0.001877	36 inch	0.012	31.30	3.37	3.07	2.13	2.93	4.90	4.70
P-6	CB-12	CB-6	0.55	2.63	5.38	94.00	0.002979	24 inch	0.012	13.37	4.46	4.18	2.04	2.32	5.75	5.71
P-5	CB-6	CB-5	0.48	2.08	4.45	164.00	0.002000	24 inch	0.012	10.96	4.79	4.46	1.71	2.04	5.88	5.80
P-4	CB-5	CB-4	0.38	1.60	3.69	254.00	0.002000	18 inch	0.012	5.09	5.30	4.79	1.70	2.21	6.28	5.94
P-3	CB-4	CB-3	0.28	1.22	2.89	84.00	0.002000	18 inch	0.012	5.09	5.47	5.30	1.53	1.70	6.42	6.35
P-2	CB-3	CB-2	0.45	0.94	2.32	133.00	0.002000	18 inch	0.012	5.09	5.73	5.47	1.27	1.53	6.56	6.47
P-1	J-1	CB-1	0.50	0.50	1.27	103.00	0.002000	12 inch	0.012	1.73	6.00	5.79	1.50	2.11	6.74	6.63
P-1A	CB-2	J-1	N/A	0.50	1.23	31.00	0.002000	15 inch	0.012	3.13	5.79	5.73	1.86	1.52	6.61	6.60
P-8	CB-9	CB-8	0.15	0.35	0.87	195.00	0.004000	15 inch	0.012	4.43	6.16	5.38	1.09	1.87	6.54	6.04
P-9	CB-10	CB-9	0.34	0.69	1.63	129.00	0.004000	15 inch	0.012	4.43	5.38	4.87	1.87	2.38	5.98	5.92
P-10	CB-10	CB-11	0.34	1.37	2.52	44.00	0.002273	18 inch	0.012	5.42	4.80	4.70	2.20	2.30	5.94	5.92
P-7	CB-8	CB-7	0.20	0.20	0.52	84.00	0.004000	12 inch	0.012	2.44	6.50	6.16	1.10	1.34	6.81	6.60
P-11	CB-12	CB-10	0.21	2.26	4.14	143.00	0.004196	18 inch	0.012	7.37	4.70	4.10	2.30	2.90	5.86	5.71
P-12	CB-13	CB-12	0.47	5.36	9.68	131.00	0.001389	30 inch	0.012	16.56	4.10	3.92	1.90	2.08	5.64	5.54
P-13	MH-1	CB-13	0.62	5.98	10.62	84.00	0.002000	30 inch	0.012	19.87	3.92	3.75	2.08	3.35	5.45	5.39
P-15	MH-2	MH-1	N/A	6.64	11.70	74.00	0.002000	30 inch	0.012	19.87	3.75	3.60	3.35	3.60	5.28	5.20
P-16	MH-2	CB-16	0.32	0.32	0.81	49.00	0.002000	12 inch	0.012	1.73	6.00	5.90	1.50	2.80	6.47	6.28
P-14	MH-1	CB-15	0.66	0.66	1.71	114.00	0.002000	15 inch	0.012	3.13	6.00	5.77	1.25	2.58	6.65	6.29
P-17	CB-17	MH-2	N/A	6.96	12.16	114.00	0.002000	36 inch	0.012	32.31	3.60	3.37	3.10	2.13	5.11	5.04
P-22	MH-5	CB-19	1.02	1.02	1.95	96.00	0.001042	18 inch	0.012	3.67	5.00	4.90	0.50	2.60	6.04	6.01
P-23	CB-11	MH-5	N/A	1.02	1.92	93.00	0.001075	18 inch	0.012	3.73	4.90	4.80	2.60	2.20	5.99	5.96

RCEC-024-DC-0001
I-2

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ATTACHMENT J

RCEC - Quantity of Flow for the Post-development Condition

Project:	Russell City Energy Center	**By:**	D. Sheth	**Date:**	11/1/2006
Location:	Hayward City, CA	**Checked:**	K. Giffin	**Date:**	11/3/2006

Post-development

Composite Runoff Coefficient Calculation

Total Area 672,661 sq.ft
15.44 acres

Land Use Sub Areas

	HSG	Cover Type	A (sq. ft)	A (acres)	C	C x A
Plant Site Area						
1	D	Aggregate Surfacing	305,978	7.024	0.65	4.57
2	D	Bituminous Paving	99,257	2.279	0.95	2.16
3	D	Concrete Slab		3.747	0.95	3.56
		Cooling Tower	45,722			
		ZLD and other	37,178			
		Power Block	30,174			
		Power Block	34,684			
		Title 22 Area	15,481			
4	D	Grass	104,188	2.392	0.20	0.48
		Sum:	672,661	15.44		10.77

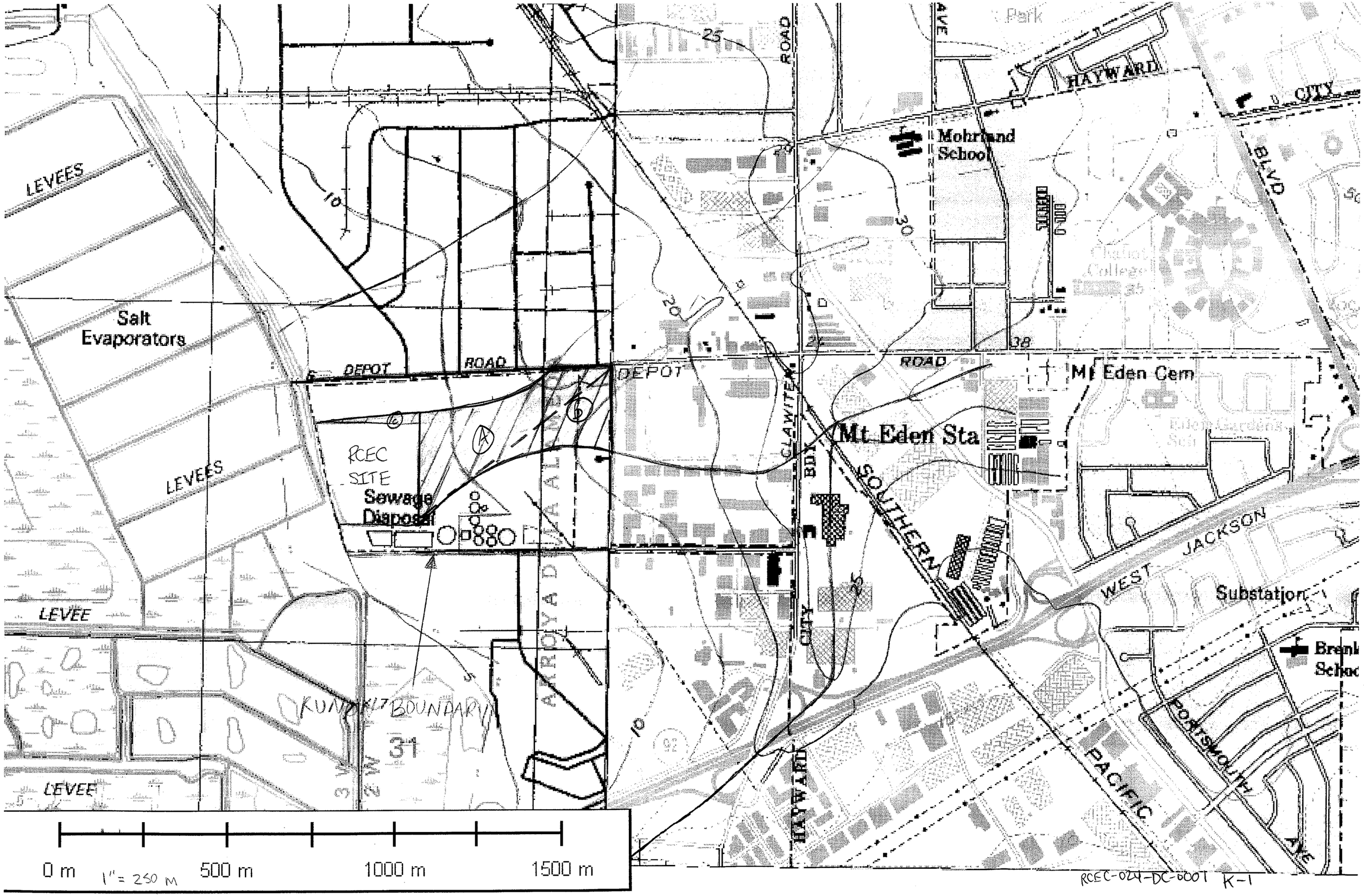
C (composite) = 0.70

RCEC-024-DC-0001
J-1

Label	Length (ft)	Section Size (in.)	Volume
P-1	103	12	81
P-1A	31	15	38
P-2	133	18	235
P-3	84	18	148
P-4	254	18	449
P-5	164	24	515
P-6	94	24	295
P-7	84	12	66
P-8	195	15	239
P-9	129	15	158
P-10	44	12	35
P-11	143	18	253
P-12	131	30	643
P-13	84	30	412
P-14	114	15	140
P-15	74	30	363
P-16	49	12	38
P-17	114	36	806
P-18	284	15	349
P-19	184	24	578
P-20	194	24	609
P-21	162	36	1145
P-22	96	18	170
P-23	93	18	164
		Total =	**7931**

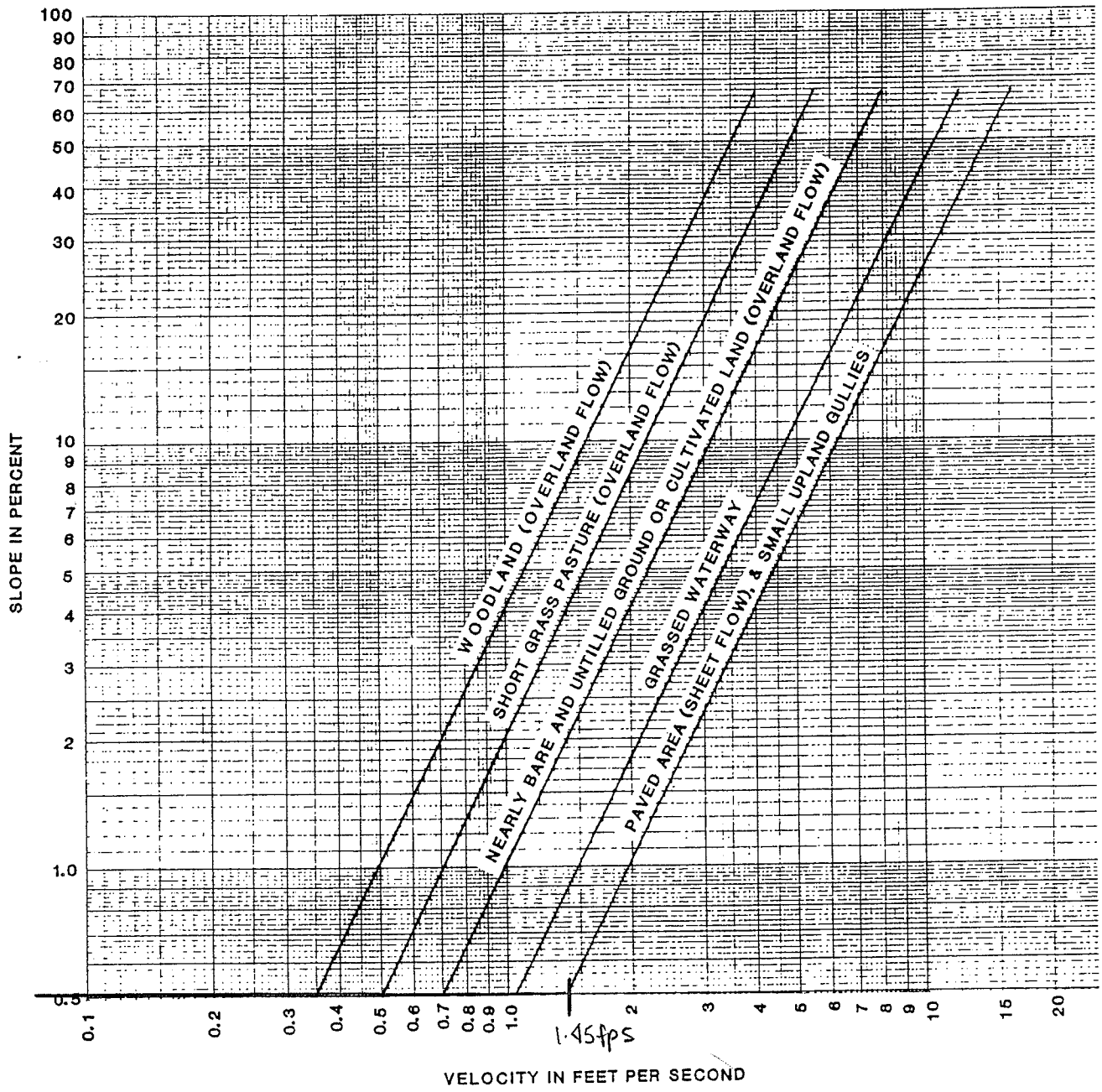
RCEC-024-DC-0001
J-2

ATTACHMENT K



RCEC-024-DC-0001 K-1

Flow due to RUNON
Use this V in the Initial Time of Concentration



ALAMEDA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT	**OVERLAND FLOW VELOCITY CHART**	DATE: FEBRUARY 1987 **FIGURE 4**

RCEC-024-DC-0001 K-2

Table 8.05g
Permissible Shear Stresses for Riprap and Temporary Liners

Lining Category	Permissible Unit Shear Stress, T_d Lining Type	(lb/ft^2)
Temporary	Woven Paper Net	0.15
	Jute Net	0.45
	Fiberglass Roving:	
	Single	0.60
	Double	0.85
	Straw with Net	1.45
	Curled Wood mat	1.55
	Synthetic Mat	2.00
	d_{50} **Stone Size** (inches)	
Gravel Riprap	1	0.33
	2	0.67
Rock Riprap	6	2.00
	9	3.00
	12	4.00
	15	5.00
	18	6.00
	21	7.80
	24	8.00

Adapted From: FHWA, HEC-15, April 1983, pgs. 17 & 37.

Design Procedure-Temporary Liners

The following is a step-by-step procedure for designing a temporary liner for a channel. Because temporary liners have a short period of service, the design Q may be reduced. For liners that are needed for six months or less, the 2-yr frequency storm is recommended.

Step 1. Select a liner material suitable for site conditions and application. Determine roughness coefficient from manufacturer's specifications or Table 8.05e, pg. 8.05.10.

Step 2. Calculate the normal flow depth using Manning's equation (Figure 8.05d). Check to see that depth is consistent with that assumed for selection of Manning's *n* in Figure 8.05d, pg. 8.05.11. For smaller runoffs Figure 8.05d is not as clearly defined. Recommended solutions can be determined by using the Manning equation.

Step 3. Calculate shear stress at normal depth.

Step 4. Compare computed shear stress with the permissible shear stress for the liner.

Step 5. If computed shear is greater than permissible shear, adjust channel dimensions to reduce shear or select a more resistant lining and repeat steps 1 through 4.

Design of a channel with temporary lining is illustrated in Sample Problem 8.05b, pg. 8.05.14.

RCEC-024-DC-0001
K-3

Diversion Channel - A
Worksheet for 15-yr - 0.004 ft/ft (Earth 0.03)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00400	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	31.30	ft^3/s

Results

Normal Depth	1.41	ft
Flow Area	10.61	ft^2
Wetted Perimeter	11.59	ft
Top Width	11.05	ft
Critical Depth	1.00	ft
Critical Slope	0.01546	ft/ft
Velocity	2.95	ft/s
Velocity Head	0.14	ft
Specific Energy	1.54	ft
Froude Number	0.53	
Flow Type	Subcritical	

>2 ft/s - Assumed permissible velocity for bare soil
Use temporary lining until grass is established.

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.41	ft
Critical Depth	1.00	ft
Channel Slope	0.00400	ft/ft
Critical Slope	0.01546	ft/ft

RCEC-024-DC-0001
K-4

Diversion Channel - A
Worksheet for 15-yr - 0.004 ft/ft (Grass 0.05)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.00400	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	31.30	ft^3/s

Results

Normal Depth	1.81	ft
Flow Area	15.42	ft^2
Wetted Perimeter	13.74	ft
Top Width	13.05	ft
Critical Depth	1.00	ft
Critical Slope	0.04294	ft/ft
Velocity	2.03	ft/s > 2 ft/s ... OK
Velocity Head	0.06	ft
Specific Energy	1.87	ft
Froude Number	0.33	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.81	ft
Critical Depth	1.00	ft
Channel Slope	0.00400	ft/ft
Critical Slope	0.04294	ft/ft

RCEC-024-DC-0001
K-5

Diversion Channels - A
Worksheet for 15-yr - 0.004 ft/ft (ECB)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.022	— From Flow master Library
Channel Slope	0.00400	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	31.30	ft^3/s

Results

Normal Depth	1.21	ft
Flow Area	8.46	ft^2
Wetted Perimeter	10.49	ft
Top Width	10.03	ft
Critical Depth	1.00	ft
Critical Slope	0.00831	ft/ft
Velocity	3.70	ft/s
Velocity Head	0.21	ft
Specific Energy	1.42	ft
Froude Number	0.71	
Flow Type	Subcritical	

Check permissible shear stress (T_d):

Jute Net T_d = 0.45 psf

T_d = 1.21 ft × 0.004 ft/ft × 62.4 pcf = 0.30 psf

OK

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.21	ft
Critical Depth	1.00	ft
Channel Slope	0.00400	ft/ft
Critical Slope	0.00831	ft/ft

RCEC-024-DC-0001
K-6

Diversion Channel - A
Worksheet for 100-yr - 0.004 ft/ft (Earth 0.03)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00400	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	40.90	ft^3/s

Results

Normal Depth	1.61	ft
Flow Area	12.90	ft^2
Wetted Perimeter	12.66	ft
Top Width	12.04	ft
Critical Depth	1.16	ft
Critical Slope	0.01490	ft/ft
Velocity	3.17	ft/s
Velocity Head	0.16	ft
Specific Energy	1.76	ft
Froude Number	0.54	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.61	ft
Critical Depth	1.16	ft
Channel Slope	0.00400	ft/ft
Critical Slope	0.01490	ft/ft

RCEC-024-DC-0001
K-7

Diversion Channel - A
Worksheet for 100-yr - 0.004 ft/ft (Grass 0.05)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.00400	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	40.90	ft^3/s

Results

Normal Depth	2.06	ft
Flow Area	18.79	ft^2
Wetted Perimeter	15.07	ft
Top Width	14.28	ft
Critical Depth	1.16	ft
Critical Slope	0.04138	ft/ft
Velocity	2.18	ft/s > 2 ft/s ... OK
Velocity Head	0.07	ft
Specific Energy	2.13	ft
Froude Number	0.33	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.06	ft
Critical Depth	1.16	ft
Channel Slope	0.00400	ft/ft
Critical Slope	0.04138	ft/ft

RCEC-024-DC-0001
K-8

Diversion Channel - A
Worksheet for 100-yr - 0.004 ft/ft (ECB)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.022	
Channel Slope	0.00400	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	40.90	ft^3/s

Results

Normal Depth	1.38	ft
Flow Area	10.28	ft^2
Wetted Perimeter	11.43	ft
Top Width	10.90	ft
Critical Depth	1.16	ft
Critical Slope	0.00801	ft/ft
Velocity	3.98	ft/s
Velocity Head	0.25	ft
Specific Energy	1.63	ft
Froude Number	0.72	
Flow Type	Subcritical	

Check permissible shear stress: Jute Net Td = 0.45 psf

1.38 ft × 0.004 ft/ft × 62.4 pcf =

0.34 psf OK

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.38	ft
Critical Depth	1.16	ft
Channel Slope	0.00400	ft/ft
Critical Slope	0.00801	ft/ft

RCEC-024-DC-0001
K-9

Diversion Channel – B
Worksheet for 15-yr - 0.004 ft/ft (Earth 0.03)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00400	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	31.30	ft^3/s

Results

Normal Depth	1.79	ft
Flow Area	10.00	ft^2
Wetted Perimeter	10.01	ft
Top Width	9.16	ft
Critical Depth	1.31	ft
Critical Slope	0.01553	ft/ft
Velocity	3.13	ft/s
Velocity Head	0.15	ft
Specific Energy	1.94	ft
Froude Number	0.53	
Flow Type	Subcritical	

> 2 ft/s Assumed permissible velocity for bare soil
Use temporary lining until grass is established.

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.79	ft
Critical Depth	1.31	ft
Channel Slope	0.00400	ft/ft
Critical Slope	0.01553	ft/ft

RCEC-024-DC-0001
K-10

Diversion Channel – B
Worksheet for 15-yr - 0.004 ft/ft (Grass 0.05)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.00400	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	31.30	ft^3/s

Results

Normal Depth	2.25	ft
Flow Area	14.64	ft^2
Wetted Perimeter	12.07	ft
Top Width	11.01	ft
Critical Depth	1.31	ft
Critical Slope	0.04315	ft/ft
Velocity	2.14	ft/s >2 ft/s ... OK
Velocity Head	0.07	ft
Specific Energy	2.32	ft
Froude Number	0.33	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.25	ft
Critical Depth	1.31	ft
Channel Slope	0.00400	ft/ft
Critical Slope	0.04315	ft/ft

RCEC-024-DC-0001
K-11

Diversion Channel – B
Worksheet for 15-yr - 0.004 ft/ft (ECB)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.022	→ From Flowmaster Library
Channel Slope	0.00400	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	31.30	ft³/s

Results

Normal Depth	1.55	ft
Flow Area	7.94	ft²
Wetted Perimeter	8.95	ft
Top Width	8.22	ft
Critical Depth	1.31	ft
Critical Slope	0.00835	ft/ft
Velocity	3.94	ft/s
Velocity Head	0.24	ft
Specific Energy	1.80	ft
Froude Number	0.71	
Flow Type	Subcritical	

Check permissible shear stress (τ_d):

Jute Net $\tau_d = 0.45$ psf

$\tau_d = 1.55$ ft $\times 0.004$ ft/ft $\times$ 62.4 pcf $= 0.39$ psf

OK

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.55	ft
Critical Depth	1.31	ft
Channel Slope	0.00400	ft/ft
Critical Slope	0.00835	ft/ft

RCEC-024-DC-0001
K-12

Diversion Channel – B
Worksheet for 100-yr - 0.004 ft/ft (Earth 0.03)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00400	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	40.90	ft^3/s

Results

Normal Depth	2.02	ft
Flow Area	12.21	ft^2
Wetted Perimeter	11.04	ft
Top Width	10.08	ft
Critical Depth	1.49	ft
Critical Slope	0.01502	ft/ft
Velocity	3.35	ft/s
Velocity Head	0.17	ft
Specific Energy	2.20	ft
Froude Number	0.54	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.02	ft
Critical Depth	1.49	ft
Channel Slope	0.00400	ft/ft
Critical Slope	0.01502	ft/ft

RCEC-024-DC-0001
K-13

Diversion Channel – B
Worksheet for 100-yr - 0.004 ft/ft (Grass 0.05)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.00400	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	40.90	ft^3/s

Results

Normal Depth	2.53	ft
Flow Area	17.88	ft^2
Wetted Perimeter	13.32	ft
Top Width	12.13	ft
Critical Depth	1.49	ft
Critical Slope	0.04172	ft/ft
Velocity	2.29	ft/s > 2ft/s..ok
Velocity Head	0.08	ft
Specific Energy	2.61	ft
Froude Number	0.33	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.53	ft
Critical Depth	1.49	ft
Channel Slope	0.00400	ft/ft
Critical Slope	0.04172	ft/ft

RCEC-024-DC-0001
K-14

Diversion Channel – B
Worksheet for 100-yr - 0.004 ft/ft (ECB)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.022	⇒ From flowmaster library
Channel Slope	0.00400	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	40.90	ft³/s

Results

Normal Depth	1.76	ft
Flow Area	9.69	ft²
Wetted Perimeter	9.86	ft
Top Width	9.03	ft
Critical Depth	1.49	ft
Critical Slope	0.00808	ft/ft
Velocity	4.22	ft/s
Velocity Head	0.28	ft
Specific Energy	2.03	ft
Froude Number	0.72	
Flow Type	Subcritical	

Check permissible shear stress:

Jute net = 0.45 psf

$T_d = 1.76\ ft \times 0.004\ ft/ft \times 62.4\ pcf = 0.44\ psf$

OK

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.76	ft
Critical Depth	1.49	ft
Channel Slope	0.00400	ft/ft
Critical Slope	0.00808	ft/ft

RCEC-024-DC-0001
K-15

Diversion Channel – C
Worksheet for 15-yr - 0.0007 ft/ft (Earth 0.03)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00070	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	31.30	ft^3/s

Results

Normal Depth	2.15	ft
Flow Area	20.13	ft^2
Wetted Perimeter	15.57	ft
Top Width	14.74	ft
Critical Depth	1.00	ft
Critical Slope	0.01546	ft/ft
Velocity	1.56	ft/s
Velocity Head	0.04	ft
Specific Energy	2.19	ft
Froude Number	0.23	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.15	ft
Critical Depth	1.00	ft
Channel Slope	0.00070	ft/ft
Critical Slope	0.01546	ft/ft

RCEC-024-DC-0001
K-16

Diversion Channel – C
Worksheet for 15-yr - 0.0007 ft/ft (Grass 0.05)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.00070	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	31.30	ft^3/s

Results

Normal Depth	2.72	ft
Flow Area	29.40	ft^2
Wetted Perimeter	18.65	ft
Top Width	17.61	ft
Critical Depth	1.00	ft
Critical Slope	0.04294	ft/ft
Velocity	1.06	ft/s
Velocity Head	0.02	ft
Specific Energy	2.74	ft
Froude Number	0.15	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.72	ft
Critical Depth	1.00	ft
Channel Slope	0.00070	ft/ft
Critical Slope	0.04294	ft/ft

RCEC-024-DC-0001
K-17

Diversion Channel – C
Worksheet for 15-yr - 0.0007 ft/ft (ECB)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.022	
Channel Slope	0.00070	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	31.30	ft^3/s

Results

Normal Depth	1.85	ft
Flow Area	16.01	ft^2
Wetted Perimeter	13.98	ft
Top Width	13.27	ft
Critical Depth	1.00	ft
Critical Slope	0.00831	ft/ft
Velocity	1.96	ft/s
Velocity Head	0.06	ft
Specific Energy	1.91	ft
Froude Number	0.31	
Flow Type	Subcritical	

Check permissible Shear Stress:
Jute Wet Td = 0.45 psf
1.85 ft × 0.0007 × 62.4 pcf = 0.08 psf OK

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.85	ft
Critical Depth	1.00	ft
Channel Slope	0.00070	ft/ft
Critical Slope	0.00831	ft/ft

RCEC-024-DC-0001
K-18

Diversion Channel – C
Worksheet for 100-yr - 0.0007 ft/ft (Earth 0.03)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00070	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	40.90	ft^3/s

Results

Normal Depth	2.43	ft
Flow Area	24.53	ft^2
Wetted Perimeter	17.10	ft
Top Width	16.17	ft
Critical Depth	1.16	ft
Critical Slope	0.01490	ft/ft
Velocity	1.67	ft/s
Velocity Head	0.04	ft
Specific Energy	2.48	ft
Froude Number	0.24	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.43	ft
Critical Depth	1.16	ft
Channel Slope	0.00070	ft/ft
Critical Slope	0.01490	ft/ft

RCEC-OLY-DC-0001
K-19

Diversion Channel – C
Worksheet for 100-yr - 0.0007 ft/ft (Grass 0.05)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.00070	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	40.90	ft^3/s

Results

Normal Depth	3.07	ft
Flow Area	35.87	ft^2
Wetted Perimeter	20.54	ft
Top Width	19.36	ft
Critical Depth	1.16	ft
Critical Slope	0.04138	ft/ft
Velocity	1.14	ft/s
Velocity Head	0.02	ft
Specific Energy	3.09	ft
Froude Number	0.15	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.07	ft
Critical Depth	1.16	ft
Channel Slope	0.00070	ft/ft
Critical Slope	0.04138	ft/ft

RCEC-024-DC-0001
K-20

Diversion Channel – C
Worksheet for 100-yr - 0.0007 ft/ft (ECB)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.022	
Channel Slope	0.00070	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	40.90	ft^3/s

Results

Normal Depth	2.11	ft
Flow Area	19.50	ft^2
Wetted Perimeter	15.34	ft
Top Width	14.53	ft
Critical Depth	1.16	ft
Critical Slope	0.00801	ft/ft
Velocity	2.10	ft/s
Velocity Head	0.07	ft
Specific Energy	2.17	ft
Froude Number	0.32	
Flow Type	Subcritical	

Check permissible shear stress:

2.11 ft × 0.0007 ft/ft × 62.4 pcf = 0.09 psf

OK

Juk Net (Td) = 0.45 psf

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.11	ft
Critical Depth	1.16	ft
Channel Slope	0.00070	ft/ft
Critical Slope	0.00801	ft/ft

RCEC-024-DC-0001
K-21

Channel A
Worksheet for 15-yr - 0.0025 ft/ft (Earth 0.03)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00250	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	32.67	ft^3/s

Results

Normal Depth	1.10	ft
Flow Area	14.58	ft^2
Wetted Perimeter	16.94	ft
Top Width	16.58	ft
Critical Depth	0.65	ft
Critical Slope	0.01627	ft/ft
Velocity	2.24	ft/s >2 ft/s → Need temp. lining
Velocity Head	0.08	ft
Specific Energy	1.18	ft
Froude Number	0.42	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.10	ft
Critical Depth	0.65	ft
Channel Slope	0.00250	ft/ft
Critical Slope	0.01627	ft/ft

RCEC-024-DC-0001
K-22

Channel A
Worksheet for 15-yr - 0.0025 ft/ft (Grass 0.05)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.00250	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	32.67	ft^3/s

Results

Normal Depth	1.45	ft
Flow Area	20.81	ft^2
Wetted Perimeter	19.17	ft
Top Width	18.70	ft
Critical Depth	0.65	ft
Critical Slope	0.04519	ft/ft
Velocity	1.57	ft/s
Velocity Head	0.04	ft
Specific Energy	1.49	ft
Froude Number	0.26	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.45	ft
Critical Depth	0.65	ft
Channel Slope	0.00250	ft/ft
Critical Slope	0.04519	ft/ft

RCEC-024-DC-0001
K-23

Channel A
Worksheet for 15-yr - 0.0025 ft/ft (ECB 0.022)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.022	
Channel Slope	0.00250	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	32.67	ft^3/s

Results

Normal Depth	0.92	ft
Flow Area	11.79	ft^2
Wetted Perimeter	15.84	ft
Top Width	15.54	ft
Critical Depth	0.65	ft
Critical Slope	0.00875	ft/ft
Velocity	2.77	ft/s
Velocity Head	0.12	ft
Specific Energy	1.04	ft
Froude Number	0.56	
Flow Type	Subcritical	

permissible shear stress

Jute Net : 0.45 psf

0.92 ft X 0.0025 ft/ft X 62.4 pcf = 0.14 psf

OK

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.92	ft
Critical Depth	0.65	ft
Channel Slope	0.00250	ft/ft
Critical Slope	0.00875	ft/ft

RCEC-024-DC-0001

K-24

Channel A
Worksheet for 100-yr - 0.0025 ft/ft (Earth 0.03)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00250	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	43.17	ft^3/s

Results

Normal Depth	1.28	ft	
Flow Area	17.69	ft^2	
Wetted Perimeter	18.09	ft	
Top Width	17.67	ft	
Critical Depth	0.77	ft	
Critical Slope	0.01551	ft/ft	
Velocity	2.44	ft/s	>2 ft/s - Need temp. lining
Velocity Head	0.09	ft	
Specific Energy	1.37	ft	
Froude Number	0.43		
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.28	ft
Critical Depth	0.77	ft
Channel Slope	0.00250	ft/ft
Critical Slope	0.01551	ft/ft

RCEC-024-DC-0001
K-25

Channel A
Worksheet for 100-yr - 0.0025 ft/ft (Grass 0.05)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.00250	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	43.17	ft^3/s

Results

Normal Depth	1.68	ft
Flow Area	25.34	ft^2
Wetted Perimeter	20.65	ft
Top Width	20.10	ft
Critical Depth	0.77	ft
Critical Slope	0.04307	ft/ft
Velocity	1.70	ft/s
Velocity Head	0.05	ft
Specific Energy	1.73	ft
Froude Number	0.27	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.68	ft
Critical Depth	0.77	ft
Channel Slope	0.00250	ft/ft
Critical Slope	0.04307	ft/ft

RCEC-024-DC-0001
K-26

Channel A
Worksheet for 100-yr - 0.0025 ft/ft (ECB 0.03)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.022	
Channel Slope	0.00250	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	43.17	ft^3/s

Results

Normal Depth	1.08	ft
Flow Area	14.26	ft^2
Wetted Perimeter	16.82	ft
Top Width	16.47	ft
Critical Depth	0.77	ft
Critical Slope	0.00834	ft/ft
Velocity	3.03	ft/s
Velocity Head	0.14	ft
Specific Energy	1.22	ft
Froude Number	0.57	
Flow Type	Subcritical	

Jute Net: 0.45 psf

1.08 ft x 0.0025 ft/ft x 62.4 pcf = 0.17 psf

OK

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.08	ft
Critical Depth	0.77	ft
Channel Slope	0.00250	ft/ft
Critical Slope	0.00834	ft/ft

RCEC-024-DC-0001
K-27

ATTACHMENT L

Culvert Calculator Report
C-1-15-yr

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	9.00	ft	Headwater Depth/Height	1.19	
Computed Headwater Elevation	7.35	ft	Discharge	31.30	cfs
Inlet Control HW Elev.	6.71	ft	Tailwater Elevation	6.71	ft → Computed HW from C-2(15-yr)
Outlet Control HW Elev.	7.35	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	3.79	ft	Downstream Invert	3.70	ft
Length	100.00	ft	Constructed Slope	0.000900	ft/ft

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	3.01	ft
Slope Type	N/A		Normal Depth	N/A	ft
Flow Regime	N/A		Critical Depth	1.81	ft
Velocity Downstream	4.43	ft/s	Critical Slope	0.004058	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.012	
Section Material	Corrugated HDPE (Smooth Interior)		Span	3.00	ft
Section Size	36 inch		Rise	3.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	7.35	ft	Upstream Velocity Head	0.30	ft
Ke	0.50		Entrance Loss	0.15	ft

Inlet Control Properties					
Inlet Control HW Elev.	6.71	ft	Flow Control	Unsubmerged	
Inlet Type	Square edge w/headwall		Area Full	7.1	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

RCEC-024-DC-0001
L-1

Culvert Calculator Report
C-1-100-yr

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	9.00 ft	Headwater Depth/Height	1.53
Computed Headwater Elevation	8.39 ft	Discharge	40.90 cfs
Inlet Control HW Elev.	7.29 ft	Tailwater Elevation	7.29 ft ← Computed HW from C-2 (100-yr)
Outlet Control HW Elev.	8.39 ft	Control Type	Outlet Control

Grades			
Upstream Invert	3.79 ft	Downstream Invert	3.70 ft
Length	100.00 ft	Constructed Slope	0.000900 ft/ft

Hydraulic Profile			
Profile	PressureProfile	Depth, Downstream	3.59 ft
Slope Type	N/A	Normal Depth	N/A ft
Flow Regime	N/A	Critical Depth	2.08 ft
Velocity Downstream	5.79 ft/s	Critical Slope	0.004670 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.012
Section Material	Corrugated HDPE (Smooth Interior)	Span	3.00 ft
Section Size	36 inch	Rise	3.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	8.39 ft	Upstream Velocity Head	0.52 ft
Ke	0.50	Entrance Loss	0.26 ft

Inlet Control Properties			
Inlet Control HW Elev.	7.29 ft	Flow Control	Unsubmerged
Inlet Type	Square edge w/headwall	Area Full	7.1 ft²
K	0.00980	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	1
C	0.03980	Equation Form	1
Y	0.67000		

RCEC-024-DC-0001
L-2

Culvert Calculator Report
C-2-15-yr

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	8.00	ft	Headwater Depth/Height	1.00	
Computed Headwater Elevation	6.71	ft	Discharge	31.30	cfs
Inlet Control HW Elev.	6.47	ft	Tailwater Elevation	5.88	ft → 3.63' + 2.25'
Outlet Control HW Elev.	6.71	ft	Control Type	Outlet Control	

↑ INV. ↑ 15-yr depth for Diversion Channel B (0.05)

Grades					
Upstream Invert	3.70	ft	Downstream Invert	3.63	ft
Length	70.00	ft	Constructed Slope	0.001000	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	2.25	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.81	ft
Velocity Downstream	5.50	ft/s	Critical Slope	0.004058	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.012	
Section Material	Corrugated HDPE (Smooth Interior)		Span	3.00	ft
Section Size	36 inch		Rise	3.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	6.71	ft	Upstream Velocity Head	0.42	ft
Ke	0.50		Entrance Loss	0.21	ft

Inlet Control Properties					
Inlet Control HW Elev.	6.47	ft	Flow Control	Unsubmerged	
Inlet Type	Square edge w/headwall		Area Full	7.1	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

RCEC-024-DC-0001
L-3

Culvert Calculator Report
C-2-100-yr

Solve For: Headwater Elevation

Culvert Summary				
Allowable HW Elevation	8.00 ft	Headwater Depth/Height	1.20	
Computed Headwater Elevation	7.29 ft	Discharge	40.90 cfs	
Inlet Control HW Elev.	7.06 ft	Tailwater Elevation	6.16 ft	→ 3.63' + 2.53'
Outlet Control HW Elev.	7.29 ft	Control Type	Outlet Control	INV. ↑

100-YR Depth for Diversion Channel B (0.05)

Grades			
Upstream Invert	3.70 ft	Downstream Invert	3.63 ft
Length	70.00 ft	Constructed Slope	0.001000 ft/ft

Hydraulic Profile			
Profile	M2	Depth, Downstream	2.53 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	2.08 ft
Velocity Downstream	6.43 ft/s	Critical Slope	0.004670 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.012
Section Material	Corrugated HDPE (Smooth Interior)	Span	3.00 ft
Section Size	36 inch	Rise	3.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	7.29 ft	Upstream Velocity Head	0.57 ft
Ke	0.50	Entrance Loss	0.28 ft

Inlet Control Properties			
Inlet Control HW Elev.	7.06 ft	Flow Control	Unsubmerged
Inlet Type	Square edge w/headwall	Area Full	7.1 ft²
K	0.00980	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	1
C	0.03980	Equation Form	1
Y	0.67000		

RCEC-024-DC-0001
L-4

Culvert Calculator Report
C-3-15-yr

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	8.00 ft	Headwater Depth/Height	1.08
Computed Headwater Elevation	6.50 ft	Discharge	31.30 cfs
Inlet Control HW Elev.	6.03 ft	Tailwater Elevation	5.95 ft → 3.23' + 2.72'
Outlet Control HW Elev.	6.50 ft	Control Type	Outlet Control

INV.

15-yr depth for Diversion Channel C (0.05)

Grades			
Upstream Invert	3.26 ft	Downstream Invert	3.23 ft
Length	30.00 ft	Constructed Slope	0.001000 ft/ft

Hydraulic Profile			
Profile	M2	Depth, Downstream	2.72 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	1.81 ft
Velocity Downstream	4.65 ft/s	Critical Slope	0.004058 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.012
Section Material	Corrugated HDPE (Smooth Interior)	Span	3.00 ft
Section Size	36 inch	Rise	3.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	6.50 ft	Upstream Velocity Head	0.33 ft
Ke	0.50	Entrance Loss	0.17 ft

Inlet Control Properties			
Inlet Control HW Elev.	6.03 ft	Flow Control	Unsubmerged
Inlet Type	Square edge w/headwall	Area Full	7.1 ft²
K	0.00980	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	1
C	0.03980	Equation Form	1
Y	0.67000		

RCEC-024-DC-0001
L-5

Culvert Calculator Report
C-3-100-yr

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	8.00	ft	Headwater Depth/Height	1.31	
Computed Headwater Elevation	7.18	ft	Discharge	40.90	cfs
Inlet Control HW Elev.	6.62	ft	Tailwater Elevation	6.30	ft
Outlet Control HW Elev.	7.18	ft	Control Type	Outlet Control	

→ 3.23' + 3.07'

Inv.

100-yr depth for Diversion Channel C (0.05)

Grades					
Upstream Invert	3.26	ft	Downstream Invert	3.23	ft
Length	30.00	ft	Constructed Slope	0.001000	ft/ft

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	3.07	ft
Slope Type	N/A		Normal Depth	N/A	ft
Flow Regime	N/A		Critical Depth	2.08	ft
Velocity Downstream	5.79	ft/s	Critical Slope	0.004670	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.012	
Section Material	Corrugated HDPE (Smooth Interior)		Span	3.00	ft
Section Size	36 inch		Rise	3.00	ft
Number Sections	1				

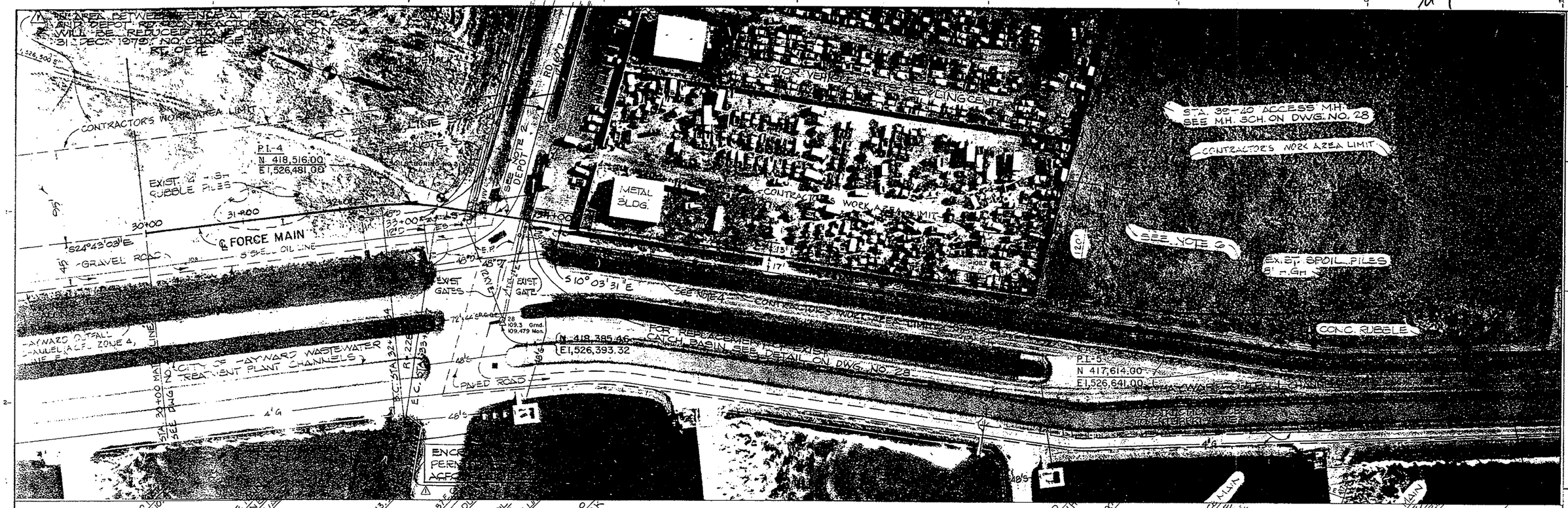
Outlet Control Properties					
Outlet Control HW Elev.	7.18	ft	Upstream Velocity Head	0.52	ft
Ke	0.50		Entrance Loss	0.26	ft

Inlet Control Properties					
Inlet Control HW Elev.	6.62	ft	Flow Control	Unsubmerged	
Inlet Type	Square edge w/headwall		Area Full	7.1	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

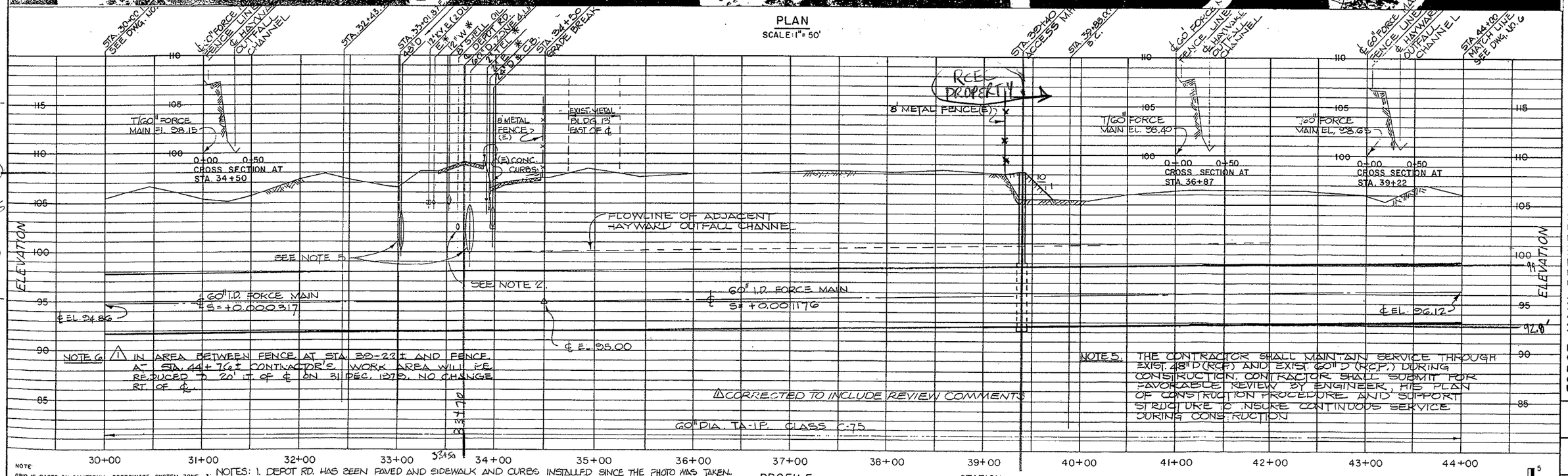
RCEC-024-DC-0001
L-6

ATTACHMENT M

RCEC-624-DC-0001
M-1



PLAN
SCALE: 1" = 50'



PROFILE
HORIZ. SCALE: 1" = 50'
VERT. SCALE: 1" = 5'

NOTE:
GRID IS BASED ON CALIFORNIA COORDINATE SYSTEM, ZONE 3.
FIELD SURVEY CONTROL BY TOWILL INC.
ELEVATIONS ARE BASED ON MEAN SEA LEVEL DATUM 1929 ADJ.
PLUS 100 FEET.
DATE OF PHOTOGRAPHY - 1975
ORTHOPHOTO MAP BY TOWILL, INC.

NOTES:
1. DEPOT RD. HAS BEEN PAVED AND SIDEWALK AND CURBS INSTALLED SINCE THE PHOTO WAS TAKEN.
2. THE CONTRACTOR SHALL CALL MR. WENDELL WILLIAMS, SHELL MAINTENANCE FOREMAN, (228-4285) 48 HOURS PRIOR TO EXCAVATING NEAR THE 8" SHELL OIL LINE.
3. THE THREE CROSS SECTIONS SHOWN ON THIS SHEET ARE CUT LOOKING SOUTHERLY.
4. BETWEEN STA. 34+48± AND STA. 39-22 ± THE CONTRACTOR SHALL CONSTRUCT A TEMPORARY 6'-0" HIGH CHAIN LINK FENCE W/3 STRANDS OF BARBED WIRE ON TOP, SLANTED OUT. THE EXIST. 8'-0" HIGH METAL FENCE (METAL POSTS SET IN 12" SQ. CONCRETE FOOTINGS 8'-0" CC.) SHALL BE REMOVED, STORED & REPLACED AFTER CONSTRUCTION BY CONTRACTOR. CONTRACTOR SHALL REMOVE TEMPORARY FENCE AFTER METAL FENCE IS REPLACED. AUTOS AND AUTO PARTS WILL BE REMOVED & REPLACED BY OTHERS. THERE ARE FOUR TELEPHONE AND ONE SPEAKER SYSTEM WIRES RUNNING ALONG THE TOP OF THE EXIST. METAL FENCE. THE CONTRACTOR SHALL TEMPORARILY SUPPORT THESE WIRES ON TOP OF THE CHAIN LINK FENCE AND REPLACE THEM AFTER THE METAL FENCE IS REPLACED. THERE IS A 1½" PLASTIC WATER PIPE RUNNING ALONG THE BOTTOM OF THE EXISTING METAL FENCE. THE CONTRACTOR SHALL INSTALL A TEMPORARY WATER SERVICE ALONG CHAIN LINK FENCE TO A POINT 30 FT. SOUTH OF EXIST. METAL BUILDING. CONTRACTOR SHALL RESTORE PLASTIC WATER PIPE TO ITS ORIGINAL CONDITION ALONG BOTTOM OF METAL FENCE AFTER METAL FENCE IS REPLACED.

GRAPHIC SCALES: 1" = 50' (0, 50, 100); 1" = 5' (0, 1, 2, 3, 4, 5)

THIS PRINT REDUCED HALF SCALE

DESIGN	CHECKED	DATE
SS		
DRAWN		
M. Eng		2 Aug 77

EAST BAY DISCHARGERS AUTHORITY
ALAMEDA COUNTY, CALIFORNIA
WATER QUALITY MANAGEMENT PROGRAM - PHASE I

FORCE MAIN BETWEEN HAYWARD AND ALVARADO

PLAN AND PROFILE

JOB N 6127

SCAL AS SHO

DWG. 5

RCEC-024-PC-0001
M-2

DATUM PLANES

ON THESE DATUM PLANES 0.00 IS ABOVE MEAN SEA LEVEL THE NUMBER OF FEET INDICATED.

8.616	City of San Francisco (City Engineer 12/10/64)
5.730	* Highest Tide at Pt. San Quentin Estimated (State Chart 11/19/51)
5.470	* Highest Tide at Pt. Richmond Estimated (State Chart 11/19/51)
5.200	* Highest Tide at Presidio 12/24/40 (State Chart 11/19/51)
3.410	City of Alameda (City Engineer 1/7/65)
3.26	Emeryville
3.17	Berkeley
3.00	City of Oakland (City Engineer 12/10/64)
2.87	* M.H.H.W. at Pt. Richmond (State Chart 11/19/51)
2.80	San Leandro (Prior to 1960)
2.65	* S.P.R.R. Coast Division (2.61 M.H.H.W. at Presidio State Chart 11/19/51)
2.03	* M.H.H.W. at Presidio (State Chart 11/19/51)
VARIES	EBMUD Mokelumne Aqueduct (Varies - See Published Lists)

0.00 USC&GS Mean Sea Level Datum of 1929:

- Alameda County
- Alameda County Flood Control & Conservation District
- Albany
- Bay Area Rapid Transit District (Verified by R.M. Towill Inc.)
- California Division of Highways Dist. IV (Since 1956)
- Central Contra Costa Sanitary District
- Concord
- Contra Costa County
- Contra Costa County Flood Control
- E.B.M.U.D.
- El Cerrito (Ord. #7100)
- Hayward
- Richmond
- Richmond - San Rafael Bridge
- San Leandro (Since 1960)
- San Pablo
- Webster St. Tube

ON THESE DATUM PLANES 0.00 IS BELOW MEAN SEA LEVEL THE NUMBER OF FEET INDICATED.

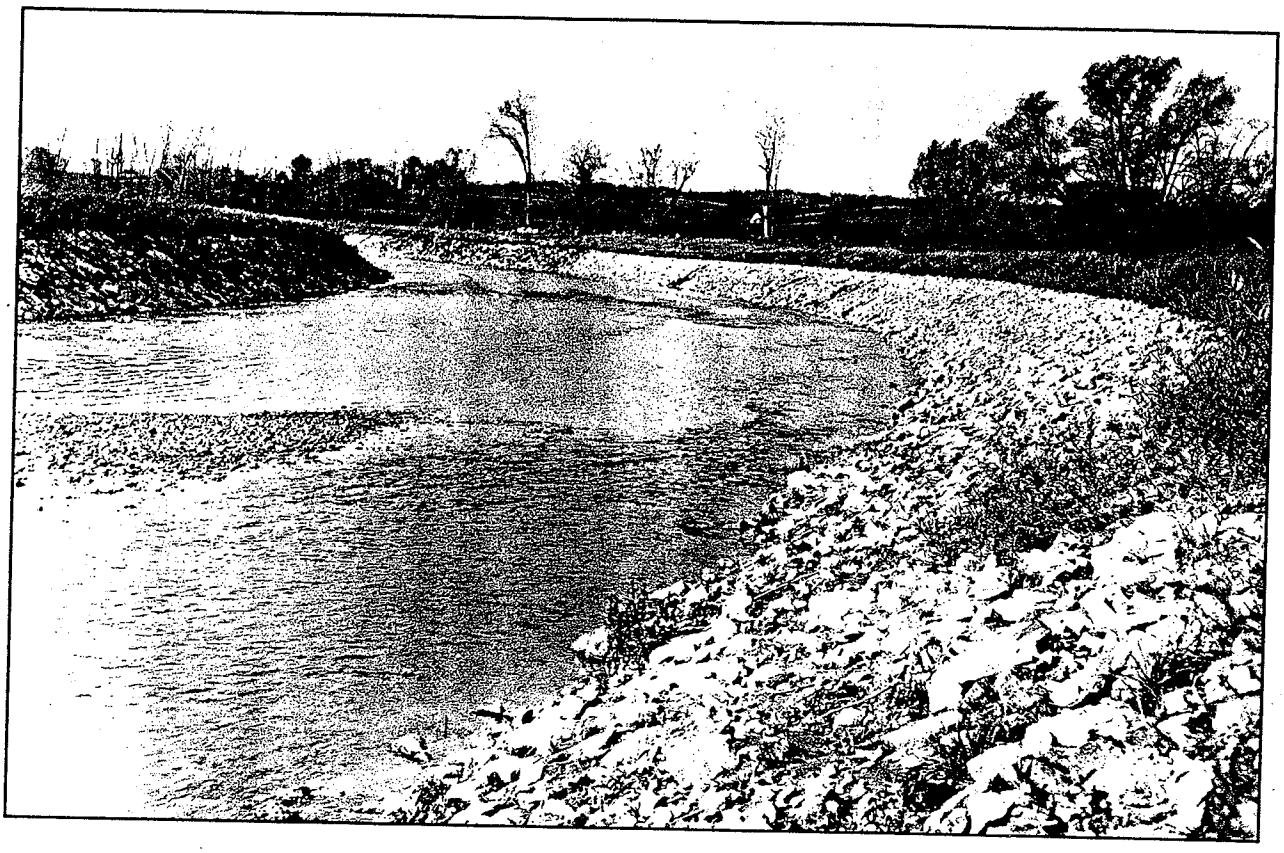
-1.44	San Pablo Reservoir (At San Pablo Dam)
-1.51	San Pablo Reservoir (At San Pablo Filter Plant)
-2.171	Richmond (Prior to 1962)
-2.77	* M.L.L.W. Pt. San Quentin (State Chart 11/19/51)
-2.83	* M.L.L.W. Pt. San Pablo (State Chart 11/19/51)
-3.03	* M.L.L.W. Pt. Richmond (State Chart 11/19/51)
-3.10	* S.F.O.B.B. & Parallel Bridge, M.L.L.W. at Presidio (State Chart 11/19/51)
-3.20	Port of Oakland (Since 1959)
-3.817	* C.P. Ry. (Western Div. - East Bay) (State Chart 11/19/51)
-4.25	* State Hwy. #1, S.F.O.B.B. East Bay Approaches (State Chart 11/19/51)
-5.50	* Lowest Tide Presidio (State & E.B.M.U.D.)
-8.600	* Bottom Presidio Staff Gage (State Charts)
-97.011	* Posey Tube Datum
-100.00	E.B.M.U.D. Water Pollution Control Div.

NOTES:

1. An elevation based on a special datum may be converted to an elevation based on USC&GS mean sea level datum by adding the indicated difference.
2. All elevations are vertical distances above or below a level surface. This surface or level datum is assumed to remain at a fixed elevation whereas the record elevation of bench marks may vary due to discrepancies, movement of marks, and readjustment of level lines. For these reasons a conversion chart is limited as to accuracy and on any project where a dependable relationship of level data is required a field check should be made.
3. * Information obtained in 1959 or earlier and not verified for this edition.

ALAMEDA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT	**BAY AREA DATUM PLANES**	DATE: FEBRUARY 1987 **FIGURE 12**

ATTACHMENT N



SUGGESTED SIZES

Depending on the factors involved in the final decision and the stone products generally available, the following is offered:

Table 1

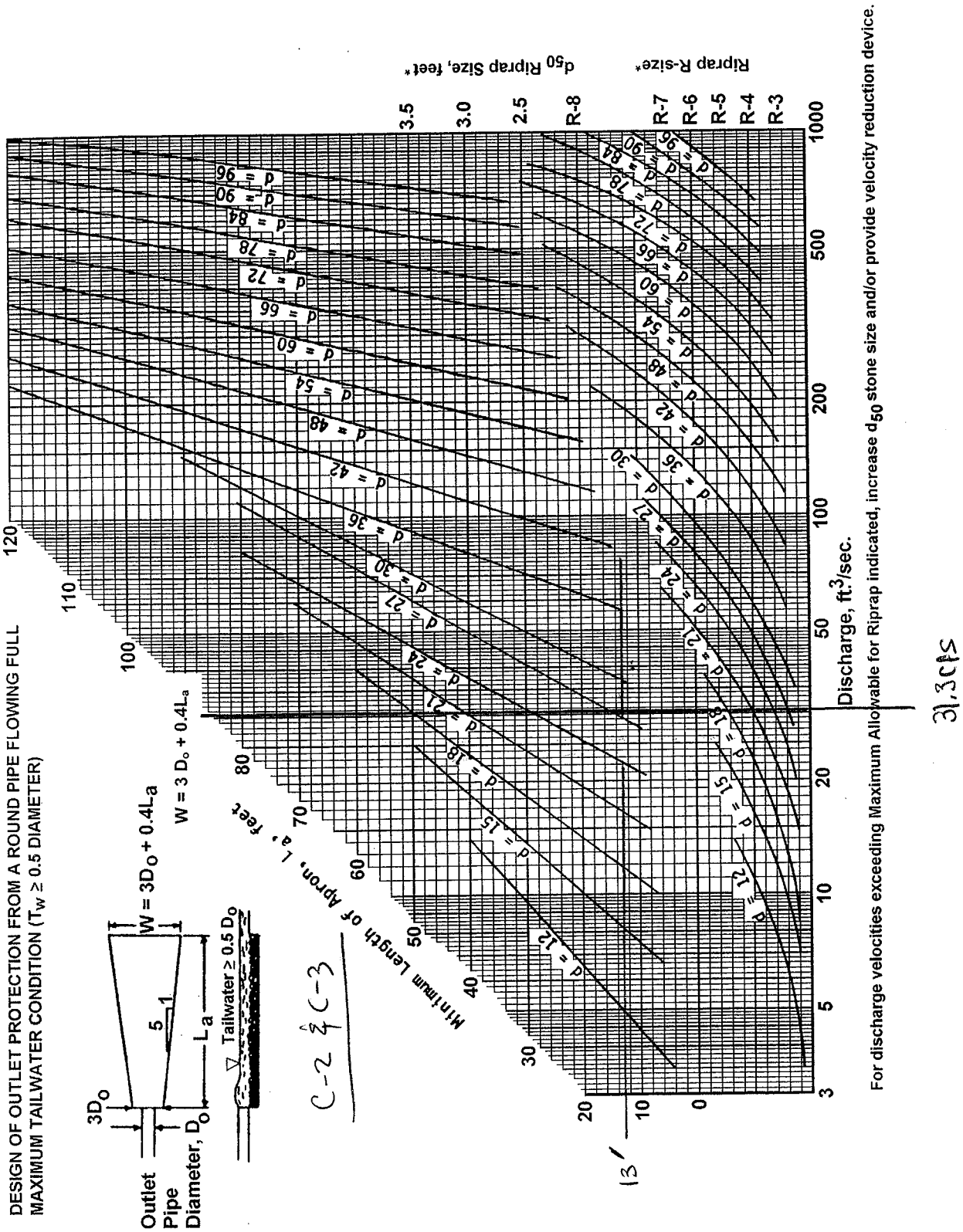
Flow Velocity (ft./sec.)	GRADED RIPRAP STONE Size Inches (sq. openings) NSA No.	Max.	Avg.	Min.	Filter Stone NSA No.
2.5	R-1	1½	¾	No. 8	FS-1
4.5	R-2	3	1½	1	FS-1
6.5	R-3	6	3	2	FS-1
9.0	R-4	12	6	3	FS-2
11.5	R-5	18	9	5	FS-2
13.0	R-6	24	12	7	FS-3
14.5	R-7	30	15	12	FS-3

Notes:
- See appendix for more complete information on riprap sizes and filter stone requirements.
- Flow velocities measured at mid-stream or 10 ft. from eroding bank, whichever is closest to bank.
- Stone sizes could be reduced about 30 percent for side slopes of 6 to 1.

REFERENCES RECOMMENDED: 2, 4, 8, 15, 16 (See page 30.)

RCEC-024-DC-0001
N-1

FIGURE 22
Riprap Apron Design, Maximum Tailwater Condition



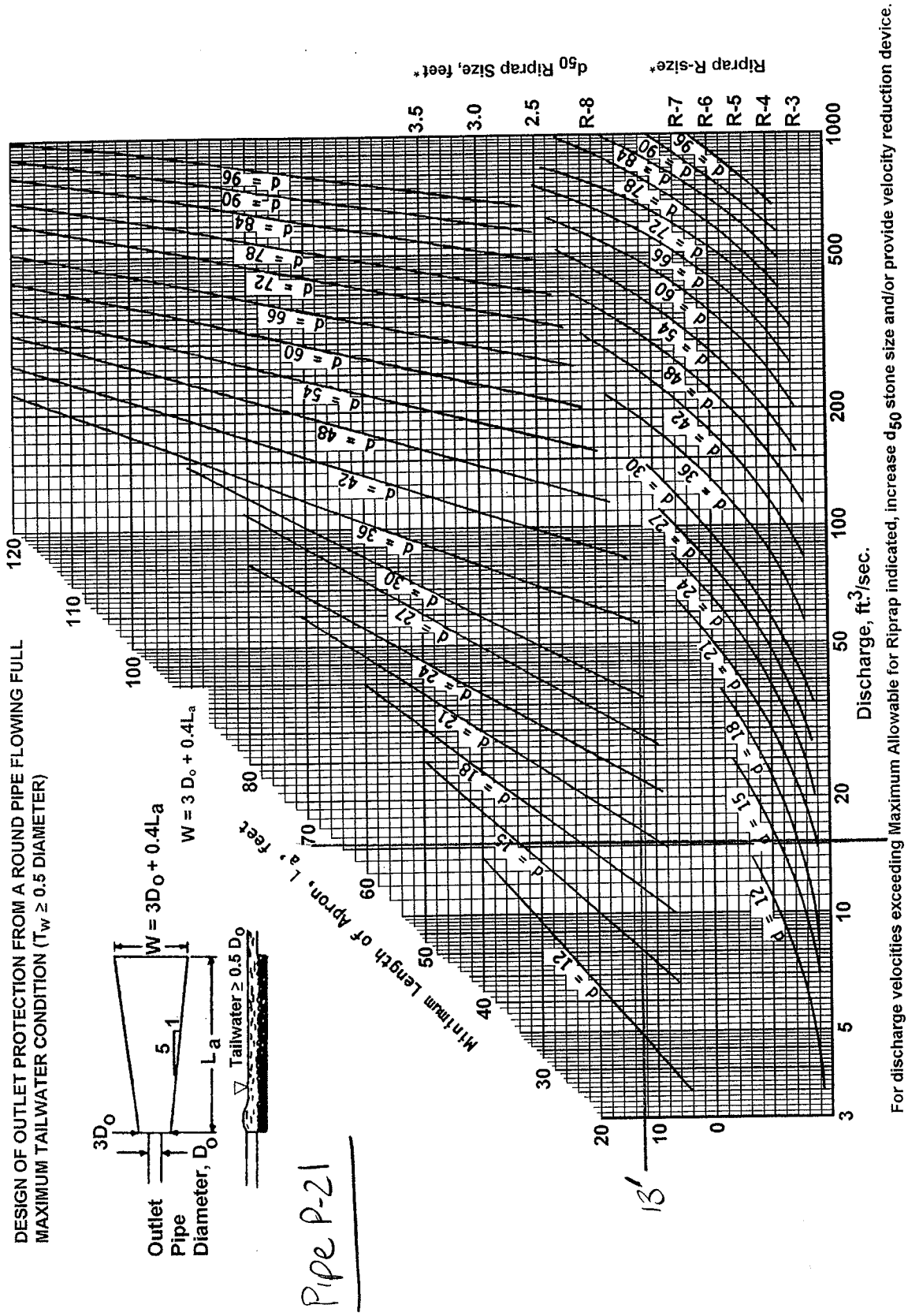
C-2 & C-3

13'

31.3 cfs

REEC-024-DC-0001
N-2

FIGURE 22
Riprap Apron Design, Maximum Tailwater Condition



RCEC-024-DC-0001
N-3

APPENDIX 2B

Erosion and Sediment Control Plan

WorleyParsons
resources & energy

CALCULATION COVER SHEET

REGISTERED PROFESSIONAL ENGINEER PRADIP KUMAR KHAN No. 54262 Exp. 12-31-07 CIVIL STATE OF CALIFORNIA

See electronic signature for date and time

CLIENT	Calpine		
PROJECT	Russell City Energy Center, Alameda County, California		
SUBJECT	Erosion and Sediment Control		
JOB NUMBER	53794801	WBS NUMBER	024
CALCULATION NO.:	RCEC-024-DC-0002	PAGE 1 OF	5

DESCRIPTION/PURPOSE

Design erosion and sediment control BMPs for use during construction of the site at the Russell City Energy Center. The design for the erosion and sediment control Best Management Practices (BMPs) will be in accordance with the California Stormwater Quality Association (CASQA), California Stormwater BMP Handbook.

METHOD OF ANALYSIS

Use the procedures described in the CASQA, California Stormwater BMP Handbook, Construction, Fact Sheets for the design of the BMPs.

CODES AND STANDARDS

None applicable.

REFERENCES

1. Federal Emergency Management Agency (FEMA), National Flood Insurance Program, Flood Boundary and Floodway Map, Flood Insurance Rate Maps (FIRM), Panels 10, 11, and 19 of 29, February 9, 2000.
2. City of Hayward, Hayward Municipal Code, 2006.
3. Alameda County General Ordinance Code, Matthew Bender & Company, Inc., 2006.
4. California Stormwater Quality Association, California Stormwater Best Management Practice (BMP) Handbook, January 2003.

ASSUMPTIONS

Contained in body of calculation.

CONCLUSIONS OR RESULTS

The construction storm water management and erosion and sediment control for the site meets the requirements of California Stormwater Quality Association (CASQA), California Stormwater BMP Handbook, Construction.

REV	DATE	DESCRIPTION	PAGES REVISED	PAGES ADDED	PAGES DELETED	BY/DATE	REV/DATE	LDE/DATE
D								
C								
B								
A	11-6-06	ORIGINAL ISSUE	NA	NA	NA	D. Shetty 11-6-06	R. Winterhalter 11-13-06	Pradip Khan 11/14/06

TABLE OF CONTENTS

TITLE	PAGE
PROJECT DESIGN CRITERIA FOR EROSION AND SEDIMENT CONTROL	3
1. Location	
2. Flood Control	3
3. Erosion and Sediment Control BMPs	3
4. General Construction Sequence	3
CONSTRUCTION LAYDOWN AREAS	4
EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICES	4
CONCLUSIONS	5

LIST OF ATTACHMENTS

A. Erosion and Sediment Control Plan (RC-GEN-DE-C1-0007)
B. Construction Laydown Areas (RC-GEN-DE-C1-0003)
C. Erosion and Sediment Control BMP Fact Sheets
D. Erosion and Sediment Control Details (RC-GEN-DE-C1-0008)

PROJECT DESIGN CRITERIA FOR EROSION AND SEDIMENT CONTROL

1. Location

   The site for the proposed Russell City Energy Center is located in Alameda County, California, and north of State Highway 92 and between Depot Road and Enterprise Road on various parcels. The total disturbed area is 15.5 acres. The Erosion and Sediment Control Plan is given in Attachment A.

2. Flood Control:

   According to the FIRM maps, (Reference 1), the southwest portion of the site falls within a flood zone, Zone A1. The base flood elevation (also called the 100-yr flood) is seven (7) feet above mean sea level (MSL) in the vicinity of the project site. From Reference 2, Chapter 9, Article 4, Flood Plain Management, Section 9.-4.110, for Zone A, the lowest floor shall be elevated to a level at or above the base flood elevation. From Reference 3, Article III, Permit Standards for Floodplain Management, the lowest floor shall be at least one foot above the base flood elevation.

   The finished floor for all structures shall be set at elevation +10.0 ft. and the site will be graded at a minimum slope of 0.5%, where appropriate.

3. Erosion and Sediment Control Best Management Practices (BMPs)

   The following best management practices (BMPs) are to be utilized at this site: velocity dissipation devices; silt fence; check dams; stabilized construction entrance/exit; stabilized construction roadway; entrance/outlet tire wash; stabilized temporary construction laydown areas; straw mulch and geotextiles and mats; street sweeping and vacuuming; storm drain inlet protection; stabilized temporary drainage swales; dewatering of excavations. All of these BMPs shall be implemented following the CASQA, California Stormwater BMP Handbook (Reference 4) Fact Sheets specific to that BMP (Attachment C).

4. General Construction Sequence:

   a. Construct diversion channels and Channel A around site perimeter.

   b. Before vegetation is established, install silt fence on the upstream side of the diversion channels and Channel A and also around site perimeter. Once vegetation is established in the channels, the silt fence can be removed.

   c. Install catch basin and pipes in the switchyard area. Use storm inlet protection until switchyard construction is completed. Once the switchyard area is stabilized with gravel, it can be utilized as a laydown area. Temporary swales may be required to collect runoff until the storm system is constructed.

   d. Install catch basin and pipes in the power block. Use storm inlet protection until construction is completed in the power block.

   e. Install catch basin and pipes in the area of the cooling tower. Use storm inlet protection until construction is completed.

CONSTRUCTION LAYDOWN AREAS

Two areas located south of the proposed Russell City Site will be used as construction laydown areas (Parcel numbers APN 439009900307 and 439009903302). The construction laydown areas are shown on drawing RC-GEN-DE-C1-0003 (Attachment B).

1. Parcel APN 439009900307

   The laydown area is approximately 3.92 acres. There is existing gravel as surfacing for an area of about 2.25 acres and no changes will be made to the surfacing. The grading will also not be changed in this area; therefore, no erosion and sediment control BMPs are required.

2. Parcel APN 439009903302

   The laydown area is approximately 1.29 acres. The existing surfacing is bare soil with visible grass and brush. A minimum 6" of gravel will be required in this area for laydown. No grading changes will be made as the existing site drains to the southwest. A silt fence will be installed around the west and south perimeter and a construction entrance will be required.

EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICES

1. Silt Fence (SE-1)

   Silt fence will be used to filter sediment-laden runoff from areas until site stormwater system is installed. Silt fence will be installed in the locations indicated on the E & S Plan (Attachment A) following the procedures described in CASQA Fact Sheet SE-1.

2. Check Dam (SE-4)

   Check Dams will be used in the diversion channels and Channel A to trap sediment and form small pools to reduce the velocity of the water so sediment can settle. Check dams shall be placed according to locations shown on the E & S Plan following the procedures described in CASQA Fact Sheet SE-4.

3. Street Sweeping and Vacuuming (SE-7)

   Street sweeping and vacuuming shall be implemented anywhere sediment is tracked from the project site onto public or private paved streets and roads, typically at points of egress. Sweeping and vacuuming are also applicable during preparation of paved surfaces for final paving.

4. Storm Drain Inlet Protection (SE-10)

   Storm drain inlet protection shall be used to trap sediment before it enters the storm drain system and keep catch basins and storm drain pipes free of sediment deposition during construction. Install storm drain inlet protection as construction of each inlet is completed.

5. Stabilized Construction Entrance/Exit (TC-1)

   A stabilized construction entrance/exit will be provided at the access road to the site as shown on the E & S Plan (Attachment A), following the procedures outlined in CASQA Fact Sheet TC-1. The stabilized construction entrance/exit will be at minimum 50' long, at minimum 30' wide, and have at minimum a 20' turning radius from the adjacent existing roadway. AASHTO M43 Size No. 1 crushed aggregate shall be laid at a minimum thickness of 12", and a filter fabric is to be provided underneath the aggregate.

6. Stabilized Construction Roadway (TC-2)

   A stabilized construction roadway is to be provided following the procedures outlined in CASQA Fact Sheet TC-2. The roadway shall be 24" wide and slope down from the crown at 2%. CALTRANS aggregate subbase, Class 3 shall be laid at a minimum thickness of 12".

7. Entrance/Outlet Tire Wash (TC-3)

   An entrance/outlet tire wash is to be provided at the stabilized construction entrance/exit as shown on the E & S Plan (Attachment A), following the procedures outlined in CASQA Fact Sheet TC-3.

8. Temporary Construction Laydown Areas

   Temporary construction laydown areas, shown on drawing RC-GEN-DE-C1-0003 (Attachment B), shall be surfaced with coarse aggregate to protect against erosion.

9. Straw Mulch (EC-6) and Geotextiles and Mats (EC-7)

   Straw mulch shall be used to provide temporary protection against erosion for disturbed soil areas and to enhance plant establishment during seeding. Geotextiles and mats shall be used to cover soil surfaces to protection against erosion and stabilize soils until vegetation is established. All areas that will remain exposed for longer than 20 days shall be immediately temporary seeded and/or mulched with straw mulch or erosion control mats to stabilize the soil and reduce damage from erosion, sediment deposition, and runoff to down-gradient areas.

