FARALLON CONSULTING

Washington
Issaquah | Bellingham | Seattle
Oregon
Portland | Bend | Baker City
California
Oakland | Sacramento | Irvine

NORTH CKD AREA LANDFILL CLOSURE
STORMWATER HYDRAULIC ANALYSIS REPORT

CEMEX DAVENPORT CEMENT PLANT
700 HIGHWAY 1
DAVENPORT, CALIFORNIA

Submitted by:

Farallon Consulting, L.L.C.
101 Parkshore Drive
Folsom, California 95630

Adams Resource Consultants Company
P.O. Box 1770
Duvall, Washington 98019

Farallon PN: 1839-001

For:
RMC Pacific Materials, L.L.C.
100 Highway 1
Davenport, California

March 26, 2018

Prepared by:

Matthew A. Hillyard, P.E.
Senior Engineer
Farallon Consulting, L.L.C.

TABLE OF CONTENTS

FIGURE

TABLES

APPENDICES

1.0 INTRODUCTION

Farallon Consulting, L.L.C. (Farallon) and Adams Resources Consultants Company (ARC) have prepared this Stormwater Hydraulic Analysis report for the north cement kiln dust (CKD) area landfill closure at the RMC Pacific Materials, L.L.C. (referred to herein as CEMEX) Davenport Cement Plant at 700 Highway 1 in Davenport, California (herein referred to as the Site) (Figure 1). The hydraulic analysis includes the north CKD area landfill, the cement plant area, and the drainage areas that direct stormwater onto the Site. CEMEX is undergoing the process to close in-place the north CKD area landfill at the Site in accordance with California Code of Regulations (CCR) Title 27.

This Stormwater Hydraulic Analysis report will be incorporated into the *Final North CKD Area Closure Plan and Postclosure Monitoring and Maintenance Plan, RMC Pacific Materials, LLC, 700 Highway 1, Davenport, California* dated April 1, 2018, prepared by Adams Resource Consultants Company (Final Closure Plan).

2.0 BACKGROUND

This report was prepared to address requirements of CCR Title 27 and specific concerns presented in the letter regarding Land Disposal Program, CEMEX Davenport Cement Plant Inactive North CKD Area – Conceptual Final Closure Plan and Post-Closure Monitoring and Maintenance Plan Conditional Approval from Mr. John M. Robertson of the Central Coast Regional Water Quality Control Board (Water Board) to Ms. Kori J. Andrews of CEMEX dated August 24, 2017 (Water Board letter) (Water Board 2017). In the Water Board letter, the Water Board provided comments on the *Conceptual Final CKD Closure Plan and Postclosure Monitoring and Maintenance Plan, North CKD Area* (Conceptual Final Closure Plan) dated April 13, 2017, prepared by Adams Resources Consultants Company (ARC) (2017) for the closure of the north CKD area landfill at the Site (Conceptual Final Closure Plan). The Water Board letter included a requirement to prepare a revised stormwater and hydraulic analysis as a standalone document or as part of an Engineered Alternative Storm Design Evaluation Report if Site drainage is not sized to handle a 1,000-year storm event, to be submitted to the Water Board by November 30, 2017.

The Water Board letter required that the following items be addressed in a revised Stormwater and Hydraulic Analysis Report or Engineered Alternative Storm Design Evaluation Report:

- Identify and address hydraulic limitations of the Highway 1 tunnel (i.e., culvert) downstream from the Retention Pond that discharges at Outfall 001.
- Identify and evaluate all hydraulic inputs to the Highway 1 culvert.
- Evaluate and document the condition and capacity of, and all hydraulic inputs to, the Highway 1 culvert.
- If the Highway 1 culvert cannot safely handle the entire design flow, include:
    - Recommendations for culvert repairs or upgrades; and/or
    - Upstream controls to reduce peak flows to a level passable through the culvert.
- Consider evaluating routing off-Site drainage from off-Site basin 2E into the bypass pipe.
- If designed stormwater conveyance features are not sized to pass the 1,000-year flow, prepare an Engineered Alternative Storm Design Evaluation Report to include:
    - Comprehensive Site drainage analysis and maps for prescriptive standard and alternative design for all areas; and
    - Evaluation of how the drainage system will perform if the storm design capacity is exceeded.

In order to conduct a proper assessment of the drainage system leading to Outfall 001 and the North Pond bypass pipe, Farallon developed a hydrologic and hydraulic model. This Stormwater Hydraulic Analysis report describes the identification and assessment of existing drainage structures and provides hydraulic analysis using modeling to assess the hydraulic conveyance and storage of the existing and proposed drainage system during the design storm for the proposed North CKD area landfill closure.