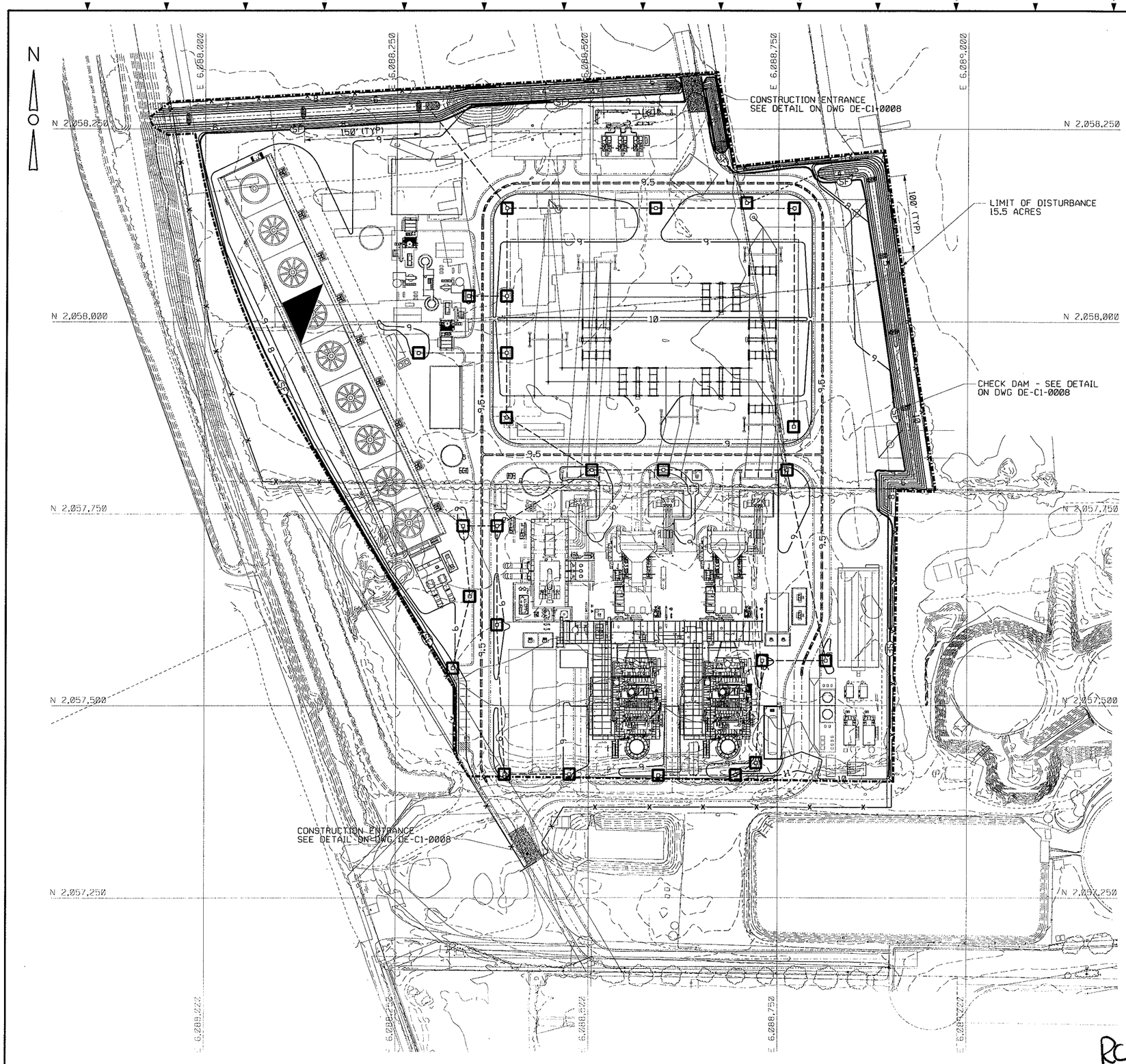
10. Dewatering of Excavations

    All excavations will be dewatered with dewatering pumps. The dewatering pumps will discharge into the permanent diversion channels and be conveyed to Channel A.

CONCLUSIONS

The construction storm water management and erosion and sediment control for the site meets the requirements of the California Stormwater Quality Association (CASQA), California Stormwater BMP Handbook, Construction.

ATTACHMENT A



LEGEND

- LIMIT OF DISTURBANCE
- SILT FENCE
- INLET SEDIMENT TRAP
- ROCK CHECK DAM

REFERENCES:

DE-C1-0001	FINAL SITE GRADING AND DRAINAGE PLAN
DE-C1-0008	EROSION AND SEDIMENT CONTROL DETAILS

60 0 60 120 180
SCALE IN FEET

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENGINEER	PROJECT ENGINEER	PROJECT MANAGER
A	11-13-06	ISSUED FOR CLIENT REVIEW	GU	AM	DS	PK	DE

DRAWN BY GJU	DATE 11-13-06
CHECKED BY ALM	DATE 11-13-06
ENGINEER D SETH	DATE 11-13-06
PROJECT ENGINEER P KHAN	DATE 11-13-06
PROJECT MANAGER DR ERALI	DATE 11-13-06

PROFESSIONAL ENGINEER STAMP

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA.

PRINT NAME PRADIP KHAN
SIGNATURE
DATE 11-13-06 LICENSE # 54262

ORIGINALLY PREPARED UNDER THE RESPONSIBLE SUPERVISION OF
PE#
LIC. NO.:
STATE:
DATE:

WorleyParsons

CALPINE

RUSSELL CITY ENERGY CENTER
HAYWARD, CALIFORNIA

CIVIL
GEN-GENERAL
EROSION AND SEDIMENT CONTROL
PLAN

SCALE 1"=60'

DWG NO. RC-GEN-DE-C1-0007 SHEET NO. 01 REVISION A

RCEC-024-PC-0002
A-1

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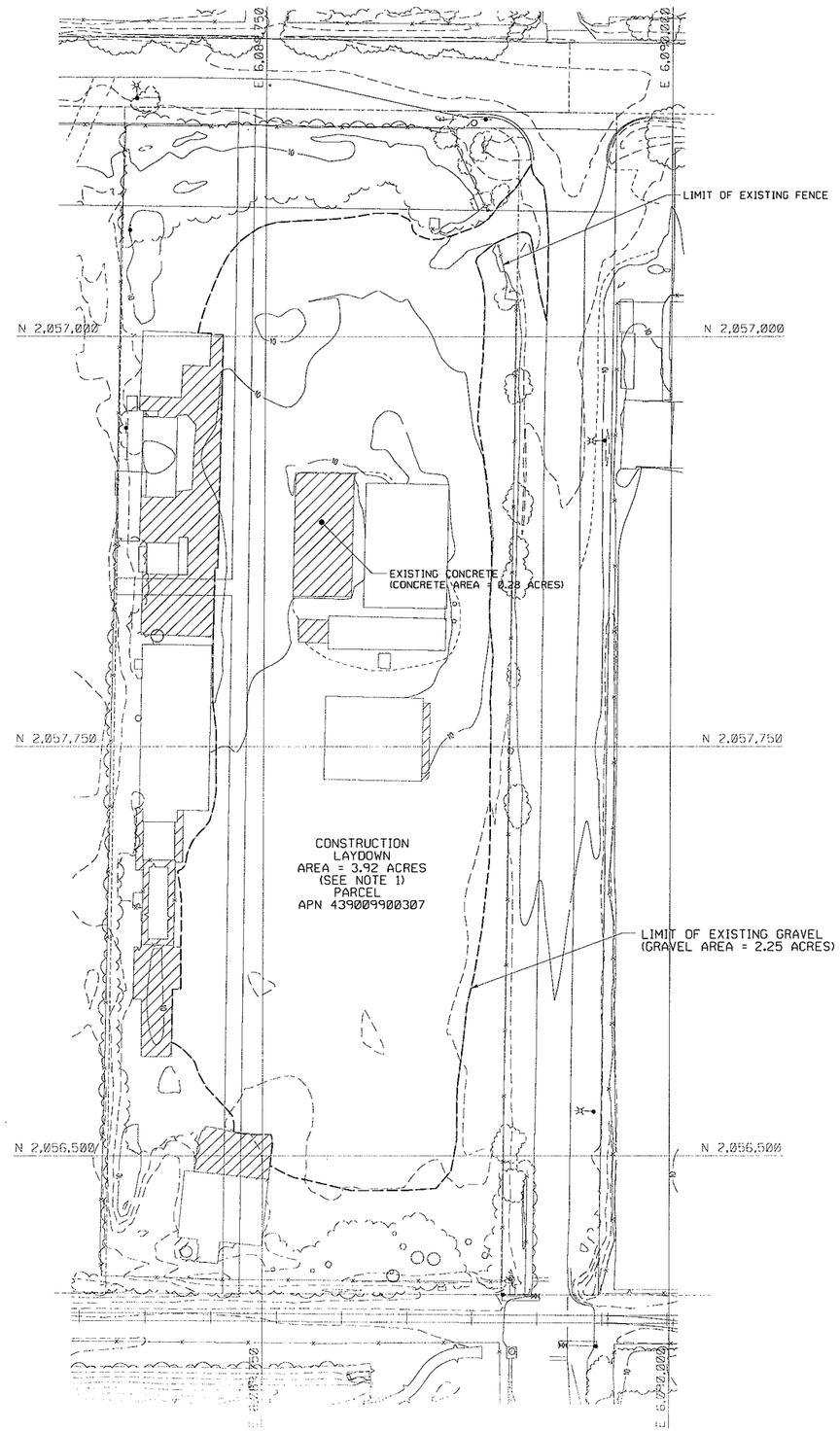
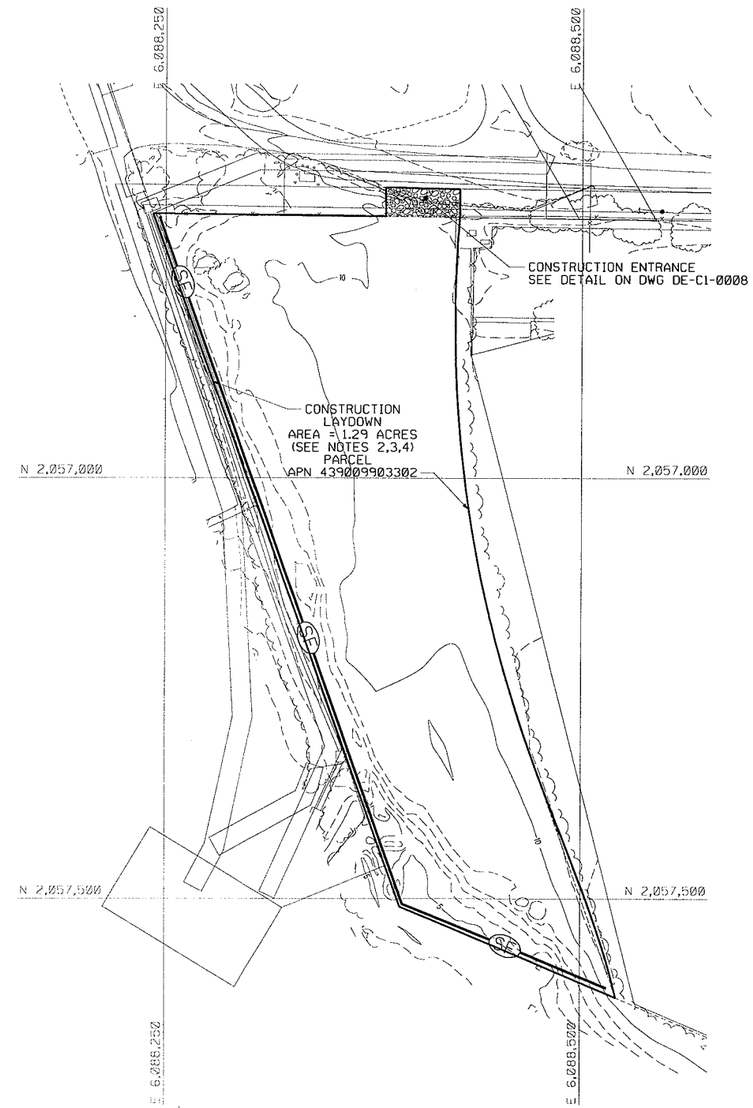


PLAN



PLAN

NOTES:

1. THE EXISTING GRADES, FEATURES AND SURFACING WILL REMAIN. NO CHANGES ARE REQUIRED FOR THIS CONSTRUCTION LAYDOWN AREA.
2. THE EXISTING GRADES AND FEATURES WILL REMAIN. HOWEVER, MINIMUM 6" OF GRAVEL SHALL BE PLACED (2" TO 3" AGGREGATE). AS PER CALTRAN STANDARD SPECIFICATIONS, SECTION 25.
3. CLEAR AND GRUB EXISTING AREA OF BRUSH WEEDS, ETC.
4. INSTALL SILT FENCE AS SHOWN ON DRAWING AND ACCORDING TO DE-C1-0008.

LEGEND

EXISTING GRADE CONTOUR

SF — SILT FENCE

REFERENCES:

FIGURE 1	SURVEY AREA (RECEIVED FROM CALPINE)
DE-C1-0008	EROSION AND SEDIMENT CONTROL DETAILS

40 0 40 80 120
SCALE IN FEET

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENGINEER	PROJECT ENGINEER	PROJECT MANAGER
A	11-13-06	ISSUED FOR CLIENT REVIEW	GU	AM	DS	PK	DE

	DATE
DRAWN BY: GJU	11-13-06
CHECKED BY: ALM	11-13-06
ENGINEER: D SHETH	11-13-06
PROJECT ENGINEER: P KHAN	11-13-06
PROJECT MANAGER: DR ERALI	11-13-06

PROFESSIONAL ENGINEER STAMP

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA.

PRINT NAME: PRADIP KHAN
SIGNATURE:
DATE: 11-13-06 LICENSE #: 54262
CITY:
LIC. NO.:
STATE:
DATE:

WorleyParsons

CALPINE

RUSSELL CITY ENERGY CENTER
HAYWARD, CALIFORNIA

CIVIL
GEN-GENERAL
CONSTRUCTION LAYDOWN AREA

SCALE: 1"=40'
DWG. NO.: RC-GEN-DE-C1-0003
SHEET NO.: 01
REVISION: A

REBC-024-DC-0002
B-1

VHL: Thu Jun 09 14:23:05 2005

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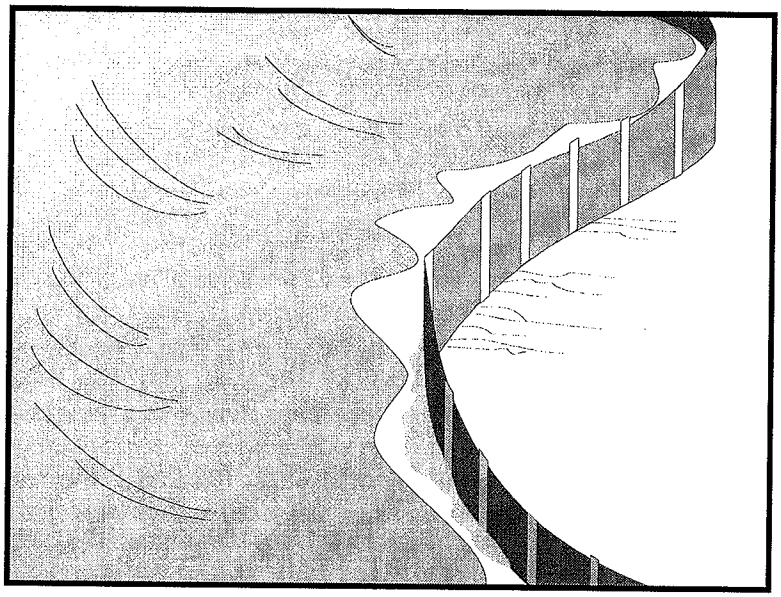
ATTACHMENT C

Silt Fence

SE-1



Objectives

EC	Erosion Control	✓
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

✓ **Primary Objective**

✓ **Secondary Objective**

Targeted Constituents

Sediment	✓
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

SE-9 Straw Bale Barrier

Description and Purpose

A silt fence is made of a filter fabric that has been entrenched, attached to supporting poles, and sometimes backed by a plastic or wire mesh for support. The silt fence detains sediment-laden water, promoting sedimentation behind the fence.

Suitable Applications

Silt fences are suitable for perimeter control, placed below areas where sheet flows discharge from the site. They should also be used as interior controls below disturbed areas where runoff may occur in the form of sheet and rill erosion. Silt fences are generally ineffective in locations where the flow is concentrated and are only applicable for sheet or overland flows. Silt fences are most effective when used in combination with erosion controls. Suitable applications include:

- Along the perimeter of a project.
- Below the toe or down slope of exposed and erodible slopes.
- Along streams and channels.
- Around temporary spoil areas and stockpiles.
- Below other small cleared areas.

Limitations

- Do not use in streams, channels, drain inlets, or anywhere flow is concentrated.

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- Do not use in locations where ponded water may cause flooding.
- Do not place fence on a slope, or across any contour line. If not installed at the same elevation throughout, silt fences will create erosion.
- Filter fences will create a temporary sedimentation pond on the upstream side of the fence and may cause temporary flooding. Fences not constructed on a level contour will be overtopped by concentrated flow resulting in failure of the filter fence.
- Improperly installed fences are subject to failure from undercutting, overlapping, or collapsing.
  - Not effective unless trenched and keyed in.
  - Not intended for use as mid-slope protection on slopes greater than 4:1 (H:V).
  - Do not allow water depth to exceed 1.5 ft at any point.

Implementation

General

A silt fence is a temporary sediment barrier consisting of filter fabric stretched across and attached to supporting posts, entrenched, and, depending upon the strength of fabric used, supported with plastic or wire mesh fence. Silt fences trap sediment by intercepting and detaining small amounts of sediment-laden runoff from disturbed areas in order to promote sedimentation behind the fence.

Silt fences are preferable to straw bale barriers in many cases. Laboratory work at the Virginia Highway and Transportation Research Council has shown that silt fences can trap a much higher percentage of suspended sediments than can straw bales. While the failure rate of silt fences is lower than that of straw bale barriers, there are many instances where silt fences have been improperly installed. The following layout and installation guidance can improve performance and should be followed:

- Use principally in areas where sheet flow occurs.
- Don't use in streams, channels, or anywhere flow is concentrated. Don't use silt fences to divert flow.
- Don't use below slopes subject to creep, slumping, or landslides.
- Select filter fabric that retains 85% of soil by weight, based on sieve analysis, but that is not finer than an equivalent opening size of 70.
- Install along a level contour, so water does not pond more than 1.5 ft at any point along the silt fence.
- The maximum length of slope draining to any point along the silt fence should be 200 ft or less.
- The maximum slope perpendicular to the fence line should be 1:1.

- Provide sufficient room for runoff to pond behind the fence and to allow sediment removal equipment to pass between the silt fence and toes of slopes or other obstructions. About 1200 ft^2 of ponding area should be provided for every acre draining to the fence.
- Turn the ends of the filter fence uphill to prevent stormwater from flowing around the fence.
- Leave an undisturbed or stabilized area immediately down slope from the fence where feasible.
- Silt fences should remain in place until the disturbed area is permanently stabilized.

Design and Layout

Selection of a filter fabric is based on soil conditions at the construction site (which affect the equivalent opening size (EOS) fabric specification) and characteristics of the support fence (which affect the choice of tensile strength). The designer should specify a filter fabric that retains the soil found on the construction site yet that it has openings large enough to permit drainage and prevent clogging. The following criteria is recommended for selection of the equivalent opening size:

1. If 50 percent or less of the soil, by weight, will pass the U.S. Standard Sieve No. 200, select the EOS to retain 85 % of the soil. The EOS should not be finer than EOS 70.
2. For all other soil types, the EOS should be no larger than the openings in the U.S. Standard Sieve No. 70 except where direct discharge to a stream, lake, or wetland will occur, then the EOS should be no larger than Standard Sieve No. 100.

To reduce the chance of clogging, it is preferable to specify a fabric with openings as large as allowed by the criteria. No fabric should be specified with an EOS smaller than U.S. Standard Sieve No. 100. If 85% or more of a soil, by weight, passes through the openings in a No. 200 sieve, filter fabric should not be used. Most of the particles in such a soil would not be retained if the EOS was too large and they would clog the fabric quickly if the EOS were small enough to capture the soil.

The fence should be supported by a plastic or wire mesh if the fabric selected does not have sufficient strength and bursting strength characteristics for the planned application (as recommended by the fabric manufacturer). Filter fabric material should contain ultraviolet inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0 °F to 120 °F.

- Layout in accordance with attached figures.
- For slopes steeper than 2:1 (H:V) and that contain a high number of rocks or large dirt clods that tend to dislodge, it may be necessary to install additional protection immediately adjacent to the bottom of the slope, prior to installing silt fence. Additional protection may be a chain link fence or a cable fence.
- For slopes adjacent to sensitive receiving waters or Environmentally Sensitive Areas (ESAs), silt fence should be used in conjunction with erosion control BMPs.

Materials

- Silt fence fabric should be woven polypropylene with a minimum width of 36 in. and a minimum tensile strength of 100 lb force. The fabric should conform to the requirements in ASTM designation D4632 and should have an integral reinforcement layer. The reinforcement layer should be a polypropylene, or equivalent, net provided by the manufacturer. The permittivity of the fabric should be between 0.1 sec^{-1} and 0.15 sec^{-1} in conformance with the requirements in ASTM designation D4491.

- Wood stakes should be commercial quality lumber of the size and shape shown on the plans. Each stake should be free from decay, splits or cracks longer than the thickness of the stake or other defects that would weaken the stakes and cause the stakes to be structurally unsuitable.

- Staples used to fasten the fence fabric to the stakes should be not less than 1.75 in. long and should be fabricated from 15 gauge or heavier wire. The wire used to fasten the tops of the stakes together when joining two sections of fence should be 9 gauge or heavier wire. Galvanizing of the fastening wire will not be required.

- There are new products that may use prefabricated plastic holders for the silt fence and use bar reinforcement instead of wood stakes. If bar reinforcement is used in lieu of wood stakes, use number four or greater bar. Provide end protection for any exposed bar reinforcement.

Installation Guidelines

Silt fences are to be constructed on a level contour. Sufficient area should exist behind the fence for ponding to occur without flooding or overtopping the fence.

- A trench should be excavated approximately 6 in. wide and 6 in. deep along the line the proposed silt fence.

- Bottom of the silt fence should be keyed-in a minimum of 12 in.

- Posts should be spaced a maximum of 6 ft apart and driven securely into the ground a minimum of 18 in. or 12 in. below the bottom of the trench.

- When standard strength filter fabric is used, a plastic or wire mesh support fence should be fastened securely to the upslope side of posts using heavy–duty wire staples at least 1 in. long. The mesh should extend into the trench. When extra-strength filter fabric and closer post spacing are used, the mesh support fence may be eliminated. Filter fabric should be purchased in a long roll, then cut to the length of the barrier. When joints are necessary, filter cloth should be spliced together only at a support post, with a minimum 6 in. overlap and both ends securely fastened to the post.

- The trench should be backfilled with compacted native material.

- Construct silt fences with a setback of at least 3 ft from the toe of a slope. Where a silt fence is determined to be not practicable due to specific site conditions, the silt fence may be constructed at the toe of the slope, but should be constructed as far from the toe of the slope as practicable. Silt fences close to the toe of the slope will be less effective and difficult to maintain.

- 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 barrier; in no case should the reach exceed 500 ft.

Costs

- Average annual cost for installation and maintenance (assumes 6 month useful life): $7 per lineal foot ($850 per drainage acre). Range of cost is $3.50 - $9.10 per lineal foot.

Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Repair undercut silt fences.
- Repair or replace split, torn, slumping, or weathered fabric. The lifespan of silt fence fabric is generally 5 to 8 months.
- Silt fences that are damaged and become unsuitable for the intended purpose should be removed from the site of work, disposed of, and replaced with new silt fence barriers.
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed at an appropriate location.
- Silt fences should be left in place until the upstream area is permanently stabilized. Until then, the silt fence must be inspected and maintained.
- Holes, depressions, or other ground disturbance caused by the removal of the silt fences should be backfilled and repaired.

References

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group-Working Paper, USEPA, April 1992.

Sedimentation and Erosion Control Practices, and Inventory of Current Practices (Draft), UESPA, 1990.

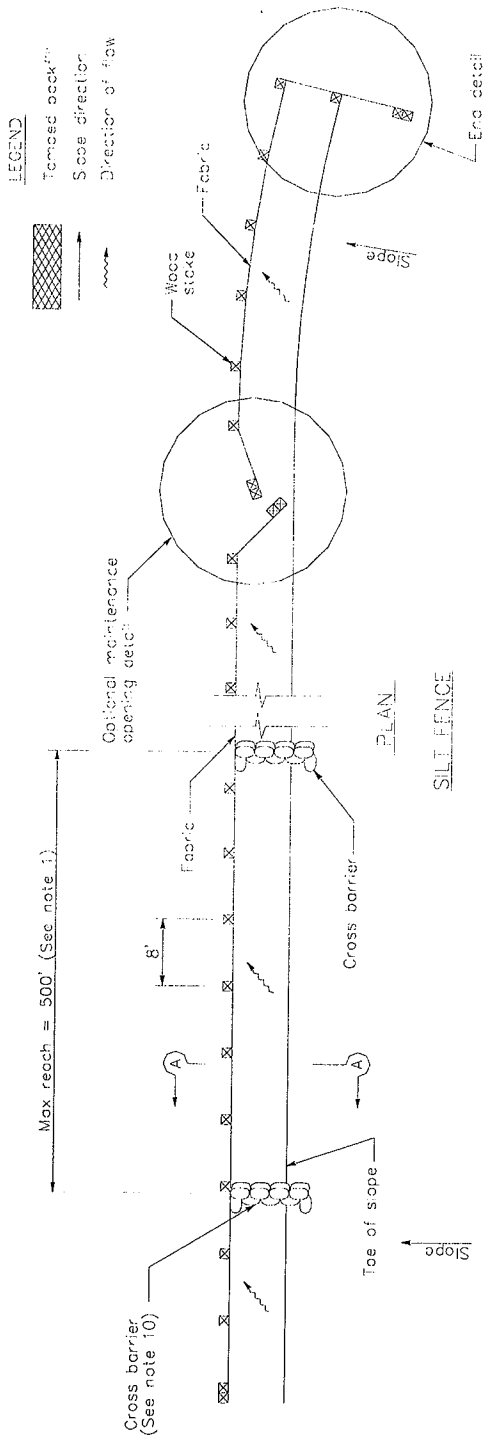
Southeastern Wisconsin Regional Planning Commission (SWRPC). Costs of Urban Nonpoint Source Water Pollution Control Measures. Technical Report No. 31. Southeastern Wisconsin Regional Planning Commission, Waukesha, WI. 1991

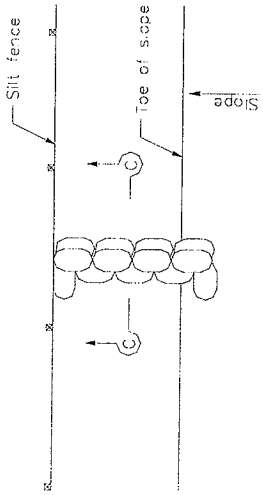
Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

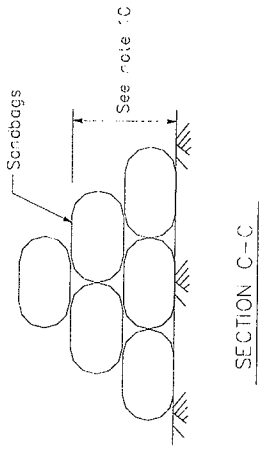
Stormwater Management Manual for The Puget Sound Basin, Washington State Department of Ecology, Public Review Draft, 1991.

U.S. Environmental Protection Agency (USEPA). Stormwater Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices. U.S. Environmental Protection Agency, Office of Water, Washington, DC, 1992.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

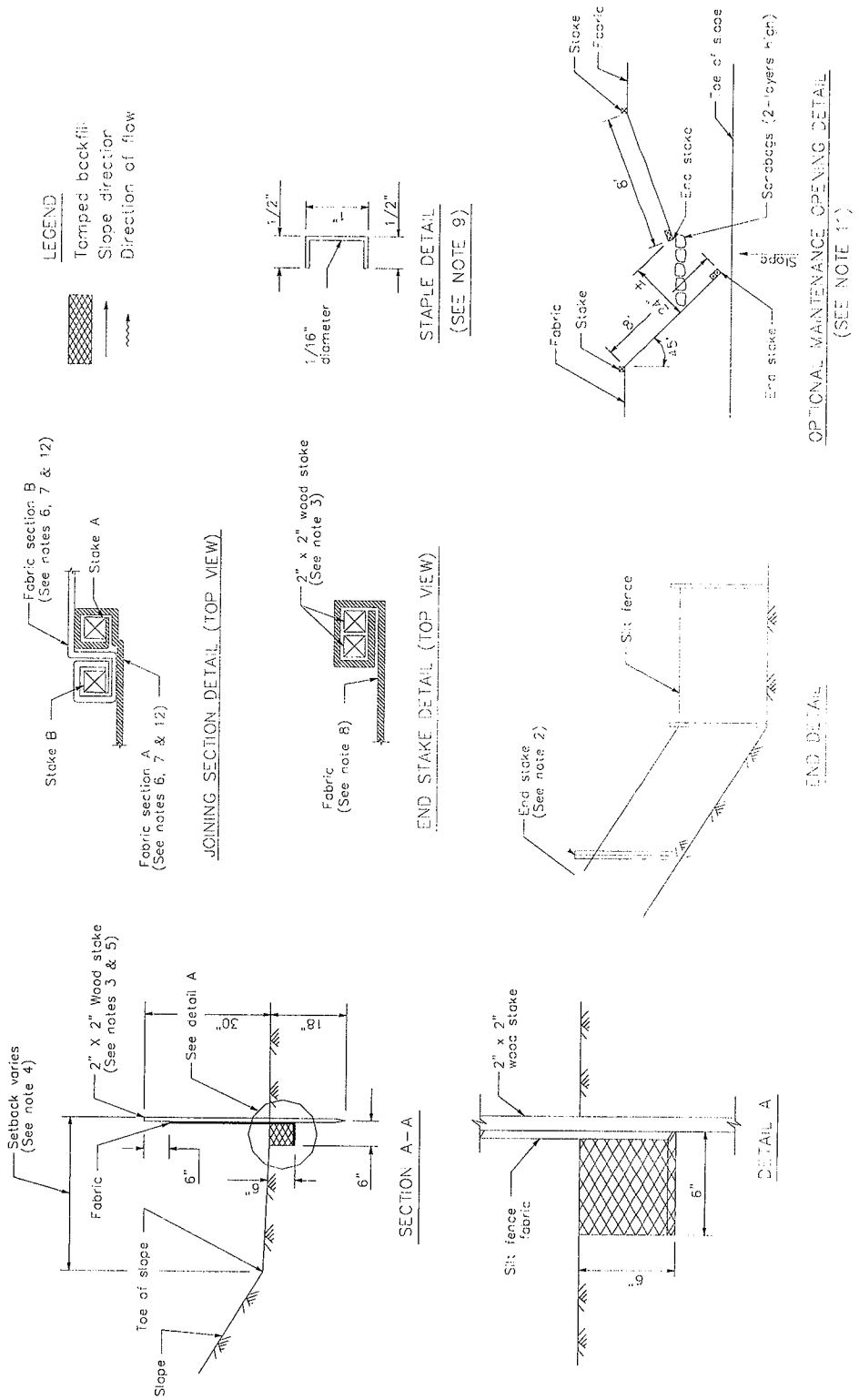






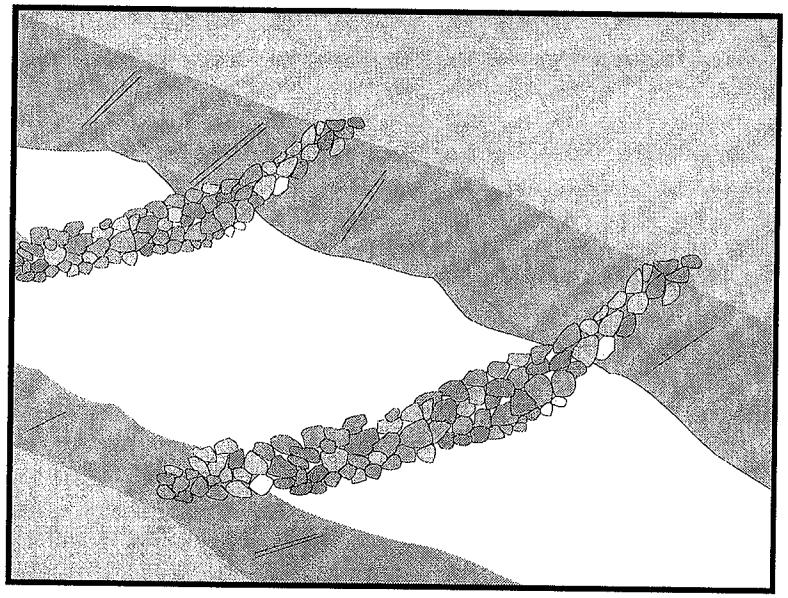
NOTES

1. 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 500'.
2. The last 8'-0" of fence shall be turned up slope.
3. Stake dimensions are nominal.
4. Dimension may vary to fit field condition.
5. Stakes shall be spaced at 8'-0" maximum and shall be positioned on downstream side of fence.
6. Stakes to overlap end fence fabric to fold around each stake one full turn. Secure fabric to stake 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. Dimensions shown are typical.
10. Cross barriers shall be a minimum of 1/3 and a maximum of 1/2 the height of the linear barrier.
11. Maintenance openings shall be constructed in a manner to ensure sediment remains behind silt fence.
12. Joining sections shall not be placed at sump locations.
13. Sandbag rows and layers shall be offset to eliminate gaps.


LEGEND
Tamped backfill
Slope direction
Direction of flow
Setback varies (See note 4)
2" X 2" Wood stake (See notes 3 & 5)
See detail A
30"
18"
Fabric
6"
6"
6"
Toe of slope
Slope
SECTION A-A
Fabric section B (See notes 6, 7 & 12)
Stake A
Stake B
Fabric section A (See notes 6, 7 & 12)
JOINING SECTION DETAIL (TOP VIEW)
1/16" diameter
1/2"
1/2"
STAPLE DETAIL
(SEE NOTE 9)
2" x 2" wood stake (See note 3)
Fabric (See note 8)
END STAKE DETAIL (TOP VIEW)
2" x 2" wood stake
Silt fence fabric
6"
6"
DETAIL A
Silt fence
End stake (See note 2)
END DETAIL
Stake
Fabric
Toe of slope
Scrabags (2-layers high)
End stake
Slope
Fabric
Stake
End stake
OPTIONAL MAINTENANCE OPENING DETAIL
(SEE NOTE 11)

Check Dams

SE-4



Objectives		
EC	Erosion Control	✓
SE	Sediment Control	✓
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

✓ **Primary Objective**

✓ **Secondary Objective**

Targeted Constituents	
Sediment	✓
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

Description and Purpose

A check dam is a small barrier constructed of rock, gravel bags, sandbags, fiber rolls, or reusable products, placed across a constructed swale or drainage ditch. Check dams reduce the effective slope of the channel, thereby reducing the velocity of flowing water, allowing sediment to settle and reducing erosion.

Suitable Applications

Check dams may be appropriate in the following situations:

- To promote sedimentation behind the dam.
- To prevent erosion by reducing the velocity of channel flow in small intermittent channels and temporary swales.
- In small open channels that drain 10 acres or less.
- In steep channels where stormwater runoff velocities exceed 5 ft/s.
- During the establishment of grass linings in drainage ditches or channels.
- In temporary ditches where the short length of service does not warrant establishment of erosion-resistant linings.

Limitations

- Not to be used in live streams or in channels with extended base flows.

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- Not appropriate in channels that drain areas greater than 10 acres.
- Not appropriate in channels that are already grass-lined unless erosion is expected, as installation may damage vegetation.
- Require extensive maintenance following high velocity flows.
- Promotes sediment trapping which can be re-suspended during subsequent storms or removal of the check dam.

Implementation

General

Check dams reduce the effective slope and create small pools in swales and ditches that drain 10 acres or less. Reduced slopes reduce the velocity of stormwater flows, thus reducing erosion of the swale or ditch and promoting sedimentation. Use of check dams for sedimentation will likely result in little net removal of sediment because of the small detention time and probable scour during longer storms. Using a series of check dams will generally increase their effectiveness. A sediment trap (SE-3) may be placed immediately upstream of the check dam to increase sediment removal efficiency.

Design and Layout

Check dams work by decreasing the effective slope in ditches and swales. An important consequence of the reduced slope is a reduction in capacity of the ditch or swale. This reduction in capacity must be considered when using this BMP, as reduced capacity can result in overtopping of the ditch or swale and resultant consequences. In some cases, such as a "permanent" ditch or swale being constructed early and used as a "temporary" conveyance for construction flows, the ditch or swale may have sufficient capacity such that the temporary reduction in capacity due to check dams is acceptable. When check dams reduce capacities beyond acceptable limits, there are several options:

- Don't use check dams. Consider alternative BMPs.
- Increase the size of the ditch or swale to restore capacity.

Maximum slope and velocity reduction is achieved when the toe of the upstream dam is at the same elevation as the top of the downstream dam. The center section of the dam should be lower than the edge sections so that the check dam will direct flows to the center of the ditch or swale.

Check dams are usually constructed of rock, gravel bags, sandbags, and fiber rolls. A number of products manufactured specifically for use as check dams are also being used, and some of these products can be removed and reused. Check dams can also be constructed of logs or lumber, and have the advantage of a longer lifespan when compared to gravel bags, sandbags, and fiber rolls. Straw bales can also be used for check dams and can work if correctly installed; but in practice, straw bale check dams have a high failure rate. Check dams should not be constructed from straw bales or silt fences, since concentrated flows quickly wash out these materials.

Rock check dams are usually constructed of 8 to 12 in. rock. The rock is placed either by hand or mechanically, but never just dumped into the channel. The dam must completely span the ditch

or swale to prevent washout. The rock used must be large enough to stay in place given the expected design flow through the channel.

Log check dams are usually constructed of 4 to 6 in. diameter logs. The logs should be embedded into the soil at least 18 in. Logs can be bolted or wired to vertical support logs that have been driven or buried into the soil.

Gravel bag and sandbag check dams are constructed by stacking bags across the ditch or swale, shaped as shown in the drawings at the end of this fact sheet.

Manufactured products should be installed in accordance with the manufacturer's instructions.

If grass is planted to stabilize the ditch or swale, the check dam should be removed when the grass has matured (unless the slope of the swales is greater than 4%).

The following guidance should be followed for the design and layout of check dams:

- Install the first check dam approximately 16 ft from the outfall device and at regular intervals based on slope gradient and soil type.
- Check dams should be placed at a distance and height to allow small pools to form between each check dam.
- Backwater from a downstream check dam should reach the toes of the upstream check dam.
- A sediment trap provided immediately upstream of the check dam will help capture sediment. Due to the potential for this sediment to be resuspended in subsequent storms, the sediment trap must be cleaned following each storm event.
- High flows (typically a 2-year storm or larger) should safely flow over the check dam without an increase in upstream flooding or damage to the check dam.
- Where grass is used to line ditches, check dams should be removed when grass has matured sufficiently to protect the ditch or swale.
- Gravel bags may be used as check dams with the following specifications:

Materials

Gravel bags used for check dams should conform to the requirements of SE-6, Gravel Bag Berms. Sandbags used for check dams should conform to SE-8, Sandbag Barrier. Fiber rolls used for check dams should conform to SE-5, Fiber Rolls. Straw bales used for check dams should conform to SE-9, Straw Bale Barrier.

Installation

- Rock should be placed individually by hand or by mechanical methods (no dumping of rock) to achieve complete ditch or swale coverage.
- Tightly abut bags and stack according to detail shown in the figure at the end of this section. Gravel bags and sandbags should not be stacked any higher than 3 ft.
- Fiber rolls and straw bales must be trenched in and firmly staked in place.

Costs

Cost consists of only installation costs if materials are readily available. If material must be imported, costs may increase. For material costs, see SE-5, SE-6, SE-8 and SE-9.

Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Replace missing rock, bags, bales, etc. Replace bags or bales that have degraded or have become damaged.
- If the check dam is used as a sediment capture device, sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed at an appropriate location.
- If the check dam is used as a grade control structure, sediment removal is not required as long as the system continues to control the grade.
- Remove accumulated sediment prior to permanent seeding or soil stabilization.
- Remove check dam and accumulated sediment when check dams are no longer needed.

References

Draft – Sedimentation and Erosion Control, and Inventory of Current Practices, USEPA, April 1990.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

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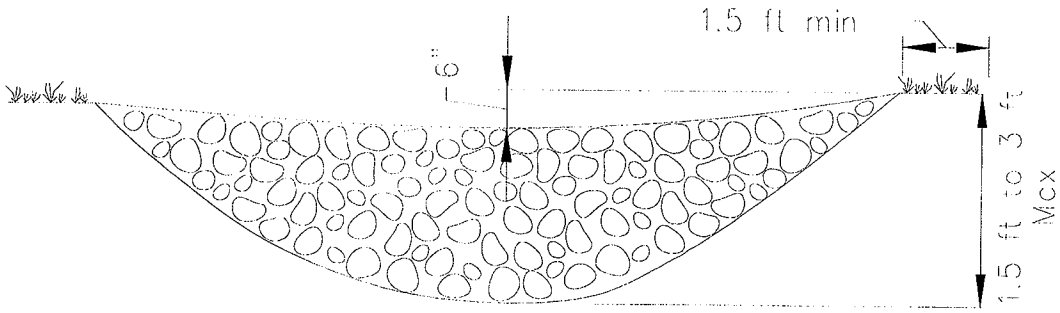
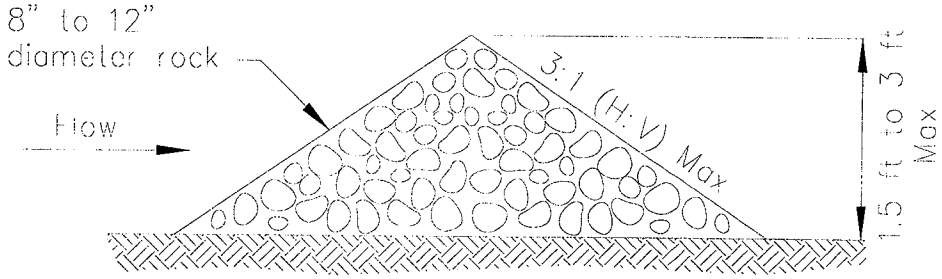
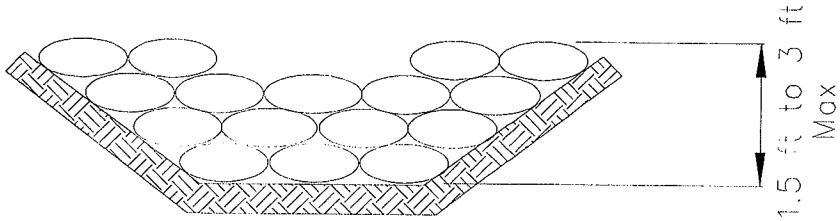


ELEVATION



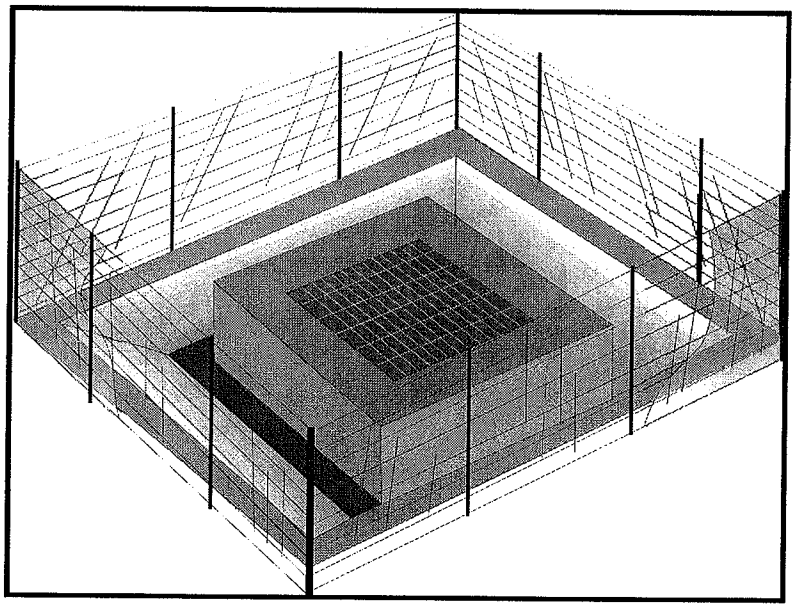
TYPICAL ROCK CHECK DAM SECTION

ROCK CHECK DAM
NOT TO SCALE



GRAVEL BAG CHECK DAM ELEVATION
NOT TO SCALE

Storm Drain Inlet Protection SE-10



Objectives

EC	Erosion Control	
SE	Sediment Control	✓
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
✓ **Primary Objective**
✓ **Secondary Objective**

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

SE-9 Straw Bale Barrier

Description and Purpose

Storm drain inlet protection consists of a sediment filter or an impounding area around or upstream of a storm drain, drop inlet, or curb inlet. Storm drain inlet protection measures temporarily pond runoff before it enters the storm drain, allowing sediment to settle. Some filter configurations also remove sediment by filtering, but usually the ponding action results in the greatest sediment reduction.

Suitable Applications

Every storm drain inlet receiving sediment-laden runoff should be protected.

Limitations

- Drainage area should not exceed 1 acre.
- Straw bales, while potentially effective, have not produced in practice satisfactory results, primarily due to improper installation.
- Requires an adequate area for water to pond without encroaching into portions of the roadway subject to traffic.
- Inlet protection usually requires other methods of temporary protection to prevent sediment-laden stormwater and non-stormwater discharges from entering the storm drain system.
- Sediment removal may be difficult in high flow conditions or if runoff is heavily sediment laden. If high flow conditions are

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expected, use other onsite sediment trapping techniques in conjunction with inlet protection.

- Frequent maintenance is required.
- For drainage areas larger than 1 acre, runoff should be routed to a sediment-trapping device designed for larger flows. See BMPs SE-2, Sediment Basin, and SE-3, Sediment Traps.
- Excavated drop inlet sediment traps are appropriate where relatively heavy flows are expected, and overflow capability is needed.

Implementation

General

Large amounts of sediment may enter the storm drain system when storm drains are installed before the upslope drainage area is stabilized, or where construction is adjacent to an existing storm drain. In cases of extreme sediment loading, the storm drain itself may clog and lose a major portion of its capacity. To avoid these problems, it is necessary to prevent sediment from entering the system at the inlets.

Inlet control measures presented in this handbook should not be used for inlets draining more than one acre. Runoff from larger disturbed areas should be first routed through SE-2, Sediment Basin or SE-3, Sediment Trap. Different types of inlet protection are appropriate for different applications depending on site conditions and the type of inlet. Inlet protection methods not presented in this handbook should be approved by the local stormwater management agency.

Design and Layout

Identify existing and planned storm drain inlets that have the potential to receive sediment-laden surface runoff. Determine if storm drain inlet protection is needed and which method to use.

- Limit upstream drainage area to 1 acre maximum. For larger drainage areas, use SE-2, Sediment Basin, or SE-3, Sediment Trap, upstream of the inlet protection device.
- The key to successful and safe use of storm drain inlet protection devices is to know where runoff will pond or be diverted.
  - Determine the acceptable location and extent of ponding in the vicinity of the drain inlet. The acceptable location and extent of ponding will influence the type and design of the storm drain inlet protection device.
  - Determine the extent of potential runoff diversion caused by the storm drain inlet protection device. Runoff ponded by inlet protection devices may flow around the device and towards the next downstream inlet. In some cases, this is acceptable; in other cases, serious erosion or downstream property damage can be caused by these diversions. The possibility of runoff diversions will influence whether or not storm drain inlet protection is suitable; and, if suitable, the type and design of the device.
- The location and extent of ponding, and the extent of diversion, can usually be controlled through appropriate placement of the inlet protection device. In some cases, moving the

inlet protection device a short distance upstream of the actual inlet can provide more efficient sediment control, limit ponding to desired areas, and prevent or control diversions.

- Four types of inlet protection are presented below. However, it is recognized that other effective methods and proprietary devices exist and may be selected.
  - Filter Fabric Fence: Appropriate for drainage basins with less than a 5% slope, sheet flows, and flows under 0.5 cfs.
  - Excavated Drop Inlet Sediment Trap: An excavated area around the inlet to trap sediment (SE-3).
  - Gravel bag barrier: Used to create a small sediment trap upstream of inlets on sloped, paved streets. Appropriate for sheet flow or when concentrated flow may exceed 0.5 cfs, and where overtopping is required to prevent flooding.
  - Block and Gravel Filter: Appropriate for flows greater than 0.5 cfs.
- Select the appropriate type of inlet protection and design as referred to or as described in this fact sheet.
- Provide area around the inlet for water to pond without flooding structures and property.
- Grates and spaces around all inlets should be sealed to prevent seepage of sediment-laden water.
- Excavate sediment sumps (where needed) 1 to 2 ft with 2:1 side slopes around the inlet.

Installation

- ***DI Protection Type 1 - Filter Fabric Fence*** - The filter fabric fence (Type 1) protection is shown in the attached figure. Similar to constructing a silt fence; see BMP SE-1, Silt Fence. Do not place filter fabric underneath the inlet grate since the collected sediment may fall into the drain inlet when the fabric is removed or replaced.
  1. Excavate a trench approximately 6 in. wide and 6 in. deep along the line of the silt fence inlet protection device.
  2. Place 2 in. by 2 in. wooden stakes around the perimeter of the inlet a maximum of 3 ft apart and drive them at least 18 in. into the ground or 12 in. below the bottom of the trench. The stakes must be at least 48 in.
  3. Lay fabric along bottom of trench, up side of trench, and then up stakes. See SE-1, Silt Fence, for details. The maximum silt fence height around the inlet is 24 in.
  4. Staple the filter fabric (for materials and specifications, see SE-1, Silt Fence) to wooden stakes. Use heavy-duty wire staples at least 1 in. in length.
  5. Backfill the trench with gravel or compacted earth all the way around.
- ***DI Protection Type 2 - Excavated Drop Inlet Sediment Trap*** - The excavated drop inlet sediment trap (Type 2) is shown in the attached figures. Install filter fabric fence in

accordance with DI Protection Type 1. Size excavated trap to provide a minimum storage capacity calculated at the rate 67 yd^3/acre of drainage area.

- ***DI Protection Type 3 - Gravel bag*** - The gravel bag barrier (Type 3) is shown in the figures. Flow from a severe storm should not overtop the curb. In areas of high clay and silts, use filter fabric and gravel as additional filter media. Construct gravel bags in accordance with SE-6, Gravel Bag Berm. Gravel bags should be used due to their high permeability.

  1. Use sand bag made of geotextile fabric (not burlap) and fill with 0.75 in. rock or 0.25 in. pea gravel.
  2. Construct on gently sloping street.
  3. Leave room upstream of barrier for water to pond and sediment to settle.
  4. Place several layers of sand bags – overlapping the bags and packing them tightly together.
  5. Leave gap of one bag on the top row to serve as a spillway. Flow from a severe storm (e.g., 10 year storm) should not overtop the curb.

- ***DI Protection Type 4 – Block and Gravel Filter*** - The block and gravel filter (Type 4) is shown in the figures. Block and gravel filters are suitable for curb inlets commonly used in residential, commercial, and industrial construction.

  1. Place hardware cloth or comparable wire mesh with 0.5 in. openings over the drop inlet so that the wire extends a minimum of 1 ft beyond each side of the inlet structure. If more than one strip is necessary, overlap the strips. Place filter fabric over the wire mesh.
  2. Place concrete blocks lengthwise on their sides in a single row around the perimeter of the inlet, so that the open ends face outward, not upward. The ends of adjacent blocks should abut. The height of the barrier can be varied, depending on design needs, by stacking combinations of blocks that are 4 in., 8 in., and 12 in. wide. The row of blocks should be at least 12 in. but no greater than 24 in. high.
  3. Place wire mesh over the outside vertical face (open end) of the concrete blocks to prevent stone from being washed through the blocks. Use hardware cloth or comparable wire mesh with 0.5 in. opening.
  4. Pile washed stone against the wire mesh to the top of the blocks. Use 0.75 to 3 in.

Costs

- Average annual cost for installation and maintenance (one year useful life) is $200 per inlet.

Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.

- Filter Fabric Fences. If the fabric becomes clogged, torn, or degrades, it should be replaced. Make sure the stakes are securely driven in the ground and are in good shape (i.e., not bent, cracked, or splintered, and are reasonably perpendicular to the ground). Replace damaged stakes.

- Gravel Filters. If the gravel becomes clogged with sediment, it must be carefully removed from the inlet and either cleaned or replaced. Since cleaning gravel at a construction site may be difficult, consider using the sediment-laden stone as fill material and put fresh stone around the inlet. Inspect bags for holes, gashes, and snags, and replace bags as needed. Check gravel bags for proper arrangement and displacement.

- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site ore disposed at an appropriate location.

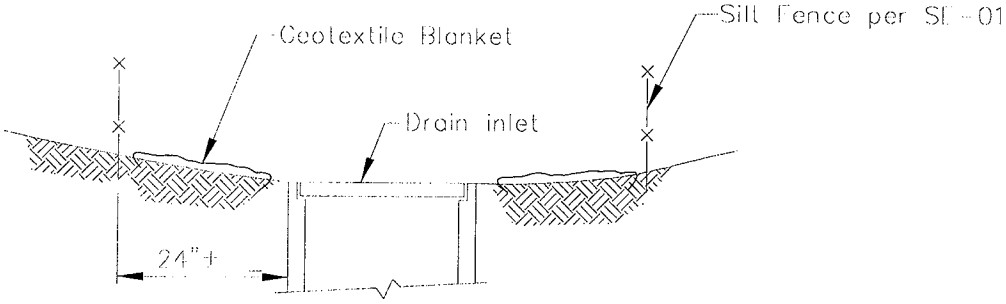
- Remove storm drain inlet protection once the drainage area is stabilized.

  - Clean and regrade area around the inlet and clean the inside of the storm drain inlet as it must be free of sediment and debris at the time of final inspection.

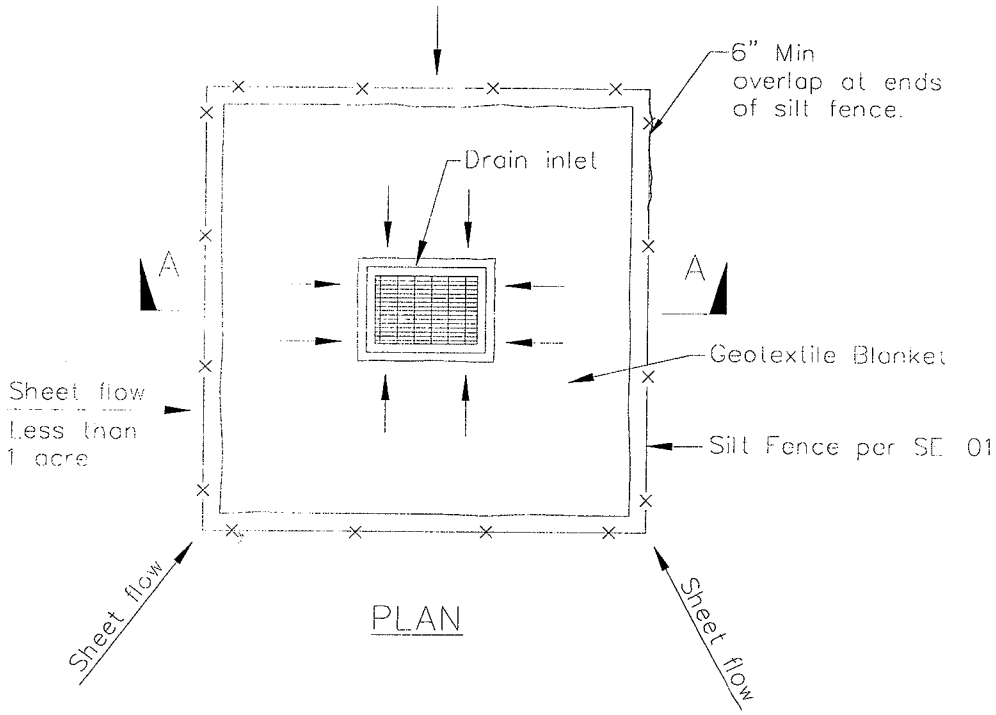
References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management Manual for The Puget Sound Basin, Washington State Department of Ecology, Public Review Draft, 1991.



SECTION A-A

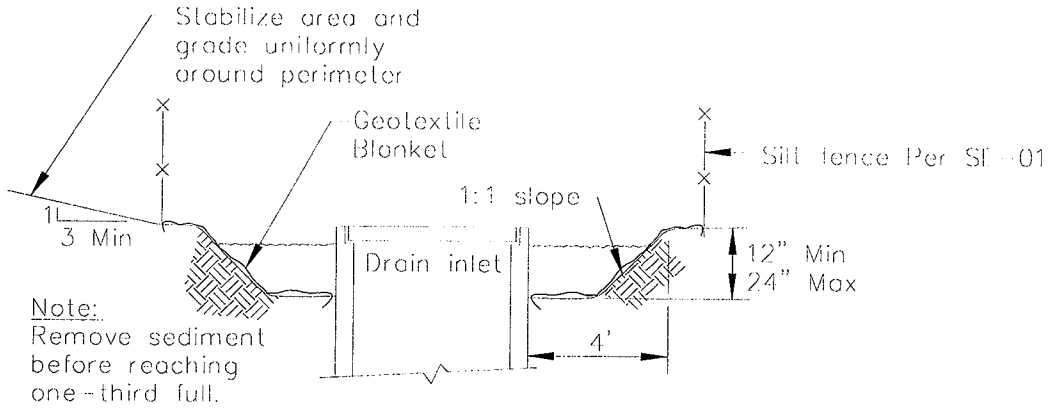


PLAN

DI PROTECTION TYPE 1
NOT TO SCALE

NOTES:

1. For use in areas where grading has been completed and final soil stabilization and seeding are pending.
2. Not applicable in paved areas.
3. Not applicable with concentrated flows.



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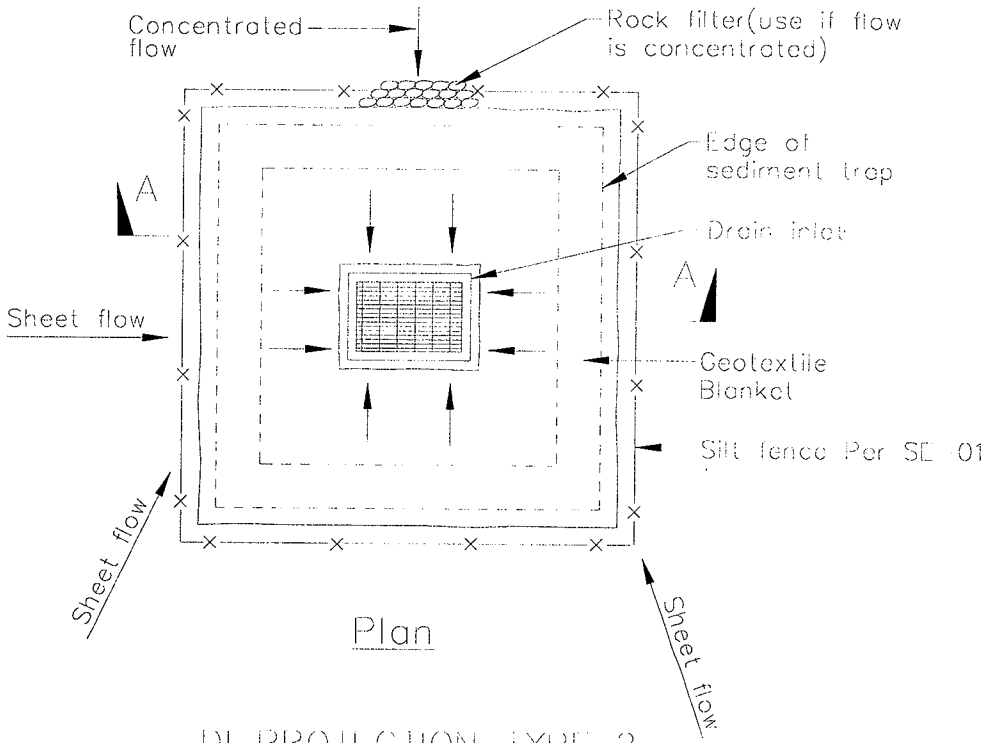
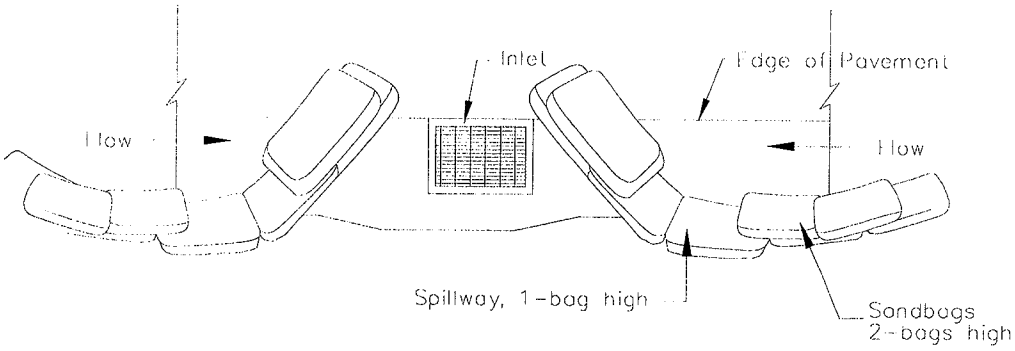


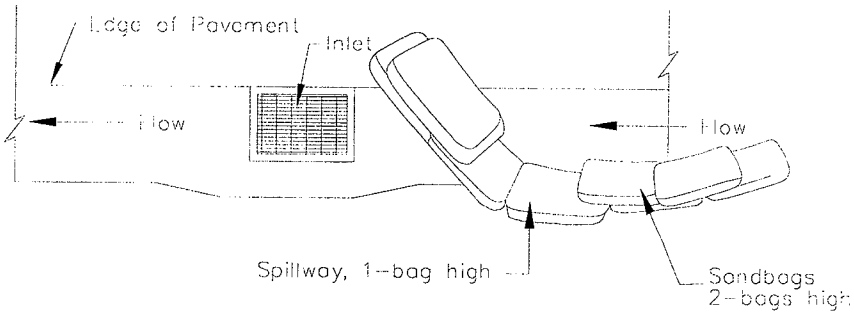
Plan

DI PROTECTION TYPE 2
NOT TO SCALE

Notes
1. For use in cleared and grubbed and in graded areas.
2. Shape basin so that longest inflow area faces longest length of trap.
3. For concentrated flows, shape basin in 2:1 ratio with length oriented towards direction of flow.



TYPICAL PROTECTION FOR INLET ON SUMP

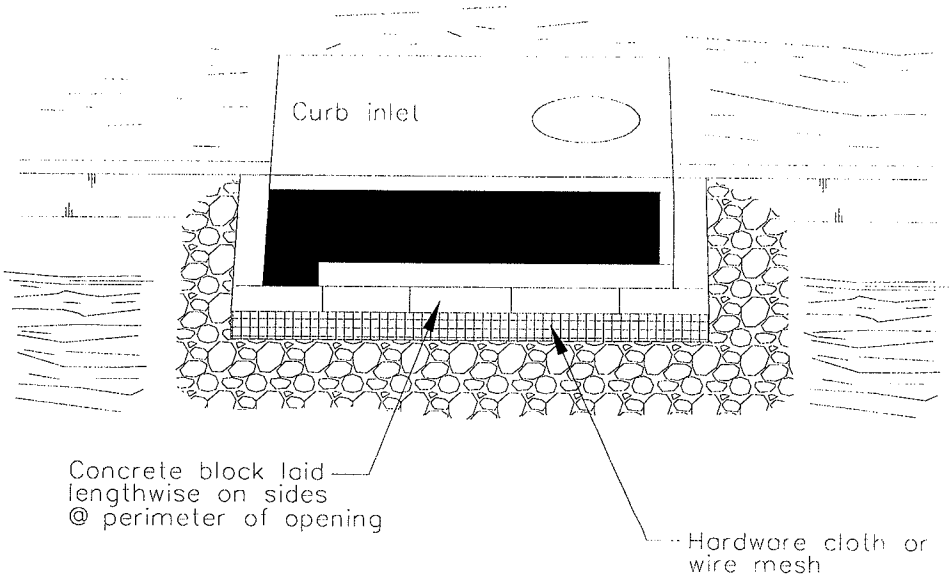


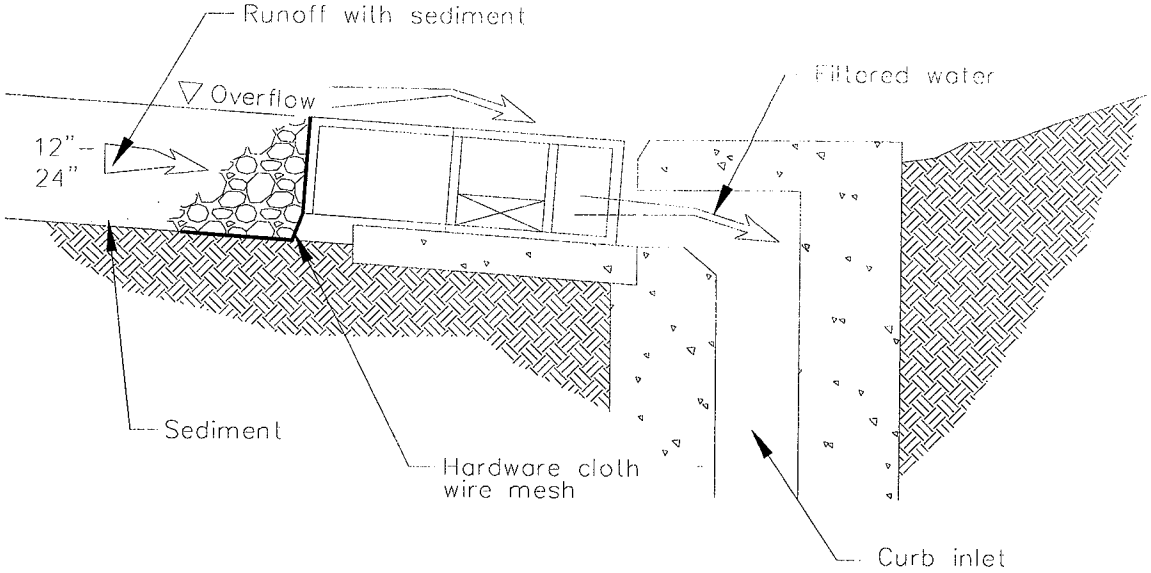
TYPICAL PROTECTION FOR INLET ON GRADE

NOTES:

1. Intended for short-term use.
2. Use to inhibit non-storm water flow.
3. Allow for proper maintenance and cleanup.
4. Bags must be removed after adjacent operation is completed
5. Not applicable in areas with high silts and clays without filter fabric.

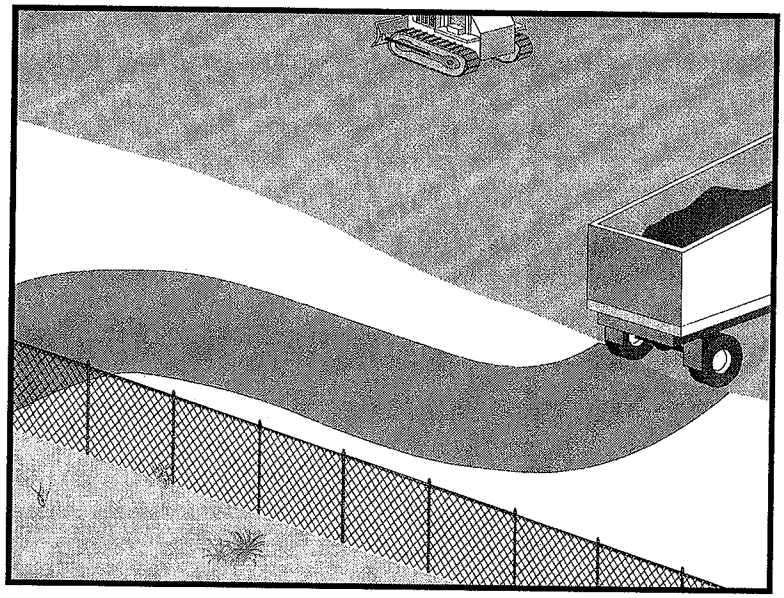
DI PROTECTION TYPE 3
NOT TO SCALE





DI PROTECTION - TYPE 4
NOT TO SCALE

Stabilized Construction Roadway TC-2



Objectives

EC	Erosion Control	✓
SE	Sediment Control	✓
TC	Tracking Control	✓
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

✓ **Primary Objective**

✓ **Secondary Objective**

Targeted Constituents

Sediment	✓
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

Description and Purpose

Access roads, subdivision roads, parking areas, and other onsite vehicle transportation routes should be stabilized immediately after grading, and frequently maintained to prevent erosion and control dust.

Suitable Applications

This BMP should be applied for the following conditions:

- Temporary Construction Traffic:
  - Phased construction projects and offsite road access
  - Construction during wet weather
- Construction roadways and detour roads:
  - Where mud tracking is a problem during wet weather
  - Where dust is a problem during dry weather
  - Adjacent to water bodies
  - Where poor soils are encountered

Limitations

- The roadway must be removed or paved when construction is complete.

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- Certain chemical stabilization methods may cause stormwater or soil pollution and should not be used. See WE-1, Wind Erosion Control.
- Management of construction traffic is subject to air quality control measures. Contact the local air quality management agency.
- Materials will likely need to be removed prior to final project grading and stabilization.
- Use of this BMP may not be applicable to very short duration projects.

Implementation

General

Areas that are graded for construction vehicle transport and parking purposes are especially susceptible to erosion and dust. The exposed soil surface is continually disturbed, leaving no opportunity for vegetative stabilization. Such areas also tend to collect and transport runoff waters along their surfaces. During wet weather, they often become muddy quagmires that generate significant quantities of sediment that may pollute nearby streams or be transported offsite on the wheels of construction vehicles. Dirt roads can become so unstable during wet weather that they are virtually unusable.

Efficient construction road stabilization not only reduces onsite erosion but also can significantly speed onsite work, avoid instances of immobilized machinery and delivery vehicles, and generally improve site efficiency and working conditions during adverse weather

Installation/Application Criteria

Permanent roads and parking areas should be paved as soon as possible after grading. As an alternative where construction will be phased, the early application of gravel or chemical stabilization may solve potential erosion and stability problems. Temporary gravel roadway should be considered during the rainy season and on slopes greater than 5%.

Temporary roads should follow the contour of the natural terrain to the maximum extent possible. Slope should not exceed 15%. Roadways should be carefully graded to drain transversely. Provide drainage swales on each side of the roadway in the case of a crowned section or one side in the case of a super elevated section. Simple gravel berms without a trench can also be used.

Installed inlets should be protected to prevent sediment laden water from entering the storm sewer system (SE-10, Storm Drain Inlet Protection). In addition, the following criteria should be considered.

- Road should follow topographic contours to reduce erosion of the roadway.
- The roadway slope should not exceed 15%.
- Chemical stabilizers or water are usually required on gravel or dirt roads to prevent dust (WE-1, Wind Erosion Control).
- Properly grade roadway to prevent runoff from leaving the construction site.
- Design stabilized access to support heaviest vehicles and equipment that will use it.

- Stabilize roadway using aggregate, asphalt concrete, or concrete based on longevity, required performance, and site conditions. The use of cold mix asphalt or asphalt concrete (AC) grindings for stabilized construction roadway is not allowed.
- Coordinate materials with those used for stabilized construction entrance/exit points.
- If aggregate is selected, place crushed aggregate over geotextile fabric to at least 12 in. depth. A crushed aggregate greater than 3 in. but smaller than 6 in. should be used.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, impact weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Keep all temporary roadway ditches clear.
- When no longer required, remove stabilized construction roadway and re-grade and repair slopes.
- Periodically apply additional aggregate on gravel roads.
- Active dirt construction roads are commonly watered three or more times per day during the dry season.

Costs

Gravel construction roads are moderately expensive, but cost is often balanced by reductions in construction delay. No additional costs for dust control on construction roads should be required above that needed to meet local air quality requirements.

References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program; Program Development and Approval Guidance, Working Group, Working Paper; USEPA, April 1992.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

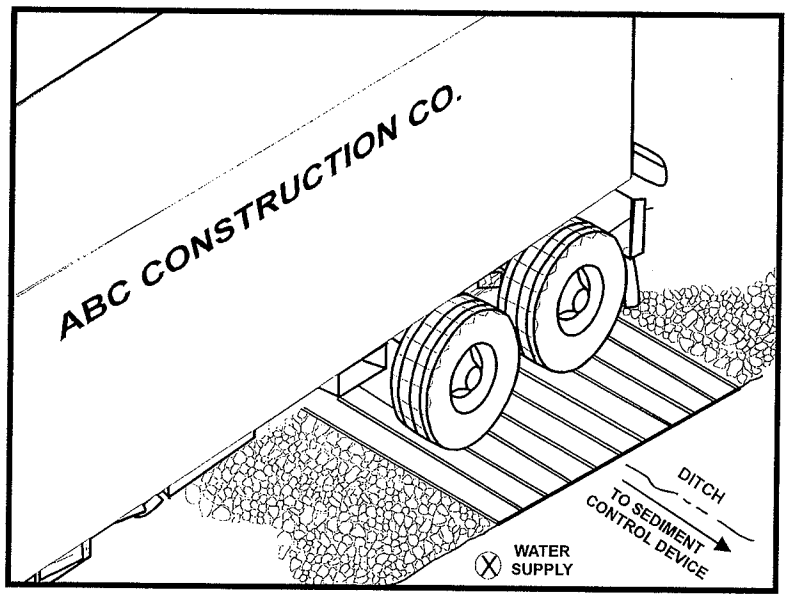
Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

TC-2 Stabilized Construction Roadway

Virginia Erosion and Sedimentation Control Handbook, Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, 1991.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Entrance/Outlet Tire Wash TC-3



Objectives

EC	Erosion Control	
SE	Sediment Control	✓
TC	Tracking Control	✔
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
✔ **Primary Objective**
✓ **Secondary Objective**

Targeted Constituents

Sediment	✔
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

TC-1 Stabilized Construction Entrance/Exit

Description and Purpose

A tire wash is an area located at stabilized construction access points to remove sediment from tires and under carriages and to prevent sediment from being transported onto public roadways.

Suitable Applications

Tire washes may be used on construction sites where dirt and mud tracking onto public roads by construction vehicles may occur.

Limitations

- The tire wash requires a supply of wash water.
- A turnout or doublewide exit is required to avoid having entering vehicles drive through the wash area.
- Do not use where wet tire trucks leaving the site leave the road dangerously slick.

Implementation

- Incorporate with a stabilized construction entrance/exit. See TC-1, Stabilized Construction Entrance/Exit.
- Construct on level ground when possible, on a pad of coarse aggregate greater than 3 in. but smaller than 6 in. A geotextile fabric should be placed below the aggregate.
- Wash rack should be designed and constructed/manufactured for anticipated traffic loads.

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- Provide a drainage ditch that will convey the runoff from the wash area to a sediment trapping device. The drainage ditch should be of sufficient grade, width, and depth to carry the wash runoff.
- Use hoses with automatic shutoff nozzles to prevent hoses from being left on.
- Require that all employees, subcontractors, and others that leave the site with mud caked tires and undercarriages to use the wash facility.
- Implement SC-7, Street Sweeping and Vacuuming, as needed.

Costs

Costs are low for installation of wash rack.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.
- Remove accumulated sediment in wash rack and/or sediment trap to maintain system performance.
- Inspect routinely for damage and repair as needed.

References

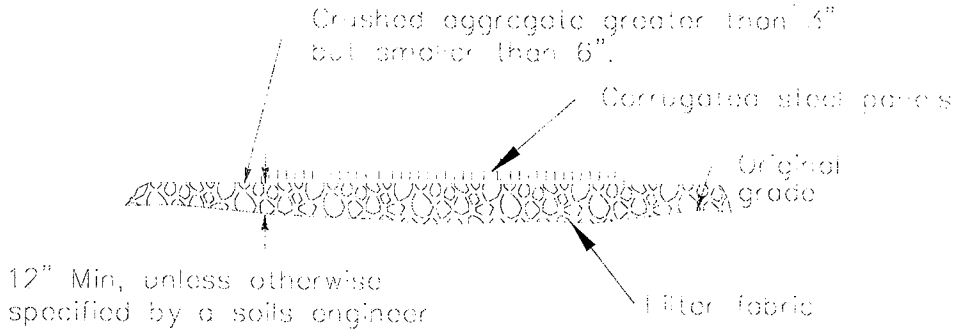
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program; Program Development and Approval Guidance, Working Group, Working Paper; USEPA, April 1992.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.



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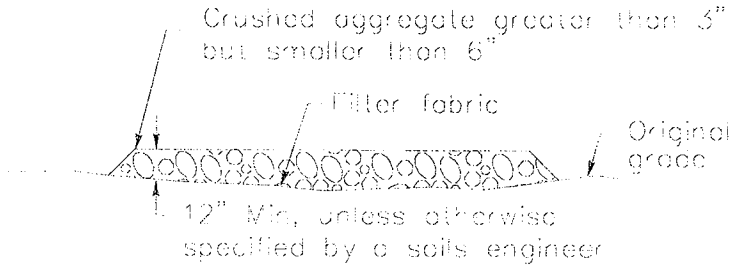
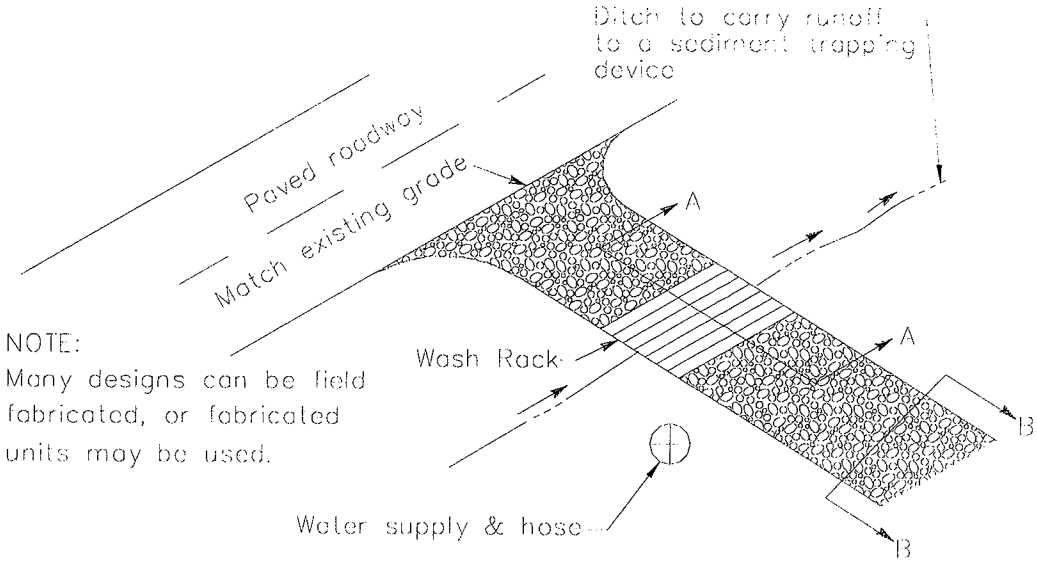


SECTION B-B
NTS

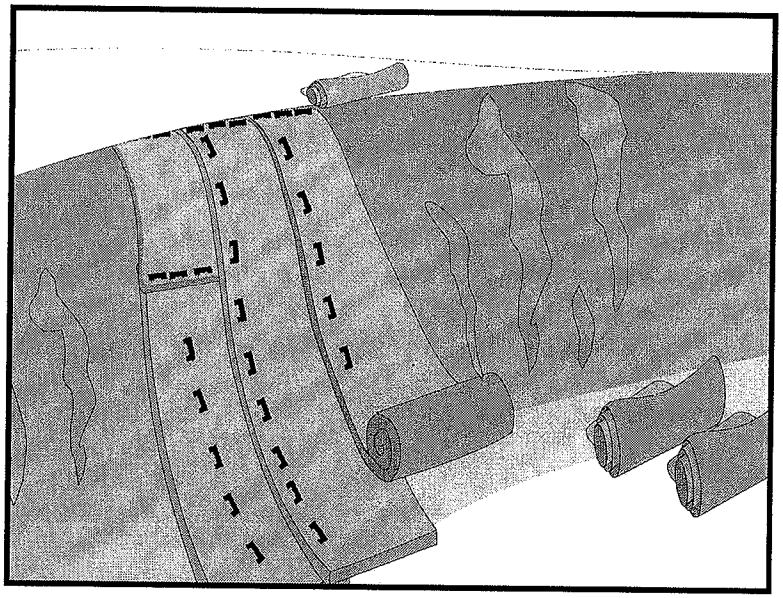


NOTE:
Many designs can be field fabricated, or fabricated units may be used.

TYPICAL TIRE WASH
NOT TO SCALE

Geotextiles and Mats

EC-7



Objectives

EC	Erosion Control	✓
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	✓
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

✓ **Primary Objective**

✓ **Secondary Objective**

Targeted Constituents

Sediment	✓
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch

EC-4 Hydroseeding

EC-5 Soil Binders

EC-6 Straw Mulch

EC-8 Wood Mulching

Description and Purpose

Mattings of natural materials are used to cover the soil surface to reduce erosion from rainfall impact, hold soil in place, and absorb and hold moisture near the soil surface. Additionally, matting may be used to stabilize soils until vegetation is established.

Suitable Applications

Mattings are commonly applied on short, steep slopes where erosion hazard is high and vegetation will be slow to establish. Mattings are also used on stream banks where moving water at velocities between 3 ft/s and 6 ft/s are likely to wash out new vegetation, and in areas where the soil surface is disturbed and where existing vegetation has been removed. Matting may also be used when seeding cannot occur (e.g., late season construction and/or the arrival of an early rain season). Erosion control matting should be considered when the soils are fine grained and potentially erosive. These measures should be considered in the following situations.

- Steep slopes, generally steeper than 3:1 (H:V)
- Slopes where the erosion potential is high
- Slopes and disturbed soils where mulch must be anchored
- Disturbed areas where plants are slow to develop
- Channels with flows exceeding 3.3 ft/s

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- Channels to be vegetated
- Stockpiles
- Slopes adjacent to water bodies of Environmentally Sensitive Areas (ESAs)

Limitations

- Properly installed mattings provide excellent erosion control but do so at relatively high cost. This high cost typically limits the use of mattings to areas of concentrated channel flow and steep slopes.
- Mattings are more costly than other BMP practices, limiting their use to areas where other BMPs are ineffective (e.g. channels, steep slopes).
- Installation is critical and requires experienced contractors. The contractor should install the matting material in such a manner that continuous contact between the material and the soil occurs.
- Geotextiles and Mats may delay seed germination, due to reduction in soil temperature.
- Blankets and mats are generally not suitable for excessively rocky sites or areas where the final vegetation will be mowed (since staples and netting can catch in mowers).
- Blankets and mats must be removed and disposed of prior to application of permanent soil stabilization measures.
- Plastic sheeting is easily vandalized, easily torn, photodegradable, and must be disposed of at a landfill.
- Plastic results in 100% runoff, which may cause serious erosion problems in the areas receiving the increased flow.
- The use of plastic should be limited to covering stockpiles or very small graded areas for short periods of time (such as through one imminent storm event) until alternative measures, such as seeding and mulching, may be installed.
- Geotextiles, mats, plastic covers, and erosion control covers have maximum flow rate limitations; consult the manufacturer for proper selection.
- Not suitable for areas that have heavy foot traffic (tripping hazard) – e.g., pad areas around buildings under construction.

Implementation

Material Selection

Organic matting materials have been found to be effective where re-vegetation will be provided by re-seeding. The choice of matting should be based on the size of area, side slopes, surface conditions such as hardness, moisture, weed growth, and availability of materials.

The following natural and synthetic mattings are commonly used:

Geotextiles

- Material should be a woven polypropylene fabric with minimum thickness of 0.06 in., minimum width of 12 ft and should have minimum tensile strength of 150 lbs (warp), 80 lbs (fill) in conformance with the requirements in ASTM Designation: D 4632. The permittivity of the fabric should be approximately 0.07 sec^{-1} in conformance with the requirements in ASTM Designation: D4491. The fabric should have an ultraviolet (UV) stability of 70 percent in conformance with the requirements in ASTM designation: D4355. Geotextile blankets must be secured in place with wire staples or sandbags and by keying into tops of slopes to prevent infiltration of surface waters under geotextile. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- Geotextiles may be reused if they are suitable for the use intended.

Plastic Covers

- Plastic sheeting should have a minimum thickness of 6 mils, and must be keyed in at the top of slope and firmly held in place with sandbags or other weights placed no more than 10 ft apart. Seams are typically taped or weighted down their entire length, and there should be at least a 12 in. to 24 in. overlap of all seams. Edges should be embedded a minimum of 6 in. in soil.

- All sheeting must be inspected periodically after installation and after significant rainstorms to check for erosion, undermining, and anchorage failure. Any failures must be repaired immediately. If washout or breakages occur, the material should be re-installed after repairing the damage to the slope.

Erosion Control Blankets/Mats

- Biodegradable rolled erosion control products (RECPs) are typically composed of jute fibers, curled wood fibers, straw, coconut fiber, or a combination of these materials. In order for an RECP to be considered 100% biodegradable, the netting, sewing or adhesive system that holds the biodegradable mulch fibers together must also be biodegradable.

  - **Jute** is a natural fiber that is made into a yarn that is loosely woven into a biodegradable mesh. It is designed to be used in conjunction with vegetation and has longevity of approximately one year. The material is supplied in rolled strips, which should be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

  - **Excelsior** (curled wood fiber) blanket material should consist of machine produced mats of curled wood excelsior with 80 percent of the fiber 6 in. or longer. The excelsior blanket should be of consistent thickness. The wood fiber must be evenly distributed over the entire area of the blanket. The top surface of the blanket should be covered with a photodegradable extruded plastic mesh. The blanket should be smolder resistant without the use of chemical additives and should be non-toxic and non-injurious to plant and animal life. Excelsior blankets should be furnished in rolled strips, a minimum of 48 in. wide, and should have an average weight of 0.8 lb/yd^2, ±10 percent, at the time of manufacture. Excelsior blankets must be secured in place with wire staples. Staples

should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Straw blanket** should be machine produced mats of straw with a lightweight biodegradable netting top layer. The straw should be attached to the netting with biodegradable thread or glue strips. The straw blanket should be of consistent thickness. The straw should be evenly distributed over the entire area of the blanket. Straw blanket should be furnished in rolled strips a minimum of 6.5 ft wide, a minimum of 80 ft long and a minimum of 0.5 lb/yd^2. Straw blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Wood fiber blanket** is composed of biodegradable fiber mulch with extruded plastic netting held together with adhesives. The material is designed to enhance re-vegetation. The material is furnished in rolled strips, which must be secured to the ground with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Coconut fiber blanket** should be a machine produced mat of 100 percent coconut fiber with biodegradable netting on the top and bottom. The coconut fiber should be attached to the netting with biodegradable thread or glue strips. The coconut fiber blanket should be of consistent thickness. The coconut fiber should be evenly distributed over the entire area of the blanket. Coconut fiber blanket should be furnished in rolled strips with a minimum of 6.5 ft wide, a minimum of 80 ft. long and a minimum of 0.5 lb/yd^2. Coconut fiber blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Coconut fiber mesh** is a thin permeable membrane made from coconut or corn fiber that is spun into a yarn and woven into a biodegradable mat. It is designed to be used in conjunction with vegetation and typically has longevity of several years. The material is supplied in rolled strips, which must be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Straw coconut fiber blanket** should be machine produced mats of 70 percent straw and 30 percent coconut fiber with a biodegradable netting top layer and a biodegradable bottom net. The straw and coconut fiber should be attached to the netting with biodegradable thread or glue strips. The straw coconut fiber blanket should be of consistent thickness. The straw and coconut fiber should be evenly distributed over the entire area of the blanket. Straw coconut fiber blanket should be furnished in rolled strips a minimum of 6.5 ft wide, a minimum of 80 ft long and a minimum of 0.5 lb/yd^2. Straw coconut fiber blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- Non-biodegradable RECPs are typically composed of polypropylene, polyethylene, nylon or other synthetic fibers. In some cases, a combination of biodegradable and synthetic fibers is used to construct the RECP. Netting used to hold these fibers together is typically non-biodegradable as well.

- **Plastic netting** is a lightweight biaxially oriented netting designed for securing loose mulches like straw or paper to soil surfaces to establish vegetation. The netting is photodegradable. The netting is supplied in rolled strips, which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Plastic mesh** is an open weave geotextile that is composed of an extruded synthetic fiber woven into a mesh with an opening size of less than ¼ in. It is used with re-vegetation or may be used to secure loose fiber such as straw to the ground. The material is supplied in rolled strips, which must be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Synthetic fiber with netting** is a mat that is composed of durable synthetic fibers treated to resist chemicals and ultraviolet light. The mat is a dense, three dimensional mesh of synthetic (typically polyolefin) fibers stitched between two polypropylene nets. The mats are designed to be re-vegetated and provide a permanent composite system of soil, roots, and geomatrix. The material is furnished in rolled strips, which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Bonded synthetic fibers** consist of a three dimensional geomatrix nylon (or other synthetic) matting. Typically it has more than 90 percent open area, which facilitates root growth. It's tough root reinforcing system anchors vegetation and protects against hydraulic lift and shear forces created by high volume discharges. It can be installed over prepared soil, followed by seeding into the mat. Once vegetated, it becomes an invisible composite system of soil, roots, and geomatrix. The material is furnished in rolled strips that must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Combination synthetic and biodegradable RECPs** consist of biodegradable fibers, such as wood fiber or coconut fiber, with a heavy polypropylene net stitched to the top and a high strength continuous filament geomatrix or net stitched to the bottom. The material is designed to enhance re-vegetation. The material is furnished in rolled strips, which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

Site Preparation

- Proper site preparation is essential to ensure complete contact of the blanket or matting with the soil.

- Grade and shape the area of installation.

- Remove all rocks, clods, vegetation or other obstructions so that the installed blankets or mats will have complete, direct contact with the soil.

- Prepare seedbed by loosening 2 to 3 in. of topsoil.

Seeding

Seed the area before blanket installation for erosion control and revegetation. Seeding after mat installation is often specified for turf reinforcement application. When seeding prior to blanket

installation, all check slots and other areas disturbed during installation must be re-seeded. Where soil filling is specified, seed the matting and the entire disturbed area after installation and prior to filling the mat with soil.

Fertilize and seed in accordance with seeding specifications or other types of landscaping plans. When using jute matting on a seeded area, apply approximately half the seed before laying the mat and the remainder after laying the mat. The protective matting can be laid over areas where grass has been planted and the seedlings have emerged. Where vines or other ground covers are to be planted, lay the protective matting first and then plant through matting according to design of planting.

Check Slots

Check slots are made of glass fiber strips, excelsior matting strips or tight folded jute matting blanket or strips for use on steep, highly erodible watercourses. The check slots are placed in narrow trenches 6 to 12 in. deep across the channel and left flush with the soil surface. They are to cover the full cross section of designed flow.

Laying and Securing Matting

- Before laying the matting, all check slots should be installed and the friable seedbed made free from clods, rocks, and roots. The surface should be compacted and finished according to the requirements of the manufacturer's recommendations.
- Mechanical or manual lay down equipment should be capable of handling full rolls of fabric and laying the fabric smoothly without wrinkles or folds. The equipment should meet the fabric manufacturer's recommendations or equivalent standards.

Anchoring

- U-shaped wire staples, metal geotextile stake pins, or triangular wooden stakes can be used to anchor mats and blankets to the ground surface.
- Wire staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.
- Metal stake pins should be 0.188 in. diameter steel with a 1.5 in. steel washer at the head of the pin, and 8 in. in length.
- Wire staples and metal stakes should be driven flush to the soil surface.

Installation on Slopes

Installation should be in accordance with the manufacturer's recommendations. In general, these will be as follows:

- Begin at the top of the slope and anchor the blanket in a 6 in. deep by 6 in. wide trench. Backfill trench and tamp earth firmly.
- Unroll blanket down slope in the direction of water flow.
- Overlap the edges of adjacent parallel rolls 2 to 3 in. and staple every 3 ft.

- When blankets must be spliced, place blankets end over end (shingle style) with 6 in. overlap. Staple through overlapped area, approximately 12 in. apart.
- Lay blankets loosely and maintain direct contact with the soil. Do not stretch.
- Staple blankets sufficiently to anchor blanket and maintain contact with the soil. Staples should be placed down the center and staggered with the staples placed along the edges. Steep slopes, 1:1 (H:V) to 2:1 (H:V), require a minimum of 2 staples/yd^2. Moderate slopes, 2:1 (H:V) to 3:1 (H:V), require a minimum of 1 ½ staples/yd^2.

Installation in Channels

Installation should be in accordance with the manufacturer's recommendations. In general, these will be as follows:

- Dig initial anchor trench 12 in. deep and 6 in. wide across the channel at the lower end of the project area.
- Excavate intermittent check slots, 6 in. deep and 6 in. wide across the channel at 25 to 30 ft intervals along the channels.
- Cut longitudinal channel anchor trenches 4 in. deep and 4 in. wide along each side of the installation to bury edges of matting, whenever possible extend matting 2 to 3 in. above the crest of the channel side slopes.
- Beginning at the downstream end and in the center of the channel, place the initial end of the first roll in the anchor trench and secure with fastening devices at 12 in. intervals. Note: matting will initially be upside down in anchor trench.
- In the same manner, position adjacent rolls in anchor trench, overlapping the preceding roll a minimum of 3 in.
- Secure these initial ends of mats with anchors at 12 in. intervals, backfill and compact soil.
- Unroll center strip of matting upstream. Stop at next check slot or terminal anchor trench. Unroll adjacent mats upstream in similar fashion, maintaining a 3 in. overlap.
- Fold and secure all rolls of matting snugly into all transverse check slots. Lay mat in the bottom of the slot then fold back against itself. Anchor through both layers of mat at 12 in. intervals, then backfill and compact soil. Continue rolling all mat widths upstream to the next check slot or terminal anchor trench.
- Alternate method for non-critical installations: Place two rows of anchors on 6 in. centers at 25 to 30 ft. intervals in lieu of excavated check slots.
- Staple shingled lap spliced ends a minimum of 12 in. apart on 12 in. intervals.
- Place edges of outside mats in previously excavated longitudinal slots; anchor using prescribed staple pattern, backfill, and compact soil.
- Anchor, fill, and compact upstream end of mat in a 12 in. by 6 in. terminal trench.

- Secure mat to ground surface using U-shaped wire staples, geotextile pins, or wooden stakes.
- Seed and fill turf reinforcement matting with soil, if specified.

Soil Filling (if specified for turf reinforcement)

- Always consult the manufacturer's recommendations for installation.
- Do not drive tracked or heavy equipment over mat.
- Avoid any traffic over matting if loose or wet soil conditions exist.
- Use shovels, rakes, or brooms for fine grading and touch up.
- Smooth out soil filling just exposing top netting of mat.

Temporary Soil Stabilization Removal

- Temporary soil stabilization removed from the site of the work must be disposed of if necessary.

Costs

Relatively high compared to other BMPs. Biodegradable materials: $0.50 - $0.57/yd^2. Permanent materials: $3.00 - $4.50/yd^2. Staples: $0.04 - $0.05/staple. Approximate costs for installed materials are shown below:

Rolled Erosion Control Products		Installed Cost per Acre
Biodegradable	Jute Mesh	$6,500
	Curled Wood Fiber	$10,500
	Straw	$8,900
	Wood Fiber	$8,900
	Coconut Fiber	$13,000
	Coconut Fiber Mesh	$31,200
	Straw Coconut Fiber	$10,900
Non-Biodegradable	Plastic Netting	$2,000
	Plastic Mesh	$3,200
	Synthetic Fiber with Netting	$34,800
	Bonded Synthetic Fibers	$50,000
	Combination with Biodegradable	$32,000

Source: Caltrans Guidance for Soil Stabilization for Temporary Slopes, Nov. 1999

Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season, and at two-week intervals during the non-rainy season.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.

- Areas where erosion is evident shall be repaired and BMPs reapplied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require reapplication of BMPs.
- If washout or breakage occurs, re-install the material after repairing the damage to the slope or channel.
- Make sure matting is uniformly in contact with the soil.
- Check that all the lap joints are secure.
- Check that staples are flush with the ground.
- Check that disturbed areas are seeded.

References

Guides for Erosion and Sediment Controls in California, USDA Soils Conservation Service, January 1991.

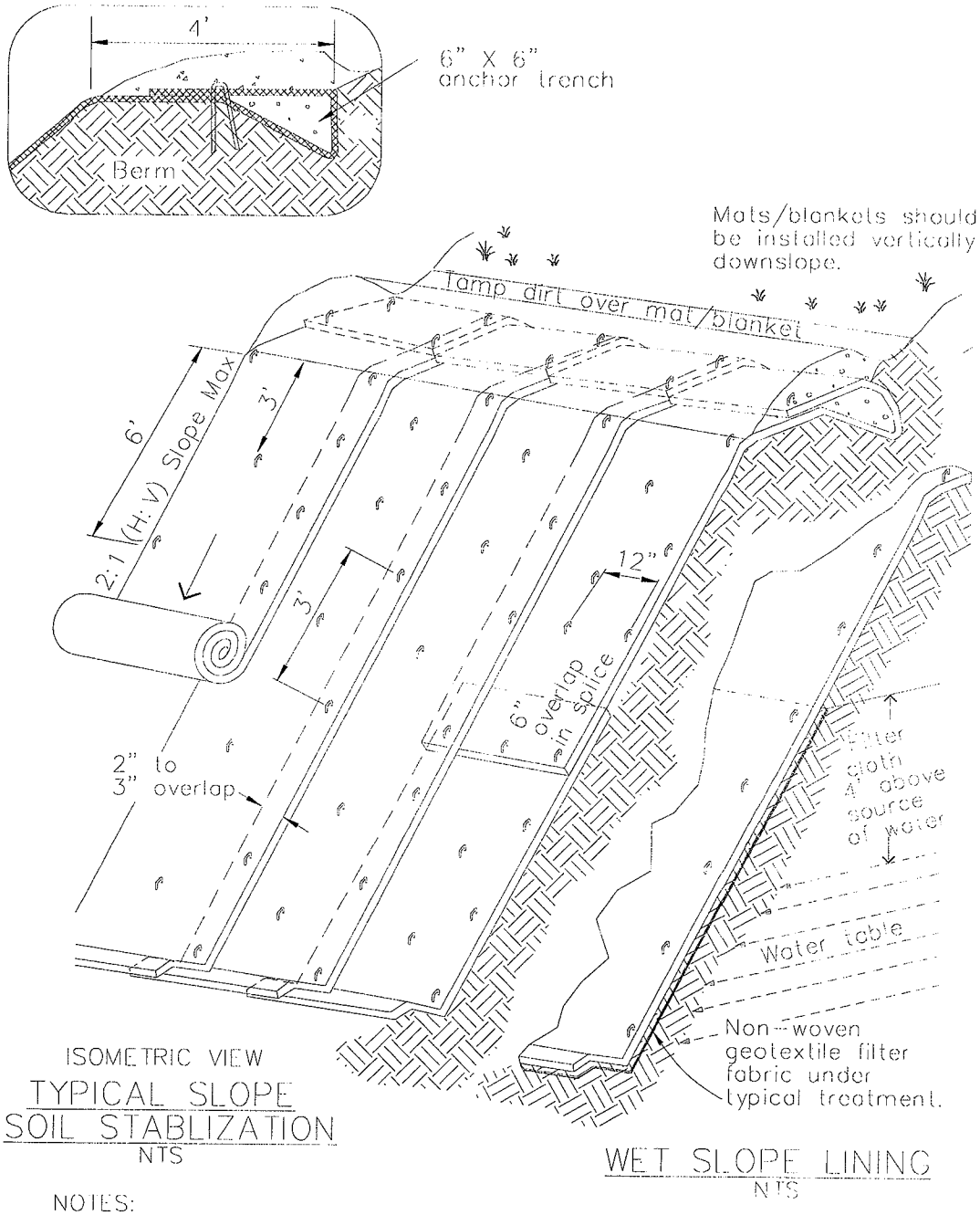
National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Guidance Document: Soil Stabilization for Temporary Slopes, State of California Department of Transportation (Caltrans), November 1999

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for The Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.



ISOMETRIC VIEW

TYPICAL SLOPE SOIL STABLIZATION

NTS

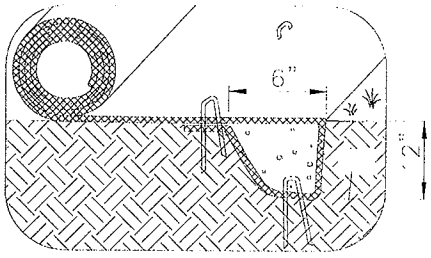
WET SLOPE LINING

NTS

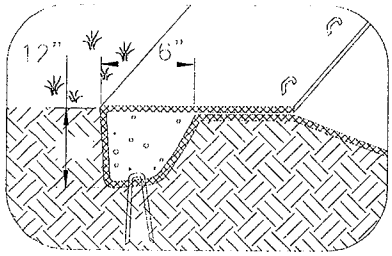
NOTES:

1. Slope surface shall be free of rocks, clods, sticks and grass. Mats/blankets shall have good soil contact.
2. Lay blankets loosely and stake or staple to maintain direct contact with the soil. Do not stretch.
3. Install per manufacturer's recommendations

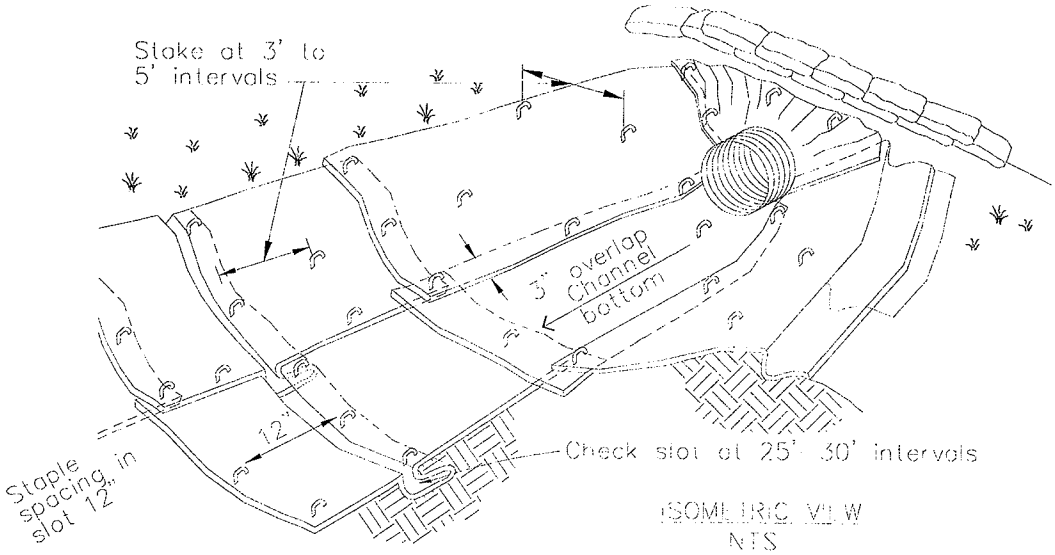
TYPICAL INSTALLATION DETAIL



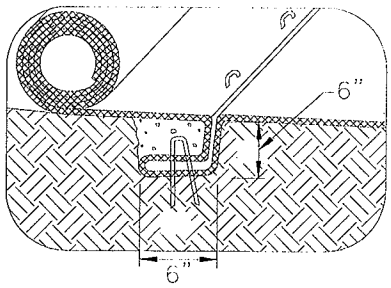
INITIAL CHANNEL ANCHOR TRENCH
NTS



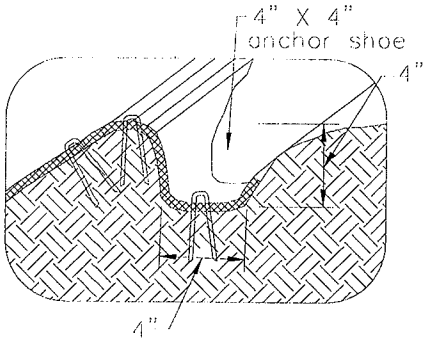
TERMINAL SLOPE AND CHANNEL ANCHOR TRENCH
NTS



ISOMETRIC VIEW
NTS



INTERMITTENT CHECK SLOT
NTS



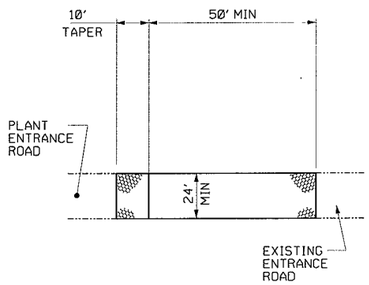
LONGITUDINAL ANCHOR TRENCH
NTS

NOTES:

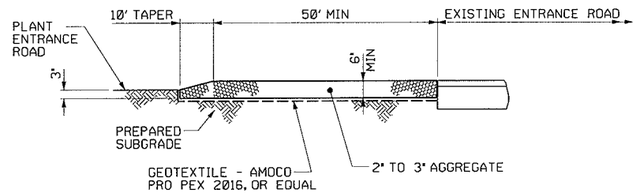
1. Check slots to be constructed per manufacturers specifications.
2. Staking or stapling layout per manufacturers specifications.
3. Install per manufacturer's recommendations

TYPICAL INSTALLATION DETAIL

ATTACHMENT D



PLAN



NOTE:
PROVIDE APPROPRIATE TRANSITION BETWEEN GRAVELED ACCESS ROAD AND ROADWAY.

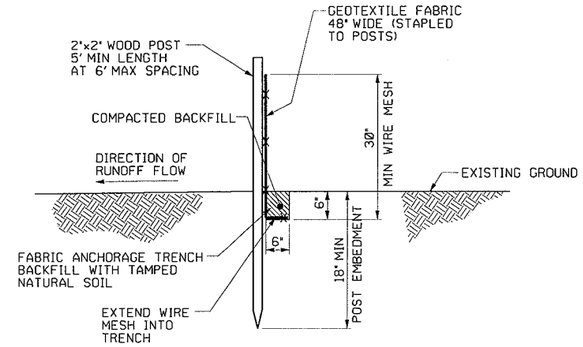
PROFILE

MAINTENANCE:

TEMPORARY GRAVELED ACCESS ROAD THICKNESS SHALL BE CONSTANTLY MAINTAINED TO THE SPECIFIED DIMENSIONS BY ADDING AGGREGATE. A STOCKPILE OF AGGREGATE SHALL BE MAINTAINED ON THE SITE FOR THIS PURPOSE. AT THE END OF EACH CONSTRUCTION DAY, ALL SEDIMENT DEPOSITED ON PUBLIC ROADWAYS SHALL BE REMOVED AND RETURNED TO THE CONSTRUCTION SITE.

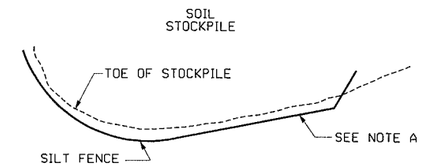
GRAVELED CONSTRUCTION ENTRANCE

NOT TO SCALE

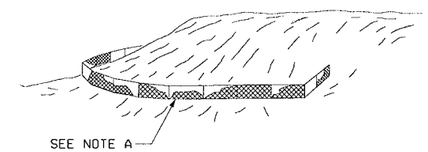


SILT FENCE - PRE ASSEMBLED

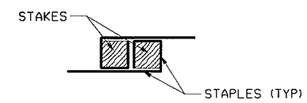
NOT TO SCALE



PLAN VIEW



ILLUSTRATION



JOINING FENCE SECTIONS

NOTES:

A) SILT FENCE MUST BE INSTALLED AT LEVEL GRADE. BOTH ENDS OF EACH FENCE SECTION MUST EXTEND AT LEAST 8 FEET UPSLOPE AT 45 DEGREES TO THE MAIN FENCE ALIGNMENT.

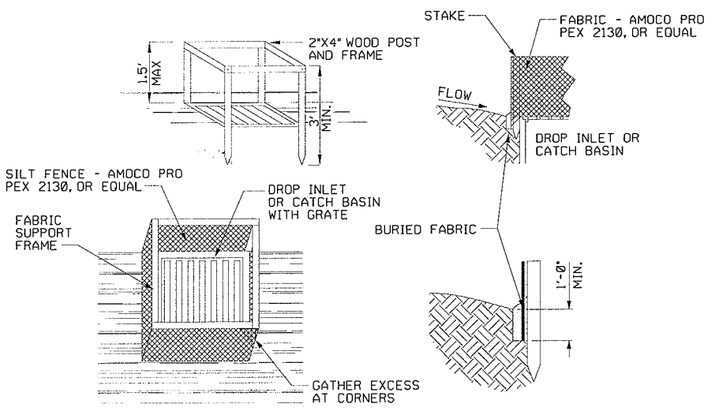
B) SEDIMENT MUST BE REMOVED WHEN ACCUMULATIONS REACH ½ THE ABOVE GROUND HEIGHT OF THE FENCE.

C) WHERE ENDS OF FABRIC COME TOGETHER, THEY MUST BE OVERLAPPED, FOLDED AND STAPLED TO PREVENT SEDIMENT BYPASS. THE TOE ANCHOR MUST BE BACKFILLED AND COMPACTED TO A DENSITY EQUAL TO THE SURROUNDING SOILS.

D) INSTALL FENCE AT LOCATIONS SHOWN ON DE-C1-0007 & SOIL STOCKPILE AS SHOWN

SILT FENCE INSTALLATION DETAILS

NOT TO SCALE



NOTES:

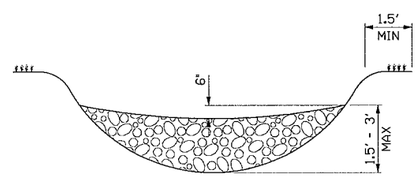
1. THE STAKES SHALL BE SPACED EVENLY AROUND THE PERIMETER OF THE INLET A MAXIMUM OF 3 FEET APART, AND SECURELY DRIVEN INTO THE GROUND, APPROXIMATELY 18 INCHES DEEP. THE FABRIC SHALL BE ENTRENCHED 12 INCHES AND BACKFILLED WITH CRUSHED STONE OR COMPACTED SOIL. FABRIC AND WIRE SHALL BE SECURELY FASTENED TO THE POSTS, AND FABRIC ENDS MUST BE OVERLAPPED A MINIMUM OF 18 INCHES OR WRAPPED TOGETHER AROUND A POST TO PROVIDE A CONTINUOUS BARRIER AROUND THE INLET.

2. THE TRAP SHALL BE INSPECTED DAILY AND REPAIRS MADE AS NEEDED. SEDIMENT SHALL BE REMOVED WHEN SEDIMENT HAS ACCUMULATED TO ONE-HALF THE HEIGHT OF THE TRAP.

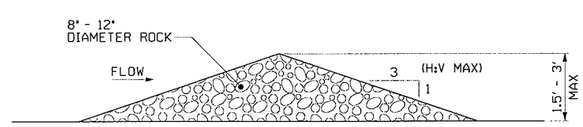
3. SEDIMENT SHALL NOT BE WASHED INTO THE INLET. IT SHALL BE REMOVED FROM THE SEDIMENT TRAP AND DISPOSED OF AND STABILIZED SO THAT IT WILL NOT AGAIN ENTER THE INLET. WHEN THE CONTRIBUTING AREA HAS BEEN PERMANENTLY STABILIZED, ALL MATERIALS AND ANY SEDIMENT SHALL BE REMOVED AND EITHER SALVAGED OR DISPOSED OF PROPERLY. THE DISTURBED AREA SHALL BE BROUGHT TO PROPER GRADE, THEN SMOOTHED AND COMPACTED. APPROPRIATELY STABILIZE ALL DISTURBED AREAS AROUND THE INLET.

INLET SEDIMENT TRAP (ISP)
FILTER FABRIC WITH SUPPORTING FRAME

NOT TO SCALE



ELEVATION



SECTION

ROCK CHECK DAM

NOT TO SCALE

REFERENCES:

DE-C1-0007 EROSION AND SEDIMENT CONTROL PLAN

RCEC-04-DC-0002

D-1

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENGINEER	PROJECT ENGINEER	PROJECT MANAGER
A	11-14-06	ISSUED FOR CLIENT REVIEW	GU	AM	DS	PK	DE

DRAWN BY: GJU	DATE: 11-14-06	PROFESSIONAL ENGINEER STAMP
CHECKED BY: ALM	DATE: 11-14-06	
ENGINEER: D SHETH	DATE: 11-14-06	
PROJECT ENGINEER: P KHAN	DATE: 11-14-06	
PROJECT MANAGER: DR ERALI	DATE: 11-14-06	

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA.

PRINT NAME: PRADIP KHAN
SIGNATURE:
DATE: 11-14-06 LICENSE #: 54262
STATE:
DATE:

ORIGINALLY PREPARED UNDER THE RESPONSIBLE SUPERVISION OF

PCE
LIC. NO.:

WorleyParsons

CALPINE

RUSSELL CITY ENERGY CENTER
HAYWARD, CALIFORNIA

CIVIL
GEN-GENERAL
EROSION AND SEDIMENT CONTROL
DETAILS

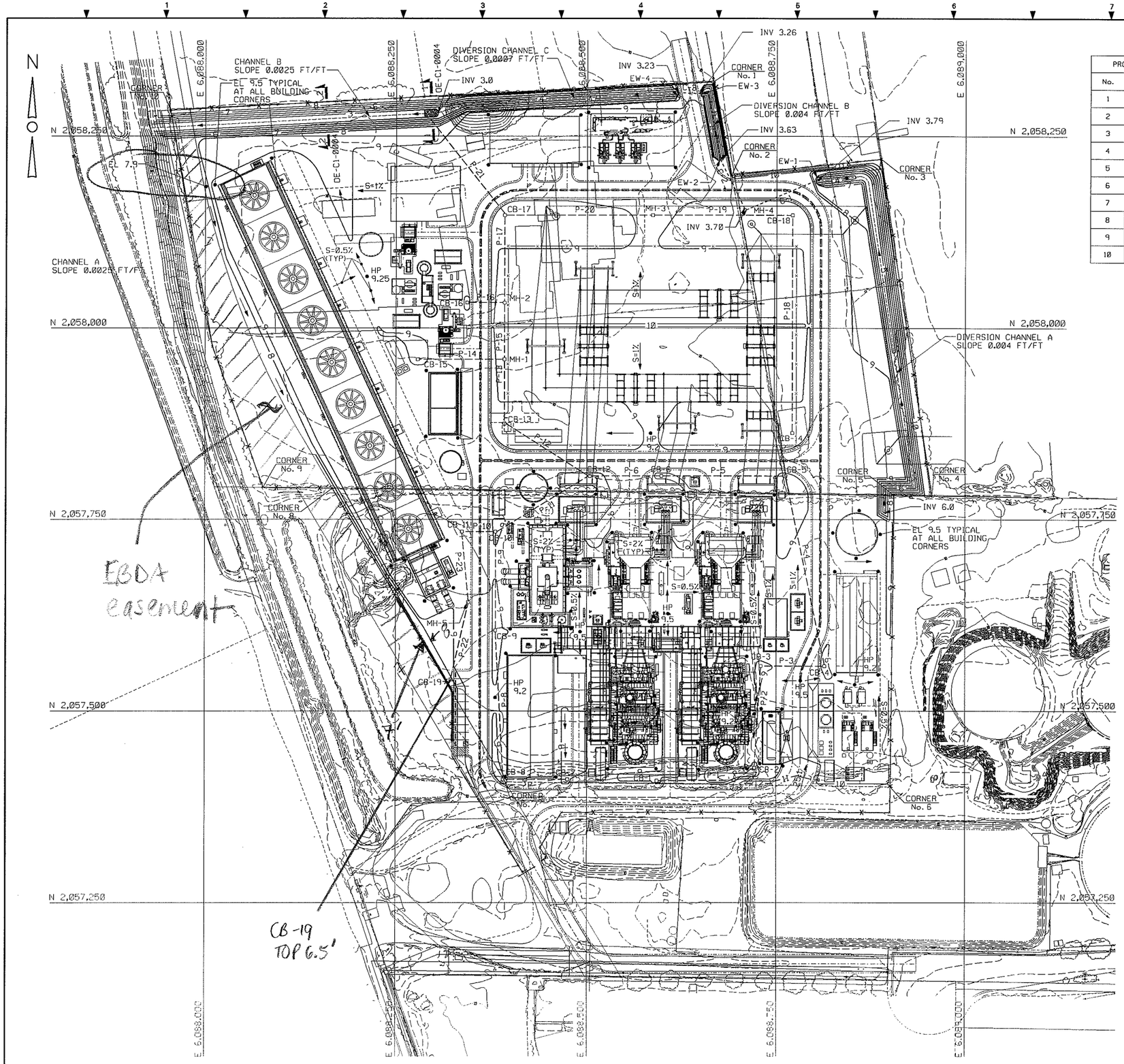
SCALE: NONE

DWG NO.: RC-GEN-DE-C1-0008 SHEET NO.: 01 REVISION: A

DWG-FILE: rc-gen-de-c1-0008.dgn
DWG-DATE: 14-Nov-06 08:42

APPENDIX 2C

Stormwater Drawings



PROPERTY CORNER COORDINATE SCHEDULE		
No.	NORTH	EAST
1	2058321.5	6088667.5
2	2058199.4	6088690.1
3	2058220.4	6088888.1
4	2057781.1	6088956.2
5	2057781.8	6088905.8
6	2057401.0	6088901.2
7	2057407.2	6088394.3
8	2057790.8	6088166.8
9	2057791.9	6088076.5
10	2058283.4	6087954.3

LEGEND

- EXISTING GRADE CONTOUR
- FINAL GRADE CONTOUR
- 9.5 — FINAL GRADE SPOT ELEVATION
- PROPOSED FENCE
- PROPOSED STORM DRAIN
- PROPOSED CULVERT
- PROPOSED STORM CATCH BASIN
- PROPOSED ENDWALL
- PROPOSED DRAINAGE CHANNEL
- DIRECTION OF FLOW

NOTES:

1. COORDINATES LISTED ARE STATE PLANE NAD83, CALIFORNIA ZONE 3.

REFERENCES:

DC-G1-0001	GENERAL ARRANGEMENT SITE PLAN
DE-C1-0002	SITE SURFACING PLAN
DE-C1-0004	GRADING DETAILS
DE-C2-0002	DRAINAGE STRUCTURES
DE-C2-0001	CATCH BASIN AND PIPE SCHEDULE

60 0 60 120 180
SCALE IN FEET

PRELIMINARY

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENGINEER	PROJECT ENGINEER	PROJECT MANAGER
- -							
- -							
- -							
- -							
- -							
- -							

DRAWN BY GJU DATE - -06
CHECKED BY DATE - -
ENGINEER JA WINTERHALTER DATE - -06
PROJECT ENGINEER N/A DATE - -
PROJECT MANAGER DR ERALI DATE - -06

PROFESSIONAL ENGINEER STAMP

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA.

PRINT NAME
SIGNATURE
DATE LICENSE #
ORIGINALLY PREPARED UNDER THE RESPONSIBLE SUPERVISION OF
FOR
LIC. NO.
STATE
DATE

WorleyParsons

CALPINE

RUSSELL CITY ENERGY CENTER
HAYWARD, CALIFORNIA

CIVIL
GEN-GENERAL
FINAL SITE GRADING
AND DRAINAGE PLAN

SCALE 1"=60'

DWG. NO. RC-GEN-DE-C1-0001
SHEET NO. 01
REVISION

FILE NAME:
PATH:
SERVER:
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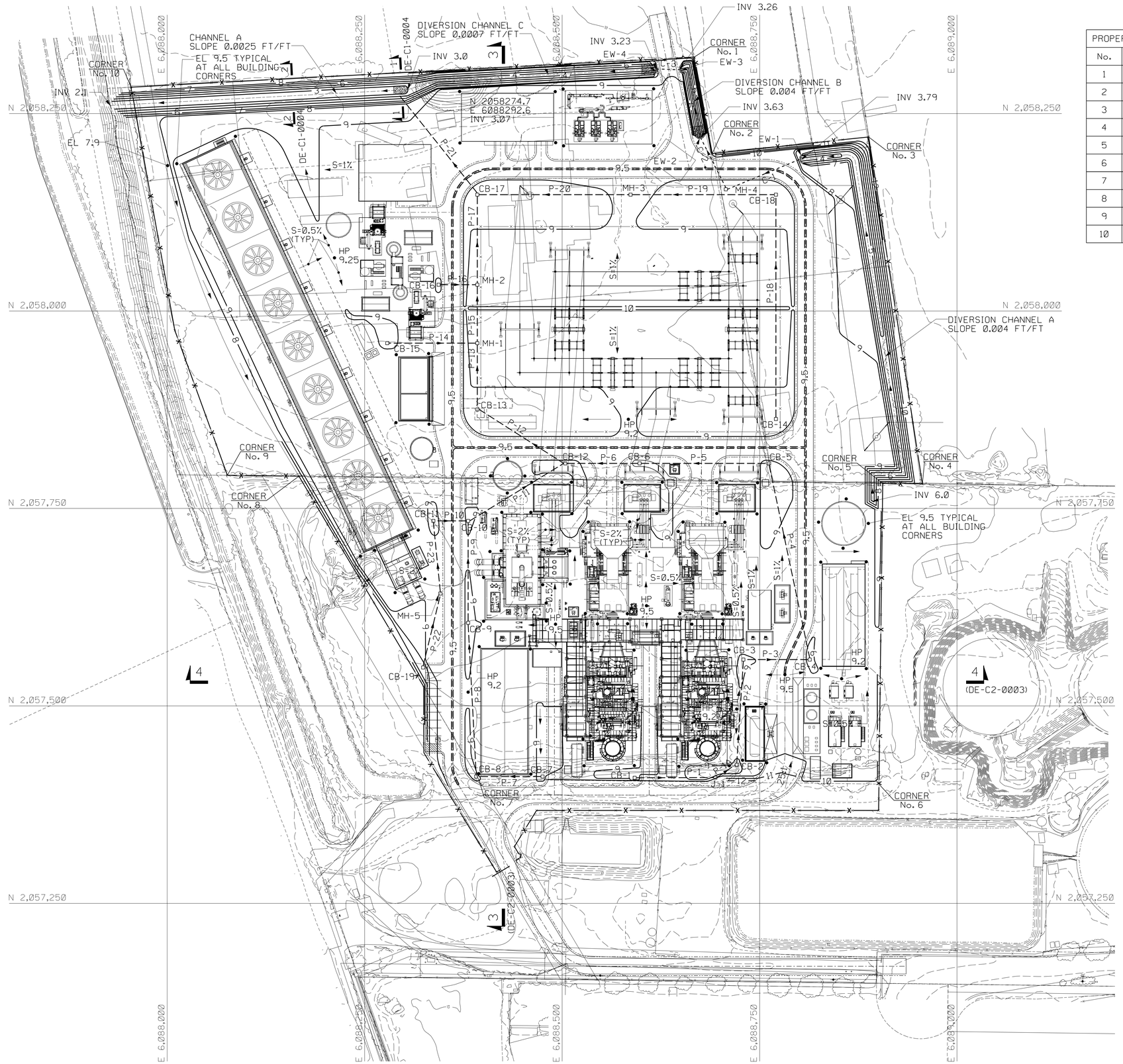
VHL: Thu Jun 09 14:23:05 2005



PROPERTY CORNER COORDINATE SCHEDULE		
No.	NORTH	EAST
1	2058321.5	6088667.5
2	2058199.4	6088690.1
3	2058220.4	6088888.1
4	2057781.1	6088956.2
5	2057781.8	6088905.8
6	2057401.0	6088901.2
7	2057407.2	6088394.3
8	2057790.8	6088166.8
9	2057791.9	6088076.5
10	2058283.4	6087954.3

LEGEND

- EXISTING GRADE CONTOUR
- FINAL GRADE CONTOUR
- FINAL GRADE SPOT ELEVATION
- PROPOSED FENCE
- PROPOSED STORM DRAIN
- PROPOSED CULVERT
- PROPOSED STORM CATCH BASIN
- PROPOSED ENDWALL
- PROPOSED DRAINAGE CHANNEL
- DIRECTION OF FLOW

NOTES:

1. COORDINATES LISTED ARE STATE PLANE NAD83, CALIFORNIA ZONE 3.
2. DRAIN INSERTS SHALL BE USED FOR ALL CATCH BASINS AND SHALL BE ACCORDING TO ULTRA DRAIN GUARD, OIL AND SEDIMENT MODEL, PART #9225, OR EQUAL.

REFERENCES:

DC-G1-0001	GENERAL ARRANGEMENT SITE PLAN
DE-C1-0002	SITE SURFACING PLAN
DE-C1-0004	GRADING DETAILS
DE-C2-0002	DRAINAGE STRUCTURES
DE-C2-0001	CATCH BASIN AND PIPE SCHEDULE
DE-C2-0003	SECTIONS

60 0 60 120 180

SCALE IN FEET

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENGINEER	PROJECT ENGINEER	PROJECT MANAGER
A	11-13-06	ISSUED FOR CLIENT REVIEW	GU	AM	DS	PK	DE

	DATE
DRAWN BY: GJU	11-13-06
CHECKED BY: ALM	11-13-06
ENGINEER: D SHETH	11-13-06
PROJECT ENGINEER: P KHAN	11-13-06
PROJECT MANAGER: DR ERALI	11-13-06

PROFESSIONAL ENGINEER STAMP

REGISTERED PROFESSIONAL ENGINEER PRADIP KUMAR KHAN No. 54262 Exp. 12-31-07 CIVIL STATE OF CALIFORNIA

See electronic signature for date and time

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA.

PRINT NAME: PRADIP KHAN

SIGNATURE

DATE: 11-13-06 LICENSE #: 54262

ORIGINALLY PREPARED UNDER THE RESPONSIBLE SUPERVISION OF

PE: STATE:

LIC. NO.: DATE:

WorleyParsons

CALPINE

RUSSELL CITY ENERGY CENTER
HAYWARD, CALIFORNIA

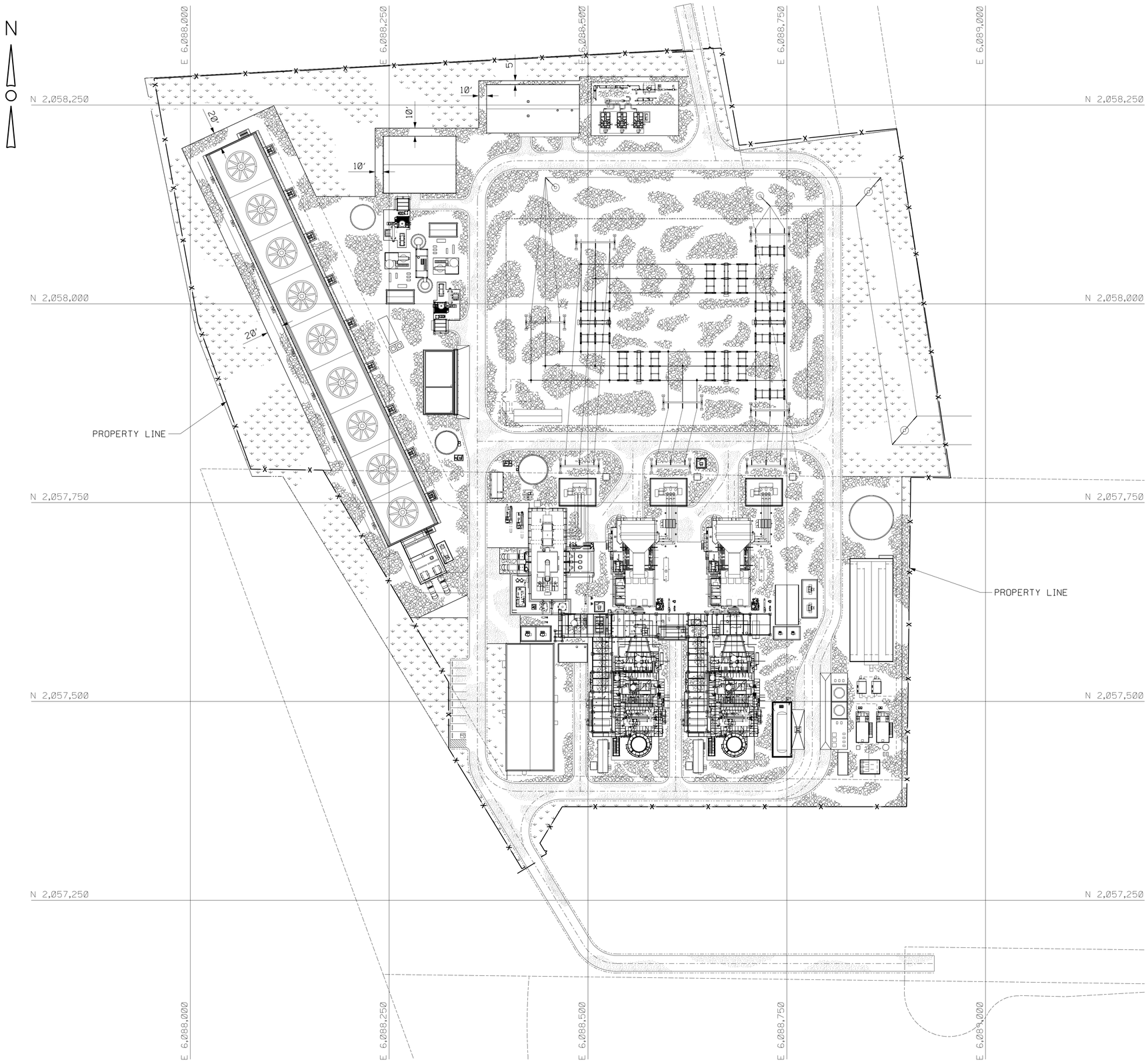
CIVIL
GEN-GENERAL
FINAL SITE GRADING
AND DRAINAGE PLAN

SCALE 1"=60'

DWG. NO.	SHEET NO.	REVISION
RC-GEN-DE-C1-0001	01	A

FILE NAME:
PATH:
SERVER:

DWG-FILE: rc-gen-de-c1-0001.dgn
DWG-DATE: 01-Nov-06 10:38



LEGEND

- AGGREGATE SURFACING
- CONCRETE SLAB
- BITUMINOUS PAVING
- GRASS

NOTES:

1. SURFACING IS BASED ON REVISION E OF THE GENERAL ARRANGEMENT DRAWING RC-GEN-DC-G1-0001.

REFERENCES:

DC-G1-0001	GENERAL ARRANGEMENT - SITE PLAN
DE-C1-0005	ROADWAY AND FENCE LOCATION - PLAN

60 0 60 120 180

SCALE IN FEET

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENGINEER	PROJECT ENGINEER	PROJECT MANAGER
	- -						
	- -						
	- -						
	- -						
	- -						
A	11-13-06	ISSUED FOR CLIENT REVIEW	GU	AM	DS	PK	DE

DRAWN BY GJU	DATE 11-13-06
CHECKED BY ALM	DATE 11-13-06
ENGINEER D SHETH	DATE 11-13-06
PROJECT ENGINEER P KHAN	DATE 11-13-06
PROJECT MANAGER DR ERALI	DATE 11-13-06

PROFESSIONAL ENGINEER STAMP

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SIGNATURE

DATE 11-13-06 LICENSE # 54262

ORIGINALLY PREPARED UNDER THE RESPONSIBLE SUPERVISION OF

PE: STATE:

LIC. NO.: DATE:

WorleyParsons

CALPINE

RUSSELL CITY ENERGY CENTER
HAYWARD, CALIFORNIA

CIVIL
GEN-GENERAL
SITE SURFACING PLAN

SCALE 1"=60'

DWG. NO.	SHEET NO.	REVISION
RC-GEN-DE-C1-0002	01	A

FILE NAME:
PATH:
SERVER:

DWG-FILE: rc-gen-de-c1-0002.dgn
DWG-DATE: 01-Nov-06 07:10

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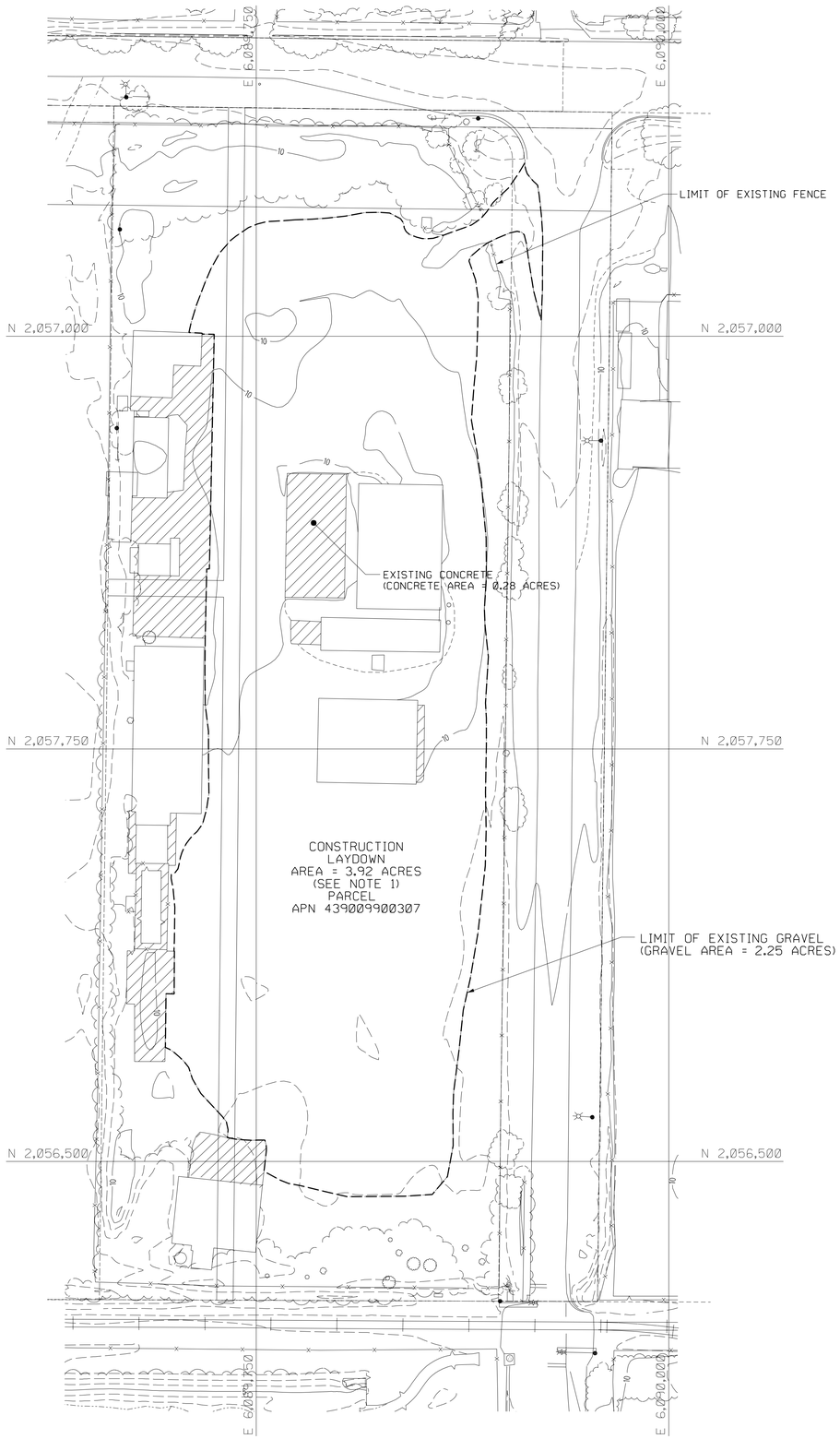
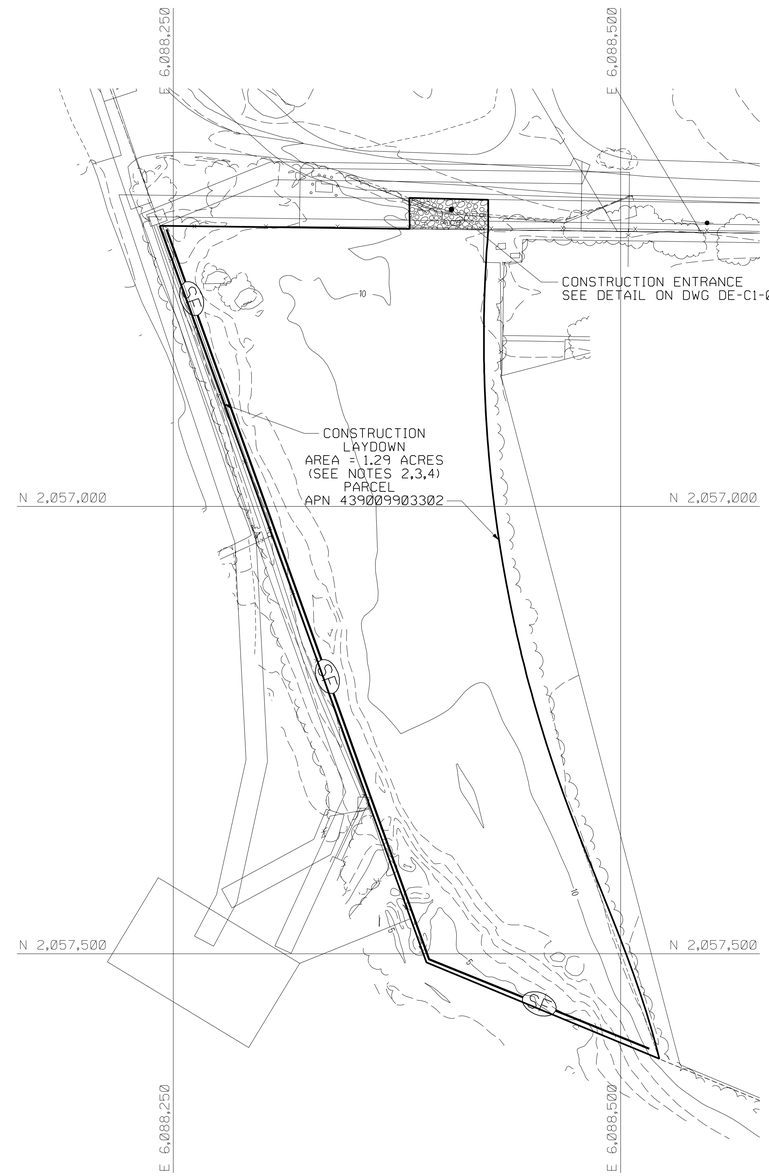


PLAN



PLAN

NOTES:

1. THE EXISTING GRADES, FEATURES AND SURFACING WILL REMAIN. NO CHANGES ARE REQUIRED FOR THIS CONSTRUCTION LAYDOWN AREA.
2. THE EXISTING GRADES AND FEATURES WILL REMAIN. HOWEVER, MINIMUM 6" OF GRAVEL SHALL BE PLACED (2" TO 3" AGGREGATE). AS PER CALTRAN STANDARD SPECIFICATIONS, SECTION 25.
3. CLEAR AND GRUB EXISTING AREA OF BRUSH WEEDS, ETC.
4. INSTALL SILT FENCE AS SHOWN ON DRAWING AND ACCORDING TO DE-C1-0008.

LEGEND

EXISTING GRADE CONTOUR

SF — SILT FENCE

REFERENCES:

FIGURE 1	SURVEY AREA (RECEIVED FROM CALPINE)
DE-C1-0008	EROSION AND SEDIMENT CONTROL DETAILS

40 0 40 80 120

SCALE IN FEET

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENGINEER	PROJECT ENGINEER	PROJECT MANAGER
A	11-13-06	ISSUED FOR CLIENT REVIEW	GJU	ALM	DS	PK	DE

	DATE
DRAWN BY: GJU	11-13-06
CHECKED BY: ALM	11-13-06
ENGINEER: D SHETH	11-13-06
PROJECT ENGINEER: P KHAN	11-13-06
PROJECT MANAGER: DR ERALI	11-13-06

PROFESSIONAL ENGINEER STAMP

REGISTERED PROFESSIONAL ENGINEER PRADIP KUMAR KHAN No. 54262 Exp. 12-31-07 CIVIL STATE OF CALIFORNIA

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SIGNATURE

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ORIGINALLY PREPARED UNDER THE RESPONSIBLE SUPERVISION OF

PE: STATE:
LIC. NO.: DATE:

WorleyParsons

CALPINE

RUSSELL CITY ENERGY CENTER
HAYWARD, CALIFORNIA

CIVIL
GEN-GENERAL
CONSTRUCTION LAYDOWN AREA

SCALE: 1"=40'

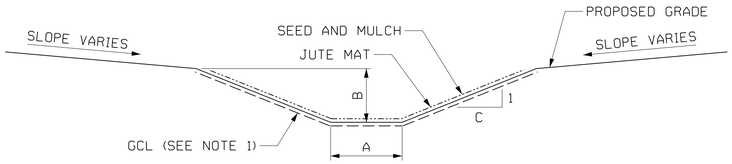
DWG. NO.	SHEET NO.	REVISION
RC-GEN-DE-C1-0003	01	A

FILE NAME:
PATH:
SERVER:

DWG-FILE: rc-gen-de-c1-0003.dgn
DWG-DATE: 13-Nov-06 15:28

VHL: Thu Jun 09 14:23:05 2005

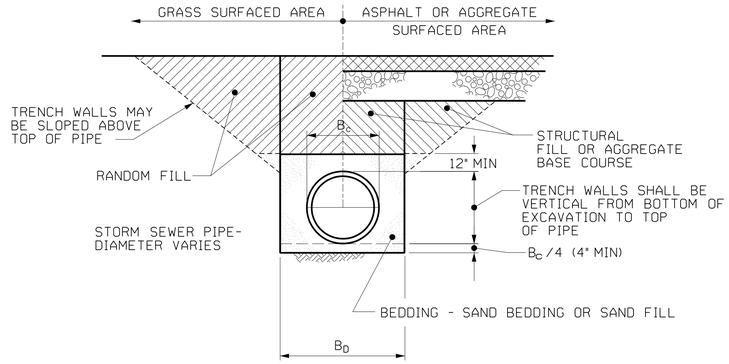
CHANNEL SCHEDULE						
CHANNEL	WIDTH (A)	DEPTH (B)	SIDE SLOPE (C)	SLOPE	LINING	TYPE
DIVERSION CHANNEL (A)	4′	3′	2.5:1	0.004 FT\FT	JUTE NET	PERMANENT
DIVERSION CHANNEL (B)	2′	3.5′	2.0:1	0.004 FT\FT	JUTE NET	PERMANENT
DIVERSION CHANNEL (C)	4′	3.7′	2.5:1	0.0007 FT\FT	JUTE NET	PERMANENT
CHANNEL (A)	10′	3′	3.0:1	0.0025 FT\FT	JUTE NET	PERMANENT



NOTE:

1. A GEOSYNTHETIC CLAY LINER (GCL) MAY BE REQUIRED IF THE WATER TABLE IS FOUND WITHIN 10 FEET OF THE BOTTOM OF THE CHANNEL. THE GCL IS TO BE DETERMINED BY THE CONTRACTOR.

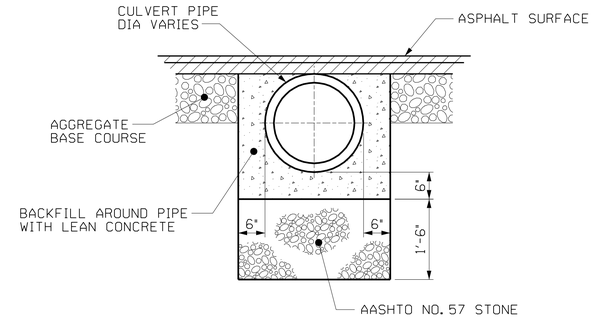
TYPICAL CHANNEL DETAIL



MINIMUM TRENCH WIDTH B_D
B_c + 18" FOR PIPE DIA UP TO 30"
B_c + 24" FOR PIPE DIA 33" TO 48"

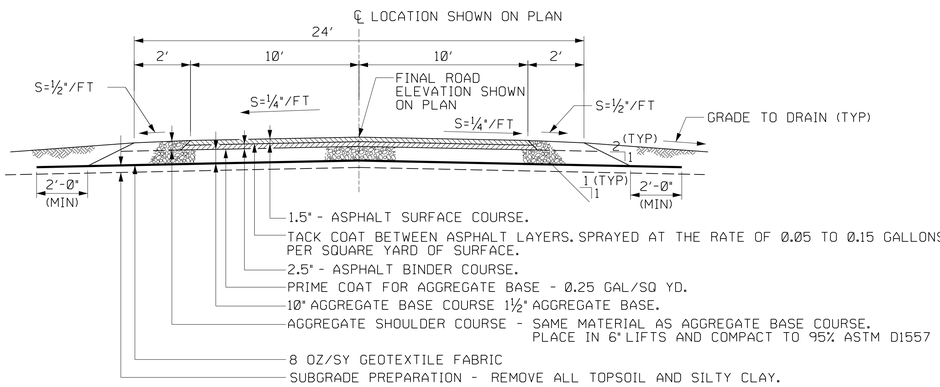
BEDDING AND BACKFILL REQUIREMENTS FOR STORM SEWER PIPE

NOT TO SCALE



BEDDING AND BACKFILL REQUIREMENTS FOR CULVERT PIPE

NOT TO SCALE

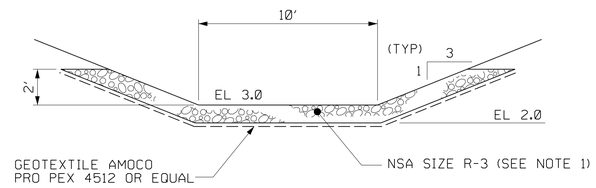


NOTE:

1. SOME ROADS TO BE ASPHALT PAVED WILL BE INSTALLED EARLY IN THE CONSTRUCTION PERIOD (IN THE INITIAL SITE WORK PHASE), AS AGGREGATE BASE ONLY AND USED AS CONSTRUCTION ROADS. PRIOR TO ASPHALT PAVING, REGRADE, REPAIR, AND ADD NEW BASE MATERIAL AS REQUIRED TO BRING THE ROAD TO REQUIRED FINAL ELEVATIONS AND PRIME AS REQUIRED BEFORE LAYING THE BITUMINOUS BINDER AND SURFACE COURSES.
2. ALL MATERIAL FOR ROAD CONSTRUCTION SHALL BE PER 2006 CALTRAN STANDARD SPECIFICATIONS, SECTION 37 THROUGH 42.

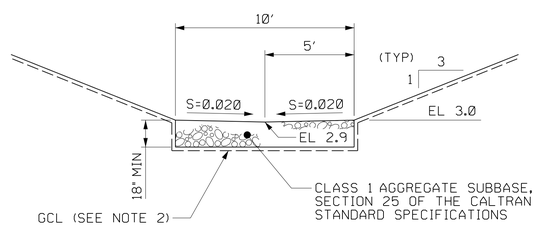
TYPICAL SECTION ASPHALT SURFACED ROADS

NOT TO SCALE



SECTION 1-1

(DE-CL-0001)



SECTION 2-2

(DE-CL-0001)

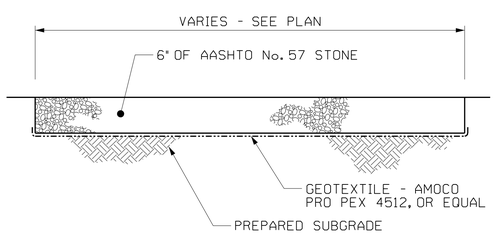
RIPRAP OUTLET PROTECTION				
CULVERT/ PIPE	WIDTH (FT)	LENGTH (FT)	RIPRAP STONE (SEE NOTE 1)	THICKNESS (IN)
P-21	14.2	13	R-3	9.0
C-2	14.2	13	R-3	9.0
C-3	14.2	13	R-3	9.0

NOTES:

1. RIPRAP SIZE IS ACCORDING TO NATIONAL STONE ASSOCIATION (NSA).
2. A GEOSYNTHETIC CLAY LINER (GCL) MAY BE REQUIRED IF THE GROUND WATER TABLE IS FOUND WITHIN 10 FEET OF THE BOTTOM OF THE CHANNEL. THE GCL IS TO BE DETERMINED BY THE CONTRACTOR.