Farallon originally prepared the *Draft North CKD Waste Pile Closure Stormwater Hydraulic Analysis Report* (draft Hydraulic Analysis) dated November 29, 2017 to evaluate the capacity of the proposed landfill closure design stormwater conveyance and existing Site drainage features to handle the 1,000-year, 24-hour storm event and address the comments from the Water Board described above. The draft Hydraulic Analysis concluded that with some minor upgrades, the existing and proposed stormwater conveyance system could pass the 1,000-year, 24-hour design storm; therefore, an engineered alternative storm design evaluation is not required.

This final Stormwater Hydraulic Analysis report presents a hydraulic analysis of the final North CKD area landfill closure stormwater conveyance design after modifications were made to address the recommendations presented in the draft Hydraulic Analysis. As part of this evaluation, information used to prepare the draft Hydraulic Analysis was updated, whenever possible, based on design modifications or improvements, additional Site inspections, further records review, and model refinement. Additionally, this report addresses comments on the draft Hydraulic Analysis provided by Mr. Martin Fletcher of the Water Board in an email to Mr. Wayne Adams dated January 23, 2018 (Water Board 2018).

3.0 EXISTING DRAINAGE ASSESSMENT

3.1 EXISTING CEMENT PLANT CONVEYANCE SYSTEM

The North CKD area landfill is located within the drainage area that collects stormwater that is ultimately discharged from a 30-inch-diameter corrugated metal pipe culvert on the west side of Highway 1 at Outfall 001 (Figure 1). In order to identify the inputs to the Outfall 001 culvert, Farallon reviewed available historical Site drainage plans and conducted Site reconnaissance inspections on September 12 and November 10, 2017.

Numerous historical drawings related to Site drainage were reviewed. Relevant drawings are included in Appendix A and are briefly described below.

- *Plans of Oceanshore RR Co.* dated 1912, prepared by the Ocean Shore Railroad Company. The plans show a 5- by 6-foot, 236-foot-long tunnel crossing under the railroad tracks on the northern side of a drainage ravine. The drainage tunnel likely was installed to convey the surface water flows of the ravine that was filled in to support the railroad.
- *Plan and Profile of State Highway, In Santa Cruz County, between One Half Mile South of Davenport and Waddel Cr.* dated September 19, 1938, prepared by the State of California Department of Public Works, Division of Highways: As-built Highway 1 construction plans indicate that an existing 5-foot by 5.5-foot tunnel from the Site was sealed with concrete and extended with a 30-inch-diameter corrugated metal pipe.
- *Drainage Tunnels at Plant* dated June 4, 1958, prepared by the Santa Cruz Portland Cement Engineering Department: The layout of the drainage tunnels in relation to the office, other nearby buildings, and a swamp (now referred to as the Retention Pond) is shown along with the dimensions of the tunnels and terminus to the west in a concrete pipe.
- *Plan & Profile, Existing Tunnel Cement Mill*, dated August 1971, revised June 14, 1979, prepared by Bowman and Williams Registered Civil Engineers: The layout of the Site drainage tunnels in relation to adjacent structures, including profile views of the tunnels with tunnel ceiling elevations, ground elevations, drains and vertical shafts, is shown along with tunnel cross sections. The tunnels are labeled A, B, C, and D. Stormwater runoff from the Retention Pond and upstream North CKD area landfill would flow into the northern end of Tunnel D. Tunnel D directs stormwater south and intersects Tunnel B. Tunnel B directs stormwater to the west and terminates at a 24-inch-diameter reinforced concrete pipe. Tunnels A and C collect cement plant stormwater runoff from the south of Tunnel B.
- *Plan of Sewage Collection System, 1972 Modifications* dated June 2, 1972, prepared by Bendy Engineering Company: Plan indicates that a 4-inch- or 6-inch-diameter sewer pipe is anchored into and suspended from the roof of Tunnels A and B. The plan also shows the alignment of the drainage tunnels, the end of Tunnel B, and the flow pathway to Outfall 001.