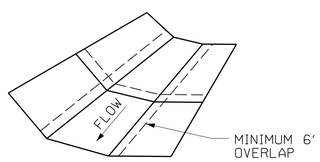
REFERENCES:

DE-C1-0001	FINAL SITE GRADING AND DRAINAGE PLAN
DE-C1-0002	SITE SURFACING PLAN
DE-C1-0005	ROADWAY AND FENCE LOCATION PLAN



TYPICAL SECTION - AGGREGATE SURFACING

NOT TO SCALE



JUTE MATTING INSTALLATION

NOT TO SCALE

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- -							
- -							
- -							
- -							
- -							
A	11-13-06	ISSUED FOR CLIENT REVIEW	GU	AM	DS	PK	DE

DRAWN BY GJU	DATE 11-13-06
CHECKED BY ALM	DATE 11-13-06
ENGINEER D SHETH	DATE 11-13-06
PROJECT ENGINEER P KHAN	DATE 11-13-06
PROJECT MANAGER DR ERALI	DATE 11-13-06

PROFESSIONAL ENGINEER STAMP

REGISTERED PROFESSIONAL ENGINEER PRADIP KUMAR KHAN No. 54262 Exp. 12-31-07 CIVIL STATE OF CALIFORNIA

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PRINT NAME PRADIP KHAN
SIGNATURE
DATE 11-13-06 LICENSE # 54262

ORIGINALLY PREPARED UNDER THE RESPONSIBLE SUPERVISION OF
PE: STATE:
LIC. NO.: DATE:

WorleyParsons

CALPINE

RUSSELL CITY ENERGY CENTER
HAYWARD, CALIFORNIA

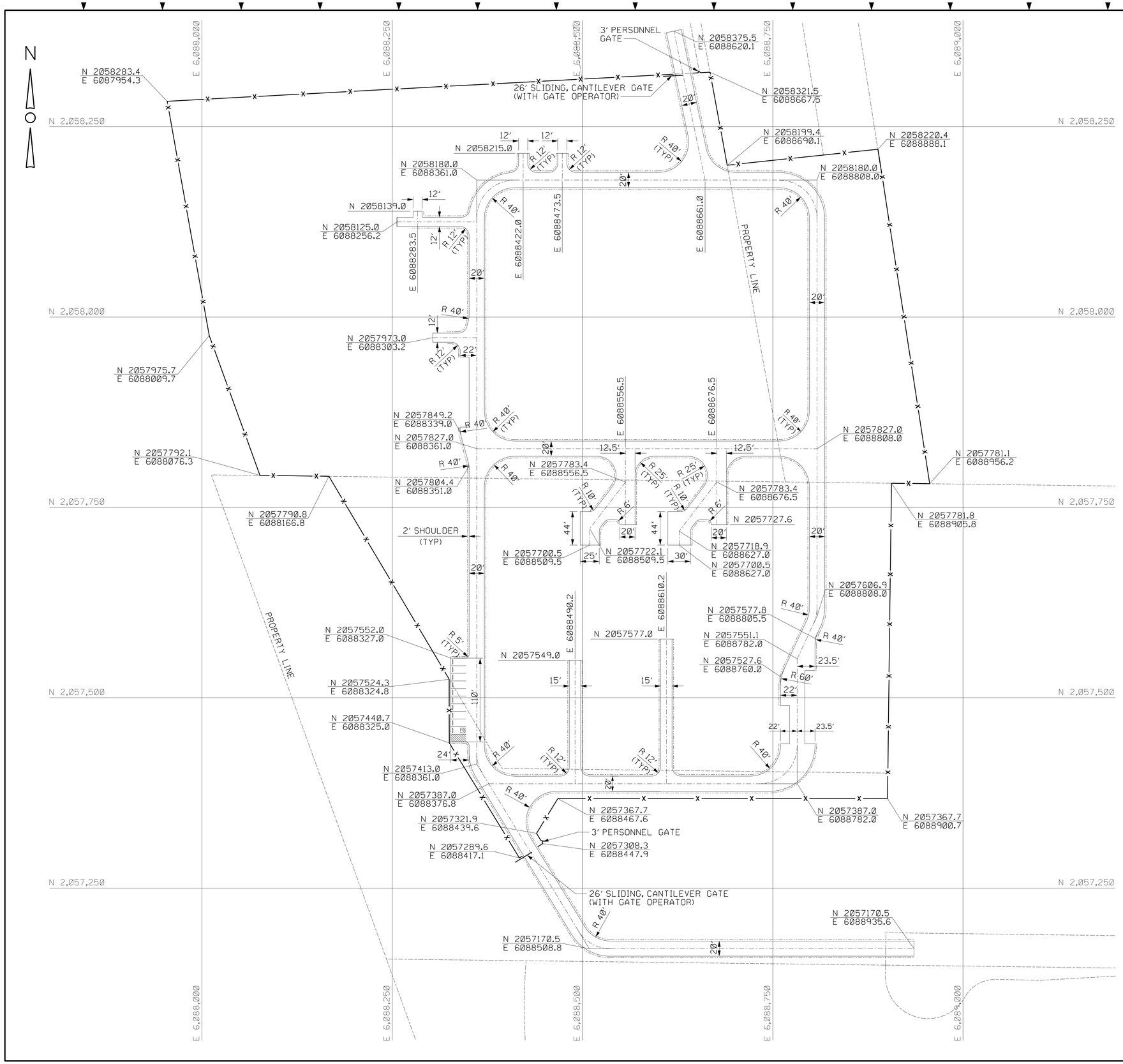
CIVIL
GEN-GENERAL
GRADING DETAILS

SCALE NONE

DWG. NO.	SHEET NO.	REVISION
RC-GEN-DE-C1-0004	01	A

FILE NAME:
PATH:
SERVER:
DWG-FILE: rc-gen-de-c1-0004.dgn
DWG-DATE: 13-Nov-06 15:26

VHL: Thu Jun 09 14:23:05 2005



NOTE:

1. THE ROADWAY AND FENCE PLAN IS BASED ON REVISION E OF THE GENERAL ARRANGEMENT DRAWING.

REFERENCES:

DE-G1-0001	GENERAL ARRANGEMENT SITE PLAN
DE-C1-0001	FINAL SITE GRADING AND DRAINAGE PLAN
DE-C1-0004	GRADING DETAILS
DE-C1-0006	FENCE DETAILS

60 0 60 120 180

SCALE IN FEET

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENGINEER	PROJECT ENGINEER	PROJECT MANAGER
- -							
- -							
- -							
- -							
- -							
A	11-14-06	ISSUED FOR CLIENT REVIEW	GU	AM	DS	PK	DE

DRAWN BY GJU	DATE 11-14-06	PROFESSIONAL ENGINEER STAMP
CHECKED BY ALM	DATE 11-14-06	REGISTERED PROFESSIONAL ENGINEER PRADIP KUMAR KHAN No. 54262 Exp. 12-31-07 CIVIL STATE OF CALIFORNIA
ENGINEER D SHETH	DATE 11-14-06	
PROJECT ENGINEER P KHAN	DATE 11-14-06	See electronic signature for date and time
PROJECT MANAGER DR ERALI	DATE 11-14-06	

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PE: STATE:

LIC. NO.: DATE:

WorleyParsons

CALPINE

RUSSELL CITY ENERGY CENTER
HAYWARD, CALIFORNIA

CIVIL
GEN-GENERAL
ROADWAY AND FENCE LOCATION PLAN

SCALE 1"=60'

DWG. NO.	SHEET NO.	REVISION
RC-GEN-DE-C1-0005	01	A

FILE NAME:
PATH:
SERVER:

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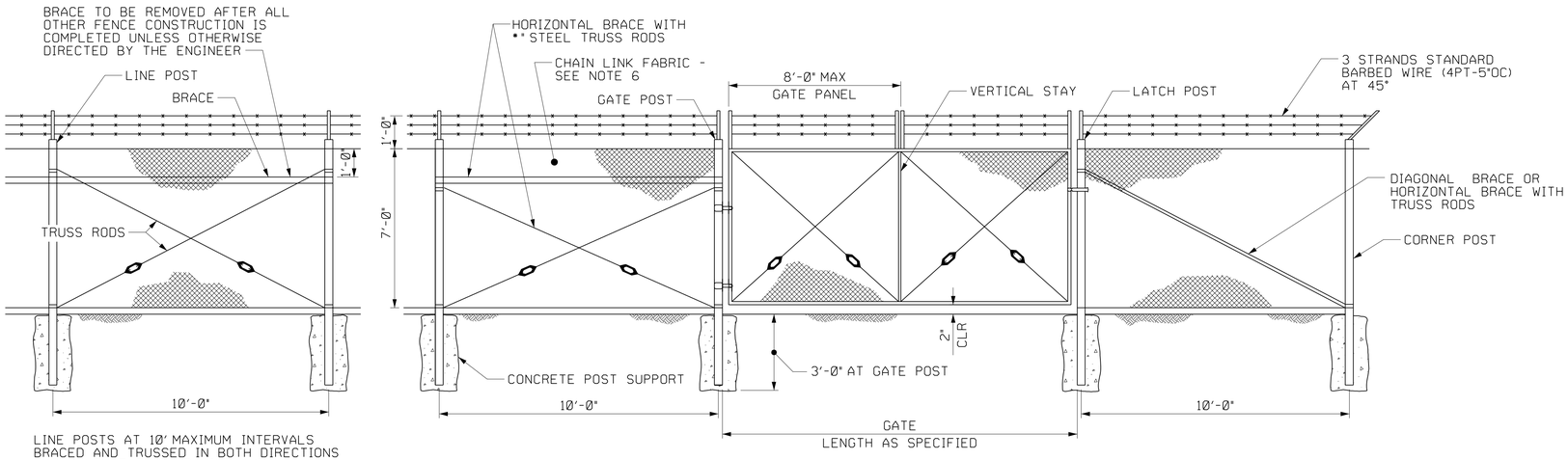
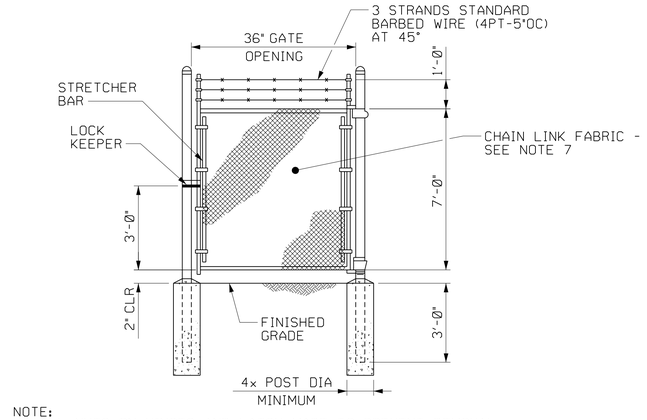


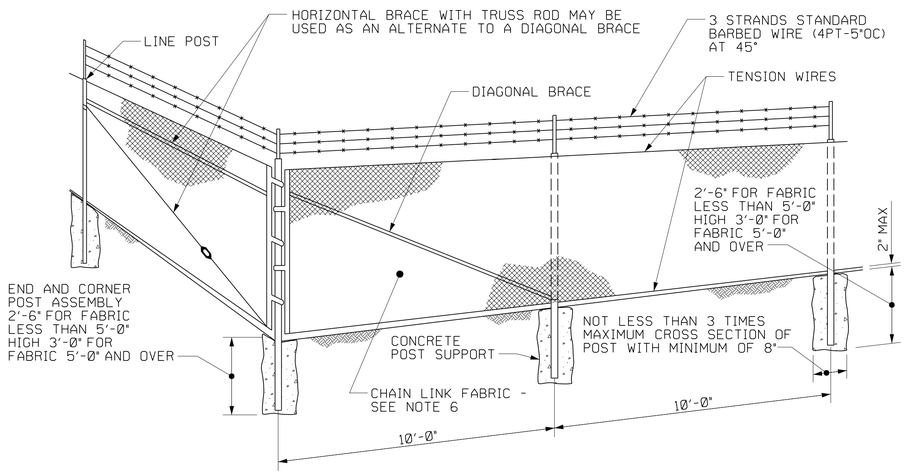
LINE POSTS AT 10' MAXIMUM INTERVALS BRACED AND TRUSSED IN BOTH DIRECTIONS EXCEPT THAT THIS BRACING AND TRUSSING MAY BE OMITTED WHEN THE FABRIC IS STRETCHED BY THE EQUIPMENT

TYPICAL FENCE ELEVATIONS
NOT TO SCALE

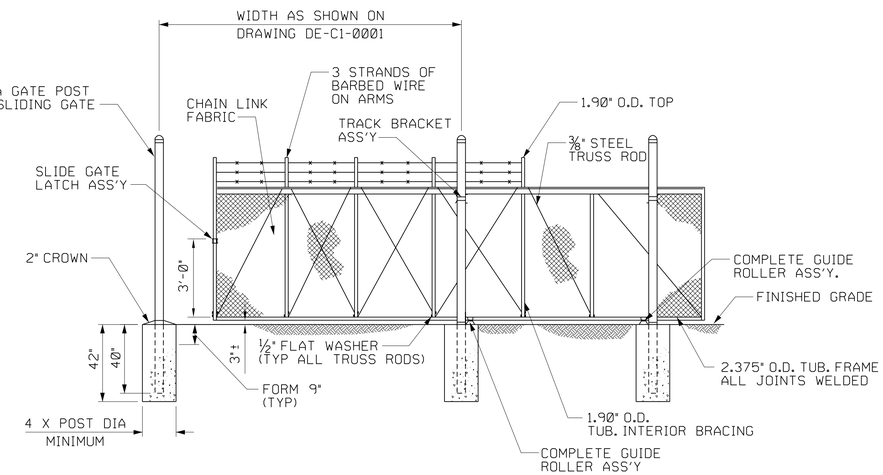


NOTE:
1. ALL NUTS ON HINGES AND LATCH MADE TO PREVENT REMOVAL FROM OUTSIDE.

TYPICAL SINGLE SWING GATE
NOT TO SCALE



TYPICAL FENCE ELEVATION
NOT TO SCALE



STANDARD CANTILEVER SLIDING GATE
NOT TO SCALE

REFERENCES:

DE-C1-0005 ROADWAY AND FENCE LOCATION PLAN

TYPICAL MEMBER DIMENSIONS (SEE NOTES)										
FENCE HEIGHT	LINE POSTS			END, LATCH & CORNER POSTS			BRACES			
	ROUND ID	H	ROLL FORMED	ROUND ID	ROLL FORMED		ROUND ID	H	ROLL FORMED	
6' & LESS	1""	1""X1""	1""X1""	2"	3""X3""	2"X1""	1""	1""X1""	1""X1""	1""X1""
OVER 6'	2"	2""X2"	2"X1""	2""	3""X3""	2""X2""	1""	1""X1""	1""X1""	1""X1""

NOTES:

1. THE ABOVE TABLE SHOWS EXAMPLES OF POST AND BRACE SECTIONS WHICH MAY COMPLY WITH THE SPECIFICATIONS.
2. SECTIONS SHOWN IN THE TABLES MUST ALSO COMPLY WITH THE STRENGTH REQUIREMENTS AND OTHER PROVISIONS OF THE SPECIFICATIONS.
3. OTHER SECTIONS WHICH COMPLY WITH THE STRENGTH REQUIREMENTS AND OTHER PROVISIONS OF THE SPECIFICATIONS MAY BE USED ON APPROVAL OF THE ENGINEER.
4. OPTIONS EXERCISED SHALL BE UNIFORM ON ANY ONE PROJECT.
5. DIMENSIONS SHOWN ARE NOMINAL.
6. CHAIN LINK FABRIC SHALL BE 9GA (BASE WIRE), 2" MESH, TOP SELVAGE TWISTED, BOT SELVAGE KNUCKLE END CLOSED.

GATE POST			
FENCE HEIGHT	GATE WIDTHS	NOMINAL ID	WEIGHT PER FOOT
6'-0" AND LESS	UP THRU 6'-0"	2""	4.95 LB
	OVER 6'-0" THRU 12'-0"	4"	10.79 LB
	OVER 12'-0" THRU 18'-0"	5"	14.62 LB
	OVER 18'-0" TO 24'-0" MAX	6"	18.97 LB
OVER 6'-0"	UP THRU 6'-0"	3"	7.58 LB
	OVER 6'-0" THRU 12'-0"	3"	14.62 LB
	OVER 12'-0" THRU 18'-0"	6"	18.97 LB
	OVER 18'-0" TO 24'-0" MAX	8"	28.55 LB

ABOVE POST DIMENSIONS AND WEIGHTS ARE MINIMUMS. LARGER SIZES MAY BE USED ON APPROVAL OF THE ENGINEER.

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENGINEER	PROJECT ENGINEER	PROJECT MANAGER
- -							
- -							
- -							
- -							
- -							
A	11-14-06	ISSUED FOR CLIENT REVIEW	GU	AM	DS	PK	DE

	DATE
DRAWN BY: GJU	11-14-06
CHECKED BY: ALM	11-14-06
ENGINEER: D SHETH	11-14-06
PROJECT ENGINEER: P KHAN	11-14-06
PROJECT MANAGER: DR ERALI	11-14-06

PROFESSIONAL ENGINEER STAMP

REGISTERED PROFESSIONAL ENGINEER PRADIP KUMAR KHAN No. 54262 12-31-07 EXP. CIVIL STATE OF CALIFORNIA

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PRINT NAME: PRADIP KHAN
SIGNATURE:
DATE: 11-14-06 LICENSE #: 54262

ORIGINALLY PREPARED UNDER THE RESPONSIBLE SUPERVISION OF
PE: STATE:
LIC. NO.: DATE:

WorleyParsons

CALPINE

RUSSELL CITY ENERGY CENTER
HAYWARD, CALIFORNIA

CIVIL
GEN-GENERAL
FENCE DETAILS

SCALE: NONE

DWG. NO.	SHEET NO.	REVISION
RC-GEN-DE-C1-0006	01	A

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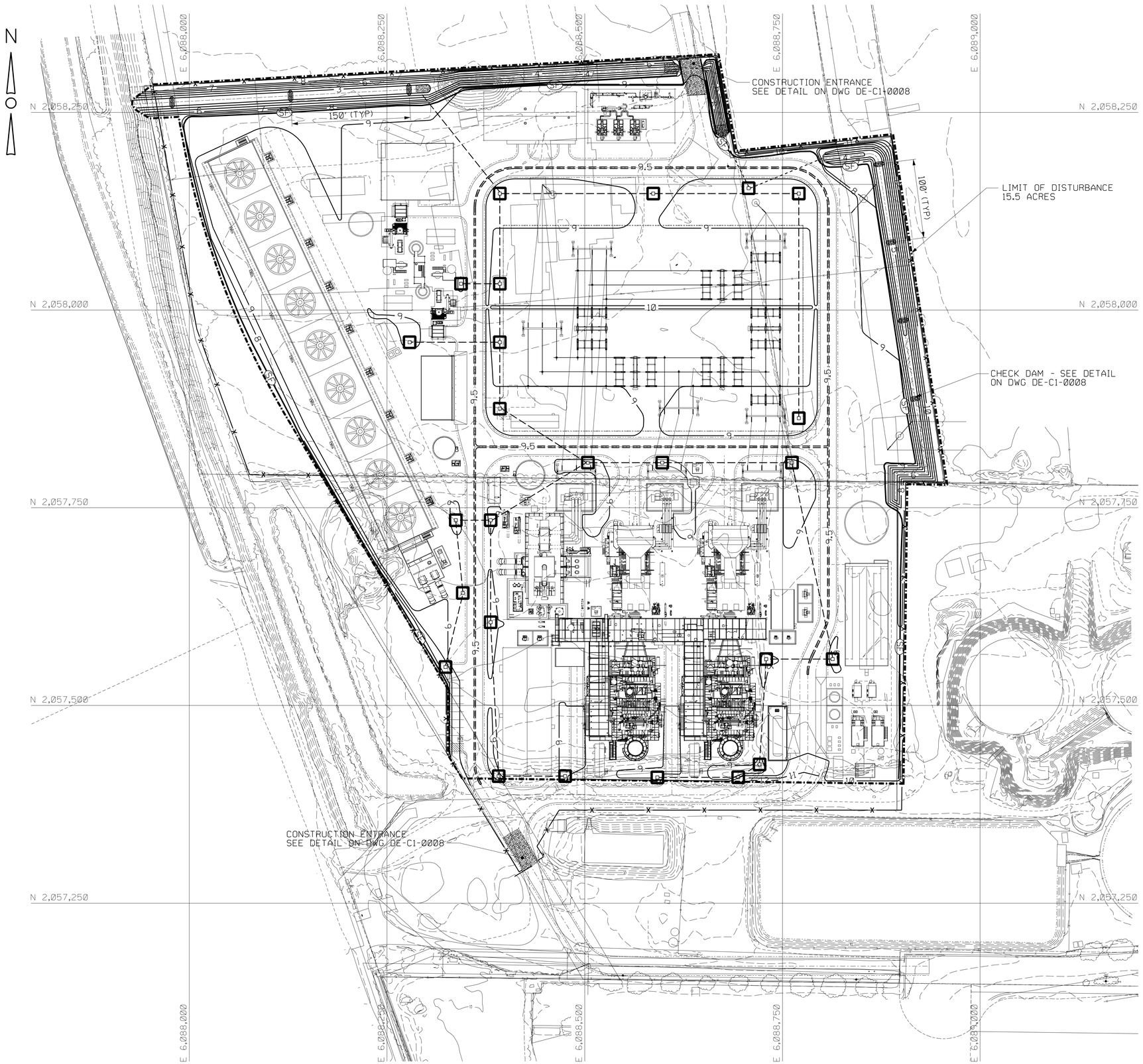

LEGEND

- LIMIT OF DISTURBANCE
- SILT FENCE
- INLET SEDIMENT TRAP
- ROCK CHECK DAM

REFERENCES:

DE-C1-0001	FINAL SITE GRADING AND DRAINAGE PLAN
DE-C1-0008	EROSION AND SEDIMENT CONTROL DETAILS

60 0 60 120 180

SCALE IN FEET

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENGINEER	PROJECT ENGINEER	PROJECT MANAGER
	- -						
	- -						
	- -						
	- -						
	- -						
A	11-13-06	ISSUED FOR CLIENT REVIEW	GU	AM	DS	PK	DE

DRAWN BY GJU	DATE 11-13-06
CHECKED BY ALM	DATE 11-13-06
ENGINEER D SETH	DATE 11-13-06
PROJECT ENGINEER P KHAN	DATE 11-13-06
PROJECT MANAGER DR ERALI	DATE 11-13-06

PROFESSIONAL ENGINEER STAMP

REGISTERED PROFESSIONAL ENGINEER PRADIP KUMAR KHAN No. 54262 Exp. 12-31-07 CIVIL STATE OF CALIFORNIA

See electronic signature for date and time

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA.

PRINT NAME PRADIP KHAN

SIGNATURE

DATE 11-13-06 | LICENSE # 54262

ORIGINALLY PREPARED UNDER THE RESPONSIBLE SUPERVISION OF

PE: STATE:
LIC. NO.: DATE:

WorleyParsons

CALPINE

RUSSELL CITY ENERGY CENTER
HAYWARD, CALIFORNIA

CIVIL
GEN-GENERAL
EROSION AND SEDIMENT CONTROL
PLAN

SCALE 1"=60'

DWG. NO.	SHEET NO.	REVISION
RC-GEN-DE-C1-0007	01	A

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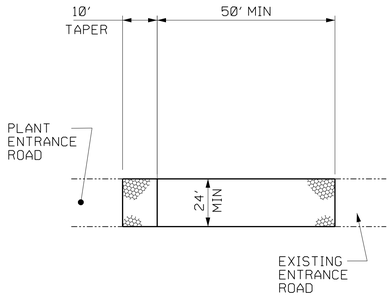
PATH:
SERVER: DWG-DATE: 13-Nov-06 15:31



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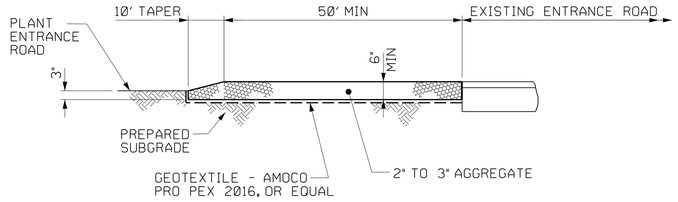


NOTE:
PROVIDE APPROPRIATE TRANSITION BETWEEN GRAVELED ACCESS ROAD AND ROADWAY.

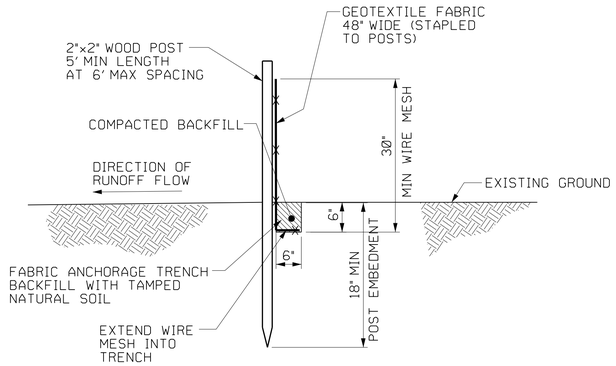
PROFILE

MAINTENANCE:

TEMPORARY GRAVELED ACCESS ROAD THICKNESS SHALL BE CONSTANTLY MAINTAINED TO THE SPECIFIED DIMENSIONS BY ADDING AGGREGATE. A STOCKPILE OF AGGREGATE SHALL BE MAINTAINED ON THE SITE FOR THIS PURPOSE. AT THE END OF EACH CONSTRUCTION DAY, ALL SEDIMENT DEPOSITED ON PUBLIC ROADWAYS SHALL BE REMOVED AND RETURNED TO THE CONSTRUCTION SITE.

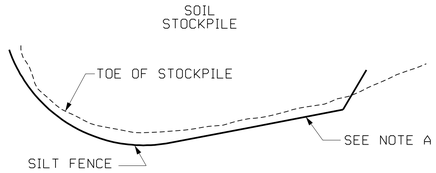
GRAVELED CONSTRUCTION ENTRANCE

NOT TO SCALE

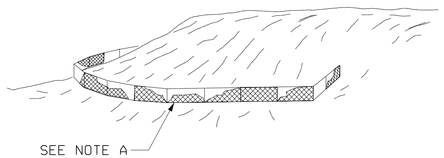


SILT FENCE - PRE ASSEMBLED

NOT TO SCALE



PLAN VIEW



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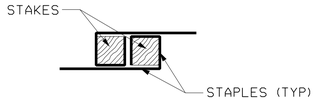


JOINING FENCE SECTIONS

NOTES:

A) SILT FENCE MUST BE INSTALLED AT LEVEL GRADE. BOTH ENDS OF EACH FENCE SECTION MUST EXTEND AT LEAST 8 FEET UPSLOPE AT 45 DEGREES TO THE MAIN FENCE ALIGNMENT.

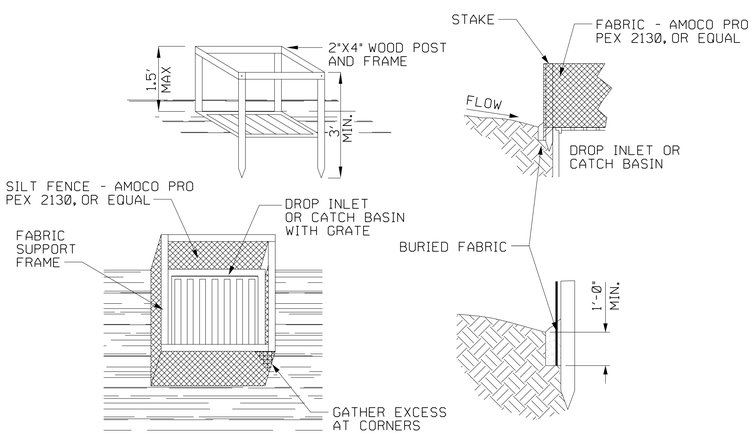
B) SEDIMENT MUST BE REMOVED WHEN ACCUMULATIONS REACH ½ THE ABOVE GROUND HEIGHT OF THE FENCE.

C) WHERE ENDS OF FABRIC COME TOGETHER, THEY MUST BE OVERLAPPED, FOLDED AND STAPLED TO PREVENT SEDIMENT BYPASS. THE TOE ANCHOR MUST BE BACKFILLED AND COMPACTED TO A DENSITY EQUAL TO THE SURROUNDING SOILS.

D) INSTALL FENCE AT LOCATIONS SHOWN ON DE-C1-0007 & SOIL STOCKPILE AS SHOWN

SILT FENCE INSTALLATION DETAILS

NOT TO SCALE



NOTES:

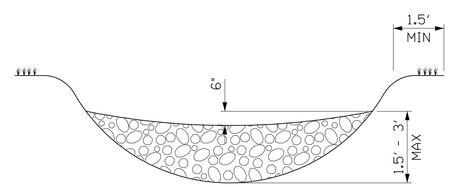
1. THE STAKES SHALL BE SPACED EVENLY AROUND THE PERIMETER OF THE INLET A MAXIMUM OF 3 FEET APART, AND SECURELY DRIVEN INTO THE GROUND, APPROXIMATELY 18 INCHES DEEP. THE FABRIC SHALL BE ENTRENCHED 12 INCHES AND BACKFILLED WITH CRUSHED STONE OR COMPACTED SOIL. FABRIC AND WIRE SHALL BE SECURELY FASTENED TO THE POSTS, AND FABRIC ENDS MUST BE OVERLAPPED A MINIMUM OF 18 INCHES OR WRAPPED TOGETHER AROUND A POST TO PROVIDE A CONTINUOUS BARRIER AROUND THE INLET.

2. THE TRAP SHALL BE INSPECTED DAILY AND REPAIRS MADE AS NEEDED. SEDIMENT SHALL BE REMOVED WHEN SEDIMENT HAS ACCUMULATED TO ONE-HALF THE HEIGHT OF THE TRAP.

3. SEDIMENT SHALL NOT BE WASHED INTO THE INLET. IT SHALL BE REMOVED FROM THE SEDIMENT TRAP AND DISPOSED OF AND STABILIZED SO THAT IT WILL NOT AGAIN ENTER THE INLET. WHEN THE CONTRIBUTING AREA HAS BEEN PERMANENTLY STABILIZED, ALL MATERIALS AND ANY SEDIMENT SHALL BE REMOVED AND EITHER SALVAGED OR DISPOSED OF PROPERLY. THE DISTURBED AREA SHALL BE BROUGHT TO PROPER GRADE, THEN SMOOTHED AND COMPACTED. APPROPRIATELY STABILIZE ALL DISTURBED AREAS AROUND THE INLET.

INLET SEDIMENT TRAP (ISP)
FILTER FABRIC WITH SUPPORTING FRAME

NOT TO SCALE



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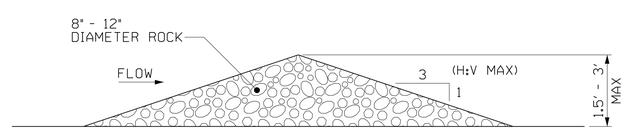

SECTION

ROCK CHECK DAM

NOT TO SCALE

REFERENCES:

DE-C1-0007 EROSION AND SEDIMENT CONTROL PLAN

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENGINEER	PROJECT ENGINEER	PROJECT MANAGER
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- -							
- -							
- -							
- -							
A	11-14-06	ISSUED FOR CLIENT REVIEW	GU	AM	DS	PK	DE

DRAWN BY GJU	DATE 11-14-06	PROFESSIONAL ENGINEER STAMP	
CHECKED BY ALM	DATE 11-14-06	REGISTERED PROFESSIONAL ENGINEER PRADIP KUMAR KHAN No. 54262 Exp. 12-31-07 CIVIL STATE OF CALIFORNIA	
ENGINEER D SHETH	DATE 11-14-06		
PROJECT ENGINEER P KHAN	DATE 11-14-06	See electronic signature for date and time	
PROJECT MANAGER DR ERALI	DATE 11-14-06		

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WorleyParsons

CALPINE

RUSSELL CITY ENERGY CENTER
HAYWARD, CALIFORNIA

CIVIL
GEN-GENERAL
EROSION AND SEDIMENT CONTROL
DETAILS

SCALE NONE

DWG. NO.	SHEET NO.	REVISION
RC-GEN-DE-C1-0008	01	A

FILE NAME:
PATH:
SERVER:
DWG-FILE: rc-gen-de-c1-0008.dgn
DWG-DATE: 14-Nov-06 08:42

LEGEND

EXISTING GRADE CONTOUR

EXISTING GRADE SPOT ELEVATION

NOTES:

1. COORDINATES LISTED ARE STATE PLANE NAD83, CALIFORNIA ZONE 3.

60 0 60 120 180

SCALE IN FEET

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENGINEER	PROJECT ENGINEER	PROJECT MANAGER
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HAYWARD, CALIFORNIA

CIVIL
GEN-GENERAL
EXISTING TOPOGRAPHY

SCALE 1"=60'

DWG. NO.	SHEET NO.	REVISION
RC-GEN-DE-C1-0009	01	A

FILE NAME:
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DWG-FILE: rc-gen-de-c1-0009.dgn
DWG-DATE: 13-Nov-06 12:34

CATCH BASIN SCHEDULE							
No.	COORDINATE		TYPE	STATE PLANE NGVD 29 DATUM			
	NORTH	EAST		TOP	INV IN	INV IN	INV OUT
CB-1	2057409.04	6088591.83	-	8.5	-	-	6.0
CB-2	2057425.37	6088721.00	-	8.5	-	5.73	5.73
CB-3	2057558.58	6088729.47	-	8.5	-	5.47	5.47
CB-4	2057558.65	6088813.46	-	8.5	-	5.30	5.30
CB-5	2057807.09	6088762.10	-	8.5	-	4.79	4.79
CB-6	2057807.09	6088598.10	-	8.5	-	4.46	4.37
CB-7	2057410.55	6088475.23	-	8.6	-	-	6.50
CB-8	2057410.55	6088391.23	-	8.5	-	6.16	6.16
CB-9	2057605.27	6088381.00	-	8.5	-	5.38	5.38
CB-10	2057734.27	6088381.00	-	8.5	4.87 (P-9)	4.70 (P-10)	4.70
CB-11	2057734.27	6088337.00	-	8.5	-	4.80	4.80
CB-12	2057807.09	6088504.10	-	8.5	4.18 (P-6)	4.10 (P-11)	4.10
CB-13	2057875.31	6088392.60	-	8.5	-	3.92	3.92
CB-14	2057863.31	6088770.60	-	8.5	-	-	6.00
CB-15	2057959.31	6088278.60	-	8.5	-	-	6.00
CB-16	2058033.31	6088343.60	-	8.5	-	-	6.00
CB-17	2058147.31	6088392.60	-	8.5	3.37 (P-17)	4.68 (P-20)	3.37
CB-18	2058147.31	6088770.60	-	8.5	-	5.43	5.43
CB-19	2057548.74	6088324.05	-	7.0	-	-	5.00
MH-1	2057959.31	6088392.60	-	9.6	3.75 (P-13)	5.77 (P-14)	3.75
MH-2	2058033.31	6088392.60	-	9.7	3.60 (P-15)	5.90 (P-16)	3.60
MH-3	2058147.31	6088586.60	-	9.0	-	5.06	5.06
MH-4	2058154.22	6088707.20	-	9.0	-	3.70	3.70
MH-5	2057642.17	6088345.84	-	9.0	-	4.90	4.90
J-1	2057409.23	6088694.05	-	8.9	-	5.79	5.79
O-1	2058274.67	6088292.63	-	-	-	-	3.07

CB = CATCH BASIN
MH = MANHOLE
J = JUNCTION BOX
O = OUTFALL

NOTES:

1. PIPE LENGTHS BETWEEN CATCH BASINS ARE FROM CENTER TO CENTER OF CATCH BASINS.
2. PIPE LENGTHS ARE TO THE OUTSIDE FACE OF THE ENDWALLS.
3. MAINTAIN MINIMUM 15" COVER OVER STORM PIPES DURING CONSTRUCTION.
4. SEE DWG DE-C1-0001 FOR PIPE ORIENTATION AT MANHOLES.

PIPE SCHEDULE				
No.	SIZE	LENGTH	SLOPE	MATERIAL
P-1	12"	103'	0.0020	SLPE
P-1A	15"	31'	0.0020	SLPE
P-2	18"	133'	0.0020	SLPE
P-3	18"	84'	0.0020	SLPE
P-4	18"	254'	0.0020	SLPE
P-5	24"	164'	0.0020	SLPE
P-6	24"	94'	0.0020	SLPE
P-7	12"	84'	0.0040	SLPE
P-8	15"	195'	0.0040	SLPE
P-9	15"	129'	0.0040	SLPE
P-10	18"	44'	0.0023	SLPE
P-11	18"	143'	0.0042	SLPE
P-12	30"	131'	0.0014	SLPE
P-13	30"	84'	0.0020	SLPE
P-14	15"	114'	0.0020	SLPE
P-15	30"	74'	0.0020	SLPE
P-16	12"	49'	0.0020	SLPE
P-17	36"	114'	0.0020	SLPE
P-18	15"	284'	0.0020	SLPE
P-19	24"	184'	0.0020	SLPE
P-20	24"	194'	0.0020	SLPE
P-21	36"	162'	0.0019	SLPE
P-22	18"	96'	0.0010	SLPE
P-23	18"	93'	0.0011	SLPE

SLPE = SMOOTH LINED POLYETHYLENE

CULVERT SCHEDULE					
No.	SIZE	LENGTH*	INV IN	INV OUT	MATERIAL
C-1	36"	100'	3.79	3.70	SLPE
C-2	36"	70'	3.70	3.63	SLPE
C-3	36"	30'	3.26	3.23	SLPE

*NOTE: CULVERT LENGTH INCLUDES FLARED END SECTIONS

REFERENCES:

DE-C1-0001 FINAL SITE GRADING AND DRAINAGE PLAN
DE-C2-0002 DRAINAGE STRUCTURES

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENGINEER	PROJECT ENGINEER	PROJECT MANAGER
A	11-13-06	ISSUED FOR CLIENT REVIEW	GU	AM	DS	PK	DE

DRAWN BY GJU	DATE 11-13-06	PROFESSIONAL ENGINEER STAMP
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PROJECT ENGINEER P KHAN	DATE 11-13-06	See electronic signature for date and time
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WorleyParsons

CALPINE

RUSSELL CITY ENERGY CENTER
HAYWARD, CALIFORNIA

CIVIL
GEN-GENERAL
CATCH BASIN AND PIPE SCHEDULE

SCALE NONE

DWG. NO.	SHEET NO.	REVISION
RC-GEN-DE-C2-0001	01	A

FILE NAME:
PATH:
SERVER:
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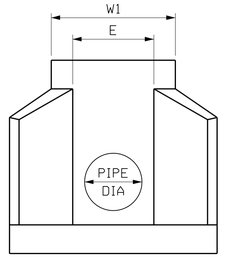
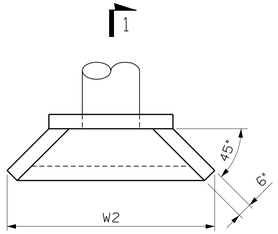
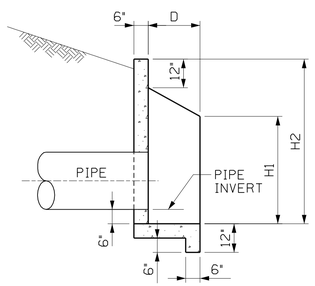


FRONT ELEVATION



TOP VIEW



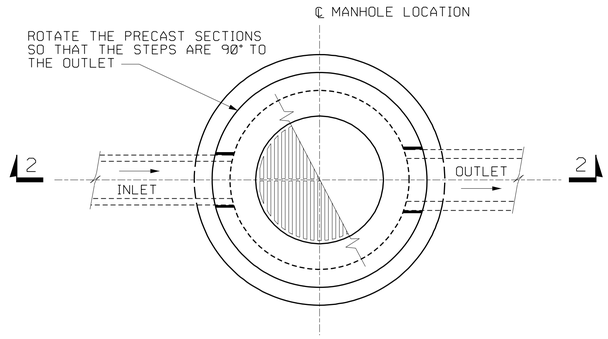
SECTION 1-1

PRECAST CONCRETE ENDWALL DIMENSIONS FOR SLPE PIPE								
EW	PIPE DIA	PIPE HOLE	W1	W2	H1	H2	D	E
EW-1	36"	48"	5'-8"	10'-10"	3'-3"	5'-9"	2'-11"	4'-3"
EW-2	36"	48"	5'-8"	10'-10"	3'-3"	5'-9"	2'-11"	4'-3"
EW-3	36"	48"	5'-8"	10'-10"	3'-3"	5'-9"	2'-11"	4'-3"
EW-4	36"	48"	5'-8"	10'-10"	3'-3"	5'-9"	2'-11"	4'-3"

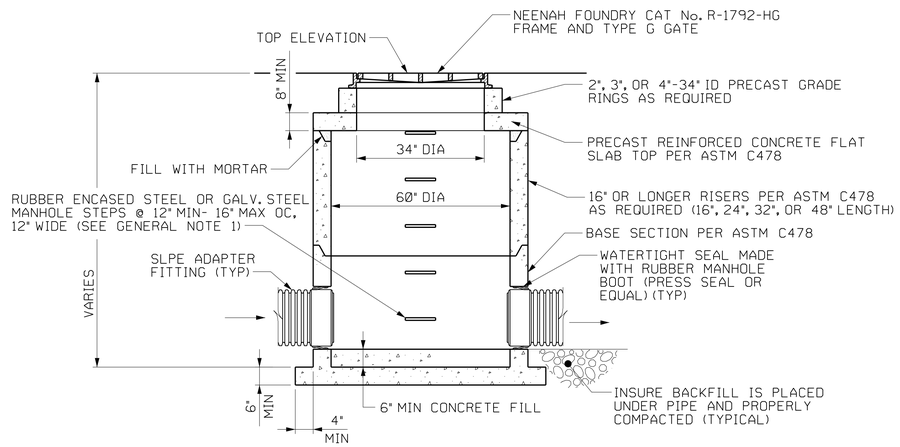
TYPICAL DETAIL
PRECAST CONCRETE ENDWALL
NOT TO SCALE

ENDWALL NOTES:

1. ALL CONCRETE TO BE 4000 PSI.
2. REINFORCEMENT STEEL MEETS ASTM A615, GRADE 60 WITH 2" MIN CLEARANCE. USE #5 REINF FOR 24" DIA PIPE AND #6 FOR 36" DIA PIPE.
3. REINFORCEMENT TO BE AT 12" C TO C, BOTH WAYS.
4. ALL EXPOSED EDGES TO HAVE A ¾" CHAMFER.
5. PLACE EXPOSED PIPE ENDS CUT-OFF FLUSH WITH FACE OF ENDWALL AND FINISH WITH NON-SHRINK CEMENTITIOUS GROUT.



PLAN



SECTION 2-2

NOTE:
PRECAST REINFORCED CONCRETE CATCH BASINS PER ASTM C913, DESIGNED ACCORDING TO ASTM C890 FOR A-16, HEAVY TRAFFIC STRUCTURAL LOADING.

DETAIL
TYPE 2 CATCH BASIN INLET
NOT TO SCALE

GENERAL NOTES:

1. PRECAST STRUCTURES OVER 5'-0" DEPTH SHALL BE PROVIDED WITH STEPS INSTALLED IN ACCORDANCE WITH OSHA STANDARD 1910.27.
2. PRECAST STRUCTURES SHALL BE PROVIDED WITH LIFT HOLES OR PINS IN ACCORDANCE WITH OSHA STANDARD 1926.704 FOR HANDLING AND PLACEMENT.

REFERENCES:

DE-C1-0001	FINAL SITE GRADING AND DRAINAGE PLAN
DE-C1-0002	SURFACING PLAN
DE-C1-0005	ROADWAY AND FENCE LOCATION PLAN
DE-C2-0001	CATCH BASIN AND PIPE SCHEDULE

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENGINEER	PROJECT ENGINEER	PROJECT MANAGER
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REGISTERED PROFESSIONAL ENGINEER PRADIP KUMAR KHAN No. 54262 Exp. 12-31-07 CIVIL STATE OF CALIFORNIA

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WorleyParsons

CALPINE

RUSSELL CITY ENERGY CENTER
HAYWARD, CALIFORNIA

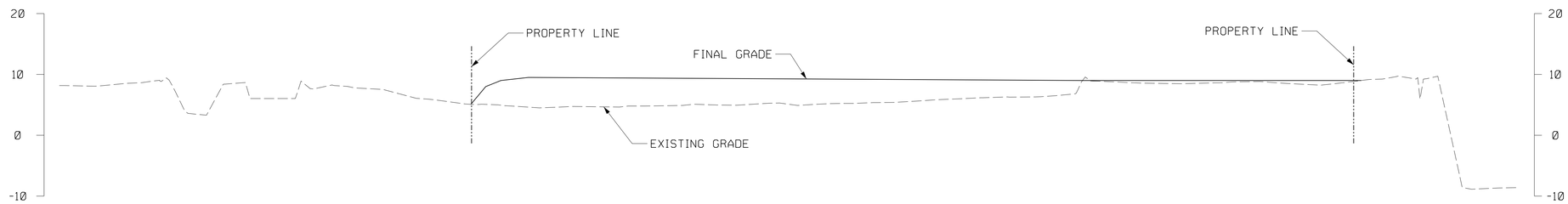
CIVIL
GEN-GENERAL
DRAINAGE STRUCTURES
DETAILS

SCALE NONE

DWG. NO. RC-GEN-DE-C2-0002 SHEET NO. 01 REVISION A

FILE NAME:
PATH:
SERVER:
DWG-FILE: rc-gen-de-c2-0002.dgn
DWG-DATE: 14-Nov-06 08:43

SECTION 3-3
SCALE: HORIZ: 1"=40'
VERT: 1"=10'
(DE-C1-0001)



SECTION 4-4
SCALE: HORIZ: 1"=40'
VERT: 1"=10'
(DE-C1-0001)

NOTE:

1. ELEVATIONS ARE BASED ON NGVD 29 DATUM.

REFERENCE:

DE-C1-0001 FINAL SITE GRADING AND DRAINAGE PLAN

REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENGINEER	PROJECT ENGINEER	PROJECT MANAGER
	- -						
	- -						
	- -						
	- -						
	- -						
A	11-13-06	ISSUED FOR CLIENT REVIEW	GU	AM	DS	PK	DE

DRAWN BY GJU	DATE 11-13-06	PROFESSIONAL ENGINEER STAMP
CHECKED BY ALM	DATE 11-13-06	REGISTERED PROFESSIONAL ENGINEER PRADIP KUMAR KHAN No. 54262 Exp. 12-31-07 CIVIL STATE OF CALIFORNIA
ENGINEER D SHETH	DATE 11-13-06	
PROJECT ENGINEER P KHAN	DATE 11-13-06	See electronic signature for date and time
PROJECT MANAGER D ERALI	DATE 11-13-06	

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA.

PRINT NAME PRADIP KHAN
SIGNATURE
DATE 11-13-06 LICENSE # 54262

ORIGINALLY PREPARED UNDER THE RESPONSIBLE SUPERVISION OF
PE: STATE:
LIC. NO.: DATE:

WorleyParsons

CALPINE

RUSSELL CITY ENERGY CENTER
HAYWARD, CALIFORNIA

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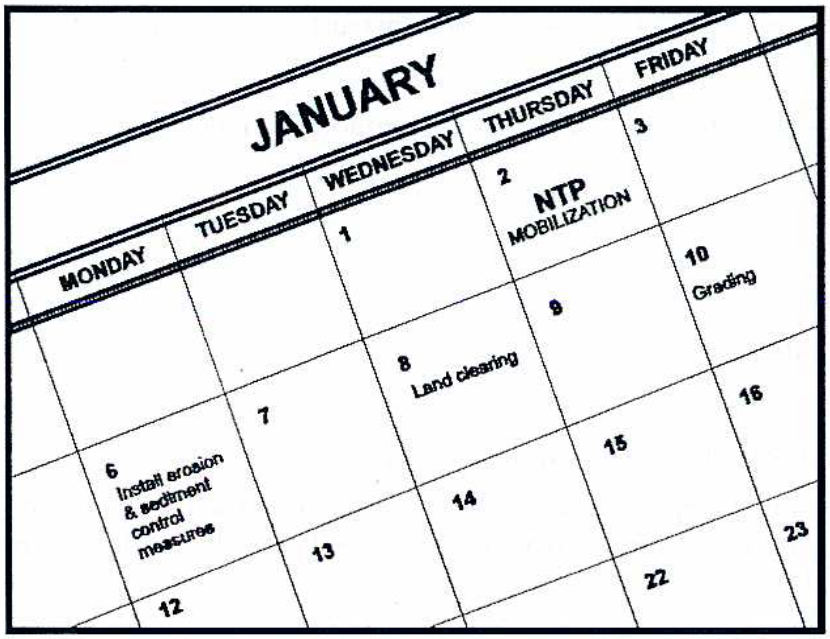
APPENDIX 3

BMP Fact Sheets

Scheduling EC-1



Objectives

EC	Erosion Control	☑
SE	Sediment Control	☒
TR	Tracking Control	☒
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

Description and Purpose

Scheduling is the development of a written plan that includes sequencing of construction activities and the implementation of BMPs such as erosion control and sediment control while taking local climate (rainfall, wind, etc.) into consideration. The purpose is to reduce the amount and duration of soil exposed to erosion by wind, rain, runoff, and vehicle tracking, and to perform the construction activities and control practices in accordance with the planned schedule.

Suitable Applications

Proper sequencing of construction activities to reduce erosion potential should be incorporated into the schedule of every construction project especially during rainy season. Use of other, more costly yet less effective, erosion and sediment control BMPs may often be reduced through proper construction sequencing.

Limitations

- Environmental constraints such as nesting season prohibitions reduce the full capabilities of this BMP.

Implementation

- Avoid rainy periods. Schedule major grading operations during dry months when practical. Allow enough time before rainfall begins to stabilize the soil with vegetation or physical means or to install sediment trapping devices.
- Plan the project and develop a schedule showing each phase of construction. Clearly show how the rainy season relates to soil

disturbing and re-stabilization activities. Incorporate the construction schedule into the SWPPP.

- Include on the schedule, details on the rainy season implementation and deployment of:
  - Erosion control BMPs
  - Sediment control BMPs
  - Tracking control BMPs
  - Wind erosion control BMPs
  - Non-stormwater BMPs
  - Waste management and materials pollution control BMPs
- Include dates for activities that may require non-stormwater discharges such as dewatering, sawcutting, grinding, drilling, boring, crushing, blasting, painting, hydro-demolition, mortar mixing, pavement cleaning, etc.
- Work out the sequencing and timetable for the start and completion of each item such as site clearing and grubbing, grading, excavation, paving, foundation pouring utilities installation, etc., to minimize the active construction area during the rainy season.
  - Sequence trenching activities so that most open portions are closed before new trenching begins.
  - Incorporate staged seeding and re-vegetation of graded slopes as work progresses.
  - Schedule establishment of permanent vegetation during appropriate planting time for specified vegetation.
- Non-active areas should be stabilized as soon as practical after the cessation of soil disturbing activities or one day prior to the onset of precipitation.
- Monitor the weather forecast for rainfall.
- When rainfall is predicted, adjust the construction schedule to allow the implementation of soil stabilization and sediment treatment controls on all disturbed areas prior to the onset of rain.
- Be prepared year round to deploy erosion control and sediment control BMPs. Erosion may be caused during dry seasons by un-seasonal rainfall, wind, and vehicle tracking. Keep the site stabilized year round, and retain and maintain rainy season sediment trapping devices in operational condition.
- Apply permanent erosion control to areas deemed substantially complete during the project's defined seeding window.

Costs

Construction scheduling to reduce erosion may increase other construction costs due to reduced economies of scale in performing site grading. The cost effectiveness of scheduling techniques should be compared with the other less effective erosion and sedimentation controls to achieve a cost effective balance.

Inspection and Maintenance

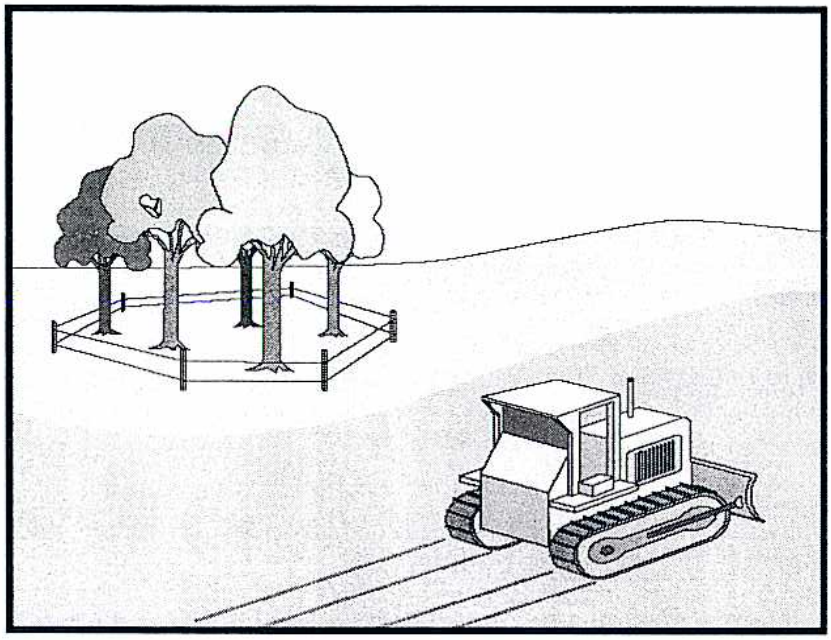
- Verify that work is progressing in accordance with the schedule. If progress deviates, take corrective actions.
- Amend the schedule when changes are warranted.
- Amend the schedule prior to the rainy season to show updated information on the deployment and implementation of construction site BMPs.

References

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities Developing Pollution Prevention Plans and Best Management Practices (EPA 832-R-92-005), U.S. Environmental Protection Agency, Office of Water, September 1992.

Preservation Of Existing Vegetation EC-2



Objectives

EC	Erosion Control	☑
SE	Sediment Control	
TR	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

Description and Purpose

Carefully planned preservation of existing vegetation minimizes the potential of removing or injuring existing trees, vines, shrubs, and grasses that protect soil from erosion.

Suitable Applications

Preservation of existing vegetation is suitable for use on most projects. Large project sites often provide the greatest opportunity for use of this BMP. Suitable applications include the following:

- Areas within the site where no construction activity occurs, or occurs at a later date. This BMP is especially suitable to multi year projects where grading can be phased.
- Areas where natural vegetation exists and is designated for preservation. Such areas often include steep slopes, watercourse, and building sites in wooded areas.
- Areas where local, state, and federal government require preservation, such as vernal pools, wetlands, marshes, certain oak trees, etc. These areas are usually designated on the plans, or in the specifications, permits, or environmental documents.
- Where vegetation designated for ultimate removal can be temporarily preserved and be utilized for erosion control and sediment control.

EC-2 Preservation Of Existing Vegetation

Limitations

- Requires forward planning by the owner/developer, contractor, and design staff.
- Limited opportunities for use when project plans do not incorporate existing vegetation into the site design.
- For sites with diverse topography, it is often difficult and expensive to save existing trees while grading the site satisfactory for the planned development.

Implementation

The best way to prevent erosion is to not disturb the land. In order to reduce the impacts of new development and redevelopment, projects may be designed to avoid disturbing land in sensitive areas of the site (e.g., natural watercourses, steep slopes), and to incorporate unique or desirable existing vegetation into the site's landscaping plan. Clearly marking and leaving a buffer area around these unique areas during construction will help to preserve these areas as well as take advantage of natural erosion prevention and sediment trapping.

Existing vegetation to be preserved on the site must be protected from mechanical and other injury while the land is being developed. The purpose of protecting existing vegetation is to ensure the survival of desirable vegetation for shade, beautification, and erosion control. Mature vegetation has extensive root systems that help to hold soil in place, thus reducing erosion. In addition, vegetation helps keep soil from drying rapidly and becoming susceptible to erosion. To effectively save existing vegetation, no disturbances of any kind should be allowed within a defined area around the vegetation. For trees, no construction activity should occur within the drip line of the tree.

Timing

- Provide for preservation of existing vegetation prior to the commencement of clearing and grubbing operations or other soil disturbing activities in areas where no construction activity is planned or will occur at a later date.

Design and Layout

- Mark areas to be preserved with temporary fencing. Include sufficient setback to protect roots.
  - Orange colored plastic mesh fencing works well.
  - Use appropriate fence posts and adequate post spacing and depth to completely support the fence in an upright position.
- Locate temporary roadways, stockpiles, and layout areas to avoid stands of trees, shrubs, and grass.
- Consider the impact of grade changes to existing vegetation and the root zone.
- Maintain existing irrigation systems where feasible. Temporary irrigation may be required.
- Instruct employees and subcontractors to honor protective devices. Prohibit heavy equipment, vehicular traffic, or storage of construction materials within the protected area.

Costs

There is little cost associated with preserving existing vegetation if properly planned during the project design, and these costs may be offset by aesthetic benefits that enhance property values. During construction, the cost for preserving existing vegetation will likely be less than the cost of applying erosion and sediment controls to the disturbed area. Replacing vegetation inadvertently destroyed during construction can be extremely expensive, sometimes in excess of $10,000 per tree.

Inspection and Maintenance

During construction, the limits of disturbance should remain clearly marked at all times. Irrigation or maintenance of existing vegetation should be described in the landscaping plan. If damage to protected trees still occurs, maintenance guidelines described below should be followed:

- Verify that protective measures remain in place. Restore damaged protection measures immediately.
- Serious tree injuries shall be attended to by an arborist.
- Damage to the crown, trunk, or root system of a retained tree shall be repaired immediately.
- Trench as far from tree trunks as possible, usually outside of the tree drip line or canopy. Curve trenches around trees to avoid large roots or root concentrations. If roots are encountered, consider tunneling under them. When trenching or tunneling near or under trees to be retained, place tunnels at least 18 in. below the ground surface, and not below the tree center to minimize impact on the roots.
- Do not leave tree roots exposed to air. Cover exposed roots with soil as soon as possible. If soil covering is not practical, protect exposed roots with wet burlap or peat moss until the tunnel or trench is ready for backfill.
- Cleanly remove the ends of damaged roots with a smooth cut.
- Fill trenches and tunnels as soon as possible. Careful filling and tamping will eliminate air spaces in the soil, which can damage roots.
- If bark damage occurs, cut back all loosened bark into the undamaged area, with the cut tapered at the top and bottom and drainage provided at the base of the wood. Limit cutting the undamaged area as much as possible.
- Aerate soil that has been compacted over a trees root zone by punching holes 12 in. deep with an iron bar, and moving the bar back and forth until the soil is loosened. Place holes 18 in. apart throughout the area of compacted soil under the tree crown.
- Fertilization
  - Fertilize stressed or damaged broadleaf trees to aid recovery.
  - Fertilize trees in the late fall or early spring.

- Apply fertilizer to the soil over the feeder roots and in accordance with label instructions, but never closer than 3 ft to the trunk. Increase the fertilized area by one-fourth of the crown area for conifers that have extended root systems.

- Retain protective measures until all other construction activity is complete to avoid damage during site cleanup and stabilization.

References

County of Sacramento Tree Preservation Ordinance, September 1981.

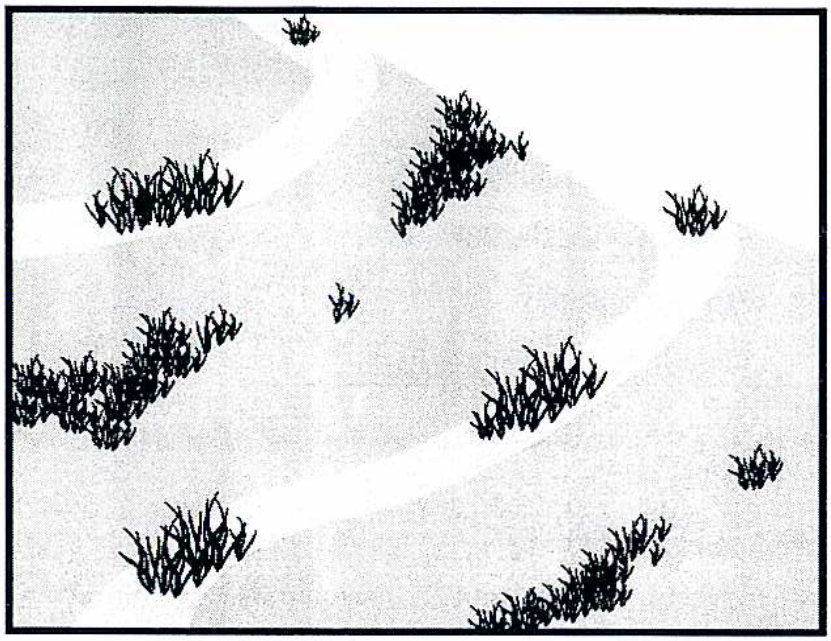
Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for The Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Hydroseeding

EC-4



Objectives

EC	Erosion Control	☑
SE	Sediment Control	
TR	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch

EC-5 Soil Binders

EC-6 Straw Mulch

EC-7 Geotextiles and Mats

EC-8 Wood Mulching

Description and Purpose

Hydroseeding typically consists of applying a mixture of wood fiber, seed, fertilizer, and stabilizing emulsion with hydro-mulch equipment, to temporarily protect exposed soils from erosion by water and wind.

Suitable Applications

Hydroseeding is suitable for soil disturbed areas requiring temporary protection until permanent stabilization is established, and disturbed areas that will be re-disturbed following an extended period of inactivity.

Limitations

- Hydroseeding may be used alone only when there is sufficient time in the season to ensure adequate vegetation establishment and coverage to provide adequate erosion control. Otherwise, hydroseeding must be used in conjunction with mulching (i.e., straw mulch).
- Steep slopes are difficult to protect with temporary seeding.
- Temporary seeding may not be appropriate in dry periods without supplemental irrigation.
- Temporary vegetation may have to be removed before permanent vegetation is applied.
- Temporary vegetation is not appropriate for short term inactivity.

Implementation

In order to select appropriate hydroseeding mixtures, an evaluation of site conditions shall be performed with respect to:

- Soil conditions
- Site topography
- Season and climate
- Vegetation types
- Maintenance requirements
- Sensitive adjacent areas
- Water availability
- Plans for permanent vegetation

The local office of the U.S.D.A. Natural Resources Conservation Service (NRCS) is an excellent source of information on appropriate seed mixes.

The following steps shall be followed for implementation:

- Avoid use of hydroseeding in areas where the BMP would be incompatible with future earthwork activities and would have to be removed.
- Hydroseeding can be accomplished using a multiple step or one step process. The multiple step process ensures maximum direct contact of the seeds to soil. When the one step process is used to apply the mixture of fiber, seed, etc., the seed rate shall be increased to compensate for all seeds not having direct contact with the soil.
- Prior to application, roughen the area to be seeded with the furrows trending along the contours.
- Apply a straw mulch to keep seeds in place and to moderate soil moisture and temperature until the seeds germinate and grow.
- All seeds shall be in conformance with the California State Seed Law of the Department of Agriculture. Each seed bag shall be delivered to the site sealed and clearly marked as to species, purity, percent germination, dealer's guarantee, and dates of test. The container shall be labeled to clearly reflect the amount of Pure Live Seed (PLS) contained. All legume seed shall be pellet inoculated. Inoculant sources shall be species specific and shall be applied at a rate of 2 lb of inoculant per 100 lb seed.
- Commercial fertilizer shall conform to the requirements of the California Food and Agricultural Code. Fertilizer shall be pelleted or granular form.
- Follow up applications shall be made as needed to cover weak spots and to maintain adequate soil protection.
- Avoid over spray onto roads, sidewalks, drainage channels, existing vegetation, etc.

Costs

Average cost for installation and maintenance may vary from as low as $300 per acre for flat slopes and stable soils, to $1600 per acre for moderate to steep slopes and/or erosive soils.

Hydroseeding		Installed Cost per Acre
High Density	Ornamentals	$400 - $1600
	Turf Species	$350
	Bunch Grasses	$300 - $1300
Fast Growing	Annual	$350 - $650
	Perennial	$300 - $800
Non-Competing	Native	$300 - $1600
	Non-Native	$400 - $500
Sterile	Cereal Grain	$500

Source: Caltrans Guidance for Soil Stabilization for Temporary Slopes, Nov. 1999

Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Areas where erosion is evident shall be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.
- Where seeds fail to germinate, or they germinate and die, the area must be re-seeded, fertilized, and mulched within the planting season, using not less than half the original application rates.
- Irrigation systems, if applicable, should be inspected daily while in use to identify system malfunctions and line breaks. When line breaks are detected, the system must be shut down immediately and breaks repaired before the system is put back into operation.
- Irrigation systems shall be inspected for complete coverage and adjusted as needed to maintain complete coverage.

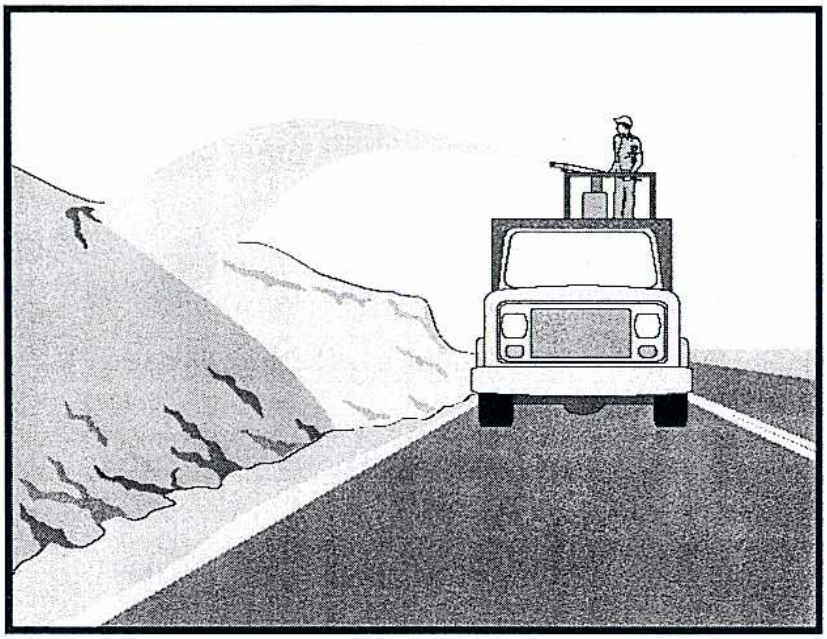
References

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Guidance Document: Soil Stabilization for Temporary Slopes, State of California Department of Transportation (Caltrans), November 1999.

Straw Mulch

EC-6



Objectives

EC	Erosion Control	☑
SE	Sediment Control	
TR	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch

EC-4 Hydroseeding

EC-5 Soil Binders

EC-7 Geotextiles and Mats

EC-8 Wood Mulching

Description and Purpose

Straw mulch consists of placing a uniform layer of straw and incorporating it into the soil with a studded roller or anchoring it with a tackifier stabilizing emulsion. Straw mulch protects the soil surface from the impact of rain drops, preventing soil particles from becoming dislodged.

Suitable Applications

Straw mulch is suitable for soil disturbed areas requiring temporary protection until permanent stabilization is established. Straw mulch is typically used for erosion control on disturbed areas until soils can be prepared for permanent vegetation. Straw mulch is also used in combination with temporary and/or permanent seeding strategies to enhance plant establishment.

Limitations

- Availability of straw and straw blowing equipment may be limited just prior to the rainy season and prior to storms due to high demand.
- There is a potential for introduction of weed seed and unwanted plant material.
- When straw blowers are used to apply straw mulch, the treatment areas must be within 150 ft of a road or surface capable of supporting trucks.
- Straw mulch applied by hand is more time intensive and potentially costly.

- Wind may limit application of straw and blow straw into undesired locations.
- May have to be removed prior to permanent seeding or prior to further earthwork.
- "Punching" of straw does not work in sandy soils, necessitating the use of tackifiers.

Implementation

- Straw shall be derived from wheat, rice, or barley. Where required by the plans, specifications, permits, or environmental documents, native grass straw shall be used.
- A tackifier is the preferred method for anchoring straw mulch to the soil on slopes.
- Crimping, punch roller-type rollers, or track walking may also be used to incorporate straw mulch into the soil on slopes. Track walking shall only be used where other methods are impractical.
- Avoid placing straw onto roads, sidewalks, drainage channels, sound walls, existing vegetation, etc.
- Straw mulch with tackifier shall not be applied during or immediately before rainfall.
- In San Diego, use of straw near wood framed home construction has been frowned on by the Fire Marshall.

Application Procedures

- Apply straw at a minimum rate of 4,000 lb/acre, either by machine or by hand distribution.
- Roughen embankments and fill rills before placing the straw mulch by rolling with a crimping or punching type roller or by track walking.
- Evenly distribute straw mulch on the soil surface.
- Anchor straw mulch to the soil surface by "punching" it into the soil mechanically (incorporating). Alternatively, use a tackifier to adhere straw fibers.
- Methods for holding the straw mulch in place depend upon the slope steepness, accessibility, soil conditions, and longevity.
  - On small areas, a spade or shovel can be used to punch in straw mulch.
  - On slopes with soils that are stable enough and of sufficient gradient to safely support construction equipment without contributing to compaction and instability problems, straw can be "punched" into the ground using a knife blade roller or a straight bladed coulter, known commercially as a "crimper".
  - On small areas and/or steep slopes, straw can also be held in place using plastic netting or jute. The netting shall be held in place using 11 gauge wire staples, geotextile pins or wooden stakes as described in EC-7, Geotextiles and Mats.
  - A tackifier acts to glue the straw fibers together and to the soil surface. The tackifier shall be selected based on longevity and ability to hold the fibers in place. A tackifier is

typically applied at a rate of 125 lb/acre. In windy conditions, the rates are typically 180 lb/acre.

Costs

Average annual cost for installation and maintenance (3-4 months useful life) is $2,500 per acre. Application by hand is more time intensive and potentially costly.

Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Areas where erosion is evident should be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.
- The key consideration in inspection and maintenance is that the straw needs to last long enough to achieve erosion control objectives.
- Maintain an unbroken, temporary mulched ground cover while disturbed soil areas are inactive. Repair any damaged ground cover and re-mulch exposed areas.
- Reapplication of straw mulch and tackifier may be required to maintain effective soil stabilization over disturbed areas and slopes.

References

Controlling Erosion of Construction Sites, Agricultural Information Bulletin #347, U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) (formerly Soil Conservation Service – SCS).

Guides for Erosion and Sediment Control in California, USDA Soils Conservation Service, January 1991.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Soil Erosion by Water, Agricultural Information Bulletin #513, U.S. Department of Agriculture, Soil Conservation Service.

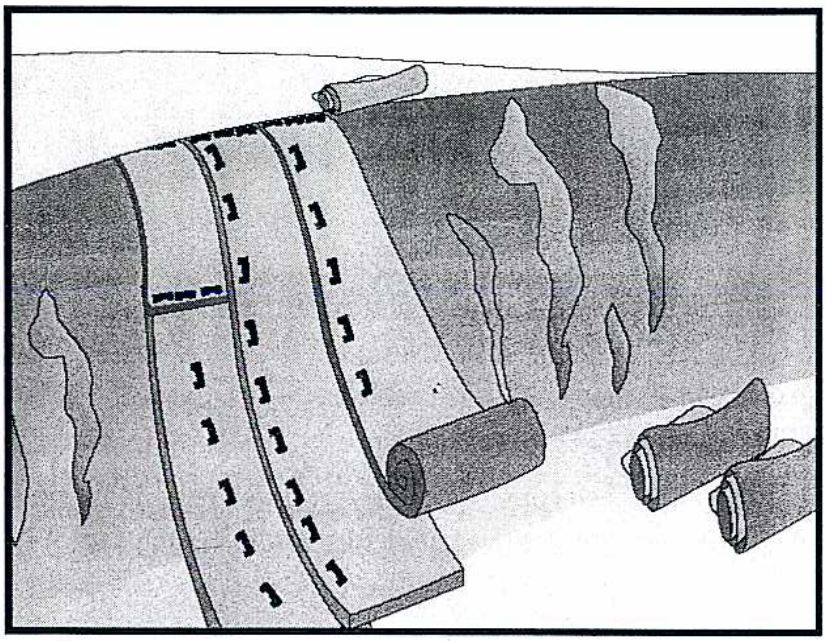
Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Geotextiles and Mats

EC-7



Objectives

EC	Erosion Control	☑
SE	Sediment Control	
TR	Tracking Control	
WE	Wind Erosion Control	3
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch

EC-4 Hydroseeding

EC-5 Soil Binders

EC-6 Straw Mulch

EC-8 Wood Mulching

Description and Purpose

Mattings of natural materials are used to cover the soil surface to reduce erosion from rainfall impact, hold soil in place, and absorb and hold moisture near the soil surface. Additionally, matting may be used to stabilize soils until vegetation is established.

Suitable Applications

Mattings are commonly applied on short, steep slopes where erosion hazard is high and vegetation will be slow to establish. Mattings are also used on stream banks where moving water at velocities between 3 ft/s and 6 ft/s are likely to wash out new vegetation, and in areas where the soil surface is disturbed and where existing vegetation has been removed. Matting may also be used when seeding cannot occur (e.g., late season construction and/or the arrival of an early rain season). Erosion control matting should be considered when the soils are fine grained and potentially erosive. These measures should be considered in the following situations.

- Steep slopes, generally steeper than 3:1 (H:V)
- Slopes where the erosion potential is high
- Slopes and disturbed soils where mulch must be anchored
- Disturbed areas where plants are slow to develop
- Channels with flows exceeding 3.3 ft/s

- Channels to be vegetated
- Stockpiles
- Slopes adjacent to water bodies of Environmentally Sensitive Areas (ESAs)

Limitations

- Properly installed mattings provide excellent erosion control but do so at relatively high cost. This high cost typically limits the use of mattings to areas of concentrated channel flow and steep slopes.
- Mattings are more costly than other BMP practices, limiting their use to areas where other BMPs are ineffective (e.g. channels, steep slopes).
- Installation is critical and requires experienced contractors. The contractor should install the matting material in such a manner that continuous contact between the material and the soil occurs.
- Geotextiles and Mats may delay seed germination, due to reduction in soil temperature.
- Blankets and mats are generally not suitable for excessively rocky sites or areas where the final vegetation will be mowed (since staples and netting can catch in mowers).
- Blankets and mats must be removed and disposed of prior to application of permanent soil stabilization measures.
- Plastic sheeting is easily vandalized, easily torn, photodegradable, and must be disposed of at a landfill.
- Plastic results in 100% runoff, which may cause serious erosion problems in the areas receiving the increased flow.
- The use of plastic should be limited to covering stockpiles or very small graded areas for short periods of time (such as through one imminent storm event) until alternative measures, such as seeding and mulching, may be installed.
- Geotextiles, mats, plastic covers, and erosion control covers have maximum flow rate limitations; consult the manufacturer for proper selection.
- Not suitable for areas that have heavy foot traffic (tripping hazard) – e.g., pad areas around buildings under construction.

Implementation

Material Selection

Organic matting materials have been found to be effective where re-vegetation will be provided by re-seeding. The choice of matting should be based on the size of area, side slopes, surface conditions such as hardness, moisture, weed growth, and availability of materials.

The following natural and synthetic mattings are commonly used:

Geotextiles

- Material should be a woven polypropylene fabric with minimum thickness of 0.06 in., minimum width of 12 ft and should have minimum tensile strength of 150 lbs (warp), 80 lbs (fill) in conformance with the requirements in ASTM Designation: D 4632. The permittivity of the fabric should be approximately 0.07 sec^{-1} in conformance with the requirements in ASTM Designation: D4491. The fabric should have an ultraviolet (UV) stability of 70 percent in conformance with the requirements in ASTM designation: D4355. Geotextile blankets must be secured in place with wire staples or sandbags and by keying into tops of slopes to prevent infiltration of surface waters under geotextile. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- Geotextiles may be reused if they are suitable for the use intended.

Plastic Covers

- Plastic sheeting should have a minimum thickness of 6 mils, and must be keyed in at the top of slope and firmly held in place with sandbags or other weights placed no more than 10 ft apart. Seams are typically taped or weighted down their entire length, and there should be at least a 12 in. to 24 in. overlap of all seams. Edges should be embedded a minimum of 6 in. in soil.

- All sheeting must be inspected periodically after installation and after significant rainstorms to check for erosion, undermining, and anchorage failure. Any failures must be repaired immediately. If washout or breakages occur, the material should be re-installed after repairing the damage to the slope.

Erosion Control Blankets/Mats

- Biodegradable rolled erosion control products (RECPs) are typically composed of jute fibers, curled wood fibers, straw, coconut fiber, or a combination of these materials. In order for an RECP to be considered 100% biodegradable, the netting, sewing or adhesive system that holds the biodegradable mulch fibers together must also be biodegradable.

  - **Jute** is a natural fiber that is made into a yarn that is loosely woven into a biodegradable mesh. It is designed to be used in conjunction with vegetation and has longevity of approximately one year. The material is supplied in rolled strips, which should be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

  - **Excelsior** (curled wood fiber) blanket material should consist of machine produced mats of curled wood excelsior with 80 percent of the fiber 6 in. or longer. The excelsior blanket should be of consistent thickness. The wood fiber must be evenly distributed over the entire area of the blanket. The top surface of the blanket should be covered with a photodegradable extruded plastic mesh. The blanket should be smolder resistant without the use of chemical additives and should be non-toxic and non-injurious to plant and animal life. Excelsior blankets should be furnished in rolled strips, a minimum of 48 in. wide, and should have an average weight of 0.8 lb/yd^2, ±10 percent, at the time of manufacture. Excelsior blankets must be secured in place with wire staples. Staples

should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Straw blanket** should be machine produced mats of straw with a lightweight biodegradable netting top layer. The straw should be attached to the netting with biodegradable thread or glue strips. The straw blanket should be of consistent thickness. The straw should be evenly distributed over the entire area of the blanket. Straw blanket should be furnished in rolled strips a minimum of 6.5 ft wide, a minimum of 80 ft long and a minimum of 0.5 lb/yd^2. Straw blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Wood fiber blanket** is composed of biodegradable fiber mulch with extruded plastic netting held together with adhesives. The material is designed to enhance re-vegetation. The material is furnished in rolled strips, which must be secured to the ground with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Coconut fiber blanket** should be a machine produced mat of 100 percent coconut fiber with biodegradable netting on the top and bottom. The coconut fiber should be attached to the netting with biodegradable thread or glue strips. The coconut fiber blanket should be of consistent thickness. The coconut fiber should be evenly distributed over the entire area of the blanket. Coconut fiber blanket should be furnished in rolled strips with a minimum of 6.5 ft wide, a minimum of 80 ft. long and a minimum of 0.5 lb/yd^2. Coconut fiber blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Coconut fiber mesh** is a thin permeable membrane made from coconut or corn fiber that is spun into a yarn and woven into a biodegradable mat. It is designed to be used in conjunction with vegetation and typically has longevity of several years. The material is supplied in rolled strips, which must be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Straw coconut fiber blanket** should be machine produced mats of 70 percent straw and 30 percent coconut fiber with a biodegradable netting top layer and a biodegradable bottom net. The straw and coconut fiber should be attached to the netting with biodegradable thread or glue strips. The straw coconut fiber blanket should be of consistent thickness. The straw and coconut fiber should be evenly distributed over the entire area of the blanket. Straw coconut fiber blanket should be furnished in rolled strips a minimum of 6.5 ft wide, a minimum of 80 ft long and a minimum of 0.5 lb/yd^2. Straw coconut fiber blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- Non-biodegradable RECPs are typically composed of polypropylene, polyethylene, nylon or other synthetic fibers. In some cases, a combination of biodegradable and synthetic fibers is used to construct the RECP. Netting used to hold these fibers together is typically non-biodegradable as well.

- **Plastic netting** is a lightweight biaxially oriented netting designed for securing loose mulches like straw or paper to soil surfaces to establish vegetation. The netting is photodegradable. The netting is supplied in rolled strips, which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Plastic mesh** is an open weave geotextile that is composed of an extruded synthetic fiber woven into a mesh with an opening size of less than ¼ in. It is used with re-vegetation or may be used to secure loose fiber such as straw to the ground. The material is supplied in rolled strips, which must be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Synthetic fiber with netting** is a mat that is composed of durable synthetic fibers treated to resist chemicals and ultraviolet light. The mat is a dense, three dimensional mesh of synthetic (typically polyolefin) fibers stitched between two polypropylene nets. The mats are designed to be re-vegetated and provide a permanent composite system of soil, roots, and geomatrix. The material is furnished in rolled strips, which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Bonded synthetic fibers** consist of a three dimensional geomatrix nylon (or other synthetic) matting. Typically it has more than 90 percent open area, which facilitates root growth. It's tough root reinforcing system anchors vegetation and protects against hydraulic lift and shear forces created by high volume discharges. It can be installed over prepared soil, followed by seeding into the mat. Once vegetated, it becomes an invisible composite system of soil, roots, and geomatrix. The material is furnished in rolled strips that must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Combination synthetic and biodegradable RECPs** consist of biodegradable fibers, such as wood fiber or coconut fiber, with a heavy polypropylene net stitched to the top and a high strength continuous filament geomatrix or net stitched to the bottom. The material is designed to enhance re-vegetation. The material is furnished in rolled strips, which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

Site Preparation

- Proper site preparation is essential to ensure complete contact of the blanket or matting with the soil.
- Grade and shape the area of installation.
- Remove all rocks, clods, vegetation or other obstructions so that the installed blankets or mats will have complete, direct contact with the soil.
- Prepare seedbed by loosening 2 to 3 in. of topsoil.

Seeding

Seed the area before blanket installation for erosion control and revegetation. Seeding after mat installation is often specified for turf reinforcement application. When seeding prior to blanket

installation, all check slots and other areas disturbed during installation must be re-seeded. Where soil filling is specified, seed the matting and the entire disturbed area after installation and prior to filling the mat with soil.

Fertilize and seed in accordance with seeding specifications or other types of landscaping plans. When using jute matting on a seeded area, apply approximately half the seed before laying the mat and the remainder after laying the mat. The protective matting can be laid over areas where grass has been planted and the seedlings have emerged. Where vines or other ground covers are to be planted, lay the protective matting first and then plant through matting according to design of planting.

Check Slots

Check slots are made of glass fiber strips, excelsior matting strips or tight folded jute matting blanket or strips for use on steep, highly erodible watercourses. The check slots are placed in narrow trenches 6 to 12 in. deep across the channel and left flush with the soil surface. They are to cover the full cross section of designed flow.

Laying and Securing Matting

- Before laying the matting, all check slots should be installed and the friable seedbed made free from clods, rocks, and roots. The surface should be compacted and finished according to the requirements of the manufacturer's recommendations.

- Mechanical or manual lay down equipment should be capable of handling full rolls of fabric and laying the fabric smoothly without wrinkles or folds. The equipment should meet the fabric manufacturer's recommendations or equivalent standards.

Anchoring

- U-shaped wire staples, metal geotextile stake pins, or triangular wooden stakes can be used to anchor mats and blankets to the ground surface.

- Wire staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- Metal stake pins should be 0.188 in. diameter steel with a 1.5 in. steel washer at the head of the pin, and 8 in. in length.

- Wire staples and metal stakes should be driven flush to the soil surface.

Installation on Slopes

Installation should be in accordance with the manufacturer's recommendations. In general, these will be as follows:

- Begin at the top of the slope and anchor the blanket in a 6 in. deep by 6 in. wide trench. Backfill trench and tamp earth firmly.

- Unroll blanket down slope in the direction of water flow.

- Overlap the edges of adjacent parallel rolls 2 to 3 in. and staple every 3 ft.

- When blankets must be spliced, place blankets end over end (shingle style) with 6 in. overlap. Staple through overlapped area, approximately 12 in. apart.
- Lay blankets loosely and maintain direct contact with the soil. Do not stretch.
- Staple blankets sufficiently to anchor blanket and maintain contact with the soil. Staples should be placed down the center and staggered with the staples placed along the edges. Steep slopes, 1:1 (H:V) to 2:1 (H:V), require a minimum of 2 staples/yd^2. Moderate slopes, 2:1 (H:V) to 3:1 (H:V), require a minimum of 1 ½ staples/yd^2.

Installation in Channels

Installation should be in accordance with the manufacturer's recommendations. In general, these will be as follows:

- Dig initial anchor trench 12 in. deep and 6 in. wide across the channel at the lower end of the project area.
- Excavate intermittent check slots, 6 in. deep and 6 in. wide across the channel at 25 to 30 ft intervals along the channels.
- Cut longitudinal channel anchor trenches 4 in. deep and 4 in. wide along each side of the installation to bury edges of matting, whenever possible extend matting 2 to 3 in. above the crest of the channel side slopes.
- Beginning at the downstream end and in the center of the channel, place the initial end of the first roll in the anchor trench and secure with fastening devices at 12 in. intervals. Note: matting will initially be upside down in anchor trench.
- In the same manner, position adjacent rolls in anchor trench, overlapping the preceding roll a minimum of 3 in.
- Secure these initial ends of mats with anchors at 12 in. intervals, backfill and compact soil.
- Unroll center strip of matting upstream. Stop at next check slot or terminal anchor trench. Unroll adjacent mats upstream in similar fashion, maintaining a 3 in. overlap.
- Fold and secure all rolls of matting snugly into all transverse check slots. Lay mat in the bottom of the slot then fold back against itself. Anchor through both layers of mat at 12 in. intervals, then backfill and compact soil. Continue rolling all mat widths upstream to the next check slot or terminal anchor trench.
- Alternate method for non-critical installations: Place two rows of anchors on 6 in. centers at 25 to 30 ft. intervals in lieu of excavated check slots.
- Staple shingled lap spliced ends a minimum of 12 in. apart on 12 in. intervals.
- Place edges of outside mats in previously excavated longitudinal slots; anchor using prescribed staple pattern, backfill, and compact soil.
- Anchor, fill, and compact upstream end of mat in a 12 in. by 6 in. terminal trench.

- Secure mat to ground surface using U-shaped wire staples, geotextile pins, or wooden stakes.
- Seed and fill turf reinforcement matting with soil, if specified.

Soil Filling (if specified for turf reinforcement)

- Always consult the manufacturer's recommendations for installation.
- Do not drive tracked or heavy equipment over mat.
- Avoid any traffic over matting if loose or wet soil conditions exist.
- Use shovels, rakes, or brooms for fine grading and touch up.
- Smooth out soil filling just exposing top netting of mat.

Temporary Soil Stabilization Removal

- Temporary soil stabilization removed from the site of the work must be disposed of if necessary.

Costs

Relatively high compared to other BMPs. Biodegradable materials: \$0.50 - \$0.57/yd^2. Permanent materials: \$3.00 - \$4.50/yd^2. Staples: \$0.04 - \$0.05/staple. Approximate costs for installed materials are shown below:

Rolled Erosion Control Products		Installed Cost per Acre
Biodegradable	Jute Mesh	\$6,500
	Curled Wood Fiber	\$10,500
	Straw	\$8,900
	Wood Fiber	\$8,900
	Coconut Fiber	\$13,000
	Coconut Fiber Mesh	\$31,200
	Straw Coconut Fiber	\$10,900
Non-Biodegradable	Plastic Netting	\$2,000
	Plastic Mesh	\$3,200
	Synthetic Fiber with Netting	\$34,800
	Bonded Synthetic Fibers	\$50,000
	Combination with Biodegradable	\$32,000

Source: Caltrans Guidance for Soil Stabilization for Temporary Slopes, Nov. 1999

Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season, and at two-week intervals during the non-rainy season.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.

- Areas where erosion is evident shall be repaired and BMPs reapplied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require reapplication of BMPs.
- If washout or breakage occurs, re-install the material after repairing the damage to the slope or channel.
- Make sure matting is uniformly in contact with the soil.
- Check that all the lap joints are secure.
- Check that staples are flush with the ground.
- Check that disturbed areas are seeded.

References

Guides for Erosion and Sediment Controls in California, USDA Soils Conservation Service, January 1991.

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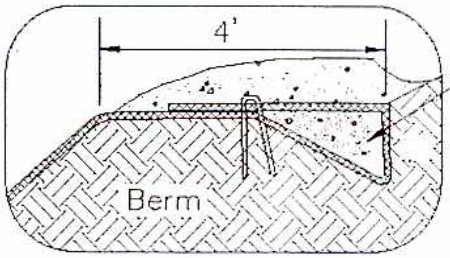
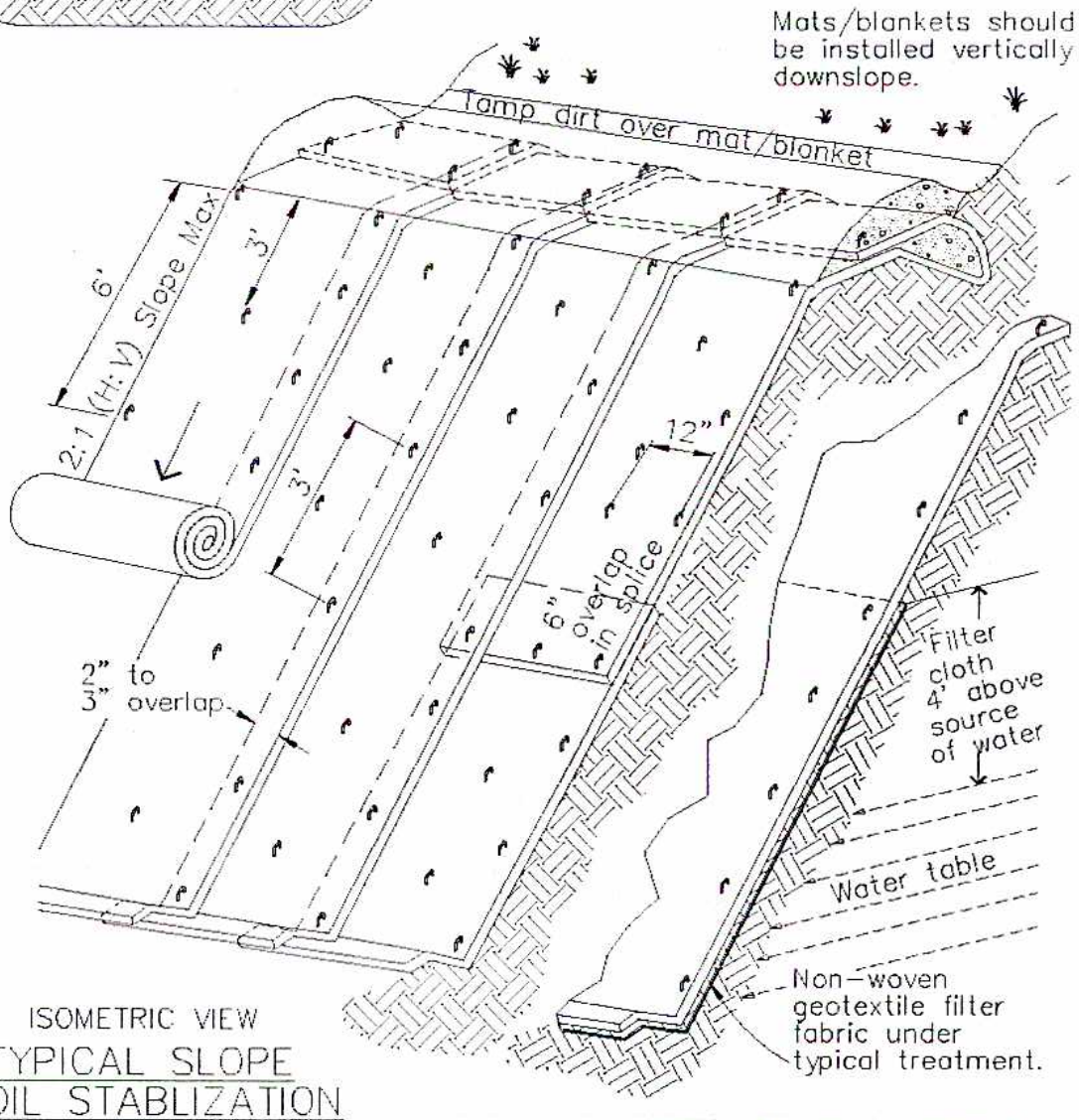




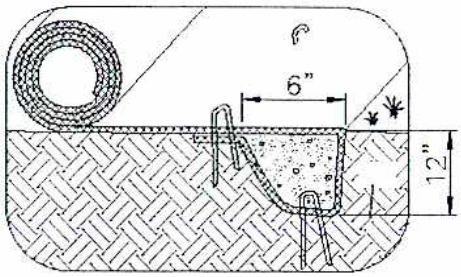
ISOMETRIC VIEW
TYPICAL SLOPE SOIL STABLIZATION
NTS

WET SLOPE LINING
NTS

NOTES:

1. Slope surface shall be free of rocks, clods, sticks and grass. Mats/blankets shall have good soil contact.
2. Lay blankets loosely and stake or staple to maintain direct contact with the soil. Do not stretch.
3. Install per manufacturer's recommendations

TYPICAL INSTALLATION DETAIL



INITIAL CHANNEL ANCHOR TRENCH
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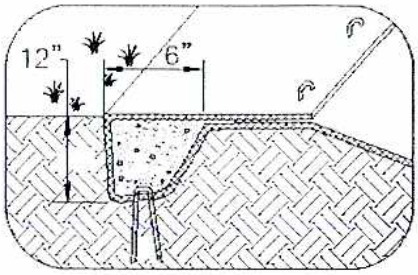

TERMINAL SLOPE AND CHANNEL ANCHOR TRENCH
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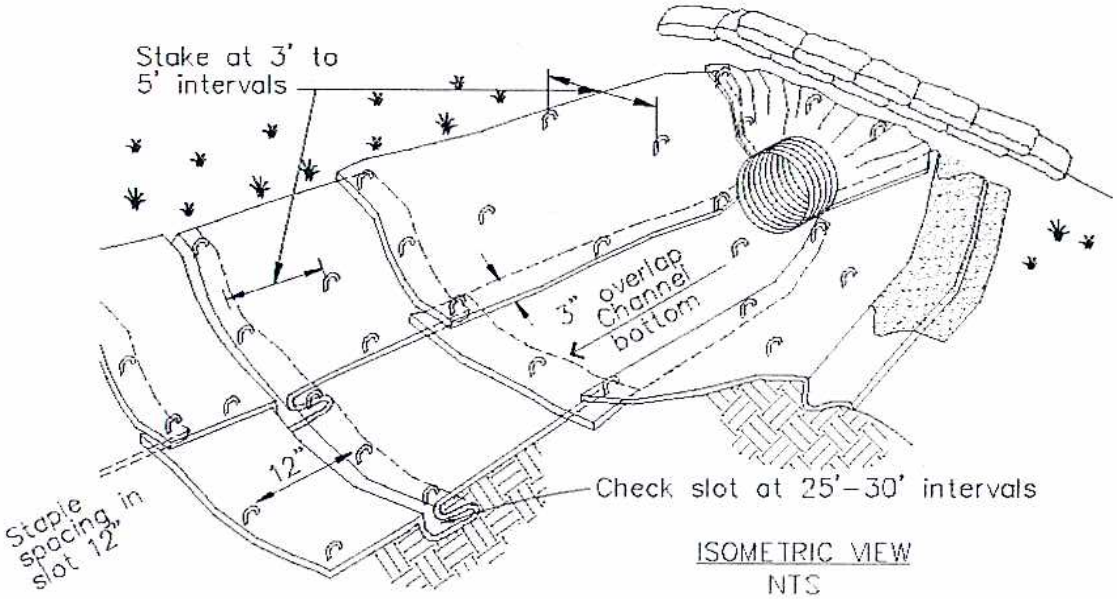

ISOMETRIC VIEW
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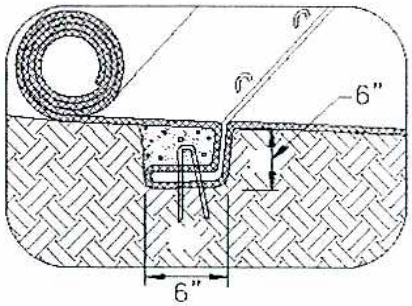
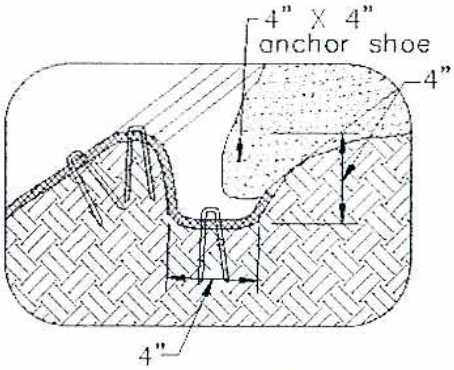


INTERMITTENT CHECK SLOT
NTS



LONGITUDINAL ANCHOR TRENCH
NTS

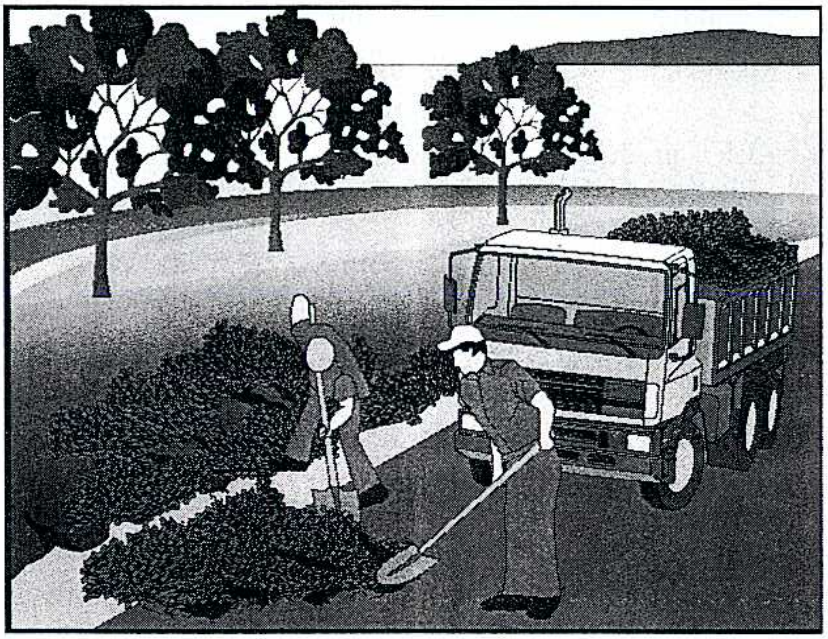
NOTES:

1. Check slots to be constructed per manufacturers specifications.
2. Staking or stapling layout per manufacturers specifications.
3. Install per manufacturer's recommendations

TYPICAL INSTALLATION DETAIL

Wood Mulching

EC-8



Objectives

EC	Erosion Control	☑
SE	Sediment Control	
TR	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch

EC-4 Hydroseeding

EC-5 Soil Binders

EC-6 Straw Mulch

EC-7 Geotextiles and Mats

Description and Purpose

Wood mulching consist of applying a mixture of shredded wood mulch, bark or compost to disturbed soils. The primary function of wood mulching is to reduce erosion by protecting bare soil from rainfall impact, increasing infiltration, and reducing runoff.

Suitable Applications

Wood mulching is suitable for disturbed soil areas requiring temporary protection until permanent stabilization is established.

Limitations

- Not suitable for use on slopes steeper than 3:1 (H:V). Best suited to flat areas or gentle slopes or 5:1 (H:V) or flatter.
- Wood mulch and compost may introduce unwanted species.
- Not suitable for areas exposed to concentrated flows.
- May need to be removed prior to further earthwork.

Implementation

Mulch Selection

There are many types of mulches. Selection of the appropriate type of mulch should be based on the type of application, site conditions, and compatibility with planned or future uses.

Application Procedures

Prior to application, after existing vegetation has been removed, roughen embankment and fill areas by rolling with a device such

as a punching type roller or by track walking. The construction application procedures for mulches vary significantly depending upon the type of mulching method specified. Two methods are highlighted here:

- Green Material: This type of mulch is produced by the recycling of vegetation trimmings such as grass, shredded shrubs, and trees. Methods of application are generally by hand although pneumatic methods are available.
  - Green material can be used as a temporary ground cover with or without seeding.
  - The green material should be evenly distributed on site to a depth of not more than 2 in.
- Shredded Wood: Suitable for ground cover in ornamental or revegetated plantings.
  - Shredded wood/bark is conditionally suitable. See note under limitations.
  - Distribute by hand or use pneumatic methods.
  - Evenly distribute the mulch across the soil surface to a depth of 2 to 3 in.
- Avoid mulch placement onto roads, sidewalks, drainage channels, existing vegetation, etc.

Costs

Average annual cost for installation and maintenance (3-4 months useful life) is around $4,000 per acre, but cost can increase if the source is not close to the project site.

Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Areas where erosion is evident shall be repaired and BMPs reapplied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require reapplication of BMPs.
- Regardless of the mulching technique selected, the key consideration in inspection and maintenance is that the mulch needs to last long enough to achieve erosion control objectives. If the mulch is applied as a stand alone erosion control method over disturbed areas (without seed), it should last the length of time the site will remain barren or until final re-grading and revegetation.
- Where vegetation is not the ultimate cover, such as ornamental and landscape applications of bark or wood chips, inspection and maintenance should focus on longevity and integrity of the mulch.
- Reapply mulch when bare earth becomes visible.

References

Controlling Erosion of Construction Sites Agriculture Information Bulletin #347, U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) (formerly Soil Conservation Service – SCS).

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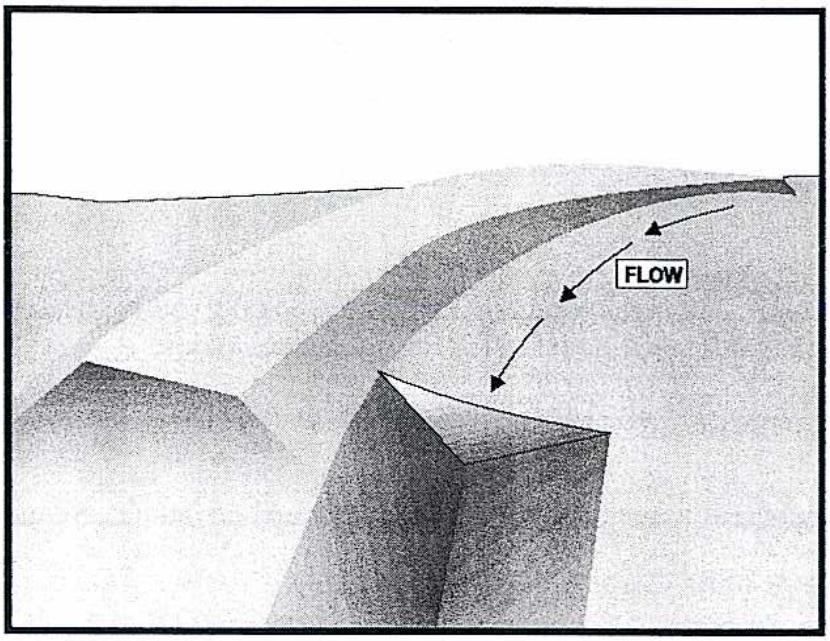
Earth Dikes and Drainage Swales EC-9



Objectives

EC	Erosion Control	☑
SE	Sediment Control	
TR	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

Description and Purpose

An earth dike is a temporary berm or ridge of compacted soil used to divert runoff or channel water to a desired location. A drainage swale is a shaped and sloped depression in the soil surface used to convey runoff to a desired location. Earth dikes and drainage swales are used to divert off site runoff around the construction site, divert runoff from stabilized areas and disturbed areas, and direct runoff into sediment basins or traps.

Suitable Applications

Earth dikes and drainage swales are suitable for use, individually or together, where runoff needs to be diverted from one area and conveyed to another.

- Earth dikes and drainage swales may be used:
  - To convey surface runoff down sloping land
  - To intercept and divert runoff to avoid sheet flow over sloped surfaces
  - To divert and direct runoff towards a stabilized watercourse, drainage pipe or channel
  - To intercept runoff from paved surfaces
  - Below steep grades where runoff begins to concentrate
  - Along roadways and facility improvements subject to flood drainage

- At the top of slopes to divert runon from adjacent or undisturbed slopes
- At bottom and mid slope locations to intercept sheet flow and convey concentrated flows
- Divert sediment laden runoff into sediment basins or traps

Limitations

Dikes should not be used for drainage areas greater than 10 acres or along slopes greater than 10 percent. For larger areas more permanent drainage structures should be built. All drainage structures should be built in compliance with local municipal requirements.

- Earth dikes may create more disturbed area on site and become barriers to construction equipment.
- Earth dikes must be stabilized immediately, which adds cost and maintenance concerns.
- Diverted stormwater may cause downstream flood damage.
- Dikes should not be constructed of soils that may be easily eroded.
- Regrading the site to remove the dike may add additional cost.
- Temporary drains and swales or any other diversion of runoff should not adversely impact upstream or downstream properties.
- Temporary drains and swales must conform to local floodplain management requirements.
- Earth dikes/drainage swales are not suitable as sediment trapping devices.
- It may be necessary to use other soil stabilization and sediment controls such as check dams, plastics, and blankets, to prevent scour and erosion in newly graded dikes, swales, and ditches.

Implementation

The temporary earth dike is a berm or ridge of compacted soil, located in such a manner as to divert stormwater to a sediment trapping device or a stabilized outlet, thereby reducing the potential for erosion and offsite sedimentation. Earth dikes can also be used to divert runoff from off site and from undisturbed areas away from disturbed areas and to divert sheet flows away from unprotected slopes.

An earth dike does not itself control erosion or remove sediment from runoff. A dike prevents erosion by directing runoff to an erosion control device such as a sediment trap or directing runoff away from an erodible area. Temporary diversion dikes should not adversely impact adjacent properties and must conform to local floodplain management regulations, and should not be used in areas with slopes steeper than 10%.

Slopes that are formed during cut and fill operations should be protected from erosion by runoff. A combination of a temporary drainage swale and an earth dike at the top of a slope can divert runoff to a location where it can be brought to the bottom of the slope (see EC-11, Slope Drains). A combination dike and swale is easily constructed by a single pass of a bulldozer or grader and

compacted by a second pass of the tracks or wheels over the ridge. Diversion structures should be installed when the site is initially graded and remain in place until post construction BMPs are installed and the slopes are stabilized.

Diversion practices concentrate surface runoff, increasing its velocity and erosive force. Thus, the flow out of the drain or swale must be directed onto a stabilized area or into a grade stabilization structure. If significant erosion will occur, a swale should be stabilized using vegetation, chemical treatment, rock rip-rap, matting, or other physical means of stabilization. Any drain or swale that conveys sediment laden runoff must be diverted into a sediment basin or trap before it is discharged from the site.

General

- Care must be applied to correctly size and locate earth dikes, drainage swales. Excessively steep, unlined dikes, and swales are subject to erosion and gully formation.
- Conveyances should be stabilized.
- Use a lined ditch for high flow velocities.
- Select flow velocity based on careful evaluation of the risks due to erosion of the measure, soil types, overtopping, flow backups, washout, and drainage flow patterns for each project site.
- Compact any fills to prevent unequal settlement.
- Do not divert runoff onto other property without securing written authorization from the property owner.
- When possible, install and utilize permanent dikes, swales, and ditches early in the construction process.
- Provide stabilized outlets.

Earth Dikes

Temporary earth dikes are a practical, inexpensive BMP used to divert stormwater runoff. Temporary diversion dikes should be installed in the following manner:

- All dikes should be compacted by earth moving equipment.
- All dikes should have positive drainage to an outlet.
- All dikes should have 2:1 or flatter side slopes, 18 in. minimum height, and a minimum top width of 24 in. Wide top widths and flat slopes are usually needed at crossings for construction traffic.
- The outlet from the earth dike must function with a minimum of erosion. Runoff should be conveyed to a sediment trapping device such as a Sediment Trap (SE-3) or Sediment Basin (SE-2) when either the dike channel or the drainage area above the dike are not adequately stabilized.

- Temporary stabilization may be achieved using seed and mulching for slopes less than 5% and either rip-rap or sod for slopes in excess of 5%. In either case, stabilization of the earth dike should be completed immediately after construction or prior to the first rain.

- If riprap is used to stabilize the channel formed along the toe of the dike, the following typical specifications apply:

Channel Grade	Riprap Stabilization
0.5-1.0%	4 in. Rock
1.1-2.0%	6 in. Rock
2.1-4.0%	8 in. Rock
4.1-5.0%	8 in. -12 in. Riprap

- The stone riprap, recycled concrete, etc. used for stabilization should be pressed into the soil with construction equipment.

- Filter cloth may be used to cover dikes in use for long periods.

- Construction activity on the earth dike should be kept to a minimum.

Drainage Swales

Drainage swales are only effective if they are properly installed. Swales are more effective than dikes because they tend to be more stable. The combination of a swale with a dike on the downhill side is the most cost effective diversion.

Standard engineering design criteria for small open channel and closed conveyance systems should be used (see the local drainage design manual). Unless local drainage design criteria state otherwise, drainage swales should be designed as follows:

- No more than 5 acres may drain to a temporary drainage swale.

- Place drainage swales above or below, not on, a cut or fill slope.

- Swale bottom width should be at least 2 ft

- Depth of the swale should be at least 18 in.

- Side slopes should be 2:1 or flatter.

- Drainage or swales should be laid at a grade of at least 1 percent, but not more than 15 percent.

- The swale must not be overtopped by the peak discharge from a 10-year storm, irrespective of the design criteria stated above.

- Remove all trees, stumps, obstructions, and other objectionable material from the swale when it is built.

- Compact any fill material along the path of the swale.

- Stabilize all swales immediately. Seed and mulch swales at a slope of less than 5 percent, and use rip-rap or sod for swales with a slope between 5 and 15 percent. For temporary swales, geotextiles and mats (EC-7) may provide immediate stabilization.
- Irrigation may be required to establish sufficient vegetation to prevent erosion.
- Do not operate construction vehicles across a swale unless a stabilized crossing is provided.
- Permanent drainage facilities must be designed by a professional engineer (see the local drainage design criteria for proper design).
- At a minimum, the drainage swale should conform to predevelopment drainage patterns and capacities.
- Construct the drainage swale with a positive grade to a stabilized outlet.
- Provide erosion protection or energy dissipation measures if the flow out of the drainage swale can reach an erosive velocity.

Costs

- Cost ranges from $15 to $55 per ft for both earthwork and stabilization and depends on availability of material, site location, and access.
- Small dikes: $2.50 - $6.50/linear ft; Large dikes: $2.50/yd^3.
- The cost of a drainage swale increases with drainage area and slope. Typical swales for controlling internal erosion are inexpensive, as they are quickly formed during routine earthwork.

Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Inspect ditches and berms for washouts. Replace lost riprap, damaged linings or soil stabilizers as needed.
- Inspect channel linings, embankments, and beds of ditches and berms for erosion and accumulation of debris and sediment. Remove debris and sediment and repair linings and embankments as needed.
- Temporary conveyances should be completely removed as soon as the surrounding drainage area has been stabilized or at the completion of construction

References

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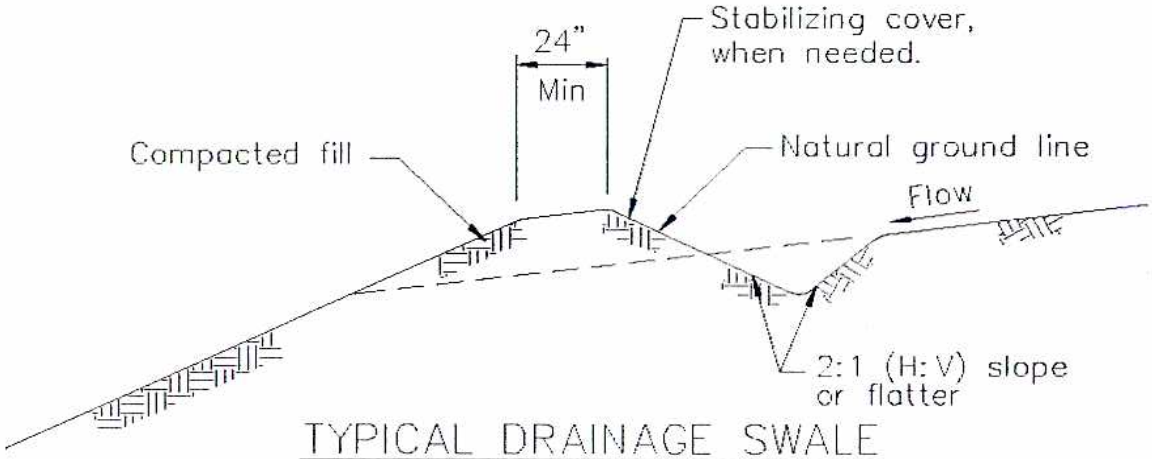
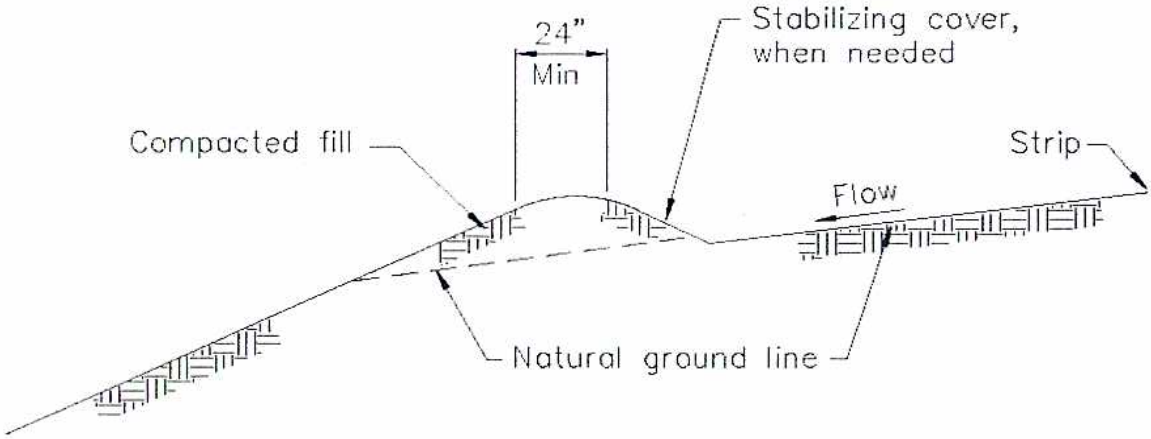


TYPICAL DRAINAGE SWALE
NOT TO SCALE

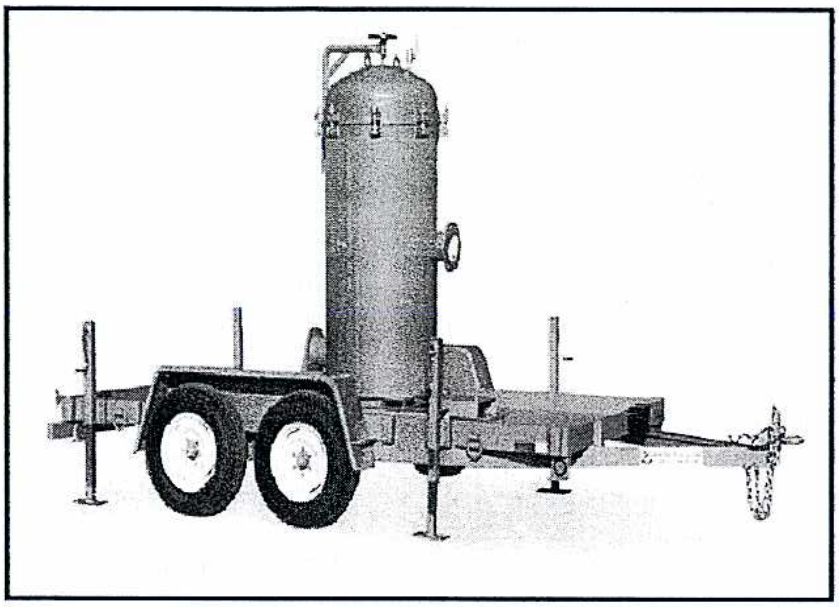
NOTES:

1. Stabilize inlet, outlets and slopes.
2. Properly compact the subgrade.



TYPICAL EARTH DIKE
NOT TO SCALE

Dewatering Operations NS-2



Objectives		
EC	Erosion Control	
SE	Sediment Control	☒
TR	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

SE-5: Fiber Roll

SE-6: Gravel Bag Berm

SE-9: Straw Bale Barrier

Description and Purpose

Dewatering operations are practices that manage the discharge of pollutants when non-stormwater and accumulated precipitation must be removed from a work location so that construction work may be accomplished.

Suitable Applications

These practices are implemented for discharges of non-stormwater from construction sites. Non-stormwaters include, but are not limited to, groundwater, water from cofferdams, water diversions, and waters used during construction activities that must be removed from a work area.

Practices identified in this section are also appropriate for implementation when managing the removal of accumulated precipitation (stormwater) from depressed areas at a construction site.

Limitations

- Site conditions will dictate design and use of dewatering operations.
- The controls discussed in this best management practice (BMP) address sediment only.
- The controls detailed in this BMP only allow for minimal settling time for sediment particles. Use only when site conditions restrict the use of the other control methods.
- Dewatering operations will require, and must comply with, applicable local permits.

- Avoid dewatering discharges where possible by using the water for dust control, by infiltration, etc.

Implementation

- Dewatering non-stormwater cannot be discharged without prior notice to and approval from the Regional Water Quality Control Board (RWQCB) and local stormwater management agency. This includes stormwater that is co-mingled with groundwater or other non-stormwater sources. Once the discharge is allowed, appropriate BMPs must be implemented to ensure the discharge complies with all permit requirements and regional and watershed-specific requirements.

- RWQCB may require a separate NPDES permit prior to the dewatering discharge of non-stormwater. These permits will have specific testing, monitoring, and discharge requirements and can take significant time to obtain.

- The flow chart shown in Figure 1 should be utilized to guide dewatering operations.

- The owner will coordinate monitoring and permit compliance.

- Additional permits or permissions from other agencies may be required for dewatering cofferdams or diversions.

- Dewatering discharges must not cause erosion at the discharge point.

A variety of methods can be used to treat water during dewatering operations. Several devices are presented below and provide options to achieve sediment removal. The size of particles present in the sediment and Permit or receiving water limitations on sediment are key considerations for selecting sediment treatment option(s); in some cases, the use of multiple devices may be appropriate.

Sediment Basin (see also SE-2)

Description:

- A sediment basin is a temporary basin with a controlled release structure that is formed by excavation or construction of an embankment to detain sediment-laden runoff and allow sediment to settle out before discharging. Sediment basins are generally larger than Sediment Traps (SE-3).

Appropriate Applications:

- Effective for the removal of gravel, sand, silt, some metals that settle out with the sediment, and trash.

Implementation:

- Excavation and construction of related facilities is required.

- Temporary sediment basins must be fenced if safety is a concern.

- Outlet protection is required to prevent erosion at the outfall location.

Maintenance:

- Maintenance is required for safety fencing, vegetation, embankment, inlet and outfall structures, as well as other features.
- Removal of sediment is required when the storage volume is reduced by one-half.

Sediment Trap (See also SE-3)

Description:

- A sediment trap is a temporary basin formed by excavation and/or construction of an earthen embankment across a waterway or low drainage area to detain sediment-laden runoff and allow sediment to settle out before discharging. Sediment traps are generally smaller than Sediment Basins (SE-2).

Appropriate Applications:

Effective for the removal of large and medium sized particles (sand and gravel) and some metals that settle out with the sediment.

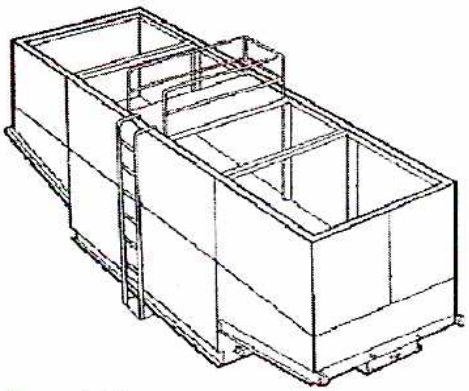
Implementation:

- Excavation and construction of related facilities is required.
- Trap inlets should be located to maximize the travel distance to the trap outlet.
- Use rock or vegetation to protect the trap outlets against erosion.

Maintenance:

- Maintenance is required for vegetation, embankment, inlet and outfall structures, as well as other features.
- Removal of sediment is required when the storage volume is reduced by one-third.

Weir Tanks



Description:

- A weir tank separates water and waste by using weirs. The configuration of the weirs (over and under weirs) maximizes the residence time in the tank and determines the waste to be removed from the water, such as oil, grease, and sediments.

Appropriate Applications:

- The tank removes trash, some settleable solids (gravel, sand, and silt), some visible oil and grease, and some metals (removed with sediment). To achieve high levels of flow, multiple tanks can be used in parallel. If additional treatment is desired, the tanks can be placed in series or as pre-treatment for other methods.

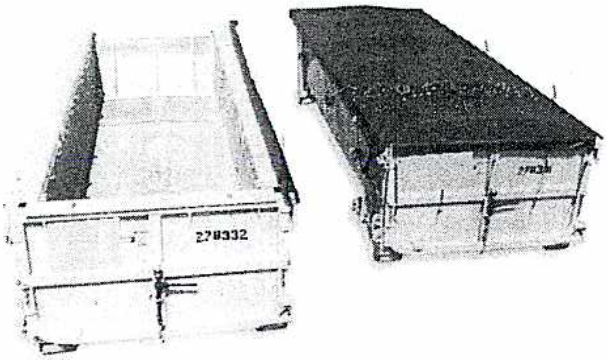
Implementation:

- Tanks are delivered to the site by the vendor, who can provide assistance with set-up and operation.
- Tank size will depend on flow volume, constituents of concern, and residency period required. Vendors should be consulted to appropriately size tank.

Maintenance:

- Periodic cleaning is required based on visual inspection or reduced flow.
- Oil and grease disposal must be by licensed waste disposal company.

Dewatering Tanks



Description:

- A dewatering tank removes debris and sediment. Flow enters the tank through the top, passes through a fabric filter, and is discharged through the bottom of the tank. The filter separates the solids from the liquids.

Appropriate Applications:

- The tank removes trash, gravel, sand, and silt, some visible oil and grease, and some metals (removed with sediment). To achieve high levels of flow, multiple tanks can be used in parallel. If additional treatment is desired, the tanks can be placed in series or as pre-treatment for other methods.

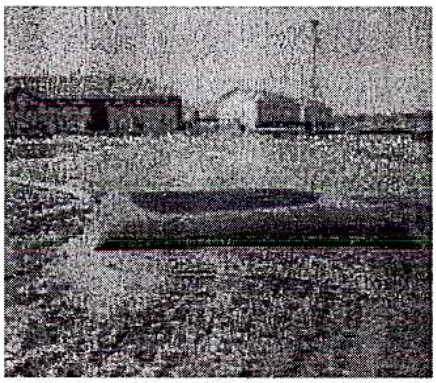
Implementation:

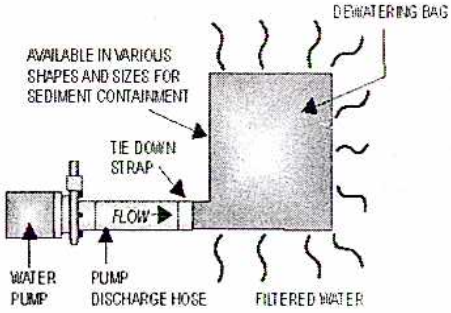
- Tanks are delivered to the site by the vendor, who can provide assistance with set-up and operation.
- Tank size will depend on flow volume, constituents of concern, and residency period required. Vendors should be consulted to appropriately size tank.

Maintenance:

- Periodic cleaning is required based on visual inspection or reduced flow.
- Oil and grease disposal must be by licensed waste disposal company.

Gravity Bag Filter





Description:

- A gravity bag filter, also referred to as a dewatering bag, is a square or rectangular bag made of non-woven geotextile fabric that collects sand, silt, and fines.

Appropriate Applications:

- Effective for the removal of sediments (gravel, sand, and silt). Some metals are removed with the sediment.

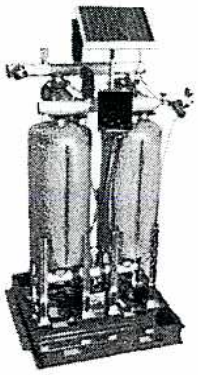
Implementation:

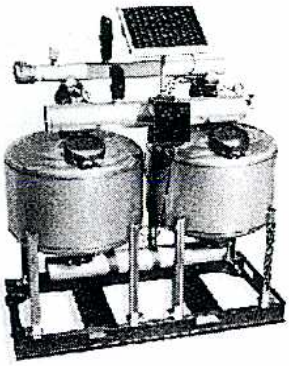
- Water is pumped into one side of the bag and seeps through the bottom and sides of the bag.
- A secondary barrier, such as a rock filter bed or straw/hay bale barrier, is placed beneath and beyond the edges of the bag to capture sediments that escape the bag.

Maintenance:

- Inspection of the flow conditions, bag condition, bag capacity, and the secondary barrier is required.
- Replace the bag when it no longer filters sediment or passes water at a reasonable rate.
- The bag is disposed of offsite.

Sand Media Particulate Filter





Description:

- Water is treated by passing it through canisters filled with sand media. Generally, sand filters provide a final level of treatment. They are often used as a secondary or higher level of treatment after a significant amount of sediment and other pollutants have been removed using other methods.

Appropriate Applications:

- Effective for the removal of trash, gravel, sand, and silt and some metals, as well as the reduction of biochemical oxygen demand (BOD) and turbidity.
- Sand filters can be used for stand-alone treatment or in conjunction with bag and cartridge filtration if further treatment is required.
- Sand filters can also be used to provide additional treatment to water treated via settling or basic filtration.

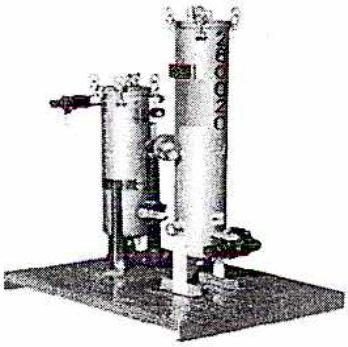
Implementation:

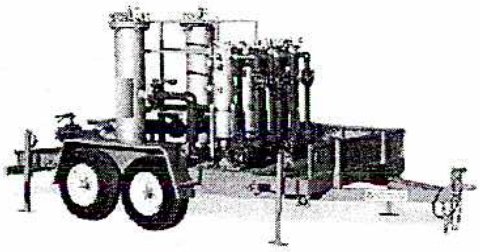
- The filters require delivery to the site and initial set up. The vendor can provide assistance with installation and operation.

Maintenance:

- The filters require regular service to monitor and maintain the level of the sand media. If subjected to high loading rates, filters can plug quickly.
- Venders generally provide data on maximum head loss through the filter. The filter should be monitored daily while in use, and cleaned when head loss reaches target levels.
- If cleaned by backwashing, the backwash water may need to be hauled away for disposal, or returned to the upper end of the treatment train for another pass through the series of dewatering BMPs.

Pressurized Bag Filter





Description:

- A pressurized bag filter is a unit composed of single filter bags made from polyester felt material. The water filters through the unit and is discharged through a header. Vendors provide bag filters in a variety of configurations. Some units include a combination of bag filters and cartridge filters for enhanced contaminant removal.

Appropriate Applications:

- Effective for the removal of sediment (sand and silt) and some metals, as well as the reduction of BOD, turbidity, and hydrocarbons. Oil absorbent bags are available for hydrocarbon removal.

- Filters can be used to provide secondary treatment to water treated via settling or basic filtration.

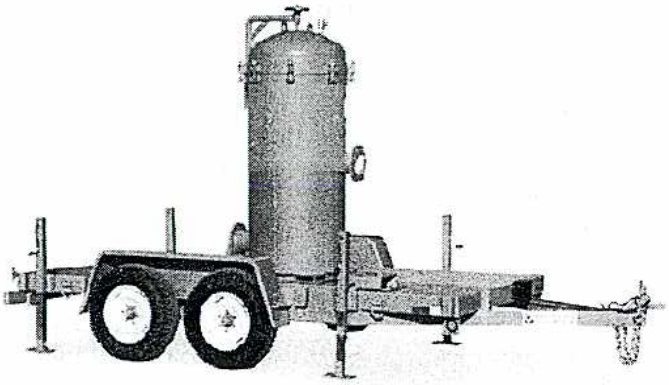
Implementation:

- The filters require delivery to the site and initial set up. The vendor can provide assistance with installation and operation.

Maintenance:

- The filter bags require replacement when the pressure differential equals or exceeds the manufacturer's recommendation.

Cartridge Filter



Description:

- Cartridge filters provide a high degree of pollutant removal by utilizing a number of individual cartridges as part of a larger filtering unit. They are often used as a secondary or higher (polishing) level of treatment after a significant amount of sediment and other pollutants are removed. Units come with various cartridge configurations (for use in series with bag filters) or with a larger single cartridge filtration unit (with multiple filters within).

Appropriate Applications:

- Effective for the removal of sediment (sand, silt, and some clays) and metals, as well as the reduction of BOD, turbidity, and hydrocarbons. Hydrocarbons can effectively be removed with special resin cartridges.

- Filters can be used to provide secondary treatment to water treated via settling or basic filtration.

Implementation:

- The filters require delivery to the site and initial set up. The vendor can provide assistance.

Maintenance:

- The cartridges require replacement when the pressure differential equals or exceeds the manufacturer's recommendation.

Costs

- Sediment controls are low to high cost measures depending on the dewatering system that is selected. Pressurized filters tend to be more expensive than gravity settling, but are often more effective. Simple tanks are generally rented on a long-term basis (one or more months) and can range from $360 per month for a 1,000 gallon tank to $2,660 per month for a 10,000 gallon tank. Mobilization and demobilization costs vary considerably.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.

- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Unit-specific maintenance requirements are included with the description of each unit.
- Sediment removed during the maintenance of a dewatering device may be either spread onsite and stabilized, or disposed of at a disposal site as approved by the owner.
- Sediment that is commingled with other pollutants must be disposed of in accordance with all applicable laws and regulations and as approved by the owner.

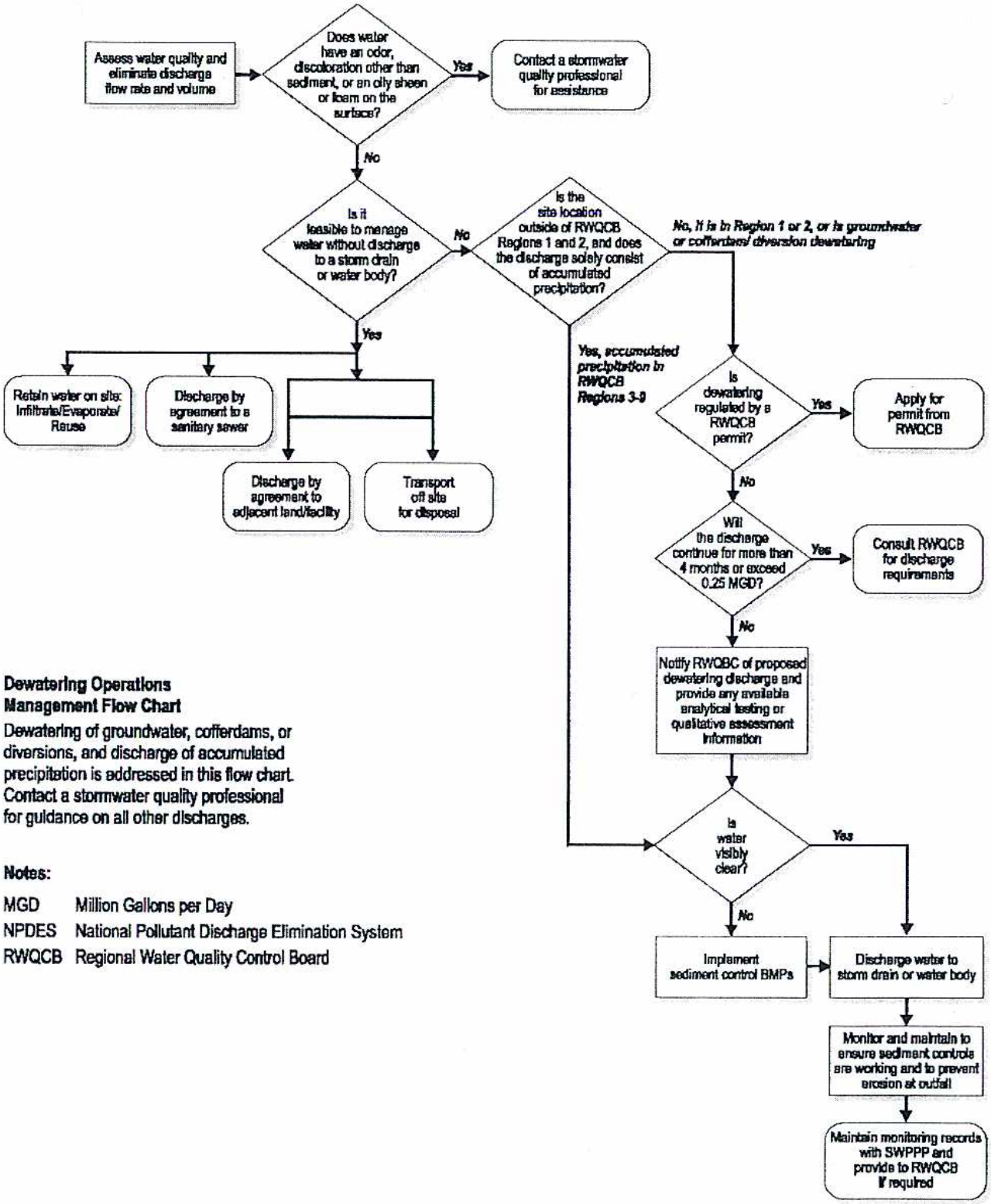
References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Labor Surcharge & Equipment Rental Rates, April 1, 2002 through March 31, 2003, California Department of Transportation (Caltrans).



Dewatering Operations Management Flow Chart

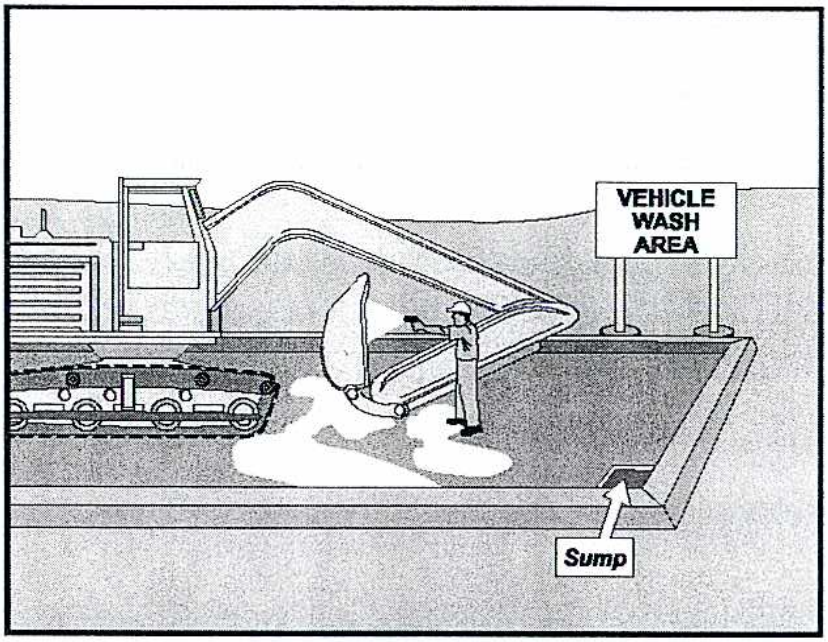
Dewatering of groundwater, cofferdams, or diversions, and discharge of accumulated precipitation is addressed in this flow chart. Contact a stormwater quality professional for guidance on all other discharges.

Notes:

MGD Million Gallons per Day
NPDES National Pollutant Discharge Elimination System
RWQCB Regional Water Quality Control Board

Figure 1
Operations Flow Chart

Vehicle and Equipment Cleaning NS-8



Objectives

EC	Erosion Control	
SE	Sediment Control	
TR	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	
Metals	
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

Description and Purpose

Vehicle and equipment cleaning procedures and practices eliminate or reduce the discharge of pollutants to stormwater from vehicle and equipment cleaning operations. Procedures and practices include but are not limited to: using offsite facilities; washing in designated, contained areas only; eliminating discharges to the storm drain by infiltrating the wash water; and training employees and subcontractors in proper cleaning procedures.

Suitable Applications

These procedures are suitable on all construction sites where vehicle and equipment cleaning is performed.

Limitations

Even phosphate-free, biodegradable soaps have been shown to be toxic to fish before the soap degrades. Sending vehicles/equipment offsite should be done in conjunction with TR-1, Stabilized Construction Entrance/Exit.

Implementation

Other options to washing equipment onsite include contracting with either an offsite or mobile commercial washing business. These businesses may be better equipped to handle and dispose of the wash waters properly. Performing this work offsite can also be economical by eliminating the need for a separate washing operation onsite.

If washing operations are to take place onsite, then:

- Use phosphate-free, biodegradable soaps.
- Educate employees and subcontractors on pollution prevention measures.
- Do not permit steam cleaning onsite. Steam cleaning can generate significant pollutant concentrates.
- Cleaning of vehicles and equipment with soap, solvents or steam should not occur on the project site unless resulting wastes are fully contained and disposed of. Resulting wastes should not be discharged or buried, and must be captured and recycled or disposed according to the requirements of WM-10, Liquid Waste Management or WM-6, Hazardous Waste Management, depending on the waste characteristics. Minimize use of solvents. Use of diesel for vehicle and equipment cleaning is prohibited.
- All vehicles and equipment that regularly enter and leave the construction site must be cleaned offsite.
- When vehicle and equipment washing and cleaning must occur onsite, and the operation cannot be located within a structure or building equipped with appropriate disposal facilities, the outside cleaning area should have the following characteristics:
  - Located away from storm drain inlets, drainage facilities, or watercourses
  - Paved with concrete or asphalt and bermed to contain wash waters and to prevent runon and runoff
  - Configured with a sump to allow collection and disposal of wash water
  - No discharge of wash waters to storm drains or watercourses
  - Used only when necessary
- When cleaning vehicles and equipment with water:
  - Use as little water as possible. High-pressure sprayers may use less water than a hose and should be considered
  - Use positive shutoff valve to minimize water usage
  - Facility wash racks should discharge to a sanitary sewer, recycle system or other approved discharge system and must not discharge to the storm drainage system, watercourses, or to groundwater

Costs

Cleaning vehicles and equipment at an offsite facility may reduce overall costs for vehicle and equipment cleaning by eliminating the need to provide similar services onsite. When onsite cleaning is needed, the cost to establish appropriate facilities is relatively low on larger, long-duration projects, and moderate to high on small, short-duration projects.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Inspection and maintenance is minimal, although some berm repair may be necessary.
- Monitor employees and subcontractors throughout the duration of the construction project to ensure appropriate practices are being implemented.
- Inspect sump regularly and remove liquids and sediment as needed.
- Prohibit employees and subcontractors from washing personal vehicles and equipment on the construction site.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

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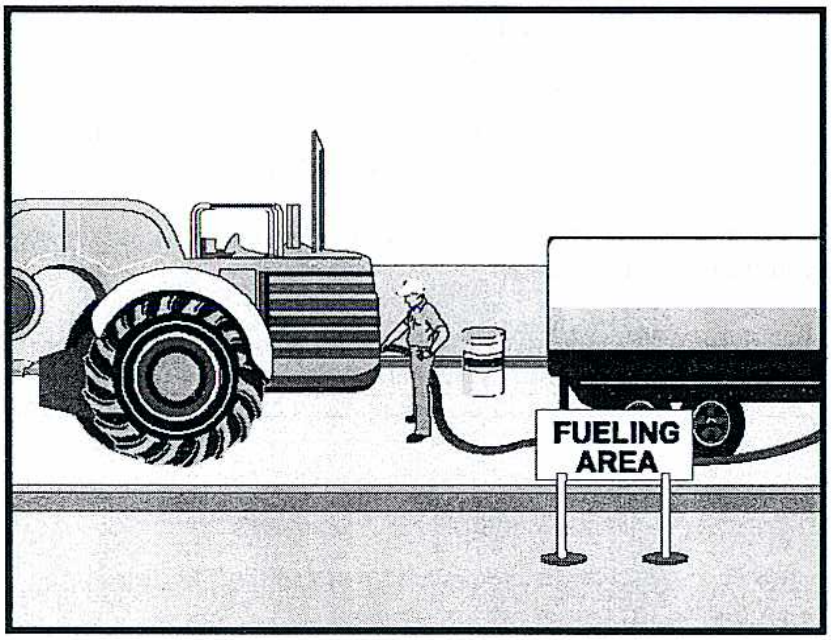
Vehicle and Equipment Fueling NS-9



Objectives

EC	Erosion Control	
SE	Sediment Control	
TR	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

None

Description and Purpose

Vehicle equipment fueling procedures and practices are designed to prevent fuel spills and leaks, and reduce or eliminate contamination of stormwater. This can be accomplished by using offsite facilities, fueling in designated areas only, enclosing or covering stored fuel, implementing spill controls, and training employees and subcontractors in proper fueling procedures.

Suitable Applications

These procedures are suitable on all construction sites where vehicle and equipment fueling takes place.

Limitations

Onsite vehicle and equipment fueling should only be used where it is impractical to send vehicles and equipment offsite for fueling. Sending vehicles and equipment offsite should be done in conjunction with TR-1, Stabilized Construction Entrance/ Exit.

Implementation

- Use offsite fueling stations as much as possible. These businesses are better equipped to handle fuel and spills properly. Performing this work offsite can also be economical by eliminating the need for a separate fueling area at a site.
- Discourage "topping-off" of fuel tanks.

- Absorbent spill cleanup materials and spill kits should be available in fueling areas and on fueling trucks, and should be disposed of properly after use.
- Drip pans or absorbent pads should be used during vehicle and equipment fueling, unless the fueling is performed over an impermeable surface in a dedicated fueling area.
- Use absorbent materials on small spills. Do not hose down or bury the spill. Remove the adsorbent materials promptly and dispose of properly.
- Avoid mobile fueling of mobile construction equipment around the site; rather, transport the equipment to designated fueling areas. With the exception of tracked equipment such as bulldozers and large excavators, most vehicles should be able to travel to a designated area with little lost time.
- Train employees and subcontractors in proper fueling and cleanup procedures.
- When fueling must take place onsite, designate an area away from drainage courses to be used. Fueling areas should be identified in the SWPPP.
- Dedicated fueling areas should be protected from stormwater runon and runoff, and should be located at least 50 ft away from downstream drainage facilities and watercourses. Fueling must be performed on level-grade areas.
- Protect fueling areas with berms and dikes to prevent runon, runoff, and to contain spills.
- Nozzles used in vehicle and equipment fueling should be equipped with an automatic shutoff to control drips. Fueling operations should not be left unattended.
- Use vapor recovery nozzles to help control drips as well as air pollution where required by Air Quality Management Districts (AQMD).
- Federal, state, and local requirements should be observed for any stationary above ground storage tanks.

Costs

- All of the above measures are low cost except for the capital costs of above ground tanks that meet all local environmental, zoning, and fire codes.

Inspection and Maintenance

- Vehicles and equipment should be inspected each day of use for leaks. Leaks should be repaired immediately or problem vehicles or equipment should be removed from the project site.
- Keep ample supplies of spill cleanup materials onsite.
- Immediately clean up spills and properly dispose of contaminated soil and cleanup materials.

References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, Working Group Working Paper; USEPA, April 1992.

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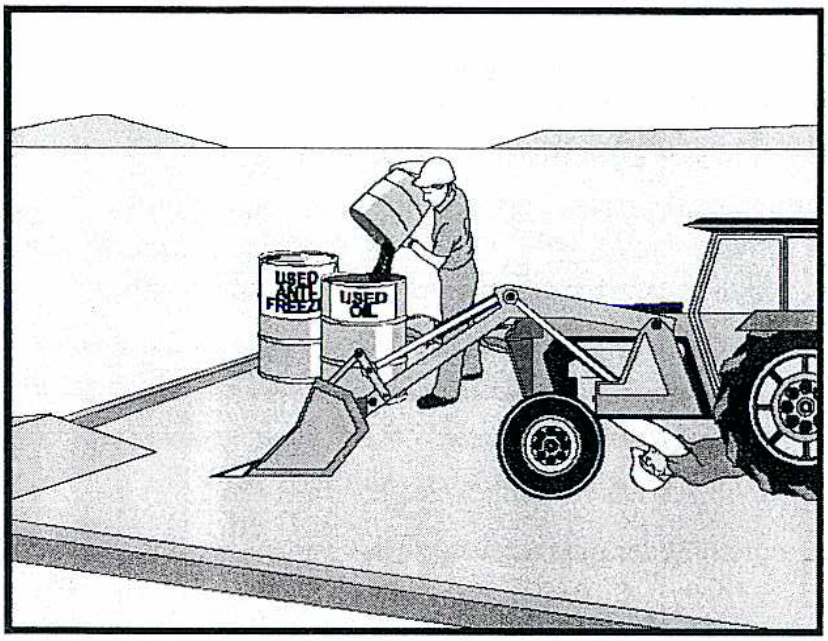
Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Vehicle & Equipment Maintenance NS-10



Objectives

EC	Erosion Control	
SE	Sediment Control	
TR	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	
Nutrients	☑
Trash	☑
Metals	
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

Description and Purpose

Prevent or reduce the contamination of stormwater resulting from vehicle and equipment maintenance by running a "dry and clean site". The best option would be to perform maintenance activities at an offsite facility. If this option is not available then work should be performed in designated areas only, while providing cover for materials stored outside, checking for leaks and spills, and containing and cleaning up spills immediately. Employees and subcontractors must be trained in proper procedures.

Suitable Applications

These procedures are suitable on all construction projects where an onsite yard area is necessary for storage and maintenance of heavy equipment and vehicles.

Limitations

Onsite vehicle and equipment maintenance should only be used where it is impractical to send vehicles and equipment offsite for maintenance and repair. Sending vehicles/equipment offsite should be done in conjunction with TR-1, Stabilized Construction Entrance/Exit.

Outdoor vehicle or equipment maintenance is a potentially significant source of stormwater pollution. Activities that can contaminate stormwater include engine repair and service, changing or replacement of fluids, and outdoor equipment storage and parking (engine fluid leaks). For further information on vehicle or equipment servicing, see NS-8, Vehicle and Equipment Cleaning, and NS-9, Vehicle and Equipment Fueling.

NS-10 Vehicle & Equipment Maintenance

Implementation

- Use offsite repair shops as much as possible. These businesses are better equipped to handle vehicle fluids and spills properly. Performing this work offsite can also be economical by eliminating the need for a separate maintenance area.
- If maintenance must occur onsite, use designated areas, located away from drainage courses. Dedicated maintenance areas should be protected from stormwater runon and runoff, and should be located at least 50 ft from downstream drainage facilities and watercourses.
- Drip pans or absorbent pads should be used during vehicle and equipment maintenance work that involves fluids, unless the maintenance work is performed over an impermeable surface in a dedicated maintenance area.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- All fueling trucks and fueling areas are required to have spill kits and/or use other spill protection devices.
- Use adsorbent materials on small spills. Remove the absorbent materials promptly and dispose of properly.
- Inspect onsite vehicles and equipment daily at startup for leaks, and repair immediately.
- Keep vehicles and equipment clean; do not allow excessive build-up of oil and grease.
- Segregate and recycle wastes, such as greases, used oil or oil filters, antifreeze, cleaning solutions, automotive batteries, hydraulic and transmission fluids. Provide secondary containment and covers for these materials if stored onsite.
- Train employees and subcontractors in proper maintenance and spill cleanup procedures.
- Drip pans or plastic sheeting should be placed under all vehicles and equipment placed on docks, barges, or other structures over water bodies when the vehicle or equipment is planned to be idle for more than 1 hour.
- For long-term projects, consider using portable tents or covers over maintenance areas if maintenance cannot be performed offsite.
- Consider use of new, alternative greases and lubricants, such as adhesive greases, for chassis lubrication and fifth-wheel lubrication.
- Properly dispose of used oils, fluids, lubricants, and spill cleanup materials.
- Do not place used oil in a dumpster or pour into a storm drain or watercourse.
- Properly dispose of or recycle used batteries.
- Do not bury used tires.
- Repair leaks of fluids and oil immediately.

Listed below is further information if you must perform vehicle or equipment maintenance onsite.

Safer Alternative Products

- Consider products that are less toxic or hazardous than regular products. These products are often sold under an "environmentally friendly" label.
- Consider use of grease substitutes for lubrication of truck fifth-wheels. Follow manufacturers label for details on specific uses.
- Consider use of plastic friction plates on truck fifth-wheels in lieu of grease. Follow manufacturers label for details on specific uses.