- *Tunnel & Pipe Alignments in the Vicinity of Administration Building* dated August 28, 1998, prepared by Bowman and Williams Consulting Civil Engineers: The plan includes a tunnel control diagram with the tunnel layout, flowline and ground elevations, and dimensions. Tunnel B is shown terminating at a 24-inch-diameter reinforced concrete pipe on the eastern side of the Union Pacific Railroad; however, the plan shows that the pipe alignment is uncertain between the 24-inch-diameter reinforced concrete pipe and the 30-inch-diameter corrugated metal pipe outlet shown on the western side of Highway 1. The uncertainty is marked on two separate lines that connect the 24-inch-diameter reinforced concrete pipe to each of the two vertical steel casings and then to the 30-inch-diameter corrugated metal pipe.
- *Overall Site and Storm Drainage Plan* dated November 5, 1998, prepared by Bowman and Williams Consulting Civil Engineers: The plan shows the tunnel layout and an additional storm drain system to the west that is connected to Tunnel D with a 24-inch-diameter reinforced concrete pipe.
- Untitled Plan prepared by Bowman and Williams Consulting Civil Engineers, undated, Drawing File No. 21358: The plan shows the tunnel layout, structures, roads, and cement plant topography. The tunnel layout and labels also are shown on the November 5, 1998 Bowman and Williams Consulting Engineers plan, but this untitled map includes topography and a tabulated summary of survey benchmarks not included on the November 5, 1998 plan. Topography in the vicinity of Highway 1 and the railroad indicates that stormwater flow not captured within or overflowed from the plant drainage system would sheet flow over the highway near the railroad crossing and then flow south along the railroad.

Additionally, two drainage ditches are present on the western side of the North CKD area landfill. The ditches are shown on the North CKD Area Closure design plans in Attachment 3 of the Final Closure Plan. The interior western perimeter ditch directs stormwater to the shop area ditches and then to the Retention Pond. The exterior western perimeter ditch directs run-on stormwater from adjacent fields to the Detention Pond, which then discharges to a shallow swale where the water combines with the flow path from the shop area ditches and then flows into the Retention Pond.

A 30-inch-diameter corrugated metal pipe collects flows from the North Pond and routes surface water from the drainage area the feeds the North Pond through and around the North CKD area landfill and discharges the water into Farmer’s Pond to the southeast of the North CKD area landfill, as shown on the North CKD Area Closure design plans (Attachment 3 of the Final Closure Plan). This drainage area historically would have discharged at Outfall 001, if the North CKD area landfill had not filled in the natural drainage canyon and the 30-inch-diameter corrugated metal pipe had not been installed.

3.2 DRAINAGE SYSTEM CONDITION ASSESSMENT

In order to assess the condition of the inputs to the Highway 1 culvert, CEMEX contracted with two different subcontractors, Subdynamic Locating Services, Inc. of San Jose, California (Subdynamic) and Easton Geology, Inc. of Santa Cruz, California, as described below.

3.2.1 Subdynamic Inspection

Subdynamic was hired by CEMEX to conduct a camera inspection of the associated drainage tunnels and culverts that connect to the Outfall 001 culvert. The assessment included Tunnel B, Tunnel D, the 30-inch-diameter corrugated metal pipe at Outfall 001, and the two vertical shafts at the assumed end of the 24-inch-diameter reinforced concrete pipe connected to the downstream end of Tunnel B. The drainage tunnels and storm drain collection system in portions of the cement plant that do not receive flow from the North CKD area landfill, including Tunnel A and associated drainage conveyance, Tunnel C and associated drainage conveyances, and the conveyance system from the cement plant area that discharges to Tunnel D, were not assessed.

On November 20, 2017, Subdynamic performed the camera inspection at the Site. Due to the depth of the tunnels, approximately 25 feet below ground surface, Subdynamic was able to examine only one conveyance: a portion of the 30-inch-diameter corrugated metal pipe at Outfall 001. Inspection efforts at five locations are summarized below. Screen shots of video recorded during the inspection are included in Appendix B.

Outfall 001: Subdynamic advanced the camera approximately 29 feet into the 30-inch-diameter corrugated metal pipe. The steepness of the culvert prevented further advancement of the camera. A constant flow of clear water was present in the bottom of the corrugated metal pipe, and no images indicating structural concerns or conveyance limitations were identified.

Western Shaft on the Eastern Side of Highway 1 and the Railroad: Approximately 8 feet of standing water was present at the bottom of the approximately 30-foot-deep, 3.2-foot-diameter concrete shaft, with no indications of flow. The standing water prohibited a clear identification of a possible connection to the 24-inch-diameter reinforced concrete pipe in the direction of the Site or other conveyance structure in the direction of Highway 1.

Eastern Shaft on the Eastern Side of Highway 1 and the Railroad: Approximately 10 feet of standing water was present at the bottom of the approximately 35-foot-deep, 2.6-foot-diameter concrete shaft, with no indications of flow. The standing water prohibited a clear identification of a possible connection to the 24-inch-diameter reinforced concrete pipe in the direction of the Site or other conveyance structure in the direction of Highway 1.