Waste Reduction

Parts are often cleaned using solvents such as trichloroethylene, trichloroethane, or methylene chloride. Many of these cleaners are listed in California Toxic Rule as priority pollutants. These materials are harmful and must not contaminate stormwater. They must be disposed of as a hazardous waste. Reducing the number of solvents makes recycling easier and reduces hazardous waste management costs. Often, one solvent can perform a job as well as two different solvents. Also, if possible, eliminate or reduce the amount of hazardous materials and waste by substituting non-hazardous or less hazardous materials. For example, replace chlorinated organic solvents with non-chlorinated solvents. Non-chlorinated solvents like kerosene or mineral spirits are less toxic and less expensive to dispose of properly. Check the list of active ingredients to see whether it contains chlorinated solvents. The "chlor" term indicates that the solvent is chlorinated. Also, try substituting a wire brush for solvents to clean parts.

Recycling and Disposal

Separating wastes allows for easier recycling and may reduce disposal costs. Keep hazardous wastes separate, do not mix used oil solvents, and keep chlorinated solvents (like,-trichloroethane) separate from non-chlorinated solvents (like kerosene and mineral spirits). Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around. Provide cover and secondary containment until these materials can be removed from the site.

Oil filters can be recycled. Ask your oil supplier or recycler about recycling oil filters.

Do not dispose of extra paints and coatings by dumping liquid onto the ground or throwing it into dumpsters. Allow coatings to dry or harden before disposal into covered dumpsters.

Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries, even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

Costs

All of the above are low cost measures. Higher costs are incurred to setup and maintain onsite maintenance areas.

NS-10 Vehicle & Equipment Maintenance

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Keep ample supplies of spill cleanup materials onsite.
- Maintain waste fluid containers in leak proof condition.
- Vehicles and equipment should be inspected on each day of use. Leaks should be repaired immediately or the problem vehicle(s) or equipment should be removed from the project site.
- Inspect equipment for damaged hoses and leaky gaskets routinely. Repair or replace as needed.

References

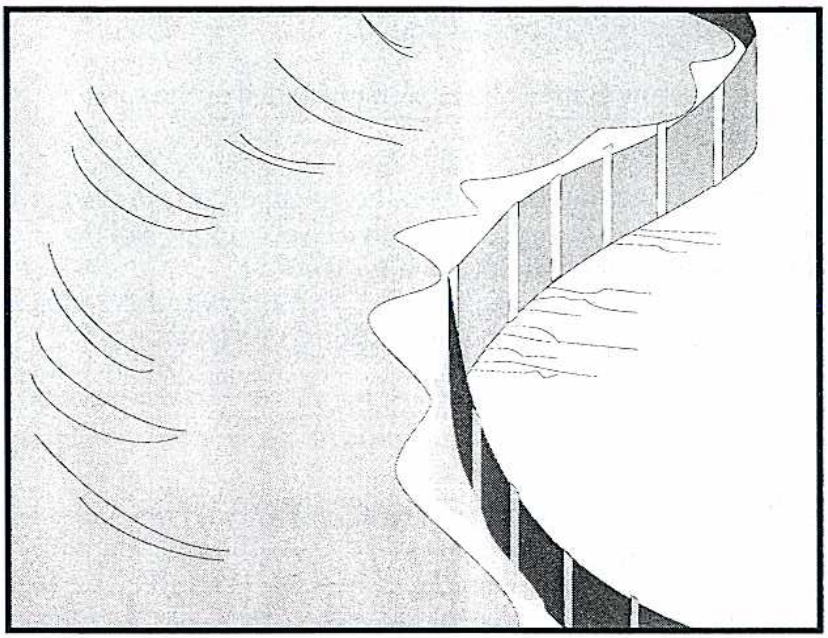
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program; Program Development and Approval Guidance, Working Group, Working Paper; USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Silt Fence

SE-1



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Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

SE-9 Straw Bale Barrier

Description and Purpose

A silt fence is made of a filter fabric that has been entrenched, attached to supporting poles, and sometimes backed by a plastic or wire mesh for support. The silt fence detains sediment-laden water, promoting sedimentation behind the fence.

Suitable Applications

Silt fences are suitable for perimeter control, placed below areas where sheet flows discharge from the site. They should also be used as interior controls below disturbed areas where runoff may occur in the form of sheet and rill erosion. Silt fences are generally ineffective in locations where the flow is concentrated and are only applicable for sheet or overland flows. Silt fences are most effective when used in combination with erosion controls. Suitable applications include:

- Along the perimeter of a project.
- Below the toe or down slope of exposed and erodible slopes.
- Along streams and channels.
- Around temporary spoil areas and stockpiles.
- Below other small cleared areas.

Limitations

- Do not use in streams, channels, drain inlets, or anywhere flow is concentrated.

- Do not use in locations where ponded water may cause flooding.
- Do not place fence on a slope, or across any contour line. If not installed at the same elevation throughout, silt fences will create erosion.
- Filter fences will create a temporary sedimentation pond on the upstream side of the fence and may cause temporary flooding. Fences not constructed on a level contour will be overtopped by concentrated flow resulting in failure of the filter fence.
- Improperly installed fences are subject to failure from undercutting, overlapping, or collapsing.
  - Not effective unless trenched and keyed in.
  - Not intended for use as mid-slope protection on slopes greater than 4:1 (H:V).
  - Do not allow water depth to exceed 1.5 ft at any point.

Implementation

General

A silt fence is a temporary sediment barrier consisting of filter fabric stretched across and attached to supporting posts, entrenched, and, depending upon the strength of fabric used, supported with plastic or wire mesh fence. Silt fences trap sediment by intercepting and detaining small amounts of sediment-laden runoff from disturbed areas in order to promote sedimentation behind the fence.

Silt fences are preferable to straw bale barriers in many cases. Laboratory work at the Virginia Highway and Transportation Research Council has shown that silt fences can trap a much higher percentage of suspended sediments than can straw bales. While the failure rate of silt fences is lower than that of straw bale barriers, there are many instances where silt fences have been improperly installed. The following layout and installation guidance can improve performance and should be followed:

- Use principally in areas where sheet flow occurs.
- Don't use in streams, channels, or anywhere flow is concentrated. Don't use silt fences to divert flow.
- Don't use below slopes subject to creep, slumping, or landslides.
- Select filter fabric that retains 85% of soil by weight, based on sieve analysis, but that is not finer than an equivalent opening size of 70.
- Install along a level contour, so water does not pond more than 1.5 ft at any point along the silt fence.
- The maximum length of slope draining to any point along the silt fence should be 200 ft or less.
- The maximum slope perpendicular to the fence line should be 1:1.

- Provide sufficient room for runoff to pond behind the fence and to allow sediment removal equipment to pass between the silt fence and toes of slopes or other obstructions. About 1200 ft^2 of ponding area should be provided for every acre draining to the fence.
- Turn the ends of the filter fence uphill to prevent stormwater from flowing around the fence.
- Leave an undisturbed or stabilized area immediately down slope from the fence where feasible.
- Silt fences should remain in place until the disturbed area is permanently stabilized.

Design and Layout

Selection of a filter fabric is based on soil conditions at the construction site (which affect the equivalent opening size (EOS) fabric specification) and characteristics of the support fence (which affect the choice of tensile strength). The designer should specify a filter fabric that retains the soil found on the construction site yet that it has openings large enough to permit drainage and prevent clogging. The following criteria is recommended for selection of the equivalent opening size:

1. If 50 percent or less of the soil, by weight, will pass the U.S. Standard Sieve No. 200, select the EOS to retain 85 % of the soil. The EOS should not be finer than EOS 70.
2. For all other soil types, the EOS should be no larger than the openings in the U.S. Standard Sieve No. 70 except where direct discharge to a stream, lake, or wetland will occur, then the EOS should be no larger than Standard Sieve No. 100.

To reduce the chance of clogging, it is preferable to specify a fabric with openings as large as allowed by the criteria. No fabric should be specified with an EOS smaller than U.S. Standard Sieve No. 100. If 85% or more of a soil, by weight, passes through the openings in a No. 200 sieve, filter fabric should not be used. Most of the particles in such a soil would not be retained if the EOS was too large and they would clog the fabric quickly if the EOS were small enough to capture the soil.

The fence should be supported by a plastic or wire mesh if the fabric selected does not have sufficient strength and bursting strength characteristics for the planned application (as recommended by the fabric manufacturer). Filter fabric material should contain ultraviolet inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0 °F to 120 °F.

- Layout in accordance with attached figures.
- For slopes steeper than 2:1 (H:V) and that contain a high number of rocks or large dirt clods that tend to dislodge, it may be necessary to install additional protection immediately adjacent to the bottom of the slope, prior to installing silt fence. Additional protection may be a chain link fence or a cable fence.
- For slopes adjacent to sensitive receiving waters or Environmentally Sensitive Areas (ESAs), silt fence should be used in conjunction with erosion control BMPs.

Materials

- Silt fence fabric should be woven polypropylene with a minimum width of 36 in. and a minimum tensile strength of 100 lb force. The fabric should conform to the requirements in ASTM designation D4632 and should have an integral reinforcement layer. The reinforcement layer should be a polypropylene, or equivalent, net provided by the manufacturer. The permittivity of the fabric should be between 0.1 sec^{-1} and 0.15 sec^{-1} in conformance with the requirements in ASTM designation D4491.

- Wood stakes should be commercial quality lumber of the size and shape shown on the plans. Each stake should be free from decay, splits or cracks longer than the thickness of the stake or other defects that would weaken the stakes and cause the stakes to be structurally unsuitable.

- Staples used to fasten the fence fabric to the stakes should be not less than 1.75 in. long and should be fabricated from 15 gauge or heavier wire. The wire used to fasten the tops of the stakes together when joining two sections of fence should be 9 gauge or heavier wire. Galvanizing of the fastening wire will not be required.

- There are new products that may use prefabricated plastic holders for the silt fence and use bar reinforcement instead of wood stakes. If bar reinforcement is used in lieu of wood stakes, use number four or greater bar. Provide end protection for any exposed bar reinforcement.

Installation Guidelines

Silt fences are to be constructed on a level contour. Sufficient area should exist behind the fence for ponding to occur without flooding or overtopping the fence.

- A trench should be excavated approximately 6 in. wide and 6 in. deep along the line the proposed silt fence.

- Bottom of the silt fence should be keyed-in a minimum of 12 in.

- Posts should be spaced a maximum of 6 ft apart and driven securely into the ground a minimum of 18 in. or 12 in. below the bottom of the trench.

- When standard strength filter fabric is used, a plastic or wire mesh support fence should be fastened securely to the upslope side of posts using heavy–duty wire staples at least 1 in. long. The mesh should extend into the trench. When extra-strength filter fabric and closer post spacing are used, the mesh support fence may be eliminated. Filter fabric should be purchased in a long roll, and then cut to the length of the barrier. When joints are necessary, filter cloth should be spliced together only at a support post, with a minimum 6 in. overlap and both ends securely fastened to the post.

- The trench should be backfilled with compacted native material.

- Construct silt fences with a setback of at least 3 ft from the toe of a slope. Where a silt fence is determined to be not practicable due to specific site conditions, the silt fence may be constructed at the toe of the slope, but should be constructed as far from the toe of the slope as practicable. Silt fences close to the toe of the slope will be less effective and difficult to maintain.

- 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 barrier; in no case should the reach exceed 500 ft.

Costs

- Average annual cost for installation and maintenance (assumes 6 month useful life): $7 per lineal foot ($850 per drainage acre). Range of cost is $3.50 - $9.10 per lineal foot.

Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Repair undercut silt fences.
- Repair or replace split, torn, slumping, or weathered fabric. The lifespan of silt fence fabric is generally 5 to 8 months.
- Silt fences that are damaged and become unsuitable for the intended purpose should be removed from the site of work, disposed of, and replaced with new silt fence barriers.
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed at an appropriate location.
- Silt fences should be left in place until the upstream area is permanently stabilized. Until then, the silt fence must be inspected and maintained.
- Holes, depressions, or other ground disturbance caused by the removal of the silt fences should be backfilled and repaired.

References

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group-Working Paper, USEPA, April 1992.

Sedimentation and Erosion Control Practices, and Inventory of Current Practices (Draft), UESPA, 1990.

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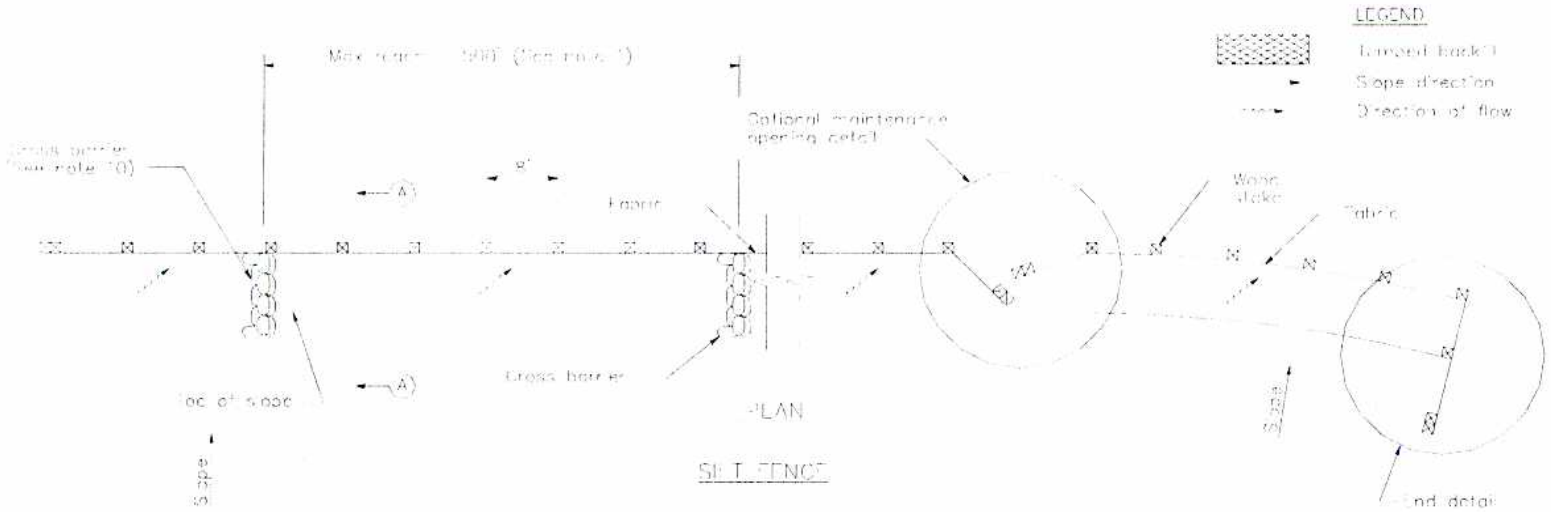
Stormwater Management Manual for The Puget Sound Basin, Washington State Department of Ecology, Public Review Draft, 1991.

U.S. Environmental Protection Agency (USEPA). Stormwater Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices. U.S. Environmental Protection Agency, Office of Water, Washington, DC, 1992.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

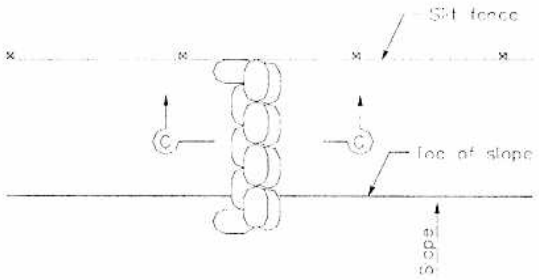
Silt Fence

SE-1

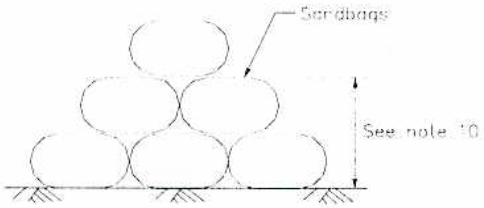


NOTES

1. 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 500'.
2. The last 8' 0" of fence shall be turned up slope.
3. Stake dimensions are nominal.
4. Dimension may vary to fit field condition.
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 to stake 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. Dimensions shown are typical.
10. Cross barriers shall be a minimum of 1/3 and a maximum of 1/2 the height of the linear barrier.
11. Maintenance openings shall be constructed in a manner to ensure sediment remains behind silt fence.
12. Joining sections shall not be placed at sump locations.
13. Sandbag rows and layers shall be offset to eliminate gaps.



CROSS BARRIER DETAIL



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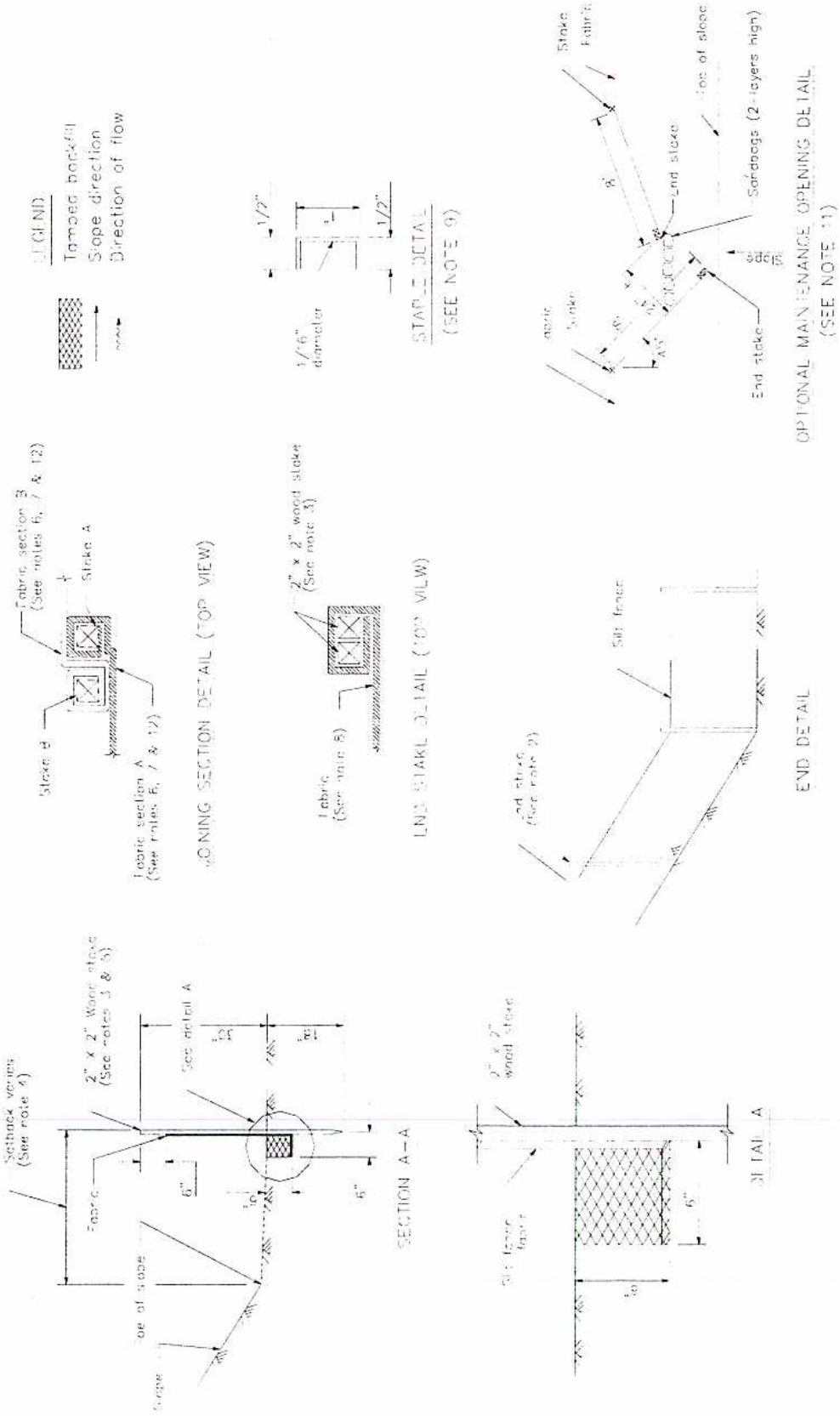
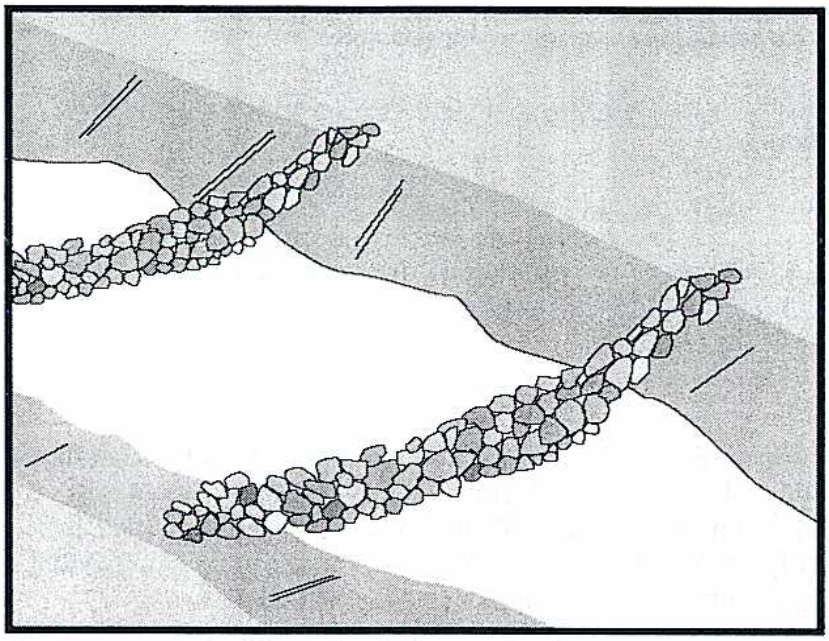

Tamped backfill
Slope direction
Direction of flow
1/2"
1/2"
1/2" diameter
STAPLE DETAIL
(SEE NOTE 9)
Stake
Fabric
Toe of slope
Sandbags (2-layers high)
End stake
End stake
OPTIONAL MAINTENANCE OPENING DETAIL
(SEE NOTE 11)
Fabric section B
(See notes 6, 7 & 12)
Stake A
Stake B
Fabric section A
(See notes 6, 7 & 12)
JOINING SECTION DETAIL (TOP VIEW)
2" x 2" wood stake
(See note 3)
Fabric
(See note 8)
LINE STAKE DETAIL (TOP VIEW)
Silt fence
End stake
(See note 9)
END DETAIL
Setback varies
(See note 4)
2" X 2" Wood stake
(See notes 3 & 5)
See detail A
Fabric
6"
6"
Toe of slope
Slope
SECTION A–A
2" x 2"
wood stake
Silt fence
fabric
6"
DETAIL A

Check Dams

SE-4



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Legend:

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Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

Description and Purpose

A check dam is a small barrier constructed of rock, gravel bags, sandbags, fiber rolls, or reusable products, placed across a constructed swale or drainage ditch. Check dams reduce the effective slope of the channel, thereby reducing the velocity of flowing water, allowing sediment to settle and reducing erosion.

Suitable Applications

Check dams may be appropriate in the following situations:

- To promote sedimentation behind the dam.
- To prevent erosion by reducing the velocity of channel flow in small intermittent channels and temporary swales.
- In small open channels that drain 10 acres or less.
- In steep channels where stormwater runoff velocities exceed 5 ft/s.
- During the establishment of grass linings in drainage ditches or channels.
- In temporary ditches where the short length of service does not warrant establishment of erosion-resistant linings.

Limitations

- Not to be used in live streams or in channels with extended base flows.

- Not appropriate in channels that drain areas greater than 10 acres.
- Not appropriate in channels that are already grass-lined unless erosion is expected, as installation may damage vegetation.
- Require extensive maintenance following high velocity flows.
- Promotes sediment trapping which can be re-suspended during subsequent storms or removal of the check dam.

Implementation

General

Check dams reduce the effective slope and create small pools in swales and ditches that drain 10 acres or less. Reduced slopes reduce the velocity of stormwater flows, thus reducing erosion of the swale or ditch and promoting sedimentation. Use of check dams for sedimentation will likely result in little net removal of sediment because of the small detention time and probable scour during longer storms. Using a series of check dams will generally increase their effectiveness. A sediment trap (SE-3) may be placed immediately upstream of the check dam to increase sediment removal efficiency.

Design and Layout

Check dams work by decreasing the effective slope in ditches and swales. An important consequence of the reduced slope is a reduction in capacity of the ditch or swale. This reduction in capacity must be considered when using this BMP, as reduced capacity can result in overtopping of the ditch or swale and resultant consequences. In some cases, such as a "permanent" ditch or swale being constructed early and used as a "temporary" conveyance for construction flows, the ditch or swale may have sufficient capacity such that the temporary reduction in capacity due to check dams is acceptable. When check dams reduce capacities beyond acceptable limits, there are several options:

- Don't use check dams. Consider alternative BMPs.
- Increase the size of the ditch or swale to restore capacity.

Maximum slope and velocity reduction is achieved when the toe of the upstream dam is at the same elevation as the top of the downstream dam. The center section of the dam should be lower than the edge sections so that the check dam will direct flows to the center of the ditch or swale.

Check dams are usually constructed of rock, gravel bags, sandbags, and fiber rolls. A number of products manufactured specifically for use as check dams are also being used, and some of these products can be removed and reused. Check dams can also be constructed of logs or lumber, and have the advantage of a longer lifespan when compared to gravel bags, sandbags, and fiber rolls. Straw bales can also be used for check dams and can work if correctly installed; but in practice, straw bale check dams have a high failure rate. Check dams should not be constructed from straw bales or silt fences, since concentrated flows quickly wash out these materials.

Rock check dams are usually constructed of 8 to 12 in. rock. The rock is placed either by hand or mechanically, but never just dumped into the channel. The dam must completely span the ditch

or swale to prevent washout. The rock used must be large enough to stay in place given the expected design flow through the channel.

Log check dams are usually constructed of 4 to 6 in. diameter logs. The logs should be embedded into the soil at least 18 in. Logs can be bolted or wired to vertical support logs that have been driven or buried into the soil.

Gravel bag and sandbag check dams are constructed by stacking bags across the ditch or swale, shaped as shown in the drawings at the end of this fact sheet.

Manufactured products should be installed in accordance with the manufacturer's instructions.

If grass is planted to stabilize the ditch or swale, the check dam should be removed when the grass has matured (unless the slope of the swales is greater than 4%).

The following guidance should be followed for the design and layout of check dams:

- Install the first check dam approximately 16 ft from the outfall device and at regular intervals based on slope gradient and soil type.
- Check dams should be placed at a distance and height to allow small pools to form between each check dam.
- Backwater from a downstream check dam should reach the toes of the upstream check dam.
- A sediment trap provided immediately upstream of the check dam will help capture sediment. Due to the potential for this sediment to be resuspended in subsequent storms, the sediment trap must be cleaned following each storm event.
- High flows (typically a 2-year storm or larger) should safely flow over the check dam without an increase in upstream flooding or damage to the check dam.
- Where grass is used to line ditches, check dams should be removed when grass has matured sufficiently to protect the ditch or swale.
- Gravel bags may be used as check dams with the following specifications:

Materials

Gravel bags used for check dams should conform to the requirements of SE-6, Gravel Bag Berms. Sandbags used for check dams should conform to SE-8, Sandbag Barrier. Fiber rolls used for check dams should conform to SE-5, Fiber Rolls. Straw bales used for check dams should conform to SE-9, Straw Bale Barrier.

Installation

- Rock should be placed individually by hand or by mechanical methods (no dumping of rock) to achieve complete ditch or swale coverage.
- Tightly abut bags and stack according to detail shown in the figure at the end of this section. Gravel bags and sandbags should not be stacked any higher than 3 ft.
- Fiber rolls and straw bales must be trenched in and firmly staked in place.

Costs

Cost consists of only installation costs if materials are readily available. If material must be imported, costs may increase. For material costs, see SE-5, SE-6, SE-8 and SE-9.

Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Replace missing rock, bags, bales, etc. Replace bags or bales that have degraded or have become damaged.
- If the check dam is used as a sediment capture device, sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed at an appropriate location.
- If the check dam is used as a grade control structure, sediment removal is not required as long as the system continues to control the grade.
- Remove accumulated sediment prior to permanent seeding or soil stabilization.
- Remove check dam and accumulated sediment when check dams are no longer needed.

References

Draft – Sedimentation and Erosion Control, and Inventory of Current Practices, USEPA, April 1990.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

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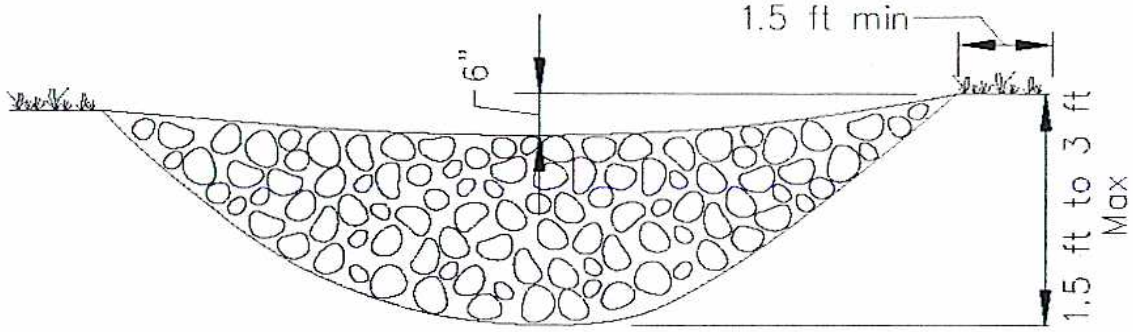
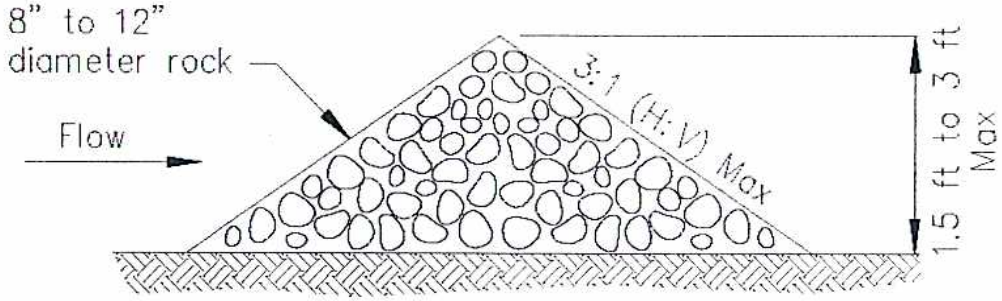
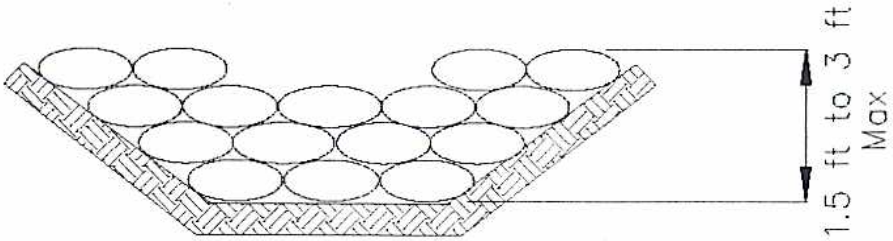


ELEVATION



TYPICAL ROCK CHECK DAM SECTION

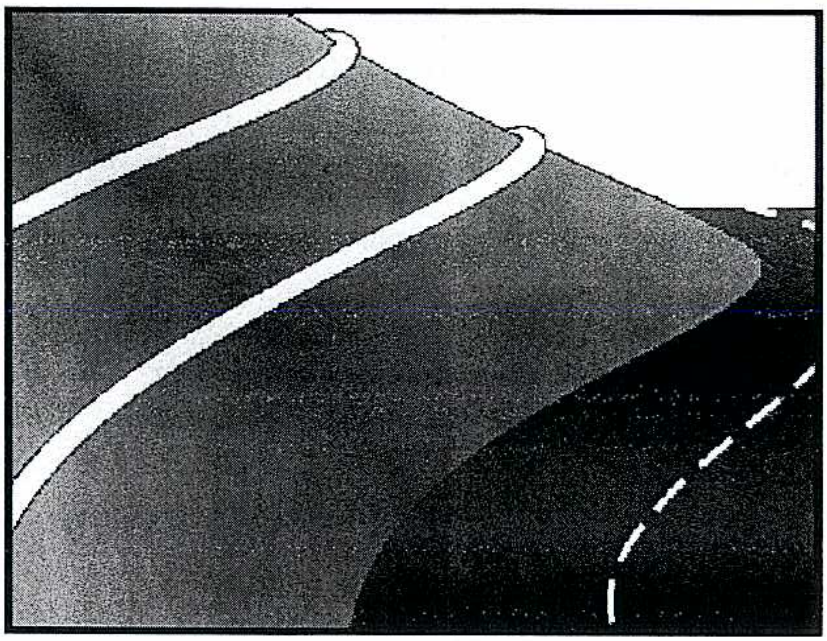
ROCK CHECK DAM
NOT TO SCALE



GRAVEL BAG CHECK DAM ELEVATION
NOT TO SCALE

Fiber Rolls

SE-5



Objectives

EC	Erosion Control	☒
SE	Sediment Control	☑
TR	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

SE-9 Straw Bale Barrier

Description and Purpose

A fiber roll consists of straw, flax, or other similar materials bound into a tight tubular roll. When fiber rolls are placed at the toe and on the face of slopes, they intercept runoff, reduce its flow velocity, release the runoff as sheet flow, and provide removal of sediment from the runoff. By interrupting the length of a slope, fiber rolls can also reduce erosion.

Suitable Applications

Fiber rolls may be suitable:

- Along the toe, top, face, and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow
- At the end of a downward slope where it transitions to a steeper slope
- Along the perimeter of a project
- As check dams in unlined ditches
- Down-slope of exposed soil areas
- Around temporary stockpiles

Limitations

- Fiber rolls are not effective unless trenched

- Fiber rolls at the toe of slopes greater than 5:1 (H:V) should be a minimum of 20 in. diameter or installations achieving the same protection (i.e. stacked smaller diameter fiber rolls, etc.).
- Difficult to move once saturated.
- If not properly staked and trenched in, fiber rolls could be transported by high flows.
- Fiber rolls have a very limited sediment capture zone.
- Fiber rolls should not be used on slopes subject to creep, slumping, or landslide.

Implementation

Fiber Roll Materials

- Fiber rolls should be either prefabricated rolls or rolled tubes of erosion control blanket.

Assembly of Field Rolled Fiber Roll

- Roll length of erosion control blanket into a tube of minimum 8 in. diameter.
- Bind roll at each end and every 4 ft along length of roll with jute-type twine.

Installation

- Locate fiber rolls on level contours spaced as follows:
  - Slope inclination of 4:1 (H:V) or flatter: Fiber rolls should be placed at a maximum interval of 20 ft.
  - Slope inclination between 4:1 and 2:1 (H:V): Fiber Rolls should be placed at a maximum interval of 15 ft. (a closer spacing is more effective).
  - Slope inclination 2:1 (H:V) or greater: Fiber Rolls should be placed at a maximum interval of 10 ft. (a closer spacing is more effective).
- Turn the ends of the fiber roll up slope to prevent runoff from going around the roll.
- Stake fiber rolls into a 2 to 4 in. deep trench with a width equal to the diameter of the fiber roll.
  - Drive stakes at the end of each fiber roll and spaced 4 ft maximum on center.
  - Use wood stakes with a nominal classification of 0.75 by 0.75 in. and minimum length of 24 in.
- If more than one fiber roll is placed in a row, the rolls should be overlapped, not abutted.

Removal

- Fiber rolls are typically left in place.

- If fiber rolls are removed, collect and dispose of sediment accumulation, and fill and compact holes, trenches, depressions or any other ground disturbance to blend with adjacent ground.

Costs

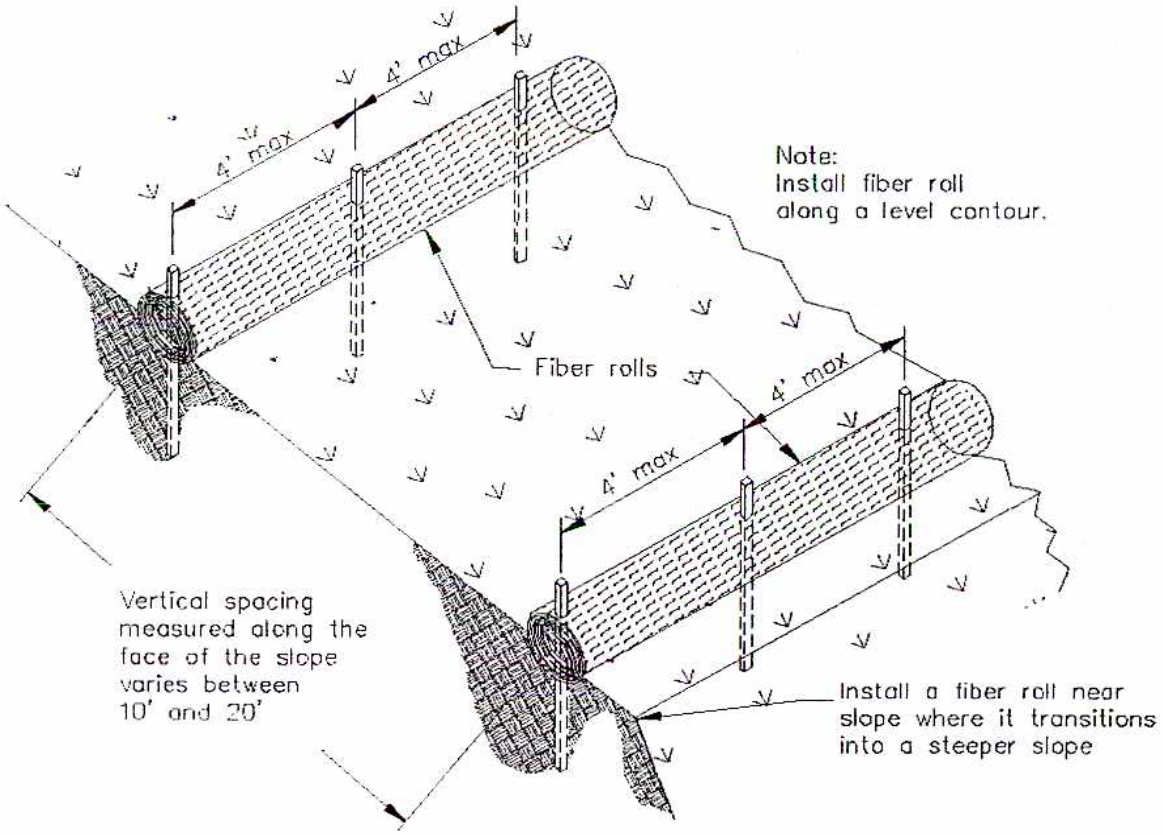
Material costs for fiber rolls range from $20 - $30 per 25 ft roll.

Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Repair or replace split, torn, unraveling, or slumping fiber rolls.
- If the fiber roll is used as a sediment capture device, or as an erosion control device to maintain sheet flows, sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when sediment accumulation reaches one-half the designated sediment storage depth, usually one-half the distance between the top of the fiber roll and the adjacent ground surface. Sediment removed during maintenance may be incorporated into earthwork on the site of disposed at an appropriate location.
- If fiber rolls are used for erosion control, such as in a mini check dam, sediment removal should not be required as long as the system continues to control the grade. Sediment control BMPs will likely be required in conjunction with this type of application.

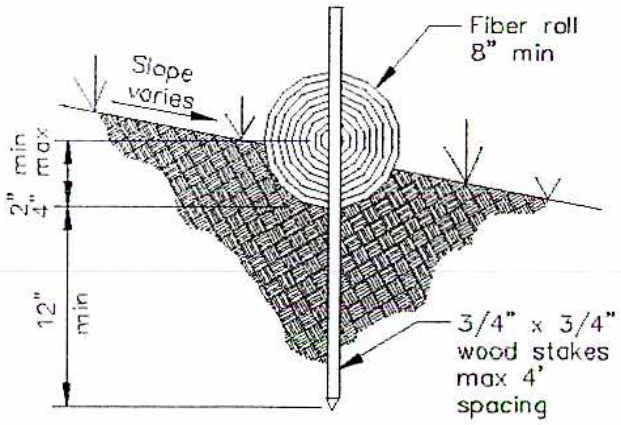
References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.



TYPICAL FIBER ROLL INSTALLATION

N.T.S.

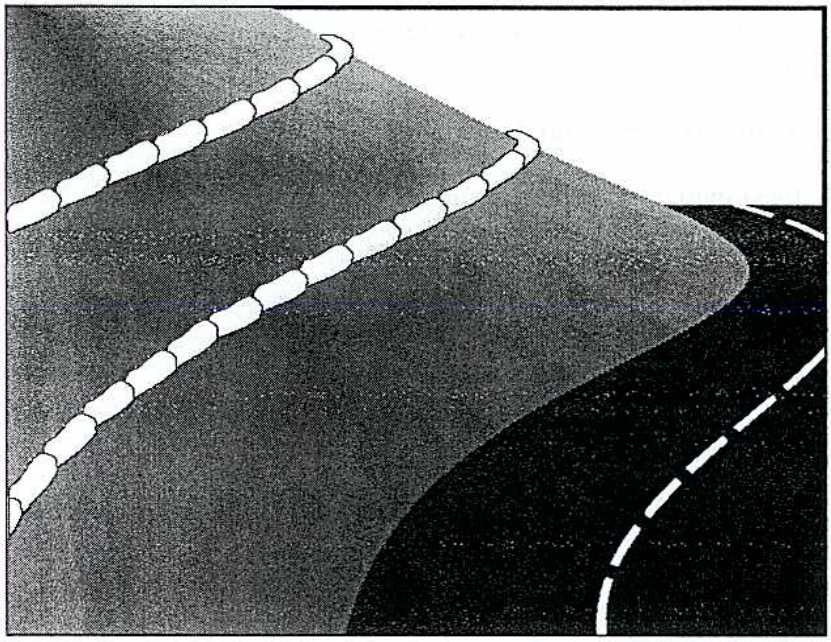


ENTRENCHMENT DETAIL

N.T.S.

Gravel Bag Berm

SE-6



Objectives

EC	Erosion Control	☒
SE	Sediment Control	☑
TR	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-5 Fiber Roll

SE-8 Sandbag Barrier

SE-9 Straw Bale Barrier

Description and Purpose

A gravel bag berm is a series of gravel-filled bags placed on a level contour to intercept sheet flows. Gravel bags pond sheet flow runoff, allowing sediment to settle out, and release runoff slowly as sheet flows, preventing erosion.

Suitable Applications

Gravel bag berms may be suitable:

- As a linear sediment control measure:
  - Below the toe of slopes and erodible slopes
  - As sediment traps at culvert/pipe outlets
  - Below other small cleared areas
  - Along the perimeter of a site
  - Down slope of exposed soil areas
  - Around temporary stockpiles and spoil areas
  - Parallel to a roadway to keep sediment off paved areas
  - Along streams and channels
- As linear erosion control measure:

- Along the face and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow
- At the top of slopes to divert runoff away from disturbed slopes
- As check dams across mildly sloped construction roads

Limitations

- Gravel berms may be difficult to remove.
- Removal problems limit their usefulness in landscaped areas.
- Gravel bag berm may not be appropriate for drainage areas greater than 5 acres.
- Runoff will pond upstream of the filter, possibly causing flooding if sufficient space does not exist.
- Degraded gravel bags may rupture when removed, spilling contents.
- Installation can be labor intensive.
- Berms may have limited durability for long-term projects.
- When used to detain concentrated flows, maintenance requirements increase.

Implementation

General

A gravel bag berm consists of a row of open graded gravel–filled bags placed on a level contour. When appropriately placed, a gravel bag berm intercepts and slows sheet flow runoff, causing temporary ponding. The temporary ponding provides quiescent conditions allowing sediment to settle. The open graded gravel in the bags is porous, which allows the ponded runoff to flow slowly through the bags, releasing the runoff as sheet flows. Gravel bag berms also interrupt the slope length and thereby reduce erosion by reducing the tendency of sheet flows to concentrate into rivulets, which erode rills, and ultimately gullies, into disturbed, sloped soils. Gravel bag berms are similar to sand bag barriers, but are more porous.

Design and Layout

- Locate gravel bag berms on level contours.
  - Slopes between 20:1 and 2:1 (H:V): Gravel bags should be placed at a maximum interval of 50 ft (a closer spacing is more effective), with the first row near the slope toe.
  - Slopes 2:1 (H:V) or steeper: Gravel bags should be placed at a maximum interval of 25 ft (a closer spacing is more effective), with the first row placed the slope toe.
- Turn the ends of the gravel bag barriers up slope to prevent runoff from going around the berm.
- Allow sufficient space up slope from the gravel bag berm to allow ponding, and to provide room for sediment storage.

- For installation near the toe of the slope, consider moving the gravel bag barriers away from the slope toe to facilitate cleaning. To prevent flows behind the barrier, bags can be placed perpendicular to a berm to serve as cross barriers.
- Drainage area should not exceed 5 acres.
- In Non-Traffic Areas:
  - Height = 18 in. maximum
  - Top width = 24 in. minimum for three or more layer construction
  - Top width = 12 in. minimum for one or two layer construction
  - Side slopes = 2:1 or flatter
- In Construction Traffic Areas:
  - Height = 12 in. maximum
  - Top width = 24 in. minimum for three or more layer construction.
  - Top width = 12 in. minimum for one or two layer construction.
  - Side slopes = 2:1 or flatter.
- Butt ends of bags tightly
- On multiple row, or multiple layer construction, overlapp butt joints of adjacent row and row beneath.
- Use a pyramid approach when stacking bags.

Materials

- ***Bag Material:*** Bags should be woven polypropylene, polyethylene or polyamide fabric or burlap, minimum unit weight of 4 ounces/yd^2, Mullen burst strength exceeding 300 lb/in^2 in conformance with the requirements in ASTM designation D3786, and ultraviolet stability exceeding 70% in conformance with the requirements in ASTM designation D4355.
- ***Bag Size:*** Each gravel-filled bag should have a length of 18 in., width of 12 in., thickness of 3 in., and mass of approximately 33 lbs. Bag dimensions are nominal, and may vary based on locally available materials.
- ***Fill Material:*** Fill material should be 0.5 to 1 in. Class 2 aggregate base, clean and free from clay, organic matter, and other deleterious material, or other suitable open graded, non-cohesive, porous gravel.

Costs

Gravel filter: Expensive, since off-site materials, hand construction, and demolition/removal are usually required. Material costs for gravel bags are average of $2.50 per empty gravel bag. Gravel costs range from $20-$35 per yd^3.

Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Gravel bags exposed to sunlight will need to be replaced every two to three months due to degrading of the bags.
- Reshape or replace gravel bags as needed.
- Repair washouts or other damage as needed.
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed at an appropriate location.
- Remove gravel bag berms when no longer needed. Remove sediment accumulation and clean, re-grade, and stabilize the area. Removed sediment should be incorporated in the project or disposed of.

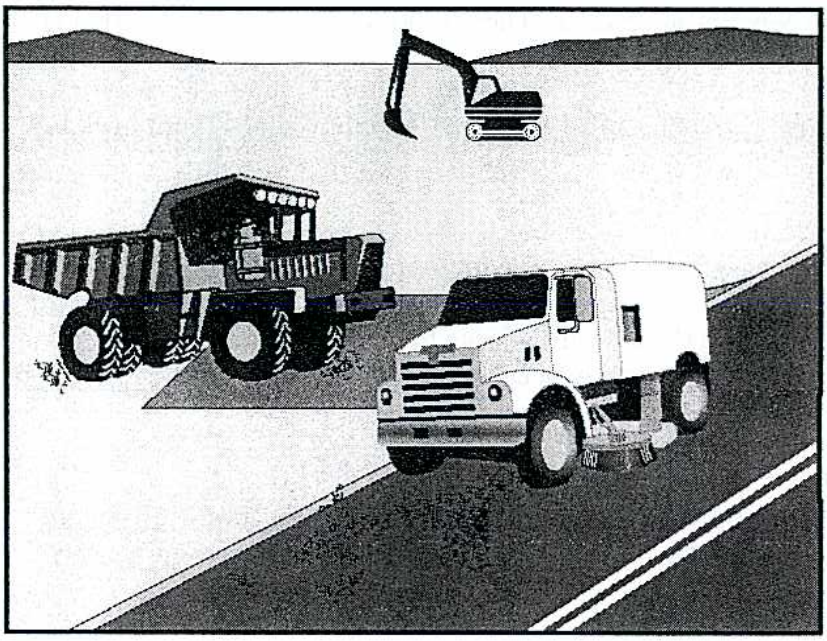
References

Handbook of Steel Drainage and Highway Construction, American Iron and Steel Institute, 1983.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Pollution Plan Handbook, First Edition, State of California, Department of Transportation Division of New Technology, Materials and Research, October 1992.

Street Sweeping and Vacuuming SE-7



Objectives

EC	Erosion Control	
SE	Sediment Control	☒
TR	Tracking Control	☑
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	☑
Metals	
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

None

Description and Purpose

Street sweeping and vacuuming includes use of self-propelled and walk-behind equipment to remove sediment from streets and roadways, and to clean paved surfaces in preparation for final paving. Sweeping and vacuuming prevents sediment from the project site from entering storm drains or receiving waters.

Suitable Applications

Sweeping and vacuuming are suitable anywhere sediment is tracked from the project site onto public or private paved streets and roads, typically at points of egress. Sweeping and vacuuming are also applicable during preparation of paved surfaces for final paving.

Limitations

Sweeping and vacuuming may not be effective when sediment is wet or when tracked soil is caked (caked soil may need to be scraped loose).

Implementation

- Controlling the number of points where vehicles can leave the site will allow sweeping and vacuuming efforts to be focused, and perhaps save money.
- Inspect potential sediment tracking locations daily.
- Visible sediment tracking should be swept or vacuumed on a daily basis.

- Do not use kick brooms or sweeper attachments. These tend to spread the dirt rather than remove it.
- If not mixed with debris or trash, consider incorporating the removed sediment back into the project

Costs

Rental rates for self-propelled sweepers vary depending on hopper size and duration of rental. Expect rental rates from $58/hour (3 yd^3 hopper) to $88/hour (9 yd^3 hopper), plus operator costs. Hourly production rates vary with the amount of area to be swept and amount of sediment. Match the hopper size to the area and expect sediment load to minimize time spent dumping.

Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- When actively in use, points of ingress and egress must be inspected daily.
- When tracked or spilled sediment is observed outside the construction limits, it must be removed at least daily. More frequent removal, even continuous removal, may be required in some jurisdictions.
- Be careful not to sweep up any unknown substance or any object that may be potentially hazardous.
- Adjust brooms frequently; maximize efficiency of sweeping operations.
- After sweeping is finished, properly dispose of sweeper wastes at an approved dumpsite.

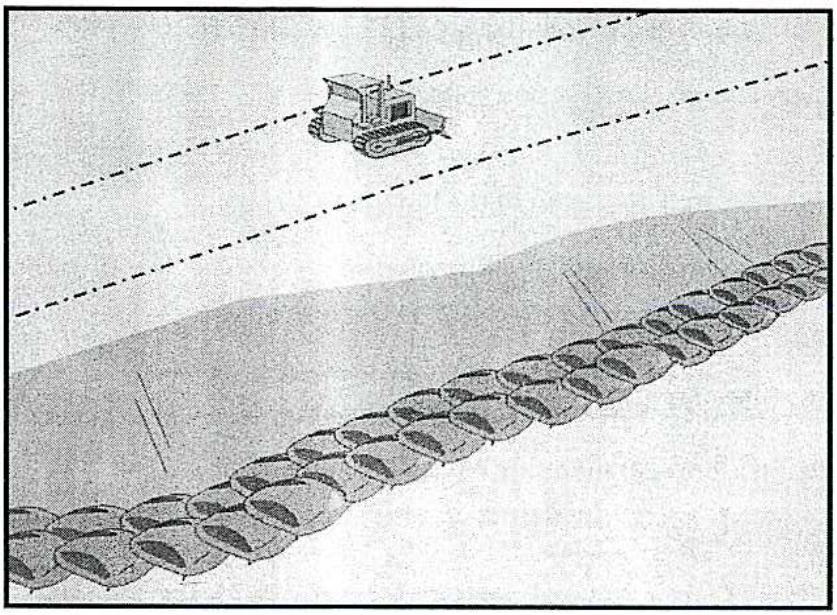
References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Labor Surcharge and Equipment Rental Rates, State of California Department of Transportation (Caltrans), April 1, 2002 – March 31, 2003.

Sandbag Barrier

SE-8



Objectives

EC	Erosion Control	☒
SE	Sediment Control	☑
TR	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-9 Straw Bale Barrier

Description and Purpose

A sandbag barrier is a series of sand-filled bags placed on a level contour to intercept sheet flows. Sandbag barriers pond sheet flow runoff, allowing sediment to settle out.

Suitable Applications

Sandbag barriers may be suitable:

- As a linear sediment control measure:
  - Below the toe of slopes and erodible slopes
  - As sediment traps at culvert/pipe outlets
  - Below other small cleared areas
  - Along the perimeter of a site
  - Down slope of exposed soil areas
  - Around temporary stockpiles and spoil areas
  - Parallel to a roadway to keep sediment off paved areas
  - Along streams and channels
- As linear erosion control measure:
  - Along the face and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow

- At the top of slopes to divert runoff away from disturbed slopes
- As check dams across mildly sloped construction roads

Limitations

- It is necessary to limit the drainage area upstream of the barrier to 5 acres.
- Degraded sandbags may rupture when removed, spilling sand.
- Installation can be labor intensive.
- Barriers may have limited durability for long-term projects.
- When used to detain concentrated flows, maintenance requirements increase.
- Burlap should not be used for sandbags.

Implementation

General

A sandbag barrier consists of a row of sand-filled bags placed on a level contour. When appropriately placed, a sandbag barrier intercepts and slows sheet flow runoff, causing temporary ponding. The temporary ponding provides quiescent conditions allowing sediment to settle. While the sand-filled bags are porous, the fine sand tends to quickly plug with sediment, limiting the rate of flow through the barrier. If a porous barrier is desired, consider SE-1, Silt Fence, SE-5, Fiber Rolls, SE-6, Gravel Bag Berms, or SE-9, Straw Bale Barriers. Sandbag barriers also interrupt the slope length and thereby reduce erosion by reducing the tendency of sheet flows to concentrate into rivulets which erode rills, and ultimately gullies, into disturbed, sloped soils. Sandbag barriers are similar to ground bag berms, but less porous.

Design and Layout

- Locate sandbag barriers on a level contour.
  - Slopes between 20:1 and 2:1 (H:V): Sandbags should be placed at a maximum interval of 50 ft (a closer spacing is more effective), with the first row near the slope toe.
  - Slopes 2:1 (H:V) or steeper: Sandbags should be placed at a maximum interval of 25 ft (a closer spacing is more effective), with the first row placed near the slope toe.
- Turn the ends of the sandbag barrier up slope to prevent runoff from going around the barrier.
- Allow sufficient space up slope from the barrier to allow ponding, and to provide room for sediment storage.
- For installation near the toe of the slope, consider moving the barrier away from the slope toe to facilitate cleaning. To prevent flow behind the barrier, sandbags can be placed perpendicular to the barrier to serve as cross barriers.
- Drainage area should not exceed 5 acres.

- Stack sandbags at least three bags high.
- Butt ends of bags tightly.
- Overlapp butt joints of row beneath with each successive row.
- Use a pyramid approach when stacking bags.
- In non-traffic areas
  - Height = 18 in. maximum
  - Top width = 24 in. minimum for three or more layer construction
  - Side slope = 2:1 or flatter
- In construction traffic areas
  - Height = 12 in. maximum
  - Top width = 24 in. minimum for three or more layer construction.
  - Side slopes = 2:1 or flatter.

Materials

- ***Sandbag Material:*** Sandbag should be woven polypropylene, polyethylene or polyamide fabric, minimum unit weight of 4 ounces/yd^2, Mullen burst strength exceeding 300 lb/in^2 in conformance with the requirements in ASTM designation D3786, and ultraviolet stability exceeding 70% in conformance with the requirements in ASTM designation D4355. Use of burlap may not acceptable in some jurisdictions.
- ***Sandbag Size:*** Each sand-filled bag should have a length of 18 in., width of 12 in., thickness of 3 in., and mass of approximately 33 lbs. Bag dimensions are nominal, and may vary based on locally available materials.
- ***Fill Material:*** All sandbag fill material should be non-cohesive, Class 1 or Class 2 permeable material free from clay and deleterious material.

Costs

Sandbag barriers are more costly, but typically have a longer useful life than other barriers. Empty sandbags cost $0.25 - $0.75. Average cost of fill material is $8 per yd^3. Pre-filled sandbags are more expensive at $1.50 - $2.00 per bag.

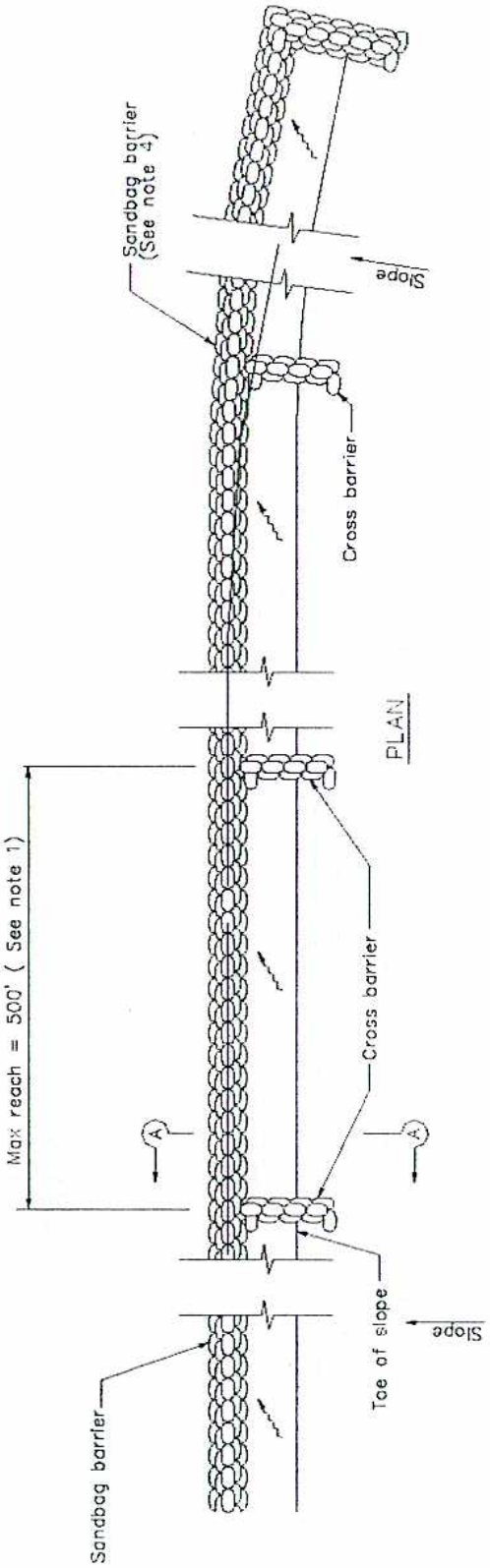
Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Sandbags exposed to sunlight will need to be replaced every two to three months due to degradation of the bags.
- Reshape or replace sandbags as needed.

- Repair washouts or other damage as needed.
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed at an appropriate location.
- Remove sandbags when no longer needed. Remove sediment accumulation, and clean, re-grade, and stabilize the area.

References

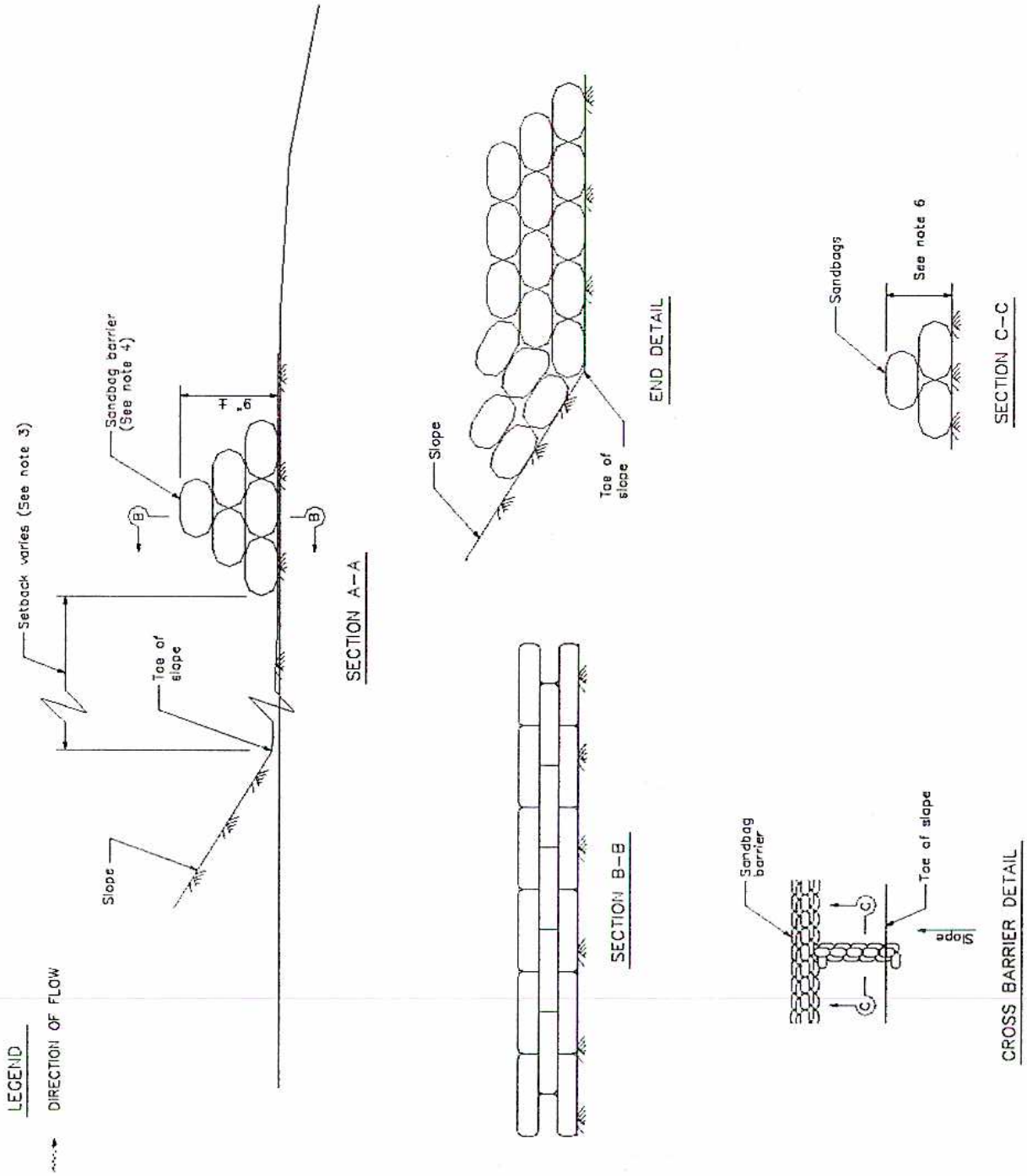
Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.



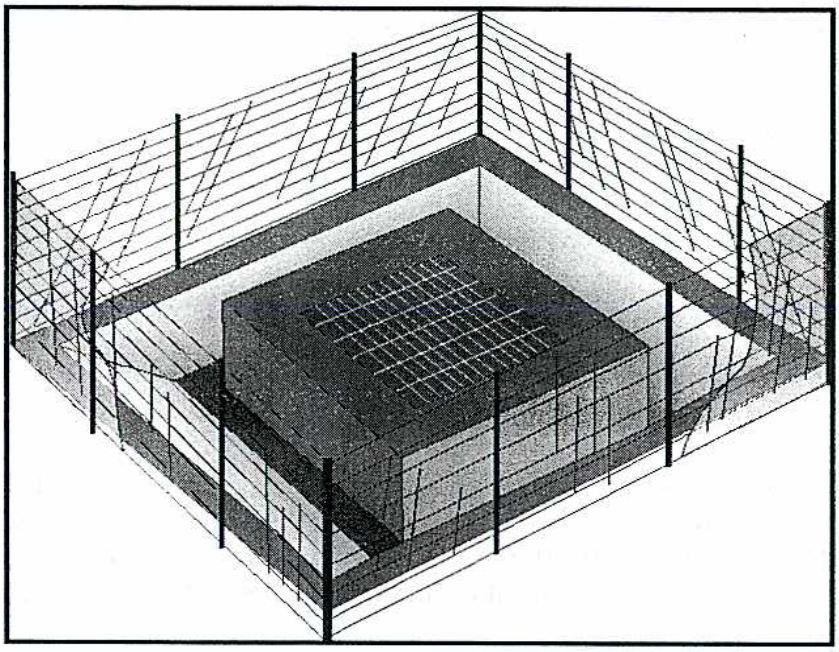
SANDBAG BARRIER

NOTES

1. Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/2 the height of the linear barrier. In no case shall the reach length exceed 500'.
2. Place sandbags tightly.
3. Dimension may vary to fit field condition.
4. Sandbag barrier shall be a minimum of 3 bags high.
5. The end of the barrier shall be turned up slope.
6. Cross barriers shall be a min of 1/2 and a max of 2/3 the height of the linear barrier.
7. Sandbag rows and layers shall be staggered to eliminate gaps.


LEGEND
DIRECTION OF FLOW
Setback varies (See note 3)
Sandbag barrier (See note 4)
9"±
B
B
Toe of slope
Slope
SECTION A–A
Slope
Toe of slope
END DETAIL
SECTION B–B
Sandbags
See note 6
SECTION C–C
Sandbag barrier
C
C
Toe of slope
Slope
CROSS BARRIER DETAIL

Storm Drain Inlet Protection SE-10



Objectives

EC	Erosion Control	
SE	Sediment Control	☑
TR	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	☑
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

SE-9 Straw Bale Barrier

Description and Purpose

Storm drain inlet protection consists of a sediment filter or an impounding area around or upstream of a storm drain, drop inlet, or curb inlet. Storm drain inlet protection measures temporarily pond runoff before it enters the storm drain, allowing sediment to settle. Some filter configurations also remove sediment by filtering, but usually the ponding action results in the greatest sediment reduction.

Suitable Applications

Every storm drain inlet receiving sediment-laden runoff should be protected.

Limitations

- Drainage area should not exceed 1 acre.
- Straw bales, while potentially effective, have not produced in practice satisfactory results, primarily due to improper installation.
- Requires an adequate area for water to pond without encroaching into portions of the roadway subject to traffic.
- Inlet protection usually requires other methods of temporary protection to prevent sediment-laden stormwater and non-stormwater discharges from entering the storm drain system.
- Sediment removal may be difficult in high flow conditions or if runoff is heavily sediment laden. If high flow conditions are

expected, use other onsite sediment trapping techniques in conjunction with inlet protection.

- Frequent maintenance is required.
- For drainage areas larger than 1 acre, runoff should be routed to a sediment-trapping device designed for larger flows. See BMPs SE-2, Sediment Basin, and SE-3, Sediment Traps.
- Excavated drop inlet sediment traps are appropriate where relatively heavy flows are expected, and overflow capability is needed.

Implementation

General

Large amounts of sediment may enter the storm drain system when storm drains are installed before the upslope drainage area is stabilized, or where construction is adjacent to an existing storm drain. In cases of extreme sediment loading, the storm drain itself may clog and lose a major portion of its capacity. To avoid these problems, it is necessary to prevent sediment from entering the system at the inlets.

Inlet control measures presented in this handbook should not be used for inlets draining more than one acre. Runoff from larger disturbed areas should be first routed through SE-2, Sediment Basin or SE-3, Sediment Trap. Different types of inlet protection are appropriate for different applications depending on site conditions and the type of inlet. Inlet protection methods not presented in this handbook should be approved by the local stormwater management agency.

Design and Layout

Identify existing and planned storm drain inlets that have the potential to receive sediment-laden surface runoff. Determine if storm drain inlet protection is needed and which method to use.

- Limit upstream drainage area to 1 acre maximum. For larger drainage areas, use SE-2, Sediment Basin, or SE-3, Sediment Trap, upstream of the inlet protection device.
- The key to successful and safe use of storm drain inlet protection devices is to know where runoff will pond or be diverted.
  - Determine the acceptable location and extent of ponding in the vicinity of the drain inlet. The acceptable location and extent of ponding will influence the type and design of the storm drain inlet protection device.
  - Determine the extent of potential runoff diversion caused by the storm drain inlet protection device. Runoff ponded by inlet protection devices may flow around the device and towards the next downstream inlet. In some cases, this is acceptable; in other cases, serious erosion or downstream property damage can be caused by these diversions. The possibility of runoff diversions will influence whether or not storm drain inlet protection is suitable; and, if suitable, the type and design of the device.
- The location and extent of ponding, and the extent of diversion, can usually be controlled through appropriate placement of the inlet protection device. In some cases, moving the

inlet protection device a short distance upstream of the actual inlet can provide more efficient sediment control, limit ponding to desired areas, and prevent or control diversions.

- Four types of inlet protection are presented below. However, it is recognized that other effective methods and proprietary devices exist and may be selected.
  - Filter Fabric Fence: Appropriate for drainage basins with less than a 5% slope, sheet flows, and flows under 0.5 cfs.
  - Excavated Drop Inlet Sediment Trap: An excavated area around the inlet to trap sediment (SE-3).
  - Gravel bag barrier: Used to create a small sediment trap upstream of inlets on sloped, paved streets. Appropriate for sheet flow or when concentrated flow may exceed 0.5 cfs, and where overtopping is required to prevent flooding.
  - Block and Gravel Filter: Appropriate for flows greater than 0.5 cfs.
- Select the appropriate type of inlet protection and design as referred to or as described in this fact sheet.
- Provide area around the inlet for water to pond without flooding structures and property.
- Grates and spaces around all inlets should be sealed to prevent seepage of sediment-laden water.
- Excavate sediment sumps (where needed) 1 to 2 ft with 2:1 side slopes around the inlet.

Installation

- ***DI Protection Type 1 - Filter Fabric Fence*** - The filter fabric fence (Type 1) protection is shown in the attached figure. Similar to constructing a silt fence; see BMP SE-1, Silt Fence. Do not place filter fabric underneath the inlet grate since the collected sediment may fall into the drain inlet when the fabric is removed or replaced.
  1. Excavate a trench approximately 6 in. wide and 6 in. deep along the line of the silt fence inlet protection device.
  2. Place 2 in. by 2 in. wooden stakes around the perimeter of the inlet a maximum of 3 ft apart and drive them at least 18 in. into the ground or 12 in. below the bottom of the trench. The stakes must be at least 48 in.
  3. Lay fabric along bottom of trench, up side of trench, and then up stakes. See SE-1, Silt Fence, for details. The maximum silt fence height around the inlet is 24 in.
  4. Staple the filter fabric (for materials and specifications, see SE-1, Silt Fence) to wooden stakes. Use heavy-duty wire staples at least 1 in. in length.
  5. Backfill the trench with gravel or compacted earth all the way around.
- ***DI Protection Type 2 - Excavated Drop Inlet Sediment Trap*** - The excavated drop inlet sediment trap (Type 2) is shown in the attached figures. Install filter fabric fence in

accordance with DI Protection Type 1. Size excavated trap to provide a minimum storage capacity calculated at the rate 67 yd^3/acre of drainage area.

- ***DI Protection Type 3 - Gravel bag*** - The gravel bag barrier (Type 3) is shown in the figures. Flow from a severe storm should not overtop the curb. In areas of high clay and silts, use filter fabric and gravel as additional filter media. Construct gravel bags in accordance with SE-6, Gravel Bag Berm. Gravel bags should be used due to their high permeability.

  1. Use sand bag made of geotextile fabric (not burlap) and fill with 0.75 in. rock or 0.25 in. pea gravel.
  2. Construct on gently sloping street.
  3. Leave room upstream of barrier for water to pond and sediment to settle.
  4. Place several layers of sand bags – overlapping the bags and packing them tightly together.
  5. Leave gap of one bag on the top row to serve as a spillway. Flow from a severe storm (e.g., 10 year storm) should not overtop the curb.

- ***DI Protection Type 4 – Block and Gravel Filter*** - The block and gravel filter (Type 4) is shown in the figures. Block and gravel filters are suitable for curb inlets commonly used in residential, commercial, and industrial construction.

  1. Place hardware cloth or comparable wire mesh with 0.5 in. openings over the drop inlet so that the wire extends a minimum of 1 ft beyond each side of the inlet structure. If more than one strip is necessary, overlap the strips. Place filter fabric over the wire mesh.
  2. Place concrete blocks lengthwise on their sides in a single row around the perimeter of the inlet, so that the open ends face outward, not upward. The ends of adjacent blocks should abut. The height of the barrier can be varied, depending on design needs, by stacking combinations of blocks that are 4 in., 8 in., and 12 in. wide. The row of blocks should be at least 12 in. but no greater than 24 in. high.
  3. Place wire mesh over the outside vertical face (open end) of the concrete blocks to prevent stone from being washed through the blocks. Use hardware cloth or comparable wire mesh with 0.5 in. opening.
  4. Pile washed stone against the wire mesh to the top of the blocks. Use 0.75 to 3 in.

Costs

- Average annual cost for installation and maintenance (one year useful life) is $200 per inlet.

Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.

- Filter Fabric Fences. If the fabric becomes clogged, torn, or degrades, it should be replaced. Make sure the stakes are securely driven in the ground and are in good shape (i.e., not bent, cracked, or splintered, and are reasonably perpendicular to the ground). Replace damaged stakes.

- Gravel Filters. If the gravel becomes clogged with sediment, it must be carefully removed from the inlet and either cleaned or replaced. Since cleaning gravel at a construction site may be difficult, consider using the sediment-laden stone as fill material and put fresh stone around the inlet. Inspect bags for holes, gashes, and snags, and replace bags as needed. Check gravel bags for proper arrangement and displacement.

- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site ore disposed at an appropriate location.

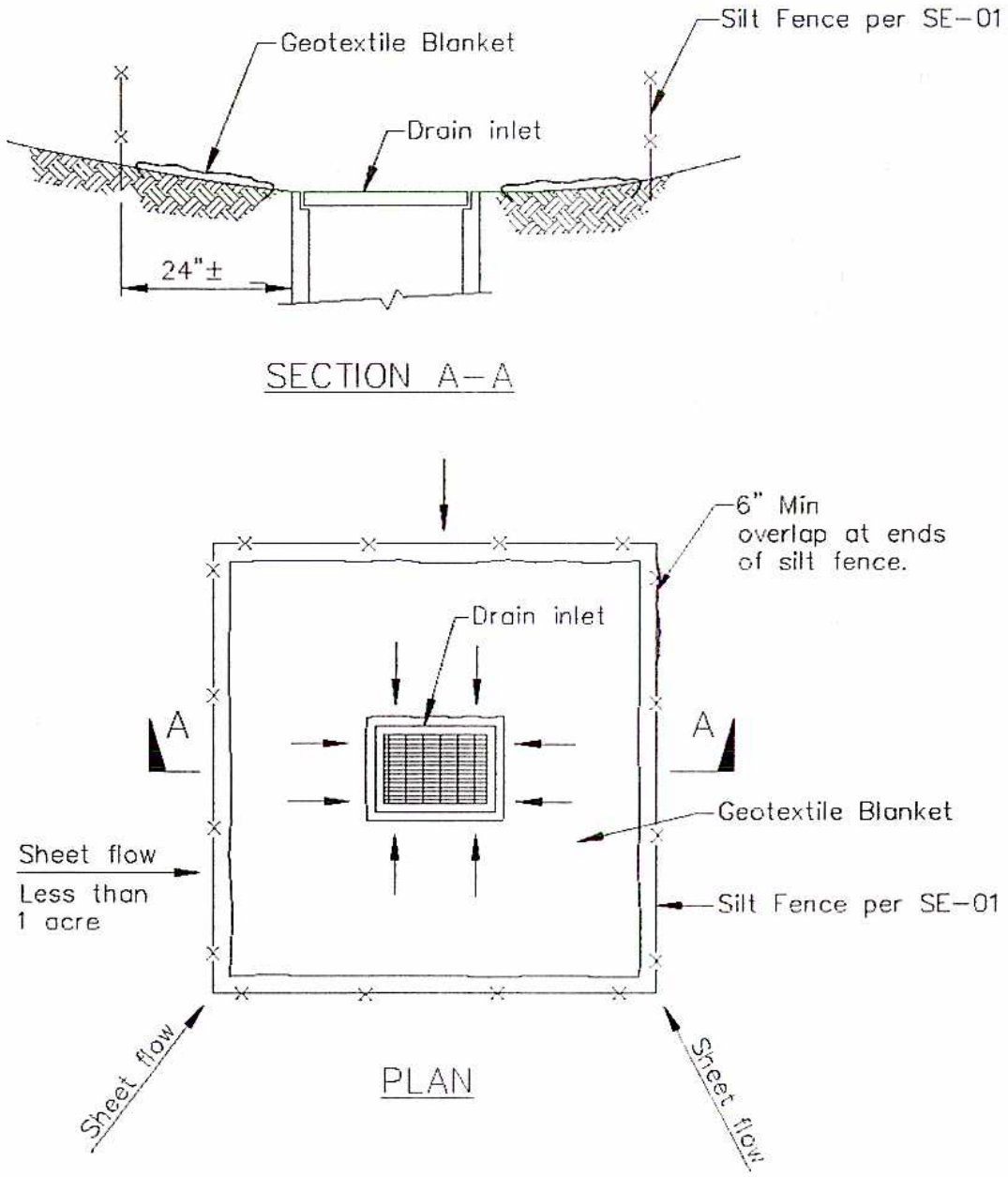
- Remove storm drain inlet protection once the drainage area is stabilized.

  - Clean and regrade area around the inlet and clean the inside of the storm drain inlet as it must be free of sediment and debris at the time of final inspection.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

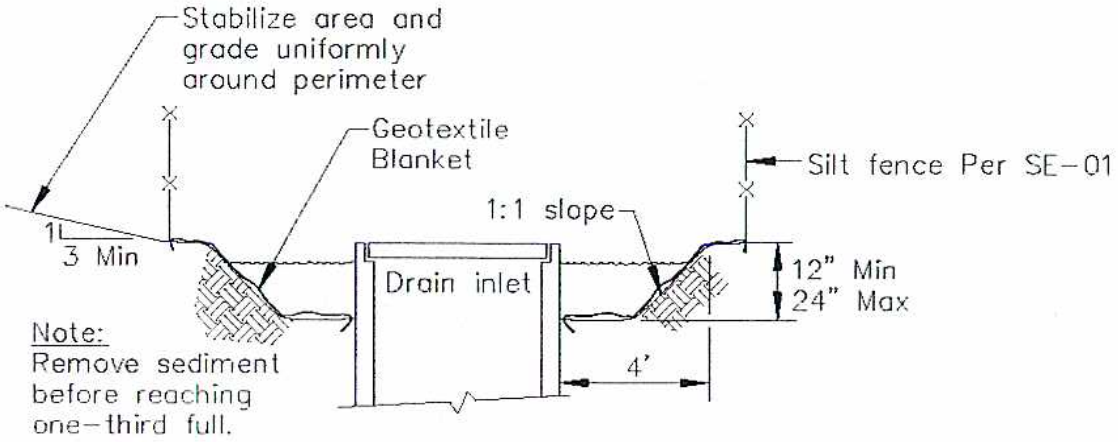
Stormwater Management Manual for The Puget Sound Basin, Washington State Department of Ecology, Public Review Draft, 1991.



DI PROTECTION TYPE 1
NOT TO SCALE

NOTES:

1. For use in areas where grading has been completed and final soil stabilization and seeding are pending.
2. Not applicable in paved areas.
3. Not applicable with concentrated flows.



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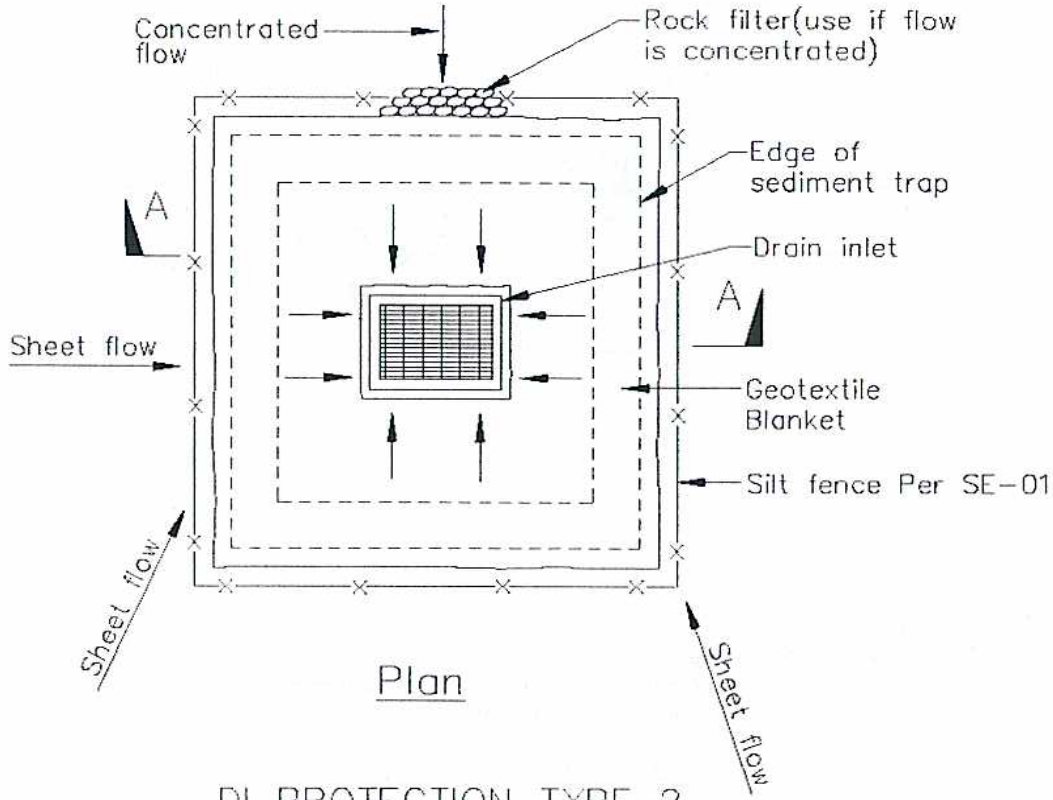
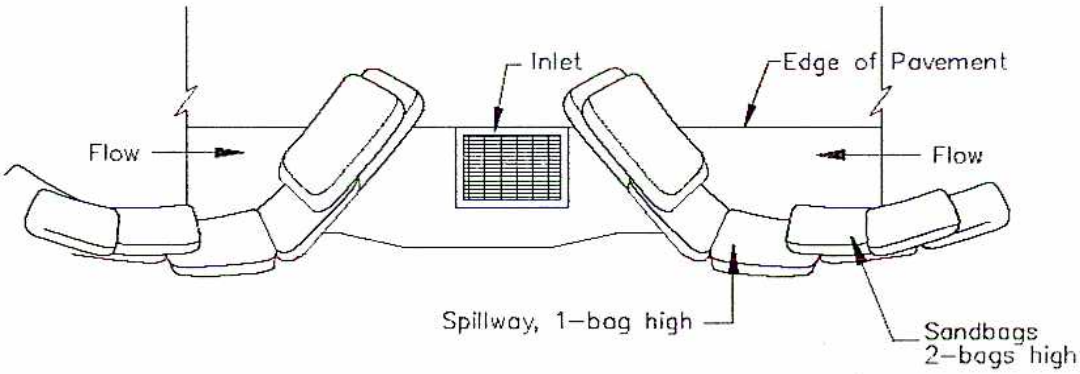


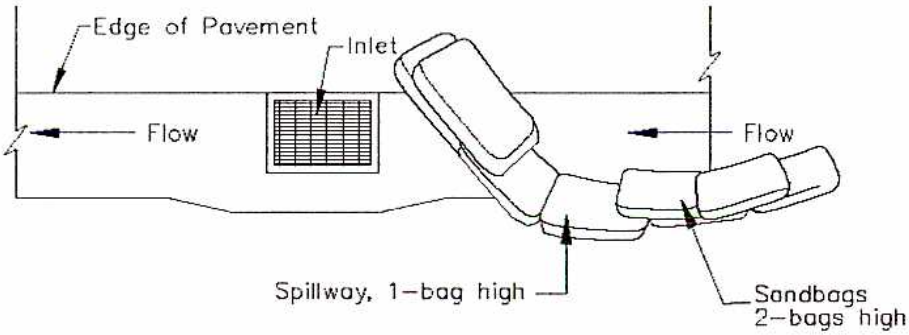
Plan

DI PROTECTION TYPE 2
NOT TO SCALE

Notes
1. For use in cleared and grubbed and in graded areas.
2. Shape basin so that longest inflow area faces longest length of trap.
3. For concentrated flows, shape basin in 2:1 ratio with length oriented towards direction of flow.



TYPICAL PROTECTION FOR INLET ON SUMP

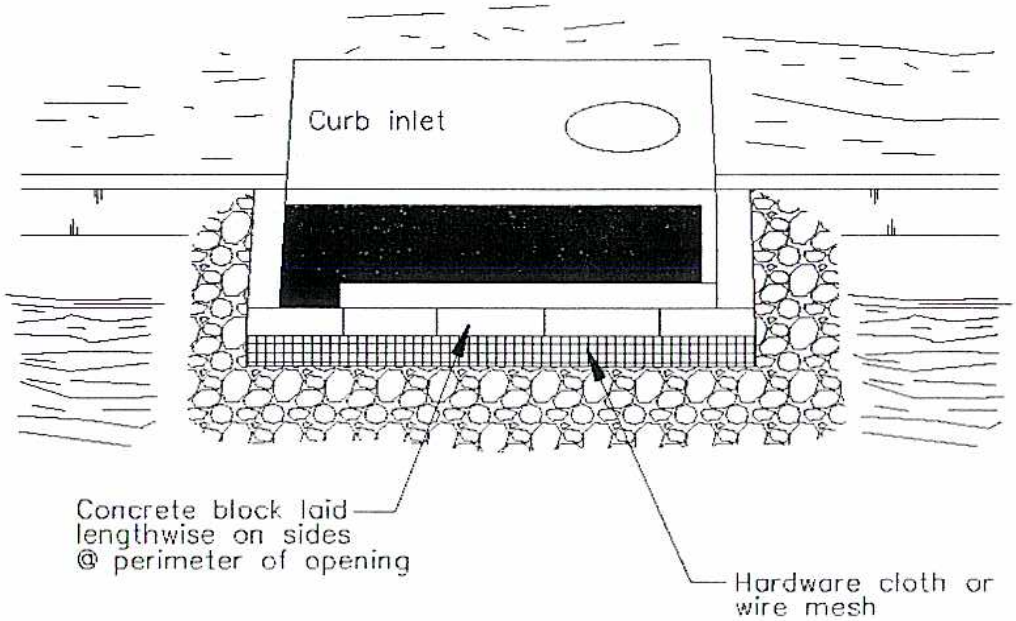


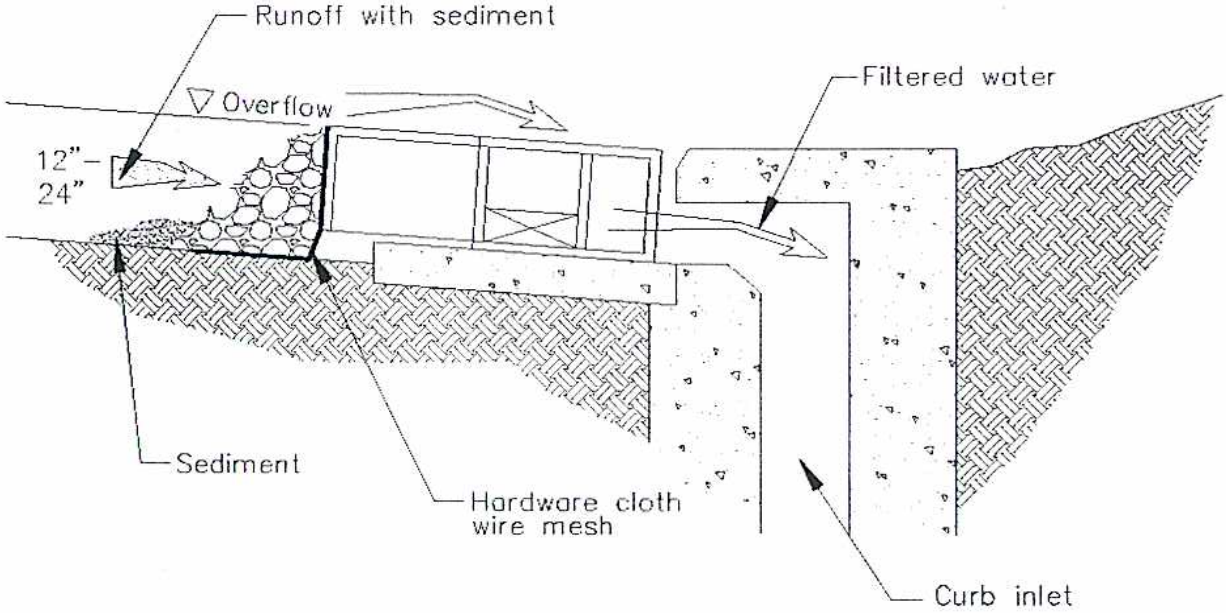
TYPICAL PROTECTION FOR INLET ON GRADE

NOTES:

1. Intended for short-term use.
2. Use to inhibit non-storm water flow.
3. Allow for proper maintenance and cleanup.
4. Bags must be removed after adjacent operation is completed
5. Not applicable in areas with high silts and clays without filter fabric.

DI PROTECTION TYPE 3
NOT TO SCALE

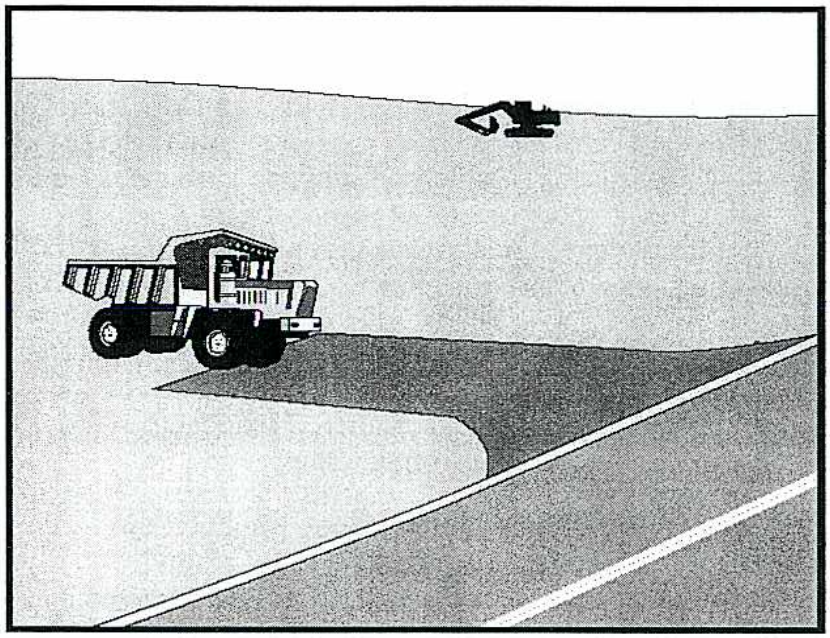




DI PROTECTION – TYPE 4

NOT TO SCALE

Stabilized Construction Entrance/Exit TC-1



Objectives

EC	Erosion Control	☒
SE	Sediment Control	☒
TC	Tracking Control	☑
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

Description and Purpose

A stabilized construction access is defined by a point of entrance/exit to a construction site that is stabilized to reduce the tracking of mud and dirt onto public roads by construction vehicles.

Suitable Applications

Use at construction sites:

- Where dirt or mud can be tracked onto public roads.
- Adjacent to water bodies.
- Where poor soils are encountered.
- Where dust is a problem during dry weather conditions.

Limitations

- Entrances and exits require periodic top dressing with additional stones.
- This BMP should be used in conjunction with street sweeping on adjacent public right of way.
- Entrances and exits should be constructed on level ground only.
- Stabilized construction entrances are rather expensive to construct and when a wash rack is included, a sediment trap of some kind must also be provided to collect wash water runoff.

Implementation

General

A stabilized construction entrance is a pad of aggregate underlain with filter cloth located at any point where traffic will be entering or leaving a construction site to or from a public right of way, street, alley, sidewalk, or parking area. The purpose of a stabilized construction entrance is to reduce or eliminate the tracking of sediment onto public rights of way or streets. Reducing tracking of sediments and other pollutants onto paved roads helps prevent deposition of sediments into local storm drains and production of airborne dust.

Where traffic will be entering or leaving the construction site, a stabilized construction entrance should be used. NPDES permits require that appropriate measures be implemented to prevent tracking of sediments onto paved roadways, where a significant source of sediments is derived from mud and dirt carried out from unpaved roads and construction sites.

Stabilized construction entrances are moderately effective in removing sediment from equipment leaving a construction site. The entrance should be built on level ground. Advantages of the Stabilized Construction Entrance/Exit is that it does remove some sediment from equipment and serves to channel construction traffic in and out of the site at specified locations. Efficiency is greatly increased when a washing rack is included as part of a stabilized construction entrance/exit.

Design and Layout

- Construct on level ground where possible.
- Select 3 to 6 in. diameter stones.
- Use minimum depth of stones of 12 in. or as recommended by soils engineer.
- Construct length of 50 ft minimum, and 30 ft minimum width.
- Rumble racks constructed of steel panels with ridges and installed in the stabilized entrance/exit will help remove additional sediment and to keep adjacent streets clean.
- Provide ample turning radii as part of the entrance.
- Limit the points of entrance/exit to the construction site.
- Limit speed of vehicles to control dust.
- Properly grade each construction entrance/exit to prevent runoff from leaving the construction site.
- Route runoff from stabilized entrances/exits through a sediment trapping device before discharge.
- Design stabilized entrance/exit to support heaviest vehicles and equipment that will use it.
- Select construction access stabilization (aggregate, asphaltic concrete, concrete) based on longevity, required performance, and site conditions. Do not use asphalt concrete (AC) grindings for stabilized construction access/roadway.

- If aggregate is selected, place crushed aggregate over geotextile fabric to at least 12 in. depth, or place aggregate to a depth recommended by a geotechnical engineer. A crushed aggregate greater than 3 in. but smaller than 6 in. should be used.
- Designate combination or single purpose entrances and exits to the construction site.
- Require that all employees, subcontractors, and suppliers utilize the stabilized construction access.
- Implement SE-7, Street Sweeping and Vacuuming, as needed.
- All exit locations intended to be used for more than a two-week period should have stabilized construction entrance/exit BMPs.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMPs are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect local roads adjacent to the site daily. Sweep or vacuum to remove visible accumulated sediment.
- Remove aggregate, separate and dispose of sediment if construction entrance/exit is clogged with sediment.
- Keep all temporary roadway ditches clear.
- Check for damage and repair as needed.
- Replace gravel material when surface voids are visible.
- Remove all sediment deposited on paved roadways within 24 hours.
- Remove gravel and filter fabric at completion of construction

Costs

Average annual cost for installation and maintenance may vary from $1,200 to $4,800 each, averaging $2,400 per entrance. Costs will increase with addition of washing rack, and sediment trap. With wash rack, costs range from $1,200 - $6,000 each, averaging $3,600 per entrance.

References

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, USEPA Agency, 2002.

Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group Working Paper, USEPA, April 1992.

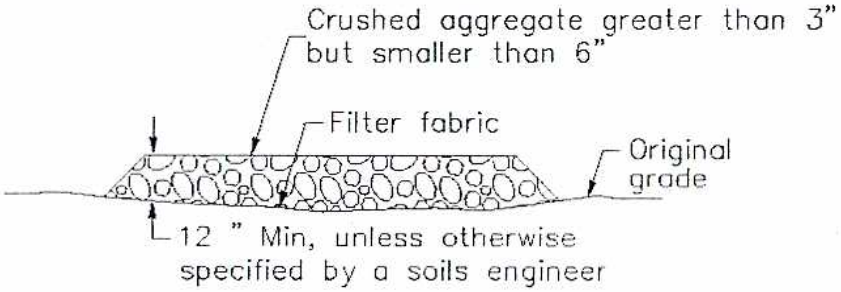
Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Virginia Erosion and Sedimentation Control Handbook, Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, 1991.

Guidance Specifying Management Measures for Nonpoint Pollution in Coastal Waters, EPA 840-B-9-002, USEPA, Office of Water, Washington, DC, 1993.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.



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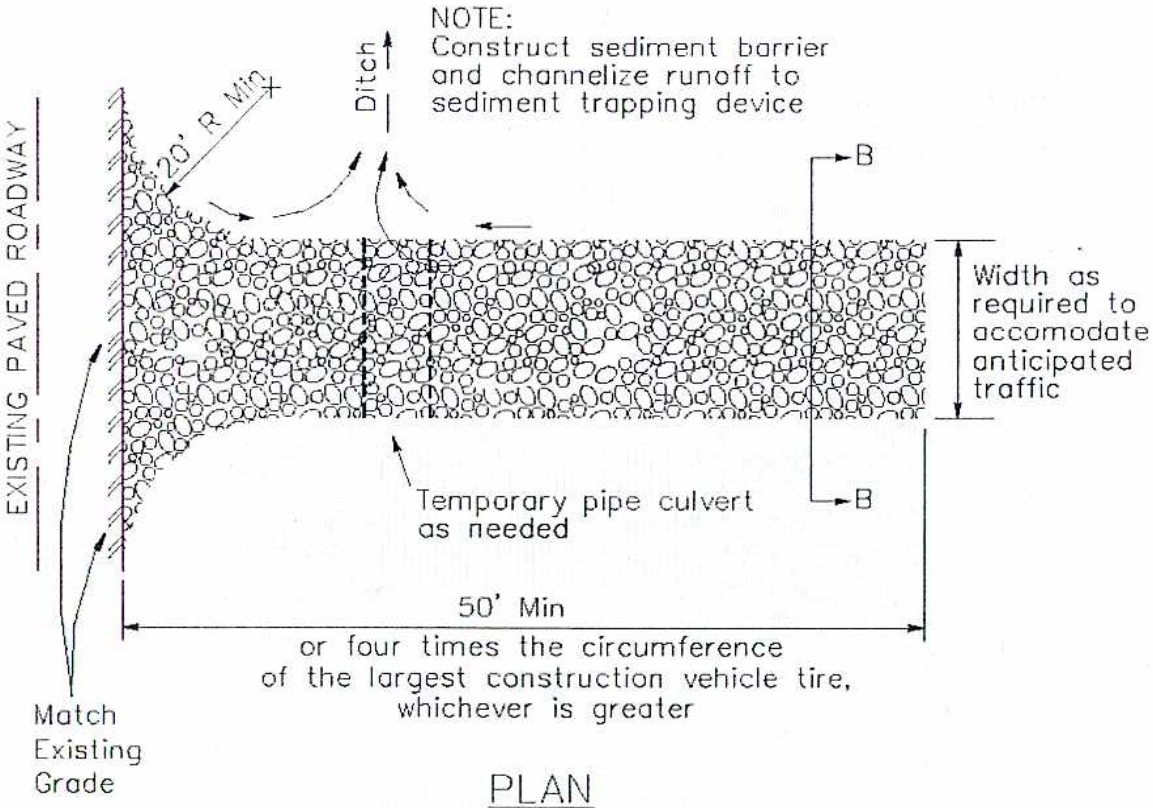

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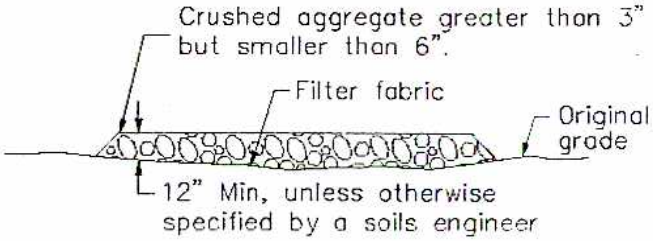

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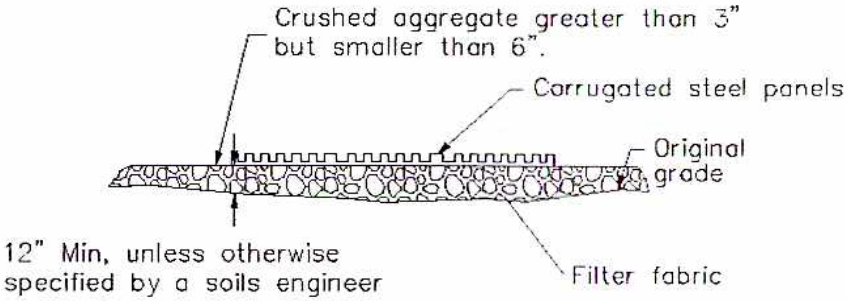

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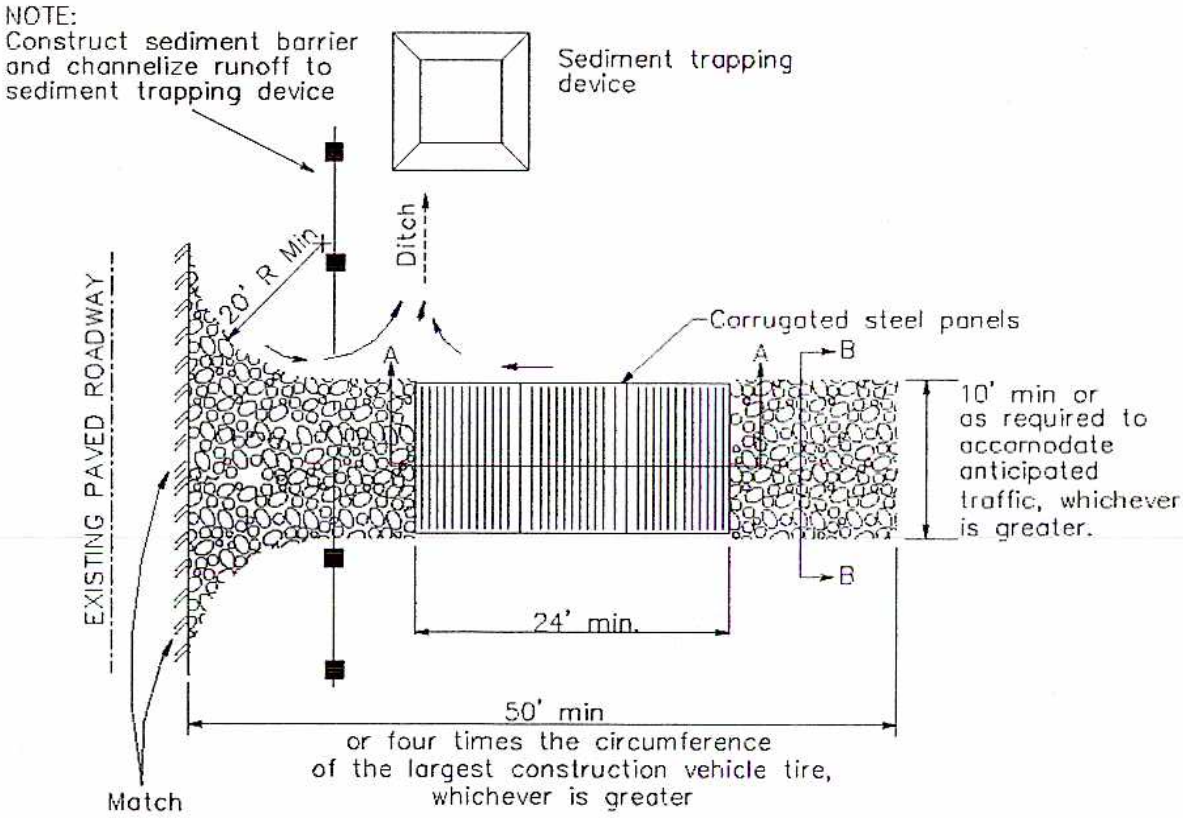

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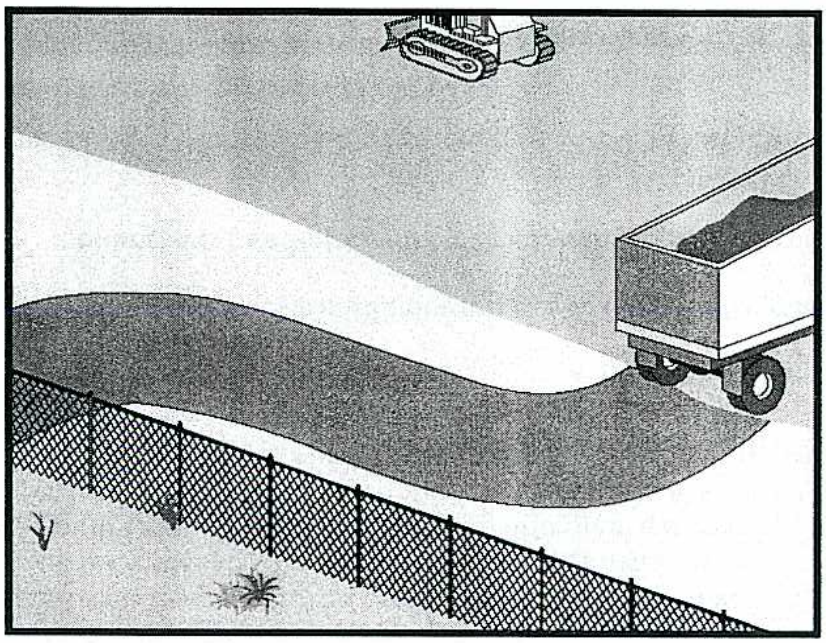
Stabilized Construction Roadway TC-2



Objectives		
EC	Erosion Control	☒
SE	Sediment Control	☒
TC	Tracking Control	☑
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

Description and Purpose

Access roads, subdivision roads, parking areas, and other onsite vehicle transportation routes should be stabilized immediately after grading, and frequently maintained to prevent erosion and control dust.

Suitable Applications

This BMP should be applied for the following conditions:

- Temporary Construction Traffic:
  - Phased construction projects and offsite road access
  - Construction during wet weather
- Construction roadways and detour roads:
  - Where mud tracking is a problem during wet weather
  - Where dust is a problem during dry weather
  - Adjacent to water bodies
  - Where poor soils are encountered

Limitations

- The roadway must be removed or paved when construction is complete.

- Certain chemical stabilization methods may cause stormwater or soil pollution and should not be used. See WE-1, Wind Erosion Control.
- Management of construction traffic is subject to air quality control measures. Contact the local air quality management agency.
- Materials will likely need to be removed prior to final project grading and stabilization.
- Use of this BMP may not be applicable to very short duration projects.

Implementation

General

Areas that are graded for construction vehicle transport and parking purposes are especially susceptible to erosion and dust. The exposed soil surface is continually disturbed, leaving no opportunity for vegetative stabilization. Such areas also tend to collect and transport runoff waters along their surfaces. During wet weather, they often become muddy quagmires that generate significant quantities of sediment that may pollute nearby streams or be transported offsite on the wheels of construction vehicles. Dirt roads can become so unstable during wet weather that they are virtually unusable.

Efficient construction road stabilization not only reduces onsite erosion but also can significantly speed onsite work, avoid instances of immobilized machinery and delivery vehicles, and generally improve site efficiency and working conditions during adverse weather

Installation/Application Criteria

Permanent roads and parking areas should be paved as soon as possible after grading. As an alternative where construction will be phased, the early application of gravel or chemical stabilization may solve potential erosion and stability problems. Temporary gravel roadway should be considered during the rainy season and on slopes greater than 5%.

Temporary roads should follow the contour of the natural terrain to the maximum extent possible. Slope should not exceed 15%. Roadways should be carefully graded to drain transversely. Provide drainage swales on each side of the roadway in the case of a crowned section or one side in the case of a super elevated section. Simple gravel berms without a trench can also be used.

Installed inlets should be protected to prevent sediment laden water from entering the storm sewer system (SE-10, Storm Drain Inlet Protection). In addition, the following criteria should be considered.

- Road should follow topographic contours to reduce erosion of the roadway.
- The roadway slope should not exceed 15%.
- Chemical stabilizers or water are usually required on gravel or dirt roads to prevent dust (WE-1, Wind Erosion Control).
- Properly grade roadway to prevent runoff from leaving the construction site.
- Design stabilized access to support heaviest vehicles and equipment that will use it.

- Stabilize roadway using aggregate, asphalt concrete, or concrete based on longevity, required performance, and site conditions. The use of cold mix asphalt or asphalt concrete (AC) grindings for stabilized construction roadway is not allowed.
- Coordinate materials with those used for stabilized construction entrance/exit points.
- If aggregate is selected, place crushed aggregate over geotextile fabric to at least 12 in. depth. A crushed aggregate greater than 3 in. but smaller than 6 in. should be used.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, impact weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Keep all temporary roadway ditches clear.
- When no longer required, remove stabilized construction roadway and re-grade and repair slopes.
- Periodically apply additional aggregate on gravel roads.
- Active dirt construction roads are commonly watered three or more times per day during the dry season.

Costs

Gravel construction roads are moderately expensive, but cost is often balanced by reductions in construction delay. No additional costs for dust control on construction roads should be required above that needed to meet local air quality requirements.

References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program; Program Development and Approval Guidance, Working Group, Working Paper; USEPA, April 1992.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

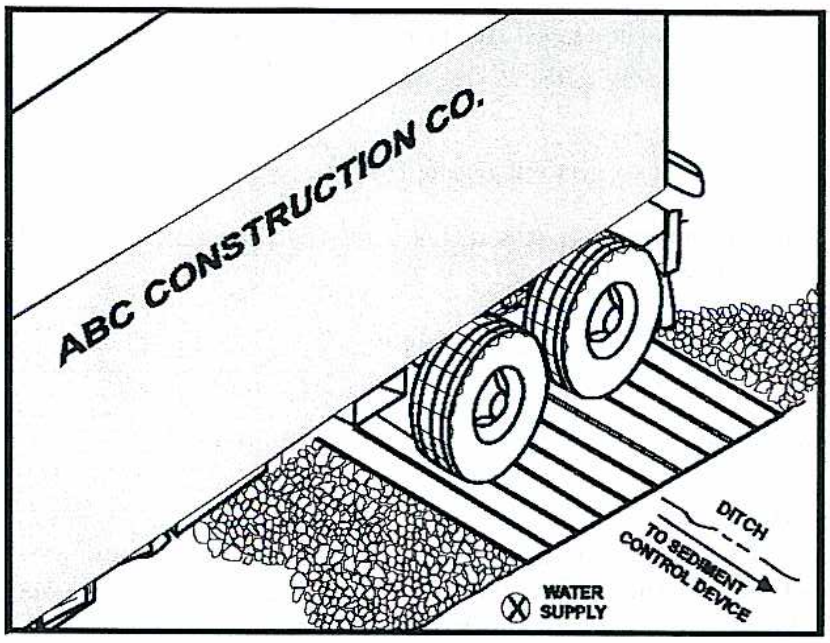
Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Virginia Erosion and Sedimentation Control Handbook, Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, 1991.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Entrance/Outlet Tire Wash TC-3



Objectives

EC	Erosion Control	
SE	Sediment Control	☒
TC	Tracking Control	☑
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

TC-1 Stabilized Construction Entrance/Exit

Description and Purpose

A tire wash is an area located at stabilized construction access points to remove sediment from tires and under carriages and to prevent sediment from being transported onto public roadways.

Suitable Applications

Tire washes may be used on construction sites where dirt and mud tracking onto public roads by construction vehicles may occur.

Limitations

- The tire wash requires a supply of wash water.
- A turnout or doublewide exit is required to avoid having entering vehicles drive through the wash area.
- Do not use where wet tire trucks leaving the site leave the road dangerously slick.

Implementation

- Incorporate with a stabilized construction entrance/exit. See TC-1, Stabilized Construction Entrance/Exit.
- Construct on level ground when possible, on a pad of coarse aggregate greater than 3 in. but smaller than 6 in. A geotextile fabric should be placed below the aggregate.
- Wash rack should be designed and constructed/manufactured for anticipated traffic loads.

- Provide a drainage ditch that will convey the runoff from the wash area to a sediment trapping device. The drainage ditch should be of sufficient grade, width, and depth to carry the wash runoff.
- Use hoses with automatic shutoff nozzles to prevent hoses from being left on.
- Require that all employees, subcontractors, and others that leave the site with mud caked tires and undercarriages to use the wash facility.
- Implement SC-7, Street Sweeping and Vacuuming, as needed.

Costs

Costs are low for installation of wash rack.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.
- Remove accumulated sediment in wash rack and/or sediment trap to maintain system performance.
- Inspect routinely for damage and repair as needed.

References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program; Program Development and Approval Guidance, Working Group, Working Paper; USEPA, April 1992.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

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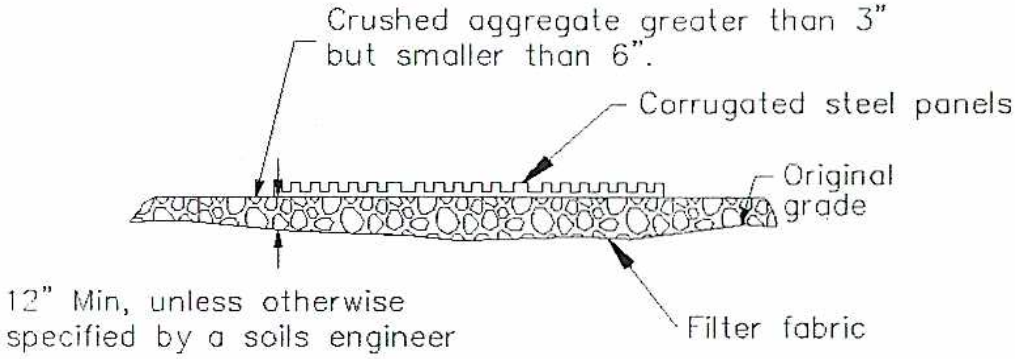

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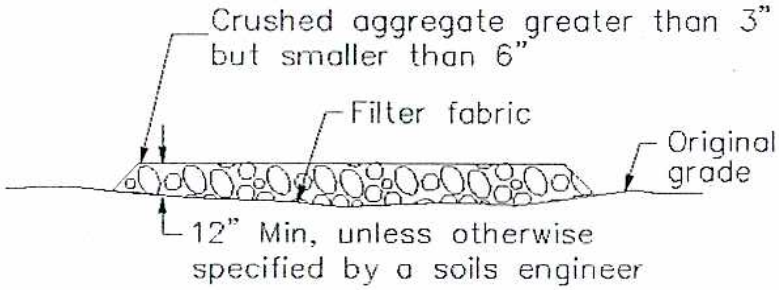
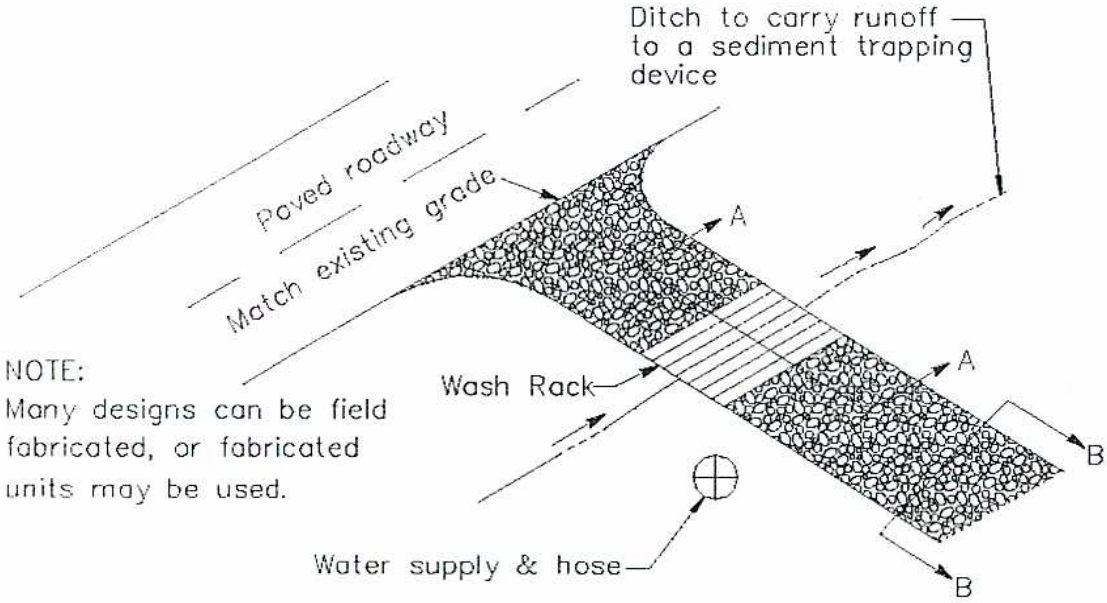


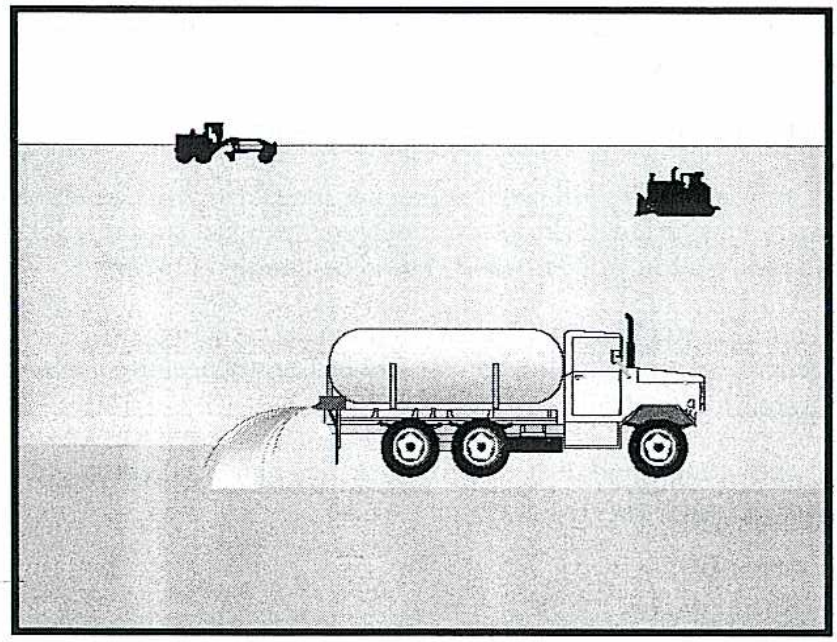
SECTION B–B
NTS



TYPICAL TIRE WASH
NOT TO SCALE

Wind Erosion Control

WE-1



Objectives

EC	Erosion Control	
SE	Sediment Control	☒
TC	Tracking Control	
WE	Wind Erosion Control	☑
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

Description and Purpose

Wind erosion or dust control consists of applying water or other dust palliatives as necessary to prevent or alleviate dust nuisance generated by construction activities. Covering small stockpiles or areas is an alternative to applying water or other dust palliatives.

Suitable Applications

Wind erosion control BMPs are suitable during the following construction activities:

- Construction vehicle traffic on unpaved roads
- Drilling and blasting activities
- Sediment tracking onto paved roads
- Soils and debris storage piles
- Batch drop from front-end loaders
- Areas with unstabilized soil
- Final grading/site stabilization

Limitations

- Watering prevents dust only for a short period and should be applied daily (or more often) to be effective.
- Over watering may cause erosion.

- Oil or oil-treated subgrade should not be used for dust control because the oil may migrate into drainageways and/or seep into the soil.
- Effectiveness depends on soil, temperature, humidity, and wind velocity.
- Chemically treated sub grades may make the soil water repellant, interfering with long-term infiltration and the vegetation/re-vegetation of the site. Some chemical dust suppressants may be subject to freezing and may contain solvents and should be handled properly.
- Asphalt, as a mulch tack or chemical mulch, requires a 24-hour curing time to avoid adherence to equipment, worker shoes, etc. Application should be limited because asphalt surfacing may eventually migrate into the drainage system.
- In compacted areas, watering and other liquid dust control measures may wash sediment or other constituents into the drainage system.

Implementation

General

California's Mediterranean climate, with short wet seasons and long hot dry seasons, allows the soils to thoroughly dry out. During these dry seasons, construction activities are at their peak, and disturbed and exposed areas are increasingly subject to wind erosion, sediment tracking and dust generated by construction equipment.

Dust control, as a BMP, is a practice that is already in place for many construction activities. Los Angeles, the North Coast, and Sacramento, among others, have enacted dust control ordinances for construction activities that cause dust to be transported beyond the construction project property line.

Recently, the State Air Resources Control Board has, under the authority of the Clean Air Act, started to address air quality in relation to inhalable particulate matter less than 10 microns (PM-10). Approximately 90 percent of these small particles are considered to be dust. Existing dust control regulations by local agencies, municipal departments, public works department, and public health departments are in place in some regions within California.

Many local agencies require dust control in order to comply with local nuisance laws, opacity laws (visibility impairment) and the requirements of the Clean Air Act. The following are measures that local agencies may have already implemented as requirements for dust control from contractors:

- Construction and Grading Permits: Require provisions for dust control plans.
- Opacity Emission Limits: Enforce compliance with California air pollution control laws.
- Increase Overall Enforcement Activities: Priority given to cases involving citizen complaints.
- Maintain Field Application Records: Require records of dust control measures from contractor;
- Stormwater Pollution Prevention Plan: (SWPPP): Integrate dust control measures into SWPPP.

Dust Control Practices

Dust control BMPs generally stabilize exposed surfaces and minimize activities that suspend or track dust particles. The following table shows dust control practices that can be applied to site conditions that cause dust. For heavily traveled and disturbed areas, wet suppression (watering), chemical dust suppression, gravel asphalt surfacing, temporary gravel construction entrances, equipment wash-out areas, and haul truck covers can be employed as dust control applications. Permanent or temporary vegetation and mulching can be employed for areas of occasional or no construction traffic. Preventive measures would include minimizing surface areas to be disturbed, limiting onsite vehicle traffic to 15 mph, and controlling the number and activity of vehicles on a site at any given time.

SITE CONDITION	DUST CONTROLPRACTICES								
	Permanent Vegetation	Mulching	Wet Suppression (Watering)	Chemical Dust Suppression	Gravel or Asphalt	Silt Fences	Temporary Gravel Construction Entrances/Equipment Wash Down	Haul Truck Covers	Minimize Extent of Disturbed Area
Disturbed Areas not Subject to Traffic	X	X	X	X	X				X
Disturbed Areas Subject to Traffic			X	X	X		X		X
Material Stock Pile Stabilization			X	X		X			X
Demolition			X				X	X	
Clearing/ Excavation			X	X		X			X
Truck Traffic on Unpaved Roads			X	X	X		X	X	
Mud/Dirt Carry Out					X		X		

Additional preventive measures include:

- Schedule construction activities to minimize exposed area (EC-1, Scheduling).
- Quickly stabilize exposed soils using vegetation, mulching, spray-on adhesives, calcium chloride, sprinkling, and stone/gravel layering.
- Identify and stabilize key access points prior to commencement of construction.
- Minimize the impact of dust by anticipating the direction of prevailing winds.
- Direct most construction traffic to stabilized roadways within the project site.
- Water should be applied by means of pressure-type distributors or pipelines equipped with a spray system or hoses and nozzles that will ensure even distribution.
- All distribution equipment should be equipped with a positive means of shutoff.
- Unless water is applied by means of pipelines, at least one mobile unit should be available at all times to apply water or dust palliative to the project.

- If reclaimed waste water is used, the sources and discharge must meet California Department of Health Services water reclamation criteria and the Regional Water Quality Control Board requirements. Non-potable water should not be conveyed in tanks or drain pipes that will be used to convey potable water and there should be no connection between potable and non-potable supplies. Non-potable tanks, pipes, and other conveyances should be marked, "NON-POTABLE WATER - DO NOT DRINK."
- Materials applied as temporary soil stabilizers and soil binders also generally provide wind erosion control benefits.
- Pave or chemically stabilize access points where unpaved traffic surfaces adjoin paved roads.
- Provide covers for haul trucks transporting materials that contribute to dust.
- Provide for wet suppression or chemical stabilization of exposed soils.
- Provide for rapid clean up of sediments deposited on paved roads. Furnish stabilized construction road entrances and vehicle wash down areas.
- Stabilize inactive construction sites using vegetation or chemical stabilization methods.
- Limit the amount of areas disturbed by clearing and earth moving operations by scheduling these activities in phases.

For chemical stabilization, there are many products available for chemically stabilizing gravel roadways and stockpiles. If chemical stabilization is used, the chemicals should not create any adverse effects on stormwater, plant life, or groundwater.

Costs

Installation costs for water and chemical dust suppression are low, but annual costs may be quite high since these measures are effective for only a few hours to a few days.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Check areas protected to ensure coverage.
- Most dust control measures require frequent, often daily, or multiple times per day attention.

References

Best Management Practices and Erosion Control Manual for Construction Sites, Flood Control District of Maricopa County, Arizona, September 1992.

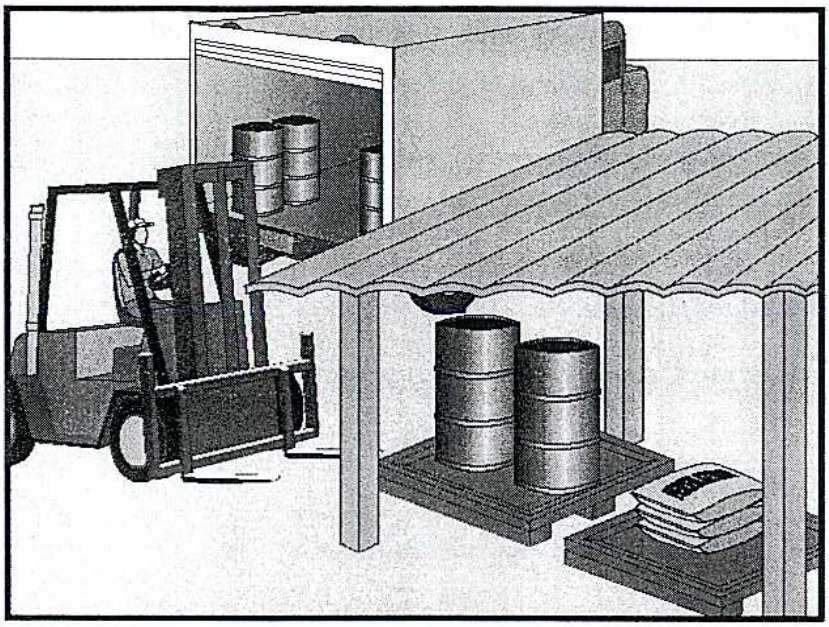
California Air Pollution Control Laws, California Air Resources Board, 1992.

Caltrans, Standard Specifications, Sections 10, "Dust Control"; Section 17, "Watering"; and Section 18, "Dust Palliative".

Prospects for Attaining the State Ambient Air Quality Standards for Suspended Particulate Matter (PM10), Visibility Reducing Particles, Sulfates, Lead, and Hydrogen Sulfide, California Air Resources Board, April 1991.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Material Delivery and Storage WM-1



Objectives		
EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents	
Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

Description and Purpose

Prevent, reduce, or eliminate the discharge of pollutants from material delivery and storage to the stormwater system or watercourses by minimizing the storage of hazardous materials onsite, storing materials in a designated area, installing secondary containment, conducting regular inspections, and training employees and subcontractors.

This best management practice covers only material delivery and storage. For other information on materials, see WM-2, Material Use, or WM-4, Spill Prevention and Control. For information on wastes, see the waste management BMPs in this section.

Suitable Applications

These procedures are suitable for use at all construction sites with delivery and storage of the following materials:

- Soil stabilizers and binders
- Pesticides and herbicides
- Fertilizers
- Detergents
- Plaster
- Petroleum products such as fuel, oil, and grease
- Asphalt and concrete components

- Hazardous chemicals such as acids, lime, glues, adhesives, paints, solvents, and curing compounds
- Concrete compounds
- Other materials that may be detrimental if released to the environment

Limitations

- Space limitation may preclude indoor storage.
- Storage sheds often must meet building and fire code requirements.

Implementation

The following steps should be taken to minimize risk:

- Temporary storage area should be located away from vehicular traffic.
- Material Safety Data Sheets (MSDS) should be supplied for all materials stored.
- Construction site areas should be designated for material delivery and storage.
- Material delivery and storage areas should be located near the construction entrances, away from waterways, if possible.
  - Avoid transport near drainage paths or waterways.
  - Surround with earth berms. See EC-9, Earth Dikes and Drainage Swales.
  - Place in an area which will be paved.
- Storage of reactive, ignitable, or flammable liquids must comply with the fire codes of your area. Contact the local Fire Marshal to review site materials, quantities, and proposed storage area to determine specific requirements. See the Flammable and Combustible Liquid Code, NFPA30.
- An up to date inventory of materials delivered and stored onsite should be kept.
- Hazardous materials storage onsite should be minimized.
- Hazardous materials should be handled as infrequently as possible.
- During the rainy season, consider storing materials in a covered area. Store materials in secondary containments such as earthen dike, horse trough, or even a children's wading pool for non-reactive materials such as detergents, oil, grease, and paints. Small amounts of material may be secondarily contained in "bus boy" trays or concrete mixing trays.
- Do not store chemicals, drums, or bagged materials directly on the ground. Place these items on a pallet and, when possible, in secondary containment.

- If drums must be kept uncovered, store them at a slight angle to reduce ponding of rainwater on the lids to reduce corrosion. Domed plastic covers are inexpensive and snap to the top of drums, preventing water from collecting.
- Chemicals should be kept in their original labeled containers.
- Employees and subcontractors should be trained on the proper material delivery and storage practices.
- Employees trained in emergency spill cleanup procedures must be present when dangerous materials or liquid chemicals are unloaded.
- If significant residual materials remain on the ground after construction is complete, properly remove materials and any contaminated soil. See WM-7, Contaminated Soil Management. If the area is to be paved, pave as soon as materials are removed to stabilize the soil.

Material Storage Areas and Practices

- Liquids, petroleum products, and substances listed in 40 CFR Parts 110, 117, or 302 should be stored in approved containers and drums and should not be overfilled. Containers and drums should be placed in temporary containment facilities for storage.
- A temporary containment facility should provide for a spill containment volume able to contain precipitation from a 25 year storm event, plus the greater of 10% of the aggregate volume of all containers or 100% of the capacity of the largest container within its boundary, whichever is greater.
- A temporary containment facility should be impervious to the materials stored therein for a minimum contact time of 72 hours.
- A temporary containment facility should be maintained free of accumulated rainwater and spills. In the event of spills or leaks, accumulated rainwater and spills should be collected and placed into drums. These liquids should be handled as a hazardous waste unless testing determines them to be non-hazardous. All collected liquids or non-hazardous liquids should be sent to an approved disposal site.
- Sufficient separation should be provided between stored containers to allow for spill cleanup and emergency response access.
- Incompatible materials, such as chlorine and ammonia, should not be stored in the same temporary containment facility.
- Throughout the rainy season, each temporary containment facility should be covered during non-working days, prior to, and during rain events.
- Materials should be stored in their original containers and the original product labels should be maintained in place in a legible condition. Damaged or otherwise illegible labels should be replaced immediately.

- Bagged and boxed materials should be stored on pallets and should not be allowed to accumulate on the ground. To provide protection from wind and rain throughout the rainy season, bagged and boxed materials should be covered during non-working days and prior to and during rain events.
- Stockpiles should be protected in accordance with WM-3, Stockpile Management.
- Materials should be stored indoors within existing structures or sheds when available.
- Proper storage instructions should be posted at all times in an open and conspicuous location.
- An ample supply of appropriate spill clean up material should be kept near storage areas.
- Also see WM-6, Hazardous Waste Management, for storing of hazardous materials.

Material Delivery Practices

- Keep an accurate, up-to-date inventory of material delivered and stored onsite.
- Arrange for employees trained in emergency spill cleanup procedures to be present when dangerous materials or liquid chemicals are unloaded.

Spill Cleanup

- Contain and clean up any spill immediately.
- Properly remove and dispose of any hazardous materials or contaminated soil if significant residual materials remain on the ground after construction is complete. See WM-7, Contaminated Soil Management.
- See WM-4, Spill Prevention and Control, for spills of chemicals and/or hazardous materials.

Cost

- The largest cost of implementation may be in the construction of a materials storage area that is covered and provides secondary containment.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Keep an ample supply of spill cleanup materials near the storage area.
- Keep storage areas clean, well organized, and equipped with ample cleanup supplies as appropriate for the materials being stored.
- Repair or replace perimeter controls, containment structures, covers, and liners as needed to maintain proper function.

References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

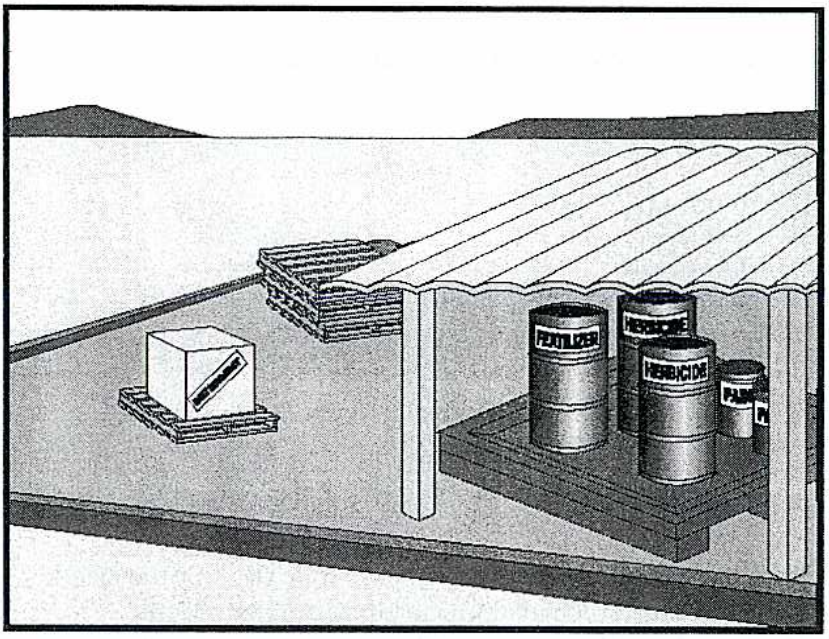
Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, Working Group Working Paper; USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Material Use

WM-2



Objectives

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

Description and Purpose

Prevent or reduce the discharge of pollutants to the storm drain system or watercourses from material use by using alternative products, minimizing hazardous material use onsite, and training employees and subcontractors.

Suitable Applications

This BMP is suitable for use at all construction projects. These procedures apply when the following materials are used or prepared onsite:

- Pesticides and herbicides
- Fertilizers
- Detergents
- Plaster
- Petroleum products such as fuel, oil, and grease
- Asphalt and other concrete components
- Other hazardous chemicals such as acids, lime, glues, adhesives, paints, solvents, and curing compounds
- Concrete compounds
- Other materials that may be detrimental if released to the environment

Limitations

Safer alternative building and construction products may not be available or suitable in every instance.

Implementation

The following steps should be taken to minimize risk:

- Minimize use of hazardous materials onsite.
- Follow manufacturer instructions regarding uses, protective equipment, ventilation, flammability, and mixing of chemicals.
- Train personnel who use pesticides. The California Department of Pesticide Regulation and county agricultural commissioners license pesticide dealers, certify pesticide applicators, and conduct onsite inspections.
- Do not over-apply fertilizers, herbicides, and pesticides. Prepare only the amount needed. Follow the recommended usage instructions. Over-application is expensive and environmentally harmful. Unless on steep slopes, till fertilizers into the soil rather than hydro seeding. Apply surface dressings in several smaller applications, as opposed to one large application, to allow time for infiltration and to avoid excess material being carried offsite by runoff. Do not apply these chemicals just before it rains.
- Train employees and subcontractors in proper material use.
- Supply Material Safety Data Sheets (MSDS) for all materials.
- Dispose of latex paint and paint cans, used brushes, rags, absorbent materials, and drop cloths, when thoroughly dry and are no longer hazardous, with other construction debris.
- Do not remove the original product label; it contains important safety and disposal information. Use the entire product before disposing of the container.
- Mix paint indoors or in a containment area. Never clean paintbrushes or rinse paint containers into a street, gutter, storm drain, or watercourse. Dispose of any paint thinners, residue, and sludge(s) that cannot be recycled, as hazardous waste.
- For water-based paint, clean brushes to the extent practicable, and rinse to a drain leading to a sanitary sewer where permitted, or into a concrete washout pit or temporary sediment trap. For oil-based paints, clean brushes to the extent practicable, and filter and reuse thinners and solvents.
- Use recycled and less hazardous products when practical. Recycle residual paints, solvents, non-treated lumber, and other materials.
- Use materials only where and when needed to complete the construction activity. Use safer alternative materials as much as possible. Reduce or eliminate use of hazardous materials onsite when practical.

- Require contractors to complete the "Report of Chemical Spray Forms" when spraying herbicides and pesticides.
- Keep an ample supply of spill clean up material near use areas. Train employees in spill clean up procedures.
- Avoid exposing applied materials to rainfall and runoff unless sufficient time has been allowed for them to dry.

Costs

All of the above are low cost measures.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two–week intervals in the non-rainy season to verify continued BMP implementation.
- Maintenance of this best management practice is minimal.
- Spot check employees and subcontractors throughout the job to ensure appropriate practices are being employed.

References

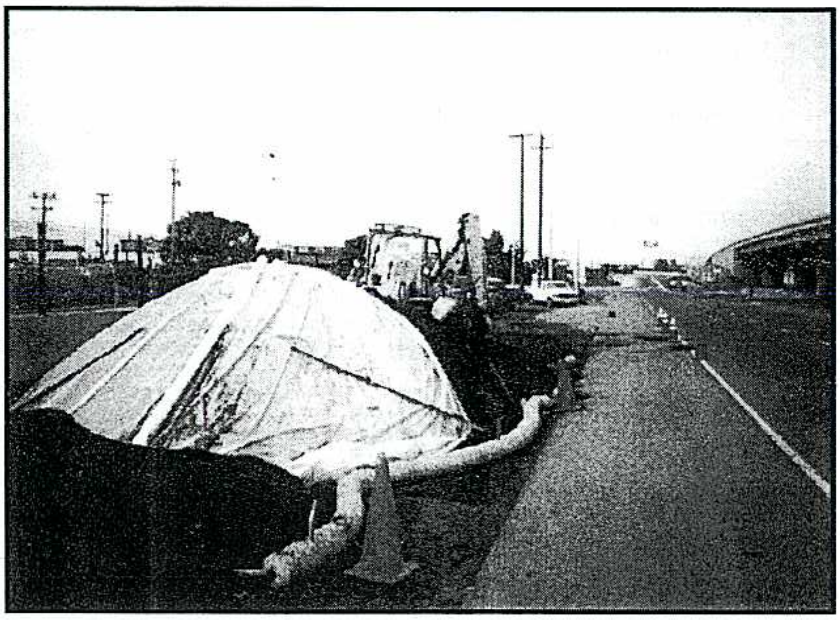
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, Working Group Working Paper; USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Stockpile Management WM-3



Objectives

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

Description and Purpose

Stockpile Management procedures and practices are designed to reduce or eliminate air and stormwater pollution from stockpiles of soil, paving materials such as portland cement concrete (PCC) rubble, asphalt concrete (AC), asphalt concrete rubble, aggregate base, aggregate sub base or pre-mixed aggregate, asphalt minder (so called "cold mix" asphalt), and pressure treated wood.

Suitable Applications

Implement in all projects that stockpile soil and other materials.

Limitations

None identified.

Implementation

Protection of stockpiles is a year-round requirement. To properly manage stockpiles:

- Locate stockpiles a minimum of 50 ft away from concentrated flows of stormwater, drainage courses, and inlets.
- Protect all stockpiles from stormwater runon using a temporary perimeter sediment barrier such as berms, dikes, fiber rolls, silt fences, sandbag, gravel bags, or straw bale barriers.

- Implement wind erosion control practices as appropriate on all stockpiled material. For specific information, see WE-1, Wind Erosion Control.
- Manage stockpiles of contaminated soil in accordance with WM-7, Contaminated Soil Management.
- Place bagged materials on pallets and under cover.

Protection of Non-Active Stockpiles

Non-active stockpiles of the identified materials should be protected further as follows:

Soil stockpiles

- During the rainy season, soil stockpiles should be covered or protected with soil stabilization measures and a temporary perimeter sediment barrier at all times.
- During the non-rainy season, soil stockpiles should be covered or protected with a temporary perimeter sediment barrier prior to the onset of precipitation.

Stockpiles of Portland cement concrete rubble, asphalt concrete, asphalt concrete rubble, aggregate base, or aggregate sub base

- During the rainy season, the stockpiles should be covered or protected with a temporary perimeter sediment barrier at all times.
- During the non-rainy season, the stockpiles should be covered or protected with a temporary perimeter sediment barrier prior to the onset of precipitation.

Stockpiles of "cold mix"

- During the rainy season, cold mix stockpiles should be placed on and covered with plastic or comparable material at all times.
- During the non-rainy season, cold mix stockpiles should be placed on and covered with plastic or comparable material prior to the onset of precipitation.

Stockpiles/Storage of pressure treated wood with copper, chromium, and arsenic or ammonical, copper, zinc, and arsenate

- During the rainy season, treated wood should be covered with plastic or comparable material at all times.
- During the non-rainy season, treated wood should be covered with plastic or comparable material at all times and cold mix stockpiles should be placed on and covered with plastic or comparable material prior to the onset of precipitation.

Protection of Active Stockpiles

Active stockpiles of the identified materials should be protected further as follows:

- All stockpiles should be protected with a temporary linear sediment barrier prior to the onset of precipitation.
- Stockpiles of "cold mix" should be placed on and covered with plastic or comparable material prior to the onset of precipitation.

Costs

All of the above are low cost measures.

Inspection and Maintenance

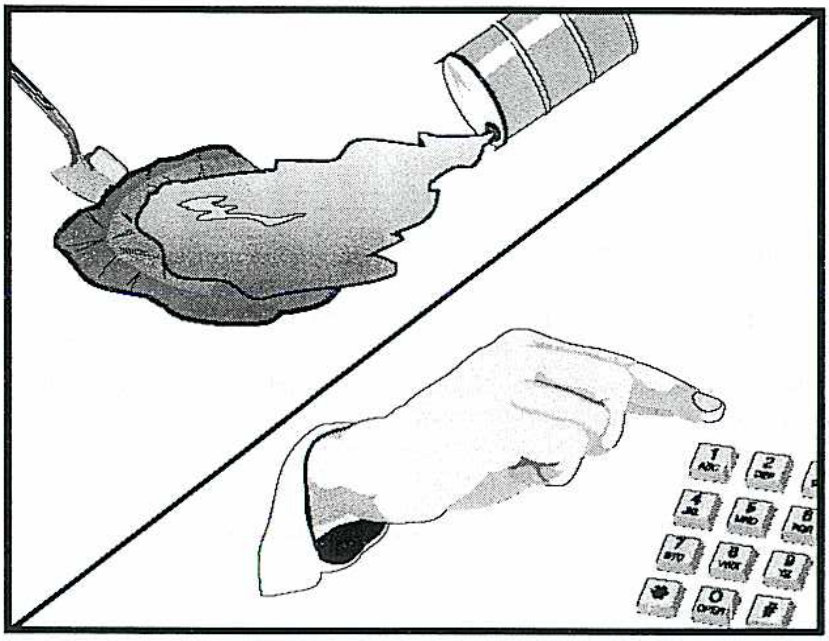
- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation

- Repair and/or replace perimeter controls and covers as needed to keep them functioning properly.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Spill Prevention and Control WM-4



Objectives

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

Description and Purpose

Prevent or reduce the discharge of pollutants to drainage systems or watercourses from leaks and spills by reducing the chance for spills, stopping the source of spills, containing and cleaning up spills, properly disposing of spill materials, and training employees.

This best management practice covers only spill prevention and control. However, WM-1, Materials Delivery and Storage, and WM-2, Material Use, also contain useful information, particularly on spill prevention. For information on wastes, see the waste management BMPs in this section.

Suitable Applications

This BMP is suitable for all construction projects. Spill control procedures are implemented anytime chemicals or hazardous substances are stored on the construction site, including the following materials:

- Soil stabilizers/binders
- Dust palliatives
- Herbicides
- Growth inhibitors
- Fertilizers
- Deicing/anti-icing chemicals

- Fuels
- Lubricants
- Other petroleum distillates

Limitations

- In some cases it may be necessary to use a private spill cleanup company.
- This BMP applies to spills caused by the contractor and subcontractors.
- Procedures and practices presented in this BMP are general. Contractor should identify appropriate practices for the specific materials used or stored onsite

Implementation

The following steps will help reduce the stormwater impacts of leaks and spills:

Education

- Be aware that different materials pollute in different amounts. Make sure that each employee knows what a "significant spill" is for each material they use, and what is the appropriate response for "significant" and "insignificant" spills.
- Educate employees and subcontractors on potential dangers to humans and the environment from spills and leaks.
- Hold regular meetings to discuss and reinforce appropriate disposal procedures (incorporate into regular safety meetings).
- Establish a continuing education program to indoctrinate new employees.
- Have contractor's superintendent or representative oversee and enforce proper spill prevention and control measures.

General Measures

- To the extent that the work can be accomplished safely, spills of oil, petroleum products, substances listed under 40 CFR parts 110,117, and 302, and sanitary and septic wastes should be contained and cleaned up immediately.
- Store hazardous materials and wastes in covered containers and protect from vandalism.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- Train employees in spill prevention and cleanup.
- Designate responsible individuals to oversee and enforce control measures.
- Spills should be covered and protected from stormwater runon during rainfall to the extent that it doesn't compromise clean up activities.
- Do not bury or wash spills with water.

- Store and dispose of used clean up materials, contaminated materials, and recovered spill material that is no longer suitable for the intended purpose in conformance with the provisions in applicable BMPs.
- Do not allow water used for cleaning and decontamination to enter storm drains or watercourses. Collect and dispose of contaminated water in accordance with WM-10, Liquid Waste Management.
- Contain water overflow or minor water spillage and do not allow it to discharge into drainage facilities or watercourses.
- Place proper storage, cleanup, and spill reporting instructions for hazardous materials stored or used on the project site in an open, conspicuous, and accessible location.
- Keep waste storage areas clean, well organized, and equipped with ample cleanup supplies as appropriate for the materials being stored. Perimeter controls, containment structures, covers, and liners should be repaired or replaced as needed to maintain proper function.

Cleanup

- Clean up leaks and spills immediately.
- Use a rag for small spills on paved surfaces, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to either a certified laundry (rags) or disposed of as hazardous waste.
- Never hose down or bury dry material spills. Clean up as much of the material as possible and dispose of properly. See the waste management BMPs in this section for specific information.

Minor Spills

- Minor spills typically involve small quantities of oil, gasoline, paint, etc. which can be controlled by the first responder at the discovery of the spill.
- Use absorbent materials on small spills rather than hosing down or burying the spill.
- Absorbent materials should be promptly removed and disposed of properly.
- Follow the practice below for a minor spill:
  - Contain the spread of the spill.
  - Recover spilled materials.
  - Clean the contaminated area and properly dispose of contaminated materials.

Semi-Significant Spills

- Semi-significant spills still can be controlled by the first responder along with the aid of other personnel such as laborers and the foreman, etc. This response may require the cessation of all other activities.

- Spills should be cleaned up immediately:
  - Contain spread of the spill.
  - Notify the project foreman immediately.
  - If the spill occurs on paved or impermeable surfaces, clean up using "dry" methods (absorbent materials, cat litter and/or rags). Contain the spill by encircling with absorbent materials and do not let the spill spread widely.
  - If the spill occurs in dirt areas, immediately contain the spill by constructing an earthen dike. Dig up and properly dispose of contaminated soil.
  - If the spill occurs during rain, cover spill with tarps or other material to prevent contaminating runoff.

Significant/Hazardous Spills

- For significant or hazardous spills that cannot be controlled by personnel in the immediate vicinity, the following steps should be taken:
  - Notify the local emergency response by dialing 911. In addition to 911, the contractor will notify the proper county officials. It is the contractor's responsibility to have all emergency phone numbers at the construction site.
  - Notify the Governor's Office of Emergency Services Warning Center, (916) 845-8911.
  - For spills of federal reportable quantities, in conformance with the requirements in 40 CFR parts 110,119, and 302, the contractor should notify the National Response Center at (800) 424-8802.
  - Notification should first be made by telephone and followed up with a written report.
  - The services of a spills contractor or a Haz-Mat team should be obtained immediately. Construction personnel should not attempt to clean up until the appropriate and qualified staffs have arrived at the job site.
  - Other agencies which may need to be consulted include, but are not limited to, the Fire Department, the Public Works Department, the Coast Guard, the Highway Patrol, the City/County Police Department, Department of Toxic Substances, California Division of Oil and Gas, Cal/OSHA, etc.