Shaft at Northern End of Tunnel D: The concrete box riser at the southern end of the Retention Pond and the very northern end of Tunnel D was inaccessible. However, a circular approximately 24-foot-deep concrete shaft adjacent to the southern limit of the Retention Pond was identified, where a 24-inch-diameter reinforced concrete pipe flows into Tunnel D. A shallow base flow was observed in the bottom of the vertical shaft. The camera could not be advanced laterally along the tunnel due to the depth of the shaft.

Shaft at Eastern End of Tunnel B: Existing shallow base flow was observed in the bottom of the approximately 26.5-foot-deep rectangular vertical shaft. The camera could not be advanced laterally along the tunnel due to the depth of the shaft.

Due to the limitations of the camera inspection equipment caused either by the depth of the tunnels and culverts or the steepness of the culvert upstream from Outfall 001, a complete assessment of the condition of the drainage tunnels and Highway 1 culvert could not be completed by Subdynamic.

3.2.2 Easton Geology Inspection

In order to complete a more thorough investigation of the drainage tunnels and vertical shafts, CEMEX contracted with Easton Geology. Easton Geology personnel conducted a manned inspection of drainage Tunnels B and D and a video inspection of the vertical shafts on the eastern side of the railroad tracks and Highway 1. The inspection report from Easton Geology is provided as Appendix C.

Easton Geology concluded that the surveyed drainage tunnels showed little to no change in profile since being surveyed in 1971 and were in acceptable condition. Easton Geology saw no significant spalling, loose rock, or obstructions within the drainage tunnels during the inspection that would hinder the tunnels' ability to convey storm runoff.

Furthermore, Easton Geology did not observe any indication that the vertical shafts on the eastern side of the railroad tracks and Highway 1 are directly connected to the subsurface drainage system from the CEMEX plant.

3.3 CONCLUSIONS

Based on the limited camera assessment conducted by Subdynamic, the manned and camera inspections conducted by Easton Geology, two Farallon Site inspections, and discussions with CEMEX personnel and other people familiar with the Site, the following conclusions can be made:

- Base, non-stormwater flow is present in Tunnels B and D and may be due to seepage into the tunnels from unsealed drainage system components, or a result of the intentional collection of natural seeps, springs, or groundwater such as for foundation footing drains.
- The uncertain pipe alignment shown on *Tunnel & Pipe Alignments in the Vicinity of Administration Building* dated August 28, 1998, prepared by Bowman and Williams Consulting Civil Engineers (Appendix A), is clarified by the 1912 Ocean Shore Railroad Company map (Appendix A) that shows a 5 ft by 6 ft drainage tunnel under the railroad as shown the Easton Geology Figure 1 in Appendix C. However, the 5- by 6-foot drainage tunnel could not be observed due to lack of access.

- Due to standing water in the bottom of the two vertical shafts at the eastern side of the railroad and Highway 1 and no visible inlet or outlet pipes in the shafts, there likely is no direct connection to the Site drainage system and drainage tunnel leading to the Outfall 001 culvert.
- Drainage Tunnels B and D are in good condition and adequate to continue conveying stormwater flow.
- The limited camera view of the 30-inch-diameter corrugated metal pipe at Outfall 001 and limited view of the 24-inch-diameter reinforced concrete pipe culvert at the end of Tunnel B did not reveal signs of structural deficiency or flow restrictions.

4.0 STORMWATER MODEL DESCRIPTION

To assess the performance and capacity of the proposed stormwater drainage conveyance system for the North CKD area landfill closure as well as the existing downstream conveyance system, a CEMEX Conveyance Capacity hydrologic and hydraulic model (CCC Model), was developed for the Site.

4.1 GENERAL METHODOLOGY AND MODEL IDENTIFICATION

In general, a hydrologic and hydraulic model uses physical geographic and climate characteristics (i.e., hydrologic data) to determine the portion of a rainfall amount that will be converted to runoff; and then uses physical dimensions of the Site's surface water conveyance and storage system (i.e., hydraulic data) to determine how the runoff will be transmitted through the system. The results of a hydrologic and hydraulic model are projected flow rates and water surface elevations at various points-of-interest throughout the Site.

The development of a Site-specific hydrologic and hydraulic model begins with the selection of the computer software that will perform the mathematical processing of the site data to represent the surface water conveyance and storage system. The U.S. Environmental Protection Agency's Storm Water Management Model, Version 5.1 (SWMM 5.1) was chosen to analyze the surface water conveyance and storage system (Rossman and Huber 2016; Rossman 2017). SWMM 5.1 is Windows-based, public domain software, which has had widespread applications in the U.S. and abroad. Previous versions of SWMM 5.1 have been in constant use since 1971. Various SWMM versions have been used extensively in the U.S. to develop stormwater and surface water management plans for large drainage basins.

4.2 DATABASE DEVELOPMENT

The Site-specific stormwater model's hydrologic and hydraulic data normally are obtained from various sources. The particular data sources for the CCC Model are identified in the Sections 4.1, Hydrologic Data, and 4.2, Hydraulic Data. In general, the most common sources of model information are local soil data from the U.S. Geological Survey (USGS) database; aerial photographs and terrain data from Google Earth; elevation data from Site topographic surveys; precipitation data; design/construction reports, closure plans and associated data; historical as-built plans and data; Site operations and reconnaissance data; and common water resources engineering data.

Assumptions have been made for some SWMM 5.1 input data for the CCC Model, such as the size and invert elevations for some of existing tunnel elements, which were not precisely identified in the available historic drainage plans. In such cases, best professional judgment of the Site data was relied upon to make appropriate data judgments. In no case, however, did these types of assumptions have any significant bearing on the assessment of the capability of the overall system to contain extreme conditions. Specific assumptions are discussed in Section 4.3, Modeling Data Assumptions and Limitations.

4.3 SWMM 5.1 ANALYSIS AND SIMULATION METHODOLOGY

The SWMM 5.1 hydraulic analysis includes assessment of the surface water conveyance and storage system's responses to specified precipitation events.

The total contributing watershed or drainage area to be modeled is divided into a number of subbasins for which SWMM 5.1 estimates runoff quantities, and transports or routes these quantities through the model. The subbasins are identified, defined, and assigned to correspond to the nodes or junctions established for the model.

The subbasin is the SWMM 5.1 element for which input of specific hydrologic data is required. This hydrologic data accounts for the geometry, terrain, surface characteristics, and soil properties of the contributing drainage basin areas. The data include estimates of subbasin area, impervious area, subbasin width, subbasin slope, surface roughness, depression storage, and soil infiltration. Design storm rainfall depths and time-distribution data also are required.

The Soil Conservation Service Curve Number method option of SWMM 5.1 is being used in the CCC Model to estimate the soil infiltration potential for each subbasin. The Soil Conservation Service Curve Number method, for each time step of the simulation, converts rainfall depth to expected stormwater runoff depth, and is based on the subbasin's initial abstraction. Abstraction is the loss of precipitation before runoff begins and includes water retained in surface depressions and water intercepted by vegetation, evaporation, and infiltration. Initial abstraction is highly variable, but generally is correlated with soil and cover parameters. The hydrologic component of the SWMM 5.1 software further routes the computed runoff depths through the subbasin to generate the subbasin's stormwater runoff hydrograph. The subbasin routing is achieved by representing the subbasin as a nonlinear reservoir for which a water balance is continuously maintained throughout the storm event, and by computing reservoir outflows via the Manning equation. The stormwater runoff hydrographs for the subbasins are then the inflow hydrographs for the hydraulic component of SWMM 5.1.

The node (or junction) and link (or reach) are the SWMM 5.1 elements for which hydraulic input data are required. These elements define the features of the SWMM 5.1. A link is a segment of a site's conveyance system, and could represent a channel, pipe, weir, or orifice. A node represents a stormwater storage facility, or a particular point-of-interest within a site's conveyance system, such as the location of a significant inflow point or the transition from one type of link to another. The hydraulic data account for the physical and engineering properties of the links, and for the storage/boundary conditions of the nodes. The data include the types, sizes, lengths, surface roughness coefficients, and energy loss coefficients of the links; and the storage facility surface areas, initial system conditions, and system outfall conditions of the nodes.

The hydraulic component of SWMM 5.1 takes the inflow hydrographs from the subbasins, via the particular node assignments, and performs a dynamic routing of the inflows through the link-node system. At each model time step (which must be small for dynamic routing: i.e., 1 to 30 seconds), the software solves the complete Saint-Venant equations that define theoretical fluid flow. Both momentum and mass are conserved and balanced (within specified tolerances) for the entire model network at each time step. SWMM 5.1 iteratively adjusts the water surface elevations at the nodes to increase or decrease the flows in the links, as the storage volumes at the nodes are simultaneously increased or decreased, until the balance tolerances are achieved. In essence, from the beginning of a time step, the system inflows are conveyed and stored within, and discharged from, the model network as allowed by the link and node data, in order to create the necessary mass and momentum balances and move to the next time step.

The most important output data from a SWMM 5.1 simulation of a continuous rainfall event are the peak flow rates and maximum water surface elevations projected throughout the surface water conveyance and storage system. The specific CCC Model inputs and results are discussed in Section 4.0, CEMEX Conveyance Capacity Model Inputs. The hydraulic data for the CCC Model is described in detail in Section 4.2, Hydraulic Data.

4.4 MODEL SCENARIOS

In the draft Hydraulic Analysis report, the CCC Model scenarios that were set up to assess the drainage system at the Site included the 24-hour, 100-year storm event, consistent with the previous hydrologic and hydraulic design for the Conceptual Final Closure Plan, and the 24-hour, 1,000-year storm event required by CCR Title 27. In addition, the 100- and 1,000-year model scenarios were modified to assess the impacts of the diversion of stormwater runoff from the grassy field of farmland northeast of the North CKD area landfill, referred to in the Water Board letter as off-Site basin 2E, to the North Pond bypass pipe instead of capturing it in the proposed North CKD area landfill eastern perimeter ditch.

The Final Hydraulic Analysis includes only the evaluation of the 1,000-year, 24-hour design storm event and the diversion of the eastern farmland area to the North Pond bypass pipe, which is included as part of the landfill closure design presented in the Final Closure Plan. The other previously modeled scenarios are not relevant to the final design.

5.0 CEMEX CONVEYANCE CAPACITY MODEL INPUTS

The hydrologic and hydraulic inputs to the CCC Model using SWMM 5.1 are described below.

5.1 HYDROLOGIC DATA

The hydrologic data used in the CCC Model are described below. Input source data for subbasin parameters and other support data described below are provided in Appendix D; a drainage basin and node network map is provided in Appendix E; and SWMM 5.1 output files with user-defined input data are provided in Appendix F.

5.1.1 Subbasin Characteristics

The subbasin locations were established after the nodes and links were identified, as described in Section 4.2.1, Node Data. (SWMM 5.1 refers to subbasins as subcatchments.) A subbasin, which represents a hydrologic unit of land whose topography and drainage system elements direct surface runoff to a single discharge point, was defined for each node, and each subbasin extended to one-half the distance along each adjoining link, as is customary for this type of modeling. Subbasins, links, and nodes defined for the CCC Model are shown on the map provided in Appendix E. The subbasin drainage areas were then delineated after review of available topography, the North CKD area landfill closure plans, and as-built drawings. Field reviews also were conducted to confirm the drainage areas and to observe whether the existing stormwater management system deviated significantly from the as-built drawings. The drainage areas were measured from the drawings or from aerial maps using AutoCAD-2018.

SWMM 5.1 uses subbasin width and average slope as parameters to account for the effects of the time-of-concentration parameter used in other methods to represent runoff travel-time through a subbasin. These parameters affect the peak flow value for the subbasin’s stormwater runoff hydrograph. Subbasin width is defined as the subbasin area divided by the length of the longest flowpath for the subbasin. Therefore, a larger width for a particular subbasin would indicate a shorter relative travel-time and higher peak flow value. The effects of slope are that steeper slopes lead to shorter relative travel-times and higher peak flow values.

Another SWMM 5.1 parameter that affects the peak flow for a subbasin’s stormwater runoff hydrographs is surface roughness. Higher surface roughness values lead to lower peak flow values. Surface roughness is split into an impervious area roughness and a pervious area roughness, and overland-flow-magnitude roughness coefficients are required. The Manning’s roughness coefficients (i.e., n values) have been estimated based on aerial photographs, observations made during Site visits, discussions with CEMEX personnel, as-built drainage drawings, North CKD area landfill closure plans, and general knowledge of the area. A Manning’s roughness coefficient of 0.013 is used in the CCC Model for all impervious areas, and a roughness coefficient of 0.15 is used for all pervious areas. The impervious value is for ordinary concrete, which is the dominant impervious surface in the area of the cement plant. The pervious value is for short grass prairie, which is indicative of the ground cover found on most of the Site. Tables of typical Manning's n values are provided in Appendix D.

Depression storage represents the amount of rainfall that can be expected to puddle due to uneven ground surfaces. SWMM 5.1 considers that an impervious surface likely will have a different depression storage characteristic than a pervious surface, allowing for separate values. A depression storage value of 0.05-inch is used for impervious surfaces, while a value of 0.2-inch is used for the pervious surfaces. The pervious surface value is for pasture ground cover. The soil type that affects the amount of infiltration and the conversion of precipitation into runoff was determined by reviewing USGS soil survey information for the Site. The Site is located generally in Hydrologic Soil Group D with poor infiltration properties. The only exception is the western farmland area in Hydrologic Soil Group –A, which has excellent infiltration properties. A USGS soil survey summary is provided in Appendix B.

Soil Conservation Services Curve Numbers (SCS-CNs) were calculated for each subbasin based on the proportion of pervious and impervious surfaces. For pervious areas in Hydrologic Soil Group A, the SCS-CN of 39 is used, and for the pervious areas in Hydrologic Soil Group D, the SCS-CN of 80 is used. For impervious areas such as roads, stockpiles, industrial and office buildings, and parking lots, the SCS-CN of 98 is used. For the North CKD area landfill, where a 26-inch-thick cover soil is placed for liner protection and vegetated cover above the impervious liner, a SCS-CN of 90 is used. The SCS-CN of 90 for the landfill cover was chosen based on the American Society of Civil Engineers publication in the "Journal of Geotechnical and Geoenvironmental Engineering – January 2013: Field Hydrology of Landfill Final Covers with Composite Barrier Layers" (Albright et al., 2013). A summary of contributing subbasins and corresponding weighted SCS-CNs is provided in Table 1.

5.1.2 Rainfall Data

Rainfall depths were obtained from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Point Precipitation Frequency Estimates, available from the NOAA National Weather Service Hydrometeorological Design Studies Center, Precipitation Data Server website at <https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html>. Appendix D includes the Precipitation Frequency tabular data for storms with various durations and recurrence intervals, including the 24-hour, 100-year and 24-hour, 1,000-year storm events.

The Site is located in the Natural Resources Conservation Service Soil Conservation Service Type-1 standard rainfall distribution area with a peak 10.1 hours after the beginning of a 24-hour storm event. A Type 1 unit hyetograph that provides the distribution of rainfall over 24 hours was obtained from the Natural Resources Conservation Service National Water & Climate Center website at <https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/water/?cid=stelprdb1044959>.

According to NOAA data, the estimated precipitation for a 24-hour, 1,000-year event is 11.6 inches. By scaling the unit hyetograph to match the total precipitation for the precipitation event, synthetic design storm data were developed and simulated in the CCC Model to generate runoff at each subbasin.

5.2 HYDRAULIC DATA

The hydraulic data used in the CCC Model is discussed below, including node and link data. The link data descriptions are provided in terms of the conduit and weir data. Existing drainage system details are presented in Appendix A; proposed North CKD area landfill closure design plan drainage details are presented in Attachment 3 of the Final Closure Plan; and a drainage basin and node network map depicting the links and nodes used in the development of the hydraulic model is presented in Appendix E.

5.2.1 Node Data

The nodes for the CCC Model analysis are either junction type, storage type, or outfall type. Common data for all nodes include information on initial water surface elevation and lowest invert elevation. The initial water elevations on all the nodes were set at the lowest invert of node, with the exception of the Retention Pond node where the water surface was set at the rim of the outfall structure. Most of the nodes in the model are set at the grade break of a conveyance ditch, an inlet, or a junction structure for the most accurate depiction of hydraulic parameters.

Junction-type Nodes 404, 405, 406, 407, and 407A (Appendix E) have no physical junction structures that daylight at Tunnel B or the tunnel beneath the railroad and Highway 1. These are transition nodes where flow direction or conduit size is changing or there is connection to a different conduit along the tunnel alignment. As-built plans indicate two 3-inch-diameter down drain connections and a 6-inch lateral connection in the vicinity of junction-type Node 405. Video inspection of the tunnel provided by Easton Geology indicates mostly clogged down drains with limited to no functional hydraulic connectivity.

Multiple storage-type nodes are included in the model; these include the North Pond, Detention Pond, Retention Pond, Tunnel B and D vertical shafts, and perimeter ditch drop structures and stilling basins. Stage-storage rating curves were developed based on available topographic information and field verification of the physical properties of each such node.

5.2.2 Conduit Data

The conduit links in the CCC Model are either open trapezoidal ditches/channels, enclosed pipes, or bedrock-cut rectangular-shaped tunnels. The required data are the same for all conduits, and include the shape, invert elevations, length, roughness characteristics, and energy loss coefficients. Most of these data were obtained from various as-built drawings, topographic survey information, tunnel inspection, and common water resources engineering data. Assumptions were made for those links along the existing tunnel segments based on the available data.

As shown in the historical drainage system drawings provided in Appendix A, Tunnel B from Nodes 403 to 406 also conveys a 6-inch-diameter sanitary sewer pipe anchored to and suspended from roof of the tunnel. The obstruction caused by this sanitary sewer pipe is estimated to be less than 0.3 square feet of cross-sectional area within Tunnel B, which is less than 2 percent of the tunnel cross section. The bedrock-cut rectangular-shaped tunnels were modeled by defining a representative custom shape of the tunnels, based on measurements made during the Easton Geology inspection and the available plans. The dimensions are 4 feet wide by 3.25 feet high with a linear transition for the peak from 4 feet wide at 3 feet of depth to 0 feet wide at 3.25 feet of depth for Tunnel D; 4.5 feet wide by 6 feet high with a linear transition for the peak from 4.5 feet wide at 5 feet of depth to 0 feet wide at 6 feet of depth for Tunnel B; and 4.5 feet wide by 4.5 feet high with a linear transition for the peak from 4 feet wide at 4 feet of depth to 0 feet wide at 4.5 feet of depth for Tunnels A and C. The linear transition assumption ignores curvature of the ceiling and offsets the obstructed cross-sectional area from the 6-inch-diameter sanitary sewer within the tunnel.

Plans used to develop the CCC Model are included in Appendix A and Attachment 3 of the Final Closure Plan. Assumptions made for conduit size and flow line elevation will have an insignificant impact on overall results of the CCC Model. Section 4.3, Modeling Data Assumptions and Limitations, includes a list of assumptions made during model development.

5.2.3 Weir and Orifice Data

Two existing pond outlet control structures are present, one each in the Detention Pond and the Retention Pond, which were modeled with orifice and weir features.

Detention Pond: A catch basin with a 6-inch-diameter ductile iron pipe connected on the side of the structure is present at bottom of the Detention Pond. This device mimics a 6-inch-diameter vertical orifice as the pond is filled with runoff.

Retention Pond: A 4-foot-long by 2-foot-8-inch-wide, rectangular vertical drop structure was constructed over the northern end Tunnel B near the southern end of the Retention Pond. This structure mimics a sharp crested weir overflowing from the Retention Pond to the tunnel when runoff reaches the rim elevation of the drop structure.

Two orifices as control devices are included in the Final Closure Plan as modifications to maximize available storage and attenuate peak flows discharging from the North CKD area landfill to the existing tunnel system. A 36-inch-diameter orifice with backflow-preventing check valve is designed at an invert elevation of 99 feet, and a 2-inch-diameter orifice with backflow-preventing check valve is designed to be installed at an elevation of 94 feet, about 2 feet above the bottom of the pond to mostly dewater the pond between storms. Conservatively, only the 36-inch-diameter orifice with backflow prevention is included in the model. The orifices were added to increase the storage capabilities of the Retention Pond below the existing rim of the drop structure, which has an elevation of 103.95 feet (i.e., without the orifice, the water at the beginning of the storm could be at 103.95 feet) and increase the flow discharging from the Retention Pond at the beginning of the design storm when there is available downstream capacity. The backflow prevention devices were added to the Retention Pond orifice design when model results indicated that the Retention Pond would receive water reverse-flowing out of the outfall structure as Tunnel B filled up with stormwater from the cement plant drainage. The backflow prevention devices ensure that the Retention Pond storage is used solely for water flowing from the North CKD area landfill.

5.2.4 Outfall Data

One new and one existing outfall were modeled at the Site. The two outfalls are described below.

New North Pond Bypass Outfall: A new 42-inch-diameter bypass pipe is proposed in the Final Closure Plan as part of drainage improvements. This 42-inch-diameter bypass pipe replaces an existing damaged 30-inch-diameter corrugated metal pipe that was discharging to Farmer's Pond, which consists of ponded water within No-Name Creek. The proposed outfall for the new bypass is on the western side of the canyon where No-Name Creek is located to the north of Farmer's Pond. Collected runoff from North Pond will be conveyed through this bypass and exit at the proposed location, via a stilling basin and rip-rap–lined ditch with free-fall tailwater conditions on the bank of the canyon.

Outfall 001: Outfall 001 is an existing outfall west of Highway 1 approximately 60 feet below the road surface elevation. The existing outfall consists of a 30-inch-diameter corrugated metal pipe connected to a drainage tunnel that crosses under the highway and adjacent railroad tracks. Stormwater discharging from Outfall 001 daylights into a drainage ditch with insignificant backwater effects on the upstream system. This outfall also is modelled as a free-fall outlet.

Seasonal Ponds Overflow: The existing seasonal ponds were included in the model with the contributing area south of proposed 42-inch bypass pipe. A stage storage rating curve was developed based on topographic information with the pond bottom at an elevation of 255 feet and the top of bank at an elevation of 265 feeet. Based on available topography, there is a potential wide overland channel connection to No-Name Creek to the west with a bottom elevation of 264.5 feet and a width of approximately 75 feet where water would flow if the seasonal ponds are full of water.

5.3 MODELING DATA ASSUMPTIONS AND LIMITATIONS

The following assumptions were made in the development of the model:

- Based on the flow monitoring data collected at Outfall 001, a base flow of 0.95 cubic feet per second is assumed. The baseflow is split into 0.5 cubic feet per second in Node 401 of Tunnel D and 0.45 cubic feet per second in Node 403 of Tunnel B because similar flows were observed