Reporting

- Report significant spills to local agencies, such as the Fire Department; they can assist in cleanup.
- Federal regulations require that any significant oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hours).

Use the following measures related to specific activities:

Vehicle and Equipment Maintenance

- If maintenance must occur onsite, use a designated area and a secondary containment, located away from drainage courses, to prevent the runon of stormwater and the runoff of spills.
- Regularly inspect onsite vehicles and equipment for leaks and repair immediately
- Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allow leaking vehicles or equipment onsite.
- Always use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- Place drip pans or absorbent materials under paving equipment when not in use.
- Use absorbent materials on small spills rather than hosing down or burying the spill. Remove the absorbent materials promptly and dispose of properly.
- Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around
- Oil filters disposed of in trashcans or dumpsters can leak oil and pollute stormwater. Place the oil filter in a funnel over a waste oil-recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask the oil supplier or recycler about recycling oil filters.
- Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

Vehicle and Equipment Fueling

- If fueling must occur onsite, use designate areas, located away from drainage courses, to prevent the runon of stormwater and the runoff of spills.
- Discourage "topping off" of fuel tanks.
- Always use secondary containment, such as a drain pan, when fueling to catch spills/ leaks.

Costs

Prevention of leaks and spills is inexpensive. Treatment and/ or disposal of contaminated soil or water can be quite expensive.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.

- Keep ample supplies of spill control and cleanup materials onsite, near storage, unloading, and maintenance areas.
- Update your spill prevention and control plan and stock cleanup materials as changes occur in the types of chemicals onsite.

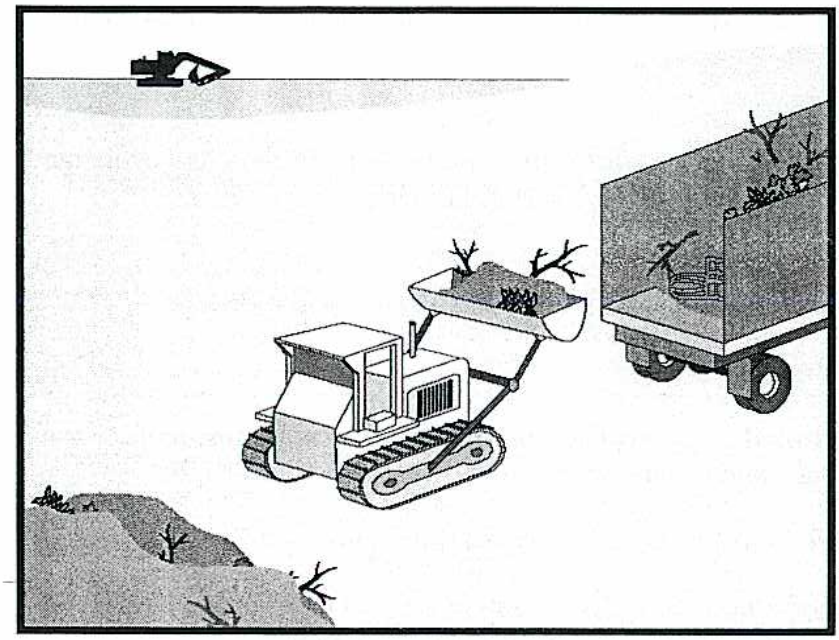
References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Solid Waste Management WM-5



Objectives

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

Description and Purpose

Solid waste management procedures and practices are designed to prevent or reduce the discharge of pollutants to stormwater from solid or construction waste by providing designated waste collection areas and containers, arranging for regular disposal, and training employees and subcontractors.

Suitable Applications

This BMP is suitable for construction sites where the following wastes are generated or stored:

- Solid waste generated from trees and shrubs removed during land clearing, demolition of existing structures (rubble), and building construction
- Packaging materials including wood, paper, and plastic
- Scrap or surplus building materials including scrap metals, rubber, plastic, glass pieces and masonry products
- Domestic wastes including food containers such as beverage cans, coffee cups, paper bags, plastic wrappers, and cigarettes
- Construction wastes including brick, mortar, timber, steel and metal scraps, pipe and electrical cuttings, non-hazardous equipment parts, styrofoam and other materials used to transport and package construction materials

- Highway planting wastes, including vegetative material, plant containers, and packaging materials

Limitations

Temporary stockpiling of certain construction wastes may not necessitate stringent drainage related controls during the non-rainy season or in desert areas with low rainfall.

Implementation

The following steps will help keep a clean site and reduce stormwater pollution:

- Select designated waste collection areas onsite.
- Inform trash-hauling contractors that you will accept only watertight dumpsters for onsite use. Inspect dumpsters for leaks and repair any dumpster that is not watertight.
- Locate containers in a covered area or in a secondary containment.
- Provide an adequate number of containers with lids or covers that can be placed over the container to keep rain out or to prevent loss of wastes when it is windy.
- Plan for additional containers and more frequent pickup during the demolition phase of construction.
- Collect site trash daily, especially during rainy and windy conditions.
- Remove this solid waste promptly since erosion and sediment control devices tend to collect litter.
- Make sure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.
- Do not hose out dumpsters on the construction site. Leave dumpster cleaning to the trash hauling contractor.
- Arrange for regular waste collection before containers overflow.
- Clean up immediately if a container does spill.
- Make sure that construction waste is collected, removed, and disposed of only at authorized disposal areas.

Education

- Have the contractor's superintendent or representative oversee and enforce proper solid waste management procedures and practices.
- Instruct employees and subcontractors on identification of solid waste and hazardous waste.
- Educate employees and subcontractors on solid waste storage and disposal procedures.

- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).
- Require that employees and subcontractors follow solid waste handling and storage procedures.
- Prohibit littering by employees, subcontractors, and visitors.
- Minimize production of solid waste materials wherever possible.

Collection, Storage, and Disposal

- Littering on the project site should be prohibited.
- To prevent clogging of the storm drainage system, litter and debris removal from drainage grates, trash racks, and ditch lines should be a priority.
- Trash receptacles should be provided in the contractor's yard, field trailer areas, and at locations where workers congregate for lunch and break periods.
- Litter from work areas within the construction limits of the project site should be collected and placed in watertight dumpsters at least weekly, regardless of whether the litter was generated by the contractor, the public, or others. Collected litter and debris should not be placed in or next to drain inlets, stormwater drainage systems, or watercourses.
- Dumpsters of sufficient size and number should be provided to contain the solid waste generated by the project.
- Full dumpsters should be removed from the project site and the contents should be disposed of by the trash hauling contractor.
- Construction debris and waste should be removed from the site biweekly or more frequently as needed.
- Construction material visible to the public should be stored or stacked in an orderly manner.
- Stormwater runon should be prevented from contacting stored solid waste through the use of berms, dikes, or other temporary diversion structures or through the use of measures to elevate waste from site surfaces.
- Solid waste storage areas should be located at least 50 ft from drainage facilities and watercourses and should not be located in areas prone to flooding or ponding.
- Except during fair weather, construction and highway planting waste not stored in watertight dumpsters should be securely covered from wind and rain by covering the waste with tarps or plastic.
- Segregate potentially hazardous waste from non-hazardous construction site waste.
- Make sure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.

- For disposal of hazardous waste, see WM-6, Hazardous Waste Management. Have hazardous waste hauled to an appropriate disposal and/or recycling facility.

- Salvage or recycle useful vegetation debris, packaging and surplus building materials when practical. For example, trees and shrubs from land clearing can be used as a brush barrier, or converted into wood chips, then used as mulch on graded areas. Wood pallets, cardboard boxes, and construction scraps can also be recycled.

Costs

All of the above are low cost measures.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.

- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur

- Inspect construction waste area regularly.

- Arrange for regular waste collection.

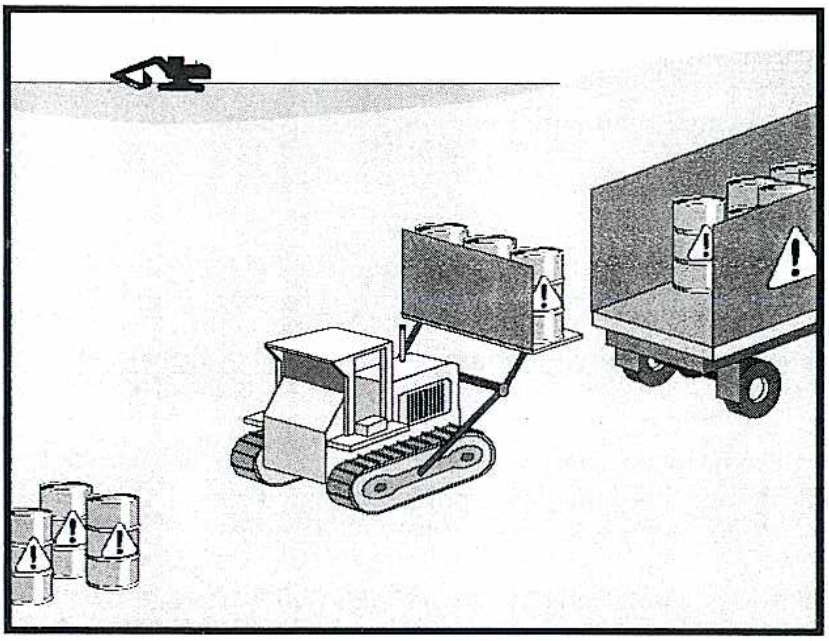
References

Processes, Procedures and Methods to Control Pollution Resulting from All Construction Activity, 430/9-73-007, USEPA, 1973.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Hazardous Waste Management WM-6



Objectives

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	☑
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

Description and Purpose

Prevent or reduce the discharge of pollutants to stormwater from hazardous waste through proper material use, waste disposal, and training of employees and subcontractors.

Suitable Applications

This best management practice (BMP) applies to all construction projects. Hazardous waste management practices are implemented on construction projects that generate waste from the use of:

- Petroleum Products
- Asphalt Products
- Concrete Curing Compounds
- Pesticides
- Palliatives
- Acids
- Septic Wastes
- Paints
- Stains
- Solvents
- Wood Preservatives
- Roofing Tar
- Any materials deemed a hazardous waste in California, Title 22 Division 4.5, or listed in 40 CFR Parts 110, 117, 261, or 302

In addition, sites with existing structures may contain wastes, which must be disposed of in accordance with federal, state, and local regulations. These wastes include:

- Sandblasting grit mixed with lead-, cadmium-, or chromium-based paints
- Asbestos
- PCBs (particularly in older transformers)

Limitations

- Hazardous waste that cannot be reused or recycled must be disposed of by a licensed hazardous waste hauler.
- Nothing in this BMP relieves the contractor from responsibility for compliance with federal, state, and local laws regarding storage, handling, transportation, and disposal of hazardous wastes.
- This BMP does not cover aerially deposited lead (ADL) soils. For ADL soils refer to WM-7, Contaminated Soil Management.

Implementation

The following steps will help reduce stormwater pollution from hazardous wastes:

Material Use

- Wastes should be stored in sealed containers constructed of a suitable material and should be labeled as required by Title 22 CCR, Division 4.5 and 49 CFR Parts 172, 173, 178, and 179.
- All hazardous waste should be stored, transported, and disposed as required in Title 22 CCR, Division 4.5 and 49 CFR 261-263.
- Waste containers should be stored in temporary containment facilities that should comply with the following requirements:
  - Temporary containment facility should provide for a spill containment volume equal to 1.5 times the volume of all containers able to contain precipitation from a 25 year storm event, plus the greater of 10% of the aggregate volume of all containers or 100% of the capacity of the largest tank within its boundary, whichever is greater.
  - Temporary containment facility should be impervious to the materials stored there for a minimum contact time of 72 hours.
  - Temporary containment facilities should be maintained free of accumulated rainwater and spills. In the event of spills or leaks, accumulated rainwater and spills should be placed into drums after each rainfall. These liquids should be handled as a hazardous waste unless testing determines them to be non-hazardous. Non-hazardous liquids should be sent to an approved disposal site.
  - Sufficient separation should be provided between stored containers to allow for spill cleanup and emergency response access.

- Incompatible materials, such as chlorine and ammonia, should not be stored in the same temporary containment facility.
- Throughout the rainy season, temporary containment facilities should be covered during non-working days, and prior to rain events. Covered facilities may include use of plastic tarps for small facilities or constructed roofs with overhangs.

- Drums should not be overfilled and wastes should not be mixed.
- Unless watertight, containers of dry waste should be stored on pallets.
- Do not over-apply herbicides and pesticides. Prepare only the amount needed. Follow the recommended usage instructions. Over application is expensive and environmentally harmful. Apply surface dressings in several smaller applications, as opposed to one large application. Allow time for infiltration and avoid excess material being carried offsite by runoff. Do not apply these chemicals just before it rains. People applying pesticides must be certified in accordance with federal and state regulations.
- Paint brushes and equipment for water and oil based paints should be cleaned within a contained area and should not be allowed to contaminate site soils, watercourses, or drainage systems. Waste paints, thinners, solvents, residues, and sludges that cannot be recycled or reused should be disposed of as hazardous waste. When thoroughly dry, latex paint and paint cans, used brushes, rags, absorbent materials, and drop cloths should be disposed of as solid waste.
- Do not clean out brushes or rinse paint containers into the dirt, street, gutter, storm drain, or stream. "Paint out" brushes as much as possible. Rinse water-based paints to the sanitary sewer. Filter and reuse thinners and solvents. Dispose of excess oil-based paints and sludge as hazardous waste.
- The following actions should be taken with respect to temporary contaminant:
  - Ensure that adequate hazardous waste storage volume is available.
  - Ensure that hazardous waste collection containers are conveniently located.
  - Designate hazardous waste storage areas onsite away from storm drains or watercourses and away from moving vehicles and equipment to prevent accidental spills.
  - Minimize production or generation of hazardous materials and hazardous waste on the job site.
  - Use containment berms in fueling and maintenance areas and where the potential for spills is high.
  - Segregate potentially hazardous waste from non-hazardous construction site debris.
  - Keep liquid or semi-liquid hazardous waste in appropriate containers (closed drums or similar) and under cover.

- Clearly label all hazardous waste containers with the waste being stored and the date of accumulation.
- Place hazardous waste containers in secondary containment.
- Do not allow potentially hazardous waste materials to accumulate on the ground.
- Do not mix wastes.
- Use all of the product before disposing of the container.
- Do not remove the original product label; it contains important safety and disposal information.

Waste Recycling Disposal

- Select designated hazardous waste collection areas onsite.
- Hazardous materials and wastes should be stored in covered containers and protected from vandalism.
- Place hazardous waste containers in secondary containment.
- Do not mix wastes, this can cause chemical reactions, making recycling impossible and complicating disposal.
- Recycle any useful materials such as used oil or water-based paint.
- Make sure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.
- Arrange for regular waste collection before containers overflow.
- Make sure that hazardous waste (e.g., excess oil-based paint and sludge) is collected, removed, and disposed of only at authorized disposal areas.

Disposal Procedures

- Waste should be disposed of by a licensed hazardous waste transporter at an authorized and licensed disposal facility or recycling facility utilizing properly completed Uniform Hazardous Waste Manifest forms.
- A Department of Health Services certified laboratory should sample waste to determine the appropriate disposal facility.
- Properly dispose of rainwater in secondary containment that may have mixed with hazardous waste.
- Attention is directed to "Hazardous Material", "Contaminated Material", and "Aerially Deposited Lead" of the contract documents regarding the handling and disposal of hazardous materials.

Education

- Educate employees and subcontractors on hazardous waste storage and disposal procedures.
- Educate employees and subcontractors on potential dangers to humans and the environment from hazardous wastes.
- Instruct employees and subcontractors on safety procedures for common construction site hazardous wastes.
- Instruct employees and subcontractors in identification of hazardous and solid waste.
- Hold regular meetings to discuss and reinforce hazardous waste management procedures (incorporate into regular safety meetings).
- The contractor's superintendent or representative should oversee and enforce proper hazardous waste management procedures and practices.
- Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.
- Warning signs should be placed in areas recently treated with chemicals.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- If a container does spill, clean up immediately.

Costs

All of the above are low cost measures.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur
- Hazardous waste should be regularly collected.
- A foreman or construction supervisor should monitor onsite hazardous waste storage and disposal procedures.
- Waste storage areas should be kept clean, well organized, and equipped with ample cleanup supplies as appropriate for the materials being stored.
- Perimeter controls, containment structures, covers, and liners should be repaired or replaced as needed to maintain proper function.
- Hazardous spills should be cleaned up and reported in conformance with the applicable Material Safety Data Sheet (MSDS) and the instructions posted at the project site.

- The National Response Center, at (800) 424-8802, should be notified of spills of federal reportable quantities in conformance with the requirements in 40 CFR parts 110, 117, and 302. Also notify the Governors Office of Emergency Services Warning Center at (916) 845-8911.
- A copy of the hazardous waste manifests should be provided.

References

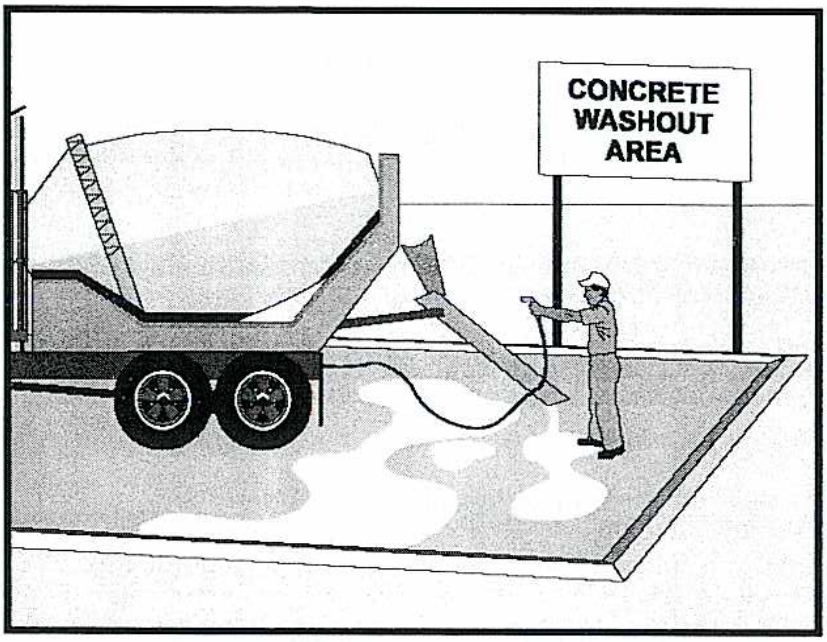
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Processes, Procedures and Methods to Control Pollution Resulting from All Construction Activity, 430/9-73-007, USEPA, 1973.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Concrete Waste Management WM-8



Objectives

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	☑
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

Description and Purpose

Prevent or reduce the discharge of pollutants to stormwater from concrete waste by conducting washout offsite, performing onsite washout in a designated area, and training employee and subcontractors.

Suitable Applications

Concrete waste management procedures and practices are implemented on construction projects where:

- Concrete is used as a construction material or where concrete dust and debris result form demolition activities
- Slurries containing portland cement concrete (PCC) or asphalt concrete (AC) are generated, such as from saw cutting, coring, grinding, grooving, and hydro-concrete demolition
- Concrete trucks and other concrete-coated equipment are washed onsite
- Mortar-mixing stations exist
- See also NS-8, Vehicle and Equipment Cleaning

Limitations

- Offsite washout of concrete wastes may not always be possible.

Implementation

The following steps will help reduce stormwater pollution from concrete wastes:

- Discuss the concrete management techniques described in this BMP (such as handling of concrete waste and washout) with the ready-mix concrete supplier before any deliveries are made.
- Incorporate requirements for concrete waste management into material supplier and subcontractor agreements.
- Store dry and wet materials under cover, away from drainage areas.
- Avoid mixing excess amounts of fresh concrete.
- Perform washout of concrete trucks offsite or in designated areas only.
- Do not wash out concrete trucks into storm drains, open ditches, streets, or streams.
- Do not allow excess concrete to be dumped onsite, except in designated areas.
- For onsite washout:
  - Locate washout area at least 50 feet from storm drains, open ditches, or water bodies. Do not allow runoff from this area by constructing a temporary pit or bermed area large enough for liquid and solid waste.
  - Wash out wastes into the temporary pit where the concrete can set, be broken up, and then disposed properly.
- Avoid creating runoff by draining water to a bermed or level area when washing concrete to remove fine particles and expose the aggregate.
- Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stockpile or dispose in the trash.

Education

- Educate employees, subcontractors, and suppliers on the concrete waste management techniques described herein.
- Arrange for contractor's superintendent or representative to oversee and enforce concrete waste management procedures.

Concrete Slurry Wastes

- PCC and AC waste should not be allowed to enter storm drains or watercourses.
- PCC and AC waste should be collected and disposed of or placed in a temporary concrete washout facility.
- A sign should be installed adjacent to each temporary concrete washout facility to inform concrete equipment operators to utilize the proper facilities.

- Below grade concrete washout facilities are typical. Above grade facilities are used if excavation is not practical.
- A foreman or construction supervisor should monitor onsite concrete working tasks, such as saw cutting, coring, grinding and grooving to ensure proper methods are implemented.
- Saw-cut PCC slurry should not be allowed to enter storm drains or watercourses. Residue from grinding operations should be picked up by means of a vacuum attachment to the grinding machine. Saw cutting residue should not be allowed to flow across the pavement and should not be left on the surface of the pavement. See also NS-3, Paving and Grinding Operations; and WM-10, Liquid Waste Management.
- Slurry residue should be vacuumed and disposed in a temporary pit (as described in OnSite Temporary Concrete Washout Facility, Concrete Transit Truck Washout Procedures, below) and allowed to dry. Dispose of dry slurry residue in accordance with WM-5, Solid Waste Management.

Onsite Temporary Concrete Washout Facility, Transit Truck Washout Procedures

- Temporary concrete washout facilities should be located a minimum of 50 ft from storm drain inlets, open drainage facilities, and watercourses. Each facility should be located away from construction traffic or access areas to prevent disturbance or tracking.
- A sign should be installed adjacent to each washout facility to inform concrete equipment operators to utilize the proper facilities.
- Temporary concrete washout facilities should be constructed above grade or below grade at the option of the contractor. Temporary concrete washout facilities should be constructed and maintained in sufficient quantity and size to contain all liquid and concrete waste generated by washout operations.
- Temporary washout facilities should have a temporary pit or bermed areas of sufficient volume to completely contain all liquid and waste concrete materials generated during washout procedures.
- Washout of concrete trucks should be performed in designated areas only.
- Only concrete from mixer truck chutes should be washed into concrete wash out.
- Concrete washout from concrete pumper bins can be washed into concrete pumper trucks and discharged into designated washout area or properly disposed of offsite.
- Once concrete wastes are washed into the designated area and allowed to harden, the concrete should be broken up, removed, and disposed of per WM-5, Solid Waste Management. Dispose of hardened concrete on a regular basis.
- Temporary Concrete Washout Facility (Type Above Grade)
  - Temporary concrete washout facility (type above grade) should be constructed as shown on the details at the end of this BMP, with a recommended minimum length and

minimum width of 10 ft, but with sufficient quantity and volume to contain all liquid and concrete waste generated by washout operations.

- Straw bales, wood stakes, and sandbag materials should conform to the provisions in SE-9, Straw Bale Barrier.

- Plastic lining material should be a minimum of 10 mil in polyethylene sheeting and should be free of holes, tears, or other defects that compromise the impermeability of the material.

- Temporary Concrete Washout Facility (Type Below Grade)

  - Temporary concrete washout facilities (type below grade) should be constructed as shown on the details at the end of this BMP, with a recommended minimum length and minimum width of 10 ft. The quantity and volume should be sufficient to contain all liquid and concrete waste generated by washout operations.

  - Lath and flagging should be commercial type.

  - Plastic lining material should be a minimum of 10 mil polyethylene sheeting and should be free of holes, tears, or other defects that compromise the impermeability of the material.

Removal of Temporary Concrete Washout Facilities

- When temporary concrete washout facilities are no longer required for the work, the hardened concrete should be removed and disposed of. Materials used to construct temporary concrete washout facilities should be removed from the site of the work and disposed of.

- Holes, depressions or other ground disturbance caused by the removal of the temporary concrete washout facilities should be backfilled and repaired.

Costs

All of the above are low cost measures.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.

- Temporary concrete washout facilities should be maintained to provide adequate holding capacity with a minimum freeboard of 4 in. for above grade facilities and 12 in. for below grade facilities. Maintaining temporary concrete washout facilities should include removing and disposing of hardened concrete and returning the facilities to a functional condition. Hardened concrete materials should be removed and disposed of.

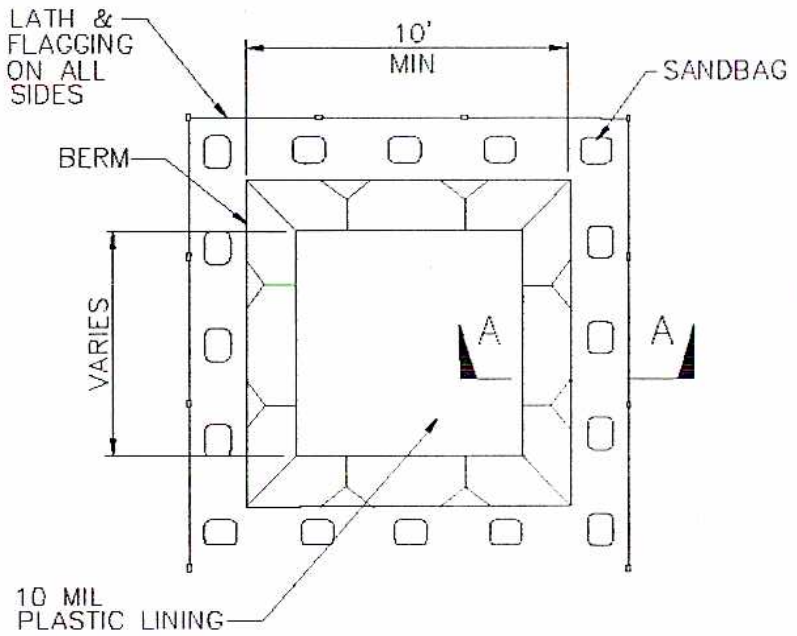
- Washout facilities must be cleaned, or new facilities must be constructed and ready for use once the washout is 75% full.

References

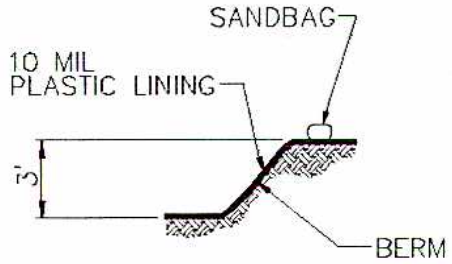
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

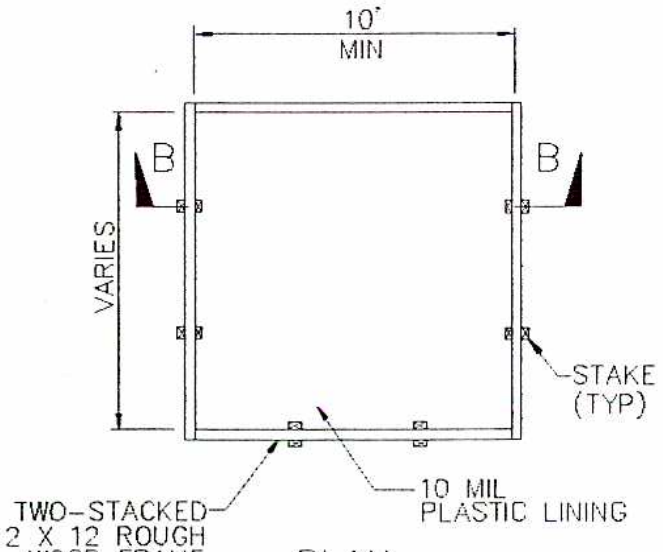
Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.



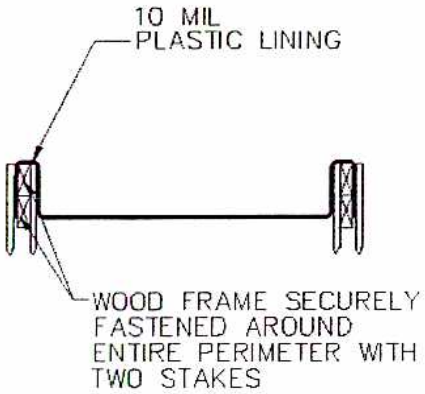
PLAN
NOT TO SCALE
TYPE "BELOW GRADE"



SECTION A–A
NOT TO SCALE



PLAN
NOT TO SCALE
TYPE "ABOVE GRADE"

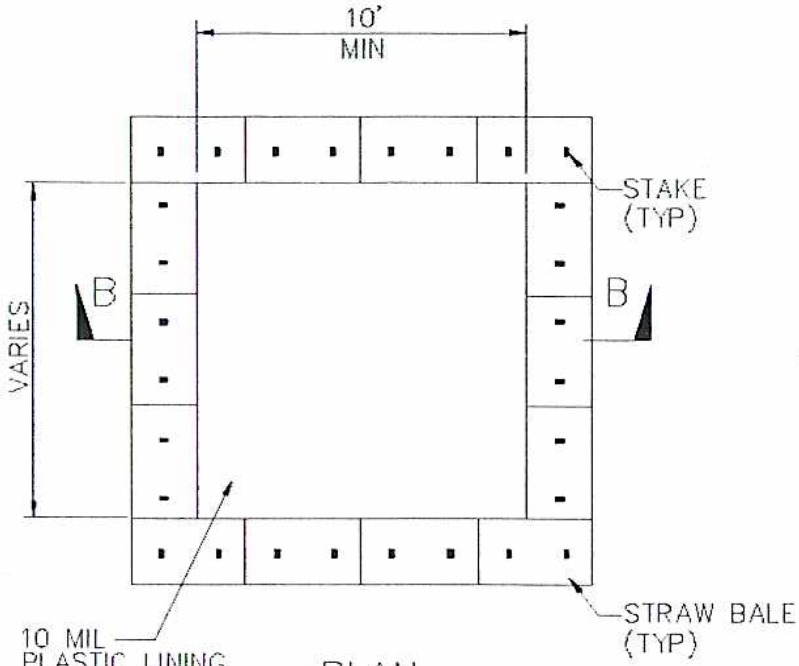


SECTION B–B
NOT TO SCALE

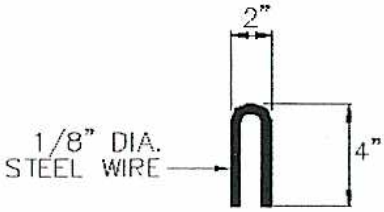
NOTES

1 ACTUAL LAYOUT DETERMINED IN FIELD.

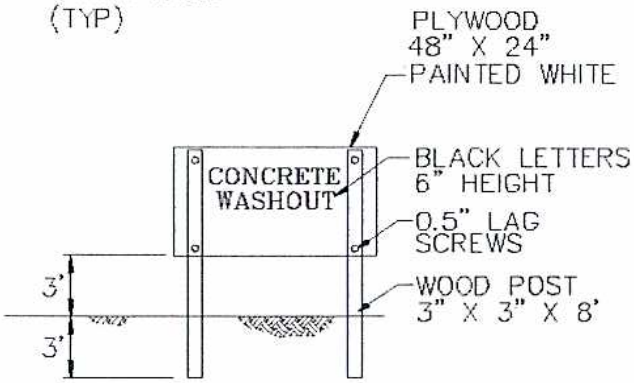
2. THE CONCRETE WASHOUT SIGN SHALL BE INSTALLED WITHIN 30 FT. OF THE TEMPORARY CONCRETE WASHOUT FACILITY.



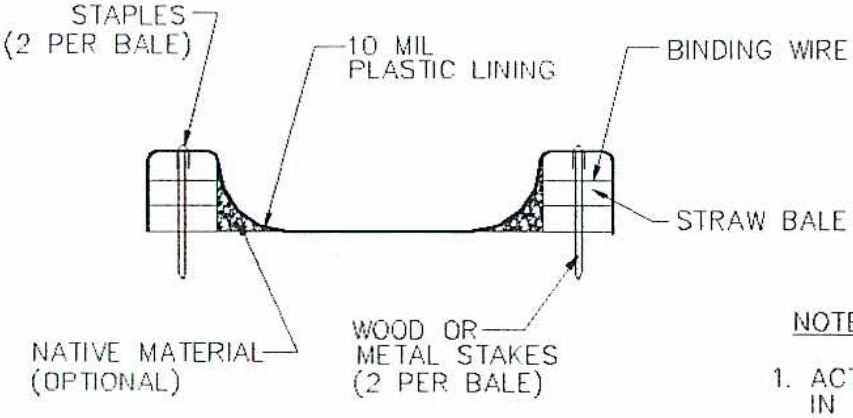
PLAN
NOT TO SCALE
TYPE "ABOVE GRADE"
WITH STRAW BALES



STAPLE DETAIL



CONCRETE WASHOUT
SIGN DETAIL
(OR EQUIVALENT)

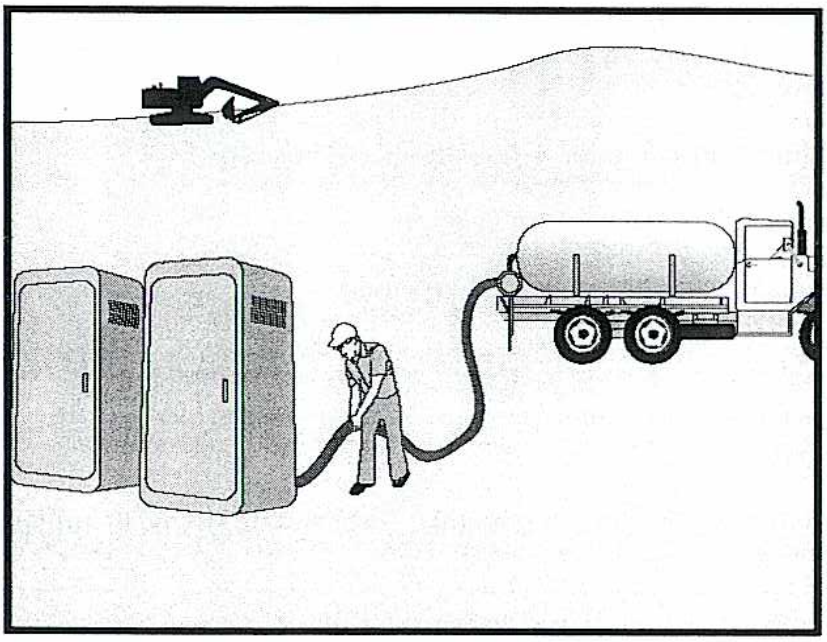


SECTION B–B
NOT TO SCALE

NOTES

1. ACTUAL LAYOUT DETERMINED IN FIELD.
2. THE CONCRETE WASHOUT SIGN SHALL BE INSTALLED WITHIN 30 FT. OF THE TEMPORARY CONCRETE WASHOUT FACILITY.

Sanitary/Septic Waste Management WM-9



Objectives

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	
Nutrients	☑
Trash	☑
Metals	
Bacteria	☑
Oil and Grease	
Organics	☑

Potential Alternatives

None

Description and Purpose

Proper sanitary and septic waste management prevent the discharge of pollutants to stormwater from sanitary and septic waste by providing convenient, well-maintained facilities, and arranging for regular service and disposal.

Suitable Applications

Sanitary septic waste management practices are suitable for use at all construction sites that use temporary or portable sanitary and septic waste systems.

Limitations

None identified.

Implementation

Sanitary or septic wastes should be treated or disposed of in accordance with state and local requirements. In many cases, one contract with a local facility supplier will be all that it takes to make sure sanitary wastes are properly disposed.

Storage and Disposal Procedures

- Temporary sanitary facilities should be located away from drainage facilities, watercourses, and from traffic circulation. When subjected to high winds or risk of high winds, temporary sanitary facilities should be secured to prevent overturning.
- Wastewater should not be discharged or buried within the project site.

- Sanitary and septic systems that discharge directly into sanitary sewer systems, where permissible, should comply with the local health agency, city, county, and sewer district requirements.
- Only reputable, licensed sanitary and septic waste haulers should be used.
- Sanitary facilities should be located in a convenient location.
- Untreated raw wastewater should never be discharged or buried.
- Temporary septic systems should treat wastes to appropriate levels before discharging.
- If using an onsite disposal system (OSDS), such as a septic system, local health agency requirements must be followed.
- Temporary sanitary facilities that discharge to the sanitary sewer system should be properly connected to avoid illicit discharges.
- Sanitary and septic facilities should be maintained in good working order by a licensed service.
- Regular waste collection by a licensed hauler should be arranged before facilities overflow.

Education

- Educate employees, subcontractors, and suppliers on sanitary and septic waste storage and disposal procedures.
- Educate employees, subcontractors, and suppliers of potential dangers to humans and the environment from sanitary and septic wastes.
- Instruct employees, subcontractors, and suppliers in identification of sanitary and septic waste.
- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).
- Establish a continuing education program to indoctrinate new employees.

Costs

All of the above are low cost measures.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Arrange for regular waste collection.
- If high winds are expected, portable sanitary facilities must be secured with spikes or weighed down to prevent over turning.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Transmission System Engineering

Data Responses 43-51

Transmission System Engineering (43-51)

PG&E Facilities Study Report

43. *Provide the PG&E Facilities Study and Re-Study Reports.*

Response: The PG&E Facilities Re-Study Report is included as Attachment DR43-1. This study supersedes the Facilities Study.

Transmission Line Routes

44. *Specify the route or routes that are seeking certification for the double circuit 230 kV interconnection line to PG&E's Eastshore substation.*

Response: The route shown on Amendment Petition Figure 2.1-1 as "Electrical Transmission Line" extends from the RCEC switchyard north to Depot Road and east to the Grant-Eastshore transmission corridor and from that point south along the Grant-Eastshore corridor to the Eastshore Substation. The route depicted in Figure 2.1-1 as the "Alternate Electrical Transmission Route" extends from the southeast corner of the RCEC project parcel directly east along the northern boundary of the City of Hayward Water Pollution Control Facility to the Grant-Eastshore transmission corridor. From this point, the alternate route would be the same as the "Electrical Transmission Line" route. RCEC seeks certification of both of these routes. Final choice of transmission interconnection will be made by PG&E in accordance with the Interconnection Agreement.

Expansion of the Eastshore Substation

45. *For identification of the facilities required for interconnection to and expansion of the Eastshore 230/115 kV substation,*

    a. *Provide electrical one-line diagrams of the Eastshore substation before and after the proposed interconnection of the RCEC showing: (i) arrangements of major equipment, such as buses, circuit breakers and disconnect switches with their respective ratings, and (ii) the transmission lines and 230/115 kV transformers connected to the substation*

    b. *Provide a post-project physical layout drawing of the Eastshore substation showing major equipment and transmission line outlets. Indicate whether or not the interconnection of the RCEC will require expansion of the Eastshore substation outside the existing substation fence line.*

Response: PG&E is preparing the preliminary one-line and layout drawings that will show Eastshore Substation before and after the RCEC is connected. These preliminary drawings will be submitted to the CEC when they become available. This is expected within 30 days.

Reconductoring of the Eastshore-San Mateo 230 kV line

46. *For the identified mitigation by reconductoring of the Eastshore-San Mateo 230 kV line (no. 1) to eliminate its overloads, provide the PG&E planned transmission project number, the expected on-line date and indicate whether or not the project has the CA ISO approval.*

    Alternatively, *to mitigate overloads on the Eastshore-San Mateo 230 kV lines (Nos. 1 & 2) and other overloads due to the RCEC interconnection, indicate whether the mitigation measures would include: SIS identifies low voltage criteria violations and describes the replacement of the existing condensers at the Humboldt substation with a 100 MVAR Static VAR Compensator (SVC) as the mitigation for these violations. Please identify whether or not the SVC project is a planned PG&E project that is needed, whether or not the HBRP is operating. Provide the project number, the expected on-line date, and inform whether or not the project has CA ISO approval.*

    a. *System reconfiguration by looping the existing Pittsburg-San Mateo 230 kV line no. 2 into the Eastshore 230 kV substation.*

    b. *Reconductoring both the Eastshore-San Mateo 230 kV lines Nos. 1 & 2 with 954 KCM SSAC conductor.*

Response: PG&E Project No. P.02186 is part of the network upgrade needed to interconnect the RCEC to the California Independent System Operator-controlled (CAISO-controlled) grid. The Eastshore-San Mateo part of the network upgrade project is expected to be on-line by 1/31/2009. CAISO approved the interconnection of the RCEC Project on 11/7/2006.

PG&E Reconductoring Information

47. *For the identified mitigation by reconductoring the Eastshore-Dumbarton 115 kV line to eliminate its overloads, provide PG&E planned transmission project number, the expected on-line date and indicate whether the project has the CA ISO approval.*

Response: PG&E Project No. P.02186 is part of the network upgrade needed to interconnect RCEC to the CAISO-controlled grid. The Eastshore-Dumbarton part of the network upgrade project is expected to be on-line by 12/31/2008. CAISO approved the interconnection of the RCEC Project on 11/7/2006.

Overload Mitigation on the Newark-Dumbarton 115 kV line and Eastshore 230/115 kV Transformer Bank

48. *To eliminate overloads on the Newark-Dumbarton 115 kV line and Eastshore 230/115 kV transformer bank Nos. 1 & 2, select and describe the respective mitigation measure. If the mitigation is a PG&E planned transmission project through their annual grid study, provide a brief description of the project, the PG&E transmission project number, the expected on-line date, and indicate whether or not the project has the CA ISO approval.*

Response: PG&E Project No. P.01769 was operational on 12/21/2006. This project replaced the existing conductors on the Newark-Dumbarton 115 kV line with 795 kcmil ACSS conductors. PG&E Project No. P.01951 is a PG&E maintenance project which is expected to be operational by 12/31/2007. This maintenance project will replace one of the two existing Eastshore 230/115 kV transformer banks with one three-phase 420 MVA bank. PG&E Project No. P.02186 is part of the network upgrade needed to interconnect the RCEC Project

and is expected to be operational by 12/31/2009. This network upgrade project will replace the other Eastshore 230/115 kV transformer bank with one three-phase 420 MVA bank. These two transformer projects will mitigate the expected overload on the Eastshore 230/115 kV transformer banks due to the RCEC Project interconnection.

PG&E Project No. P0423

49. *Please provide a brief description of PG&E project no. P0423, the identified mitigation for overload violations on the Contra Costa-Delta Pumps and Tesla-Delta Pumps 230 kV lines. The description should include a general discussion of the facilities involved in the project, the expected on-line date and should indicate whether or not the project has the CA ISO approval.*

Response: PG&E Project No. P0523 was incorrectly identified as Project No. P0423 in the December 13, 2005 System Impact Study (SIS) Report. Project No. P0523 is a generation project with 157.2 MW output to the CAISO-controlled grid. This generation project will be connected to the existing 230 kV bus at Contra Costa Power Plant Substation with an expected commercial operation date of January 2008. This project is responsible for mitigating the overloads on Contra Costa-Delta Pumps and Tesla-Delta Pumps 230 kV lines according to SIS for this project issued on 11/29/2005. This project is in the SIS re-study process because one of the higher-queued generation projects affecting Project No. P0523's interconnection was removed from the queue.

Overload Mitigation on the Sobrante-Moraga 115 kV line and Contra Costa-Brentwood 230 kV line

50. *To eliminate overloads on the Sobrante-Moraga 115 kV line and Contra Costa-Brentwood 230 kV line, identify and describe the selected respective mitigation measure and provide a report or letter from PG&E documenting that the mitigation is acceptable. If the mitigation is a PG&E planned transmission project through their annual grid study, provide a brief description of the project, the PG&E transmission project number, the expected on-line date, and indicate whether or not the project has the CA ISO approval. Where the mitigation is required solely for the reliable interconnection of the RCEC and includes reconductoring or other facility upgrades outside the fence line of an existing facility, provide (if not already provided) a description of the mitigation project with the expected on-line date including the line routes, a general environmental analysis of the physical impacts and any recommended mitigation measures sufficient to meet CEQA requirements for indirect project impacts.*

Response: PG&E and CAISO agreed that the RCEC Project is not responsible for mitigating the slight (1 percent) overload on the Sobrante-Moraga 115 kV line during Category B contingencies. This is because higher (3 percent to 8 percent) overloads occur on the same line without the RCEC, during Category B contingencies. At this time, there is no project identified in the annual PG&E planning studies which assesses summer peak loading periods only in this area. PG&E Project No. P0523 is responsible for mitigating the overloads on Contra Costa-Brentwood 230 kV line according to the SIS for this project issued on 11/29/2005. This project is in the SIS re-study process because one of the higher-queued generation projects affecting Project No. P0523's interconnection was removed from the queue.

SPS Recommendation

51. *Provide verification from PG&E and the CA ISO whether or not a SPS as recommended by the CA ISO in 2002, is still required to mitigate CA ISO Category C (N-2) contingency overloads regardless of whether or not the Eastshore-San Mateo 230 kV line Nos. 1 & 2 are reconductored.*

Response: The CAISO preliminary approval letter dated 9/10/2001 was for the RCEC project design studied in the SIS dated 10/10/2001. It has 620 MW output to the CAISO-controlled grid with an expected on-line date of July 2003. The amended RCEC design includes a combined output of 600 MW. The new project has a later on-line date, different queue position and a new SIS. As a result, the original RCEC Project was cancelled. Hence, the result of the SIS dated 10/10/2001 is no longer valid.

Attachment DR43-1

PG&E Facilities Re-Study Report

Interconnection Facilities Study Report (Re-study)

Generation Interconnection

Calpine Corporation

RCEC 230 kV Generator Tie-Lines

Pacific Gas and Electric Company

WE DELIVER ENERGY.

November 2, 2006

Table of Contents

1. Executive Summary 1

2. Project and Interconnection Information 2

3. 230 kV Generator Tie-Line Cost Summary and Schedule 3

3.1 Interconnection Facilities Cost 4

3.2 Preliminary Construction Schedule 4

4. RCEC (2X1) Cost Summary and Schedule 5

4.1 RCEC (2X1) Interconnection Facilities Costs 5

4.2 RCEC (2X1) Network Upgrade Costs 6

5. Study Assumptions 7

6. System Impact Study Results 8

7. Facilities Study Scope 10

7.1 Transmission Tie-Line Evaluation 10

7.2 RCEC Switchyard Evaluation 10

7.3 Land Evaluation 10

8. Environmental Evaluation / Permitting 11

8.1 CPUC General Order 131-D 11

8.2 CPUC Section 851 12

8.3 Supplemental PG&E Environmental / Permitting Activity 12

9. Study Updates 12

10. Stand-by Power 13

1. Executive Summary

Calpine Corporation (Calpine) has proposed the Russell City Energy Center (RCEC) Project and the Russell City Energy Center Expansion Project (collectively called the Project), a combined cycle plant consisting of two combustion gas turbines and one steam turbine generator. The nominal net output to the Pacific Gas & Electric Company (PG&E) Transmission grid will be 600 MW. The commercial operational date is June 1, 2010. PG&E issued Facilities Study (FS) reports for both projects under Amendment 39 on March 14 and March 16, 2006 that provided work scope and cost estimates for the interconnection of the Project. Following the issuance of the FS reports, and in accordance with Section 5 of FERC's Large Generation Interconnection Procedures (LGIP), the Project transitioned from the Amendment 39 process to the Large Generator Interconnection Procedures (LGIP).

The FS reports originally assumed that Calpine would engineer, construct, own and maintain the generator tie lines from the Project to the 230 kV bus at PG&E's East Shore Substation. Hence, no work scope and cost estimates were provided in the FS reports for the generator tie lines.

However, on April 4, 2006, after issuance of the FS reports, Calpine requested PG&E to engineer, procure, construct, own and maintain the generator tie lines for the Project and change the Commercial Operation Date to June 1, 2010. On April 7, 2006, the California Independent System Operator (CAISO) and PG&E agreed that these changes were not Material Modifications pursuant to Section 4.4 of the LGIP and that a re-study was acceptable under the terms of Section 8.5 of the LGIP. On April 12, 2006, Calpine requested PG&E to proceed with this re-study report (Re-Study). Consequently, the Interconnection Facilities Study (IFAS) Plan was issued and agreed upon to determine the work scope and cost estimates for the generation tie line facilities assuming PG&E would engineer, procure, construct, own and maintain these Interconnection Facilities. On May 2, 2006 PG&E delivered a signed copy of the Interconnection Facilities Study Agreement, which was executed by Calpine and returned to PG&E on May 18, 2006.

This IFAS provides:

1. Work scope and cost estimates for the Interconnection Facilities[1] necessary to interconnect the Project to PG&E's grid.

The additional Interconnection Facilities addressed in this Re-Study consist of constructing a double-circuit 230 kV generator tie line from the Project to PG&E's East Shore Substation.

The cost of these additional Interconnection Facilities to interconnect the project would be approximately **$7.6 million** exclusive of ITCC[2], as shown in Table 3-2 of this Re-Study.

[1] Interconnection Facilities are those transmission facilities necessary to physically and electrically interconnect the Project to the CAISO Controlled Grid at the point of interconnection

A cost summary for the entire combined cycle (2X1) Project is provided in Section 4. These costs were compiled from the Russell City Energy Center Project FS Report dated March 14, 2006, the Russell City Energy Center Expansion Project dated March 16, 2006, and this Re-Study. Collectively, the facilities for the entire Project comprise the Interconnection Facilities costs summarized in Table 4-2 and the Network Upgrades costs shown in Table 4-3. Table 4-1 shows all Interconnection Facilities and Network Upgrades required to interconnect the Project to the CAISO controlled grid.

2. Project and Interconnection Information

The Project will consist of two gas turbine generators each rated at 180 MW and one steam turbine generator rated at 254 MW. The plant auxiliary load is 14 MW. The total net output to the PG&E transmission grid of the combined cycle Russell City Energy Center will be 600 MW. Each generator will have a three-phase 18/230 kV step-up transformer. The Project will be connected to PG&E's 230 kV bus at East Shore Substation in the city of Hayward, California via two 230 kV generator tie lines. A conceptual one-line diagram of the Project is shown in Figure 2-1.

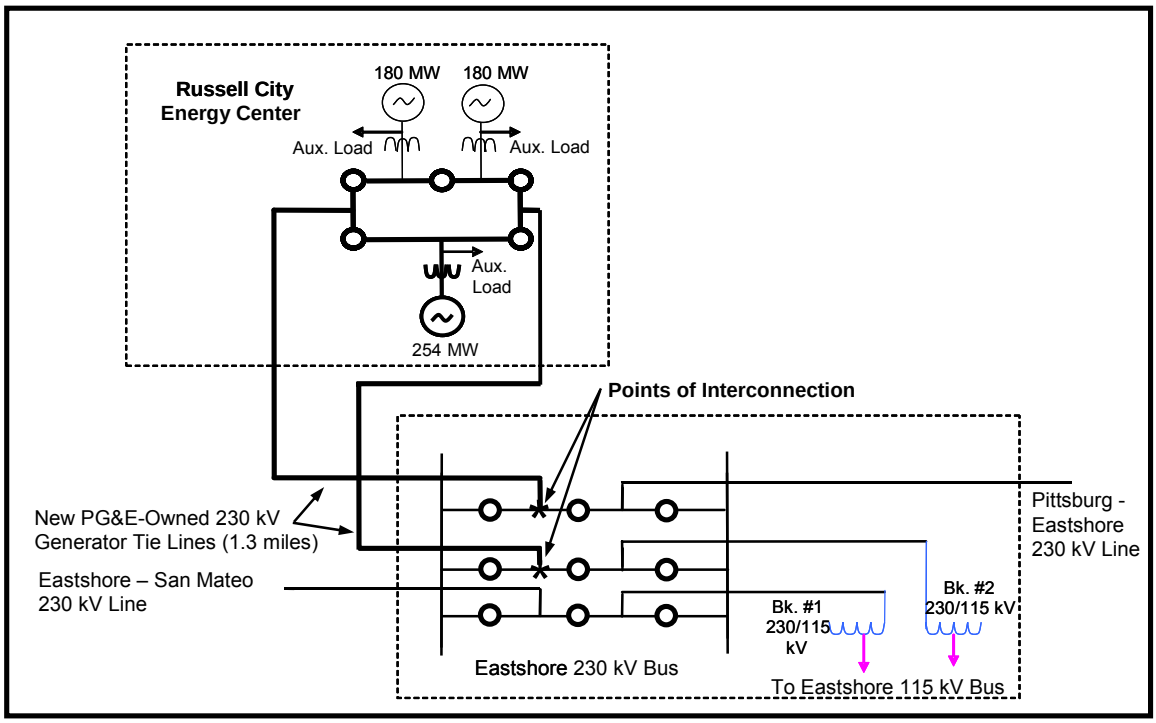


Figure 2-1: Conceptual Single-line Diagram

[2] Income Tax Component of Contribution

Figure 2-2 shows the approximate location of the Project and the transmission facilities in the area. The entire 230 kV generator tie line will be located within PG&E's existing Grant – East Shore 115 kV right-of-way, with the exception of an approximate 500 foot section from the PG&E right-of-way to the Project, where additional right of way must be acquired.

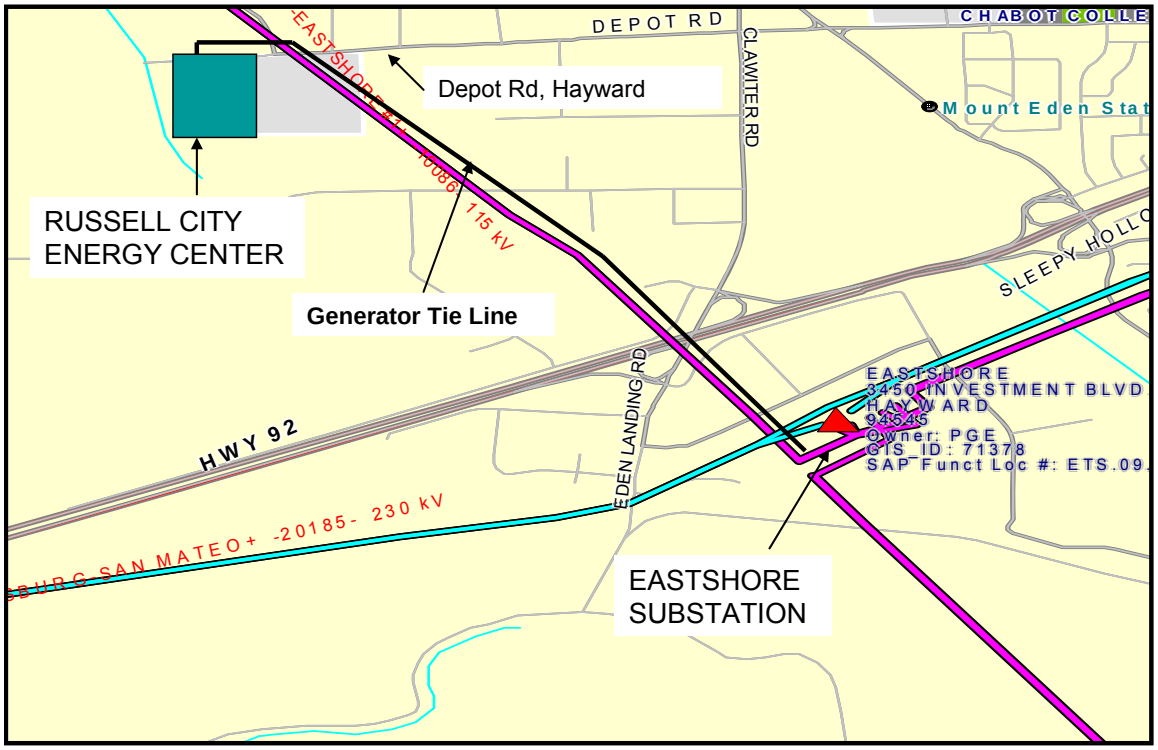


Figure 2-2: Location Map

3. 230 kV Generator Tie-Line Cost Summary and Schedule

A summary of the estimated costs are provided below in Table 3-1, with more detailed Interconnection Facilities costs provided in Subsection 3.1. Costs provided are not final and will need to be reconciled with actual costs upon completion of the project. Section 7 provides the work scope of the required work.

Table 3-1 Cost Estimate Summary

Total Interconnection Facilities Cost	**$7,600,000**		
ITCC Tax @ 34 %	**$2,584,000**		
Total Interconnection Facilities Cost with ITCC		**$10,184,000**	
Total Additional Interconnection Costs as determined in this Re-Study			**$10,184,000**

3.1 Interconnection Facilities Cost

A summary of the Interconnection Facilities cost estimates for the facilities required to interconnect the Project with PG&E's transmission system is shown in Table 3-2. These facilities are necessary to physically and electrically interconnect the Project to the CAISO Controlled Grid at the point of interconnection. These costs are not final and will need to be reconciled with actual costs upon completion of the project.

Table 3-2 Interconnection Facilities Cost Estimates

Transmission Line Work:			
Russell City EC-East Shore 230 kV Line			
Transmission line engineering, design, materials and construction of double-circuit 230 kV generator tie line from RCEC to East Shore Substation	$6,600,000		
Subtotal Transmission Line Work		**$6,600,000**	
Land Services Work			
Land engineering support, acquisition of rights-of-way and permitting activities[3]	$1,000,000		
Subtotal Land Services Work		**$1,000,000**	
Total Interconnection Facilities Cost before ITCC as determined by this Re-Study			**$7,600,000**

3.2 Preliminary Construction Schedule

The Preliminary Construction Schedule (Schedule) to construct the Interconnection Facilities based on the work scope outlined in this IFAS is approximately 30 to 36 months from the execution of the Large Generator Interconnection Agreement (LGIA) and payment of the estimated Interconnection Facilities and Network Upgrade costs which were determined in the Facilities Study reports for the Project under Amendment 39 on March 14 and March 16, 2006. Such costs are to be paid according to a schedule which meets PG&E's payment obligations consistent with the Schedule, and as mutually agreed between Calpine and PG&E. This schedule reflects the time PG&E requires to engineer, design, schedule, procure materials and construct the necessary facilities.

The Schedule also includes the time required to obtain permits anticipated in Section 7.3. The Schedule specifically includes a CPCN for the generator tie line, which may take at least 6 months up to 18 months or more to obtain. Other permits that may be required by the CPUC, state, local, or federal agencies are described in Section 8. Additional permits required beyond those anticipated could impact the Project's schedule.

[3] A portion of these costs are associated with acquiring additional rights-of-way from PG&E's existing transmission corridor to the Project, a distance of approximately 500 feet. PG&E confirms that there is sufficient width within its existing corridor to physically accommodate the new 230 kV lines consistent with PG&E transmission design criteria, and does not require the acquisition of any new rights-of-way within the existing corridor.

The FS reports for the combined cycle (2X1) Russell City Energy Center Project determined the tentative schedule to design, permit, and construct the Interconnection Facilities and Network Upgrade facilities for the entire Project is approximately 30 to 42 months[4] from the execution of the LGIA and payment of the estimated Interconnection Facilities and Network Upgrade costs.

4. RCEC (2X1) Cost Summary and Schedule

A cost summary for the entire combined cycle (2X1) Russell City Energy Center Project Interconnection is shown in Table 4-1. All costs provided are not final and will need to be reconciled with the actual costs upon completion of the Project. These costs were compiled from the Russell City Energy Center Project FS Report dated March 14, 2006, the Russell City Energy Center Expansion Project FS Report dated March 16, 2006, and Section 3 of this report. The estimates in this section shall be used to provide a payment schedule (as noted in Section 3.2 above) in the LGIA to be negotiated between PG&E, CAISO and Calpine, and will differ from the summation of the three reports.

Table 4-1 Cost Estimate Summary: 600 MW Combined Cycle Plant

Russell City Energy Center (2X1) Interconnection Facilities Cost	**$8,200,000**		
ITCC Tax @ 34 %	**$2,788,800**		
Total Interconnection Facilities Cost with ITCC		**$10,988,000**	
Russell City Energy Center (2X1) Network Upgrade Cost	**$37,510,000**		
Total Network Upgrade Cost		**$37,510,000**	
Total Interconnection Cost			**$48,498,000**

4.1 RCEC (2X1) Interconnection Facilities Costs

A summary of the Interconnection Facilities cost estimates for the facilities required to interconnect the combined cycle (2X1) Russell City Energy Center Project to PG&E's transmission system is shown in Table 4-2. This information was compiled from the FS reports provided to Calpine dated March 14 and March 16, 2006.

Together with the Interconnection Facilities described in Section 3.1 above, these are the facilities necessary to physically and electrically interconnect the Project to the CAISO Controlled Grid at the point of interconnection. These costs are not final and will need to be reconciled with actual costs upon completion of the project.

[4] Please see section 8.3 and the Transmission Upgrade Evaluation Report dated October 3, 2006.

Table 4-2 Interconnection Facilities Cost Estimates: 600 MW Combined Cycle Plant (2X1)

Substation Work			
Russell City EC Project Facility			
Pre-parallel inspection, testing, SCADA, EMS setup, engineering support, etc.	$300,000		
PG&E's East Shore Substation			
Install two line disconnect switches and associated substation construction up to the point of interconnection	$300,000		
Subtotal Substation Work		**$600,000**	
Transmission Line Work:			
Russell City EC-East Shore 230 kV Line			
Transmission line engineering, design and construction activities from RCEC to East Shore Substation	$6,600,000		
Subtotal Transmission Line Work		**$6,600,000**	
Land Services Work			
Land engineering support, rights–of-way, permitting activities and preparing and filing a CPCN	$1,000,000		
Subtotal Land Services Work		**$1,000,000**	
Total Interconnection Facilities Cost before ITCC			**$8,200,000**

4.2 RCEC (2X1) Network Upgrade Costs

A summary of the Network Upgrade cost estimates for the facilities required to interconnect the combined cycle (2X1) Russell City Energy Center Project to PG&E's transmission system is shown in Table 4-3. This information was compiled from the FS reports provided to Calpine dated March 14 and March 16, 2006.

These are the facilities necessary to physically and electrically interconnect the Project to the CAISO Controlled Grid beyond the point of interconnection. These costs are not final and will need to be reconciled with actual costs upon completion of the project.

Table 4-3 Network Upgrade Cost Estimates: 600 MW Combined Cycle Plant (2X1)

Substation Work			
PG&E's East Shore Substation			
Re-configure the 230kV bus to a breaker-and-a-half (BAAH) scheme and replace one 115/230 kV transformer.	$20,000,000		
PG&E's San Mateo Substation			
Protective relay replacement and telecommunication changes.	$380,000		
PG&E's Pittsburg Substation			
Protective relay replacement and telecommunication changes.	$380,000		
Subtotal Substation Work		**$20,760,000**	
Transmission Line Work:			
PG&E's East Shore-San Mateo 230 kV Line			
Re-conductor with 954 kcmil ACSS	$7,750,000		
PG&E's East Shore-Dumbarton 115 kV Line			
Re-conductor with 2-477 kcmil ACSS running parallel	$8,600,000		
Subtotal Transmission Line Work		**$16,350,000**	
Land Services Work			
Land engineering support, rights–of-way and permitting activities	$350,000		
Subtotal Land Services Work		**$350,000**	
Miscellaneous Work			
Pre-parallel inspection, testing, SCADA, EMS setup, engineering support, etc.	$50,000		
Subtotal Miscellaneous Work		**$50,000**	
Total Network Upgrade Cost			**$37,510,000**

5. Study Assumptions

PG&E conducted the IFAS with the following assumptions:

1) The Project consists of two combustion turbine generators each rated at 180 MW and one steam turbine generator rated at 254 MW for a total output of 614 MW. There is an expected total plant load of 14 MW. The maximum nominal net output to the PG&E transmission grid will be 600 MW at ISO[5] conditions.

[5] International Standards Organization definition for standard temperature and pressure

2) The expected commercial operation date is June 1, 2010.

3) The Project has three step-up transformers. Each combustion turbine has a three phase, 13.8/230 kV transformer, rated for150/200/250 MVA (OA/FA/FA) with an impedance of 10% @ 150 MVA base. The steam turbine has a three phase, 18/230 kV transformer, rated for 180/240/300 MVA (OA/FA/FA) with an impedance of 10% @ 180 MVA base.

4) Calpine will engineer, procure, construct, own and maintain its project facility.

5) PG&E will engineer, procure, construct, own and maintain the double-circuit generator tie lines from the Project to the 230 kV bus at East Shore Substation.

6) The generator tie lines are approximately 1.3 miles in length and will be located within PG&E's existing Grant – East Shore 115 kV right-of-way, with the exception of an approximately 500 foot section from the PG&E right-of-way to the Project

7) East Shore 230 kV bus is assumed to be reconfigured to a Breaker-And-A-Half scheme (BAAH) for the Russell City Energy Center Project.

6. System Impact Study Results

The SIS for the Russell City Energy Center Project issued on July 1, 2005 concluded that the Project would:

1) Cause one normal overload that will require mitigation by the Project. The overloaded facility is the East Shore-San Mateo 230 kV Line.

2) Cause five CAISO Category "B" emergency overloads that will require mitigation by the Project. These overloaded facilities are:

   - East Shore-San Mateo 230 kV Line
   - East Shore-Dumbarton 115 kV Line
   - Dumbarton-Newark 115 kV Line
   - East Shore 230/115 kV Transformer Bank No. 1
   - East Shore 230/115 kV Transformer Bank No. 2

3) Cause several CAISO Category "C" emergency overloads on the transmission system that will require mitigation by the Project. The IFAS does not provide specific cost estimate on mitigating these emergency overloads.

4) Cause no significant transient stability impacts on the transmission system.

5) Cause the reconfiguration of the 230 kV bus at East Shore Substation to a new breaker-and-a-half (BAAH) scheme. This work will be completed within PG&E substation property.

6) Require a fully redundant, double current differential protection scheme utilizing fiber optic communications between the Project and East Shore Substation. The two paths will be determined during final engineering and design and could include an overhead fiber cable on the new 230 kV tower structures and an underground cable.

7) Cause further overstress of fourteen (14) circuit breakers. Replacement of these circuit breakers is not the responsibility of the Project.

The SIS for the Russell City Energy Center Expansion Project issued on December 13, 2005 concluded that the Project would:

1) Exacerbate two (2) pre-project normal overloads. The pre-project normal overloads were mitigated by Project P0423. It should be noted that P0423 may not be in place prior to the proposed on-line date of the Project. If such would be the case, mitigation alternatives would be restudied and the preferred solution implemented as a part of the Project's Network Upgrades.

   Cause one (1) new Category "B" emergency overload that will require mitigation by the Project. The overload is:

   - East Shore-Dumbarton 115 kV Line

   This overload was mitigated in the IFAS Report for the Russell City Energy Center Project, dated March 14, 2006, as a part of the Network Upgrades

2) Cause three new CAISO Category "C" emergency overloads that will require mitigation by the Project. These overload are:

   - Sobrante – Moraga 115 kV Line
   - East Shore – Dumbarton 115 kV Line
   - Dumbarton – Newark 115 kV Line

   The last two Category "C" overloads will be mitigated by the Russell City Energy Center Project as a part of the Network Upgrades, and a PG&E capacity project, respectively.

   CAISO Category "C" contingency overloads may be mitigated by load shedding or generation dropping. PG&E, CAISO or both may require new generators to take part in, as well as to be responsible for the costs of operating procedures and/or special protection schemes that will eventually be planned to mitigate these CAISO Category "C" overloads

3) Exacerbate several CAISO Category "C" emergency overloads on the transmission system. The IFAS will not provide mitigation of these overloads

4) Cause no significant transient stability impacts on the transmission system

5) Require a fully redundant, double current differential protection scheme utilizing fiber optic communications between the Project and East Shore Substation

6) Cause further overstress of two (2) 230 kV circuit breakers at Pittsburg Substation. Replacement of these circuit breakers is not the responsibility of the Project

7. Facilities Study Scope

The IFAS provides the work scope and cost estimates for the Interconnection Facilities required to interconnect the Project to the PG&E grid. These facilities are in addition to the Interconnection Facilities identified in the previously completed FS reports provided to Calpine dated March 14 and March 16, 2006 for the Project. Specific studies conducted in the IFAS are:

7.1 Transmission Tie-Line Evaluation

The transmission line work scope includes constructing a double-circuit 230 kV generator tie line and fiber optic communication lines from the Project to East Shore Substation. The line will be constructed within PG&E's existing 115 kV Grant-East Shore ROW and will be owned, operated and maintained by PG&E.

7.2 RCEC Switchyard Evaluation

The Project's switchyard[6] will be built and owned by Calpine, therefore, no cost estimates or work scope documents are provided in the IFAS for this switchyard. The switchyard shall incorporate the required relaying as specified in the PG&E interconnection handbook per Section G2.1. Note that there is a redundancy requirement for the application of multifunction relays.

The PG&E substation evaluation for the Project was conducted in previous Facilities Studies, in which the Interconnection Facilities work scope and cost estimates were determined.

7.3 Land Evaluation

PG&E's Land Services determined that PG&E's existing 115 kV Grant-East Shore ROW is adequate to accommodate the construction and operation of the new RCEC double circuit 230 kV line in a manner consistent with PG&E transmission design criteria. The land and permitting work scope includes the acquisition of additional ROW from the RCEC switchyard to PG&E's transmission corridor, preparing and filing a CPCN pursuant to Section 8.1

[6] PG&E will own the 230 kV generator tie line from PG&E's East Shore Substation to the A-frame structure at the RCEC switchyard. The point of change-of-ownership shall be at the insulator on the PG&E side of the insulator.

below, as well as various land engineering, surveying and mapping activities.

8. Environmental Evaluation / Permitting

8.1 CPUC General Order 131-D

PG&E is subject to the jurisdiction of the California Public Utilities Commission (CPUC); and must comply with CPUC General Order 131-D (Order) on the construction, modification, alteration, or addition of all electric transmission facilities (i.e., lines, substations, switchyards, etc.). This includes facilities to be constructed by others and deeded to PG&E. In most cases where PG&E's electric facilities are under 200 kV and are part of a larger project (i.e., electric generation plant), the Order exempts PG&E from obtaining an approval from the CPUC provided its planned facilities have been included in the larger project's California Environmental Quality Act (CEQA) review, the review has included circulation with the State Clearinghouse, and the project's lead agency (i.e., California Energy Commission) finds no significant unavoidable environmental impacts. PG&E or the project developer may proceed with construction once PG&E has filed notice with the CPUC and the public on the project's exempt status, and the public has had a chance to protest PG&E's claim of exemption. If PG&E facilities are not included in the larger project's CEQA review, or if the project does not qualify for the exemption, PG&E may need to seek approval from the CPUC (i.e., Certificate of Public Convenience and Necessity or Permit to Construct) taking as much as 18 months or more since the CPUC would need to conduct its own environmental evaluation (i.e., Negative Declaration or Environmental Impact Report).

PG&E recommends that the project proponent include PG&E facility work in its project description and application to the lead agency performing CEQA review on the project. The lead agency must consider the environmental impacts of the interconnection electric facility, whether built by the developer with the intent to transfer ownership to PG&E or to be built and owned by PG&E directly, and make a finding of no significant unavoidable environmental impacts from construction of those facilities. Once the project has completed the review process and the environmental document (i.e., Negative Declaration or Environmental Impact Report) finds no significant unavoidable environmental impacts from PG&E's work, PG&E would file an Advice Letter with the CPUC and publish public notice of the proposed construction of the facilities. The noticing process takes about 90 days if no protests are filed, but should be done as early as possible so that a protest does not delay construction. PG&E has no control over the time it takes the CPUC to respond when issues arise. If the protest is granted, PG&E may then need to apply for a formal permit to construct the project (i.e., Certificate of Public Convenience and Necessity or Permit to Construct). Facilities built under this procedure must also be designed to include consideration of electric and magnetic field (EMF) mitigation measures pursuant to PG&E "EMF Design Guidelines of New Electrical Facilities: Transmission, Substation and Distribution".

Please see Section III, in General Order 131-D. This document can be found in the CPUC's web page at:

http://www.cpuc.ca.gov/PUBLISHED/GENERAL_ORDER/589.htm

8.2 CPUC Section 851

Since PG&E is subject to the jurisdiction of the CPUC, it must also comply with Public Utilities Code Section 851. Among other things, this code provision requires PG&E to obtain CPUC approval of leases and licenses to use PG&E property, including rights-of-way granted to third parties for interconnection facilities. Obtaining CPUC approval for a Section 851 application can take several months, and requires compliance with the California Environmental Quality Act (CEQA). PG&E recommends that Section 851 issues be identified as early as possible so that the necessary application can be prepared and processed.

8.3 Supplemental PG&E Environmental / Permitting Activity

At Calpine's request, PG&E conducted environmental and permitting activities prior to the execution of the LGIA. PG&E issued a Transmission Upgrade Evaluation Report on October 3, 2006 describing PG&E's preliminary assessment of the transmission upgrades necessary to interconnect RCEC to the PG&E transmission system. This report should be referenced for more detailed information regarding environmental and permitting activities, as well as a project schedule with detailed milestones.

9. Study Updates

This IFAS was performed according to the assumptions shown in the Section titled "Study Assumptions." In the event that these assumptions are changed, a Re-study may be required to re-evaluate the Project's impact on PG&E's transmission grid. Calpine would be responsible for paying for any such Re-study. Other changes that might prompt a Re-study are:

- A higher-queued project withdraws from the Queue.
- Calpine changes the location of the Project's Interconnection Point.
- Material modification (LGIP Section 4.4).

10. Stand-by Power

This study does not address any requirements for stand-by power that the Project may require. Calpine should contact their Generation Interconnection Services representative regarding this service.

Note: Calpine is urged to contact their Generation Interconnection Services representative promptly regarding stand-by service in order to ensure its availability for the Project's start-up date.

Waste Management

Data Response 52

Waste Management (52)

Remedial Action Plan

52. *Please explain why RCEC proposes to eliminate the requirement for a remedial action plan when contamination has been detected on each of the parcels.*

Response: A Remedial Action Plan (RAP) was put in place at the Runnels Industry property because the plan had been required by the lead agency, the San Francisco Bay Regional Water Quality Control Board due to a broader groundwater contamination cleanup program. However, the RCEC will no longer be constructed on the Runnels Property and, therefore, this Parcel and its Remedial Action Plan are no longer part of the project (except for limited use as parking and laydown areas.)

While some contamination has been identified on the current project site, the Applicant anticipates that cleanup will consist of the relatively straightforward removal of total petroleum hydrocarbon (TPH) or other contamination "hot spots" before construction. A soil management contingency plan will be prepared before construction to address any potential contamination that may be found during construction activities. Therefore, it is not anticipated that a RAP will be required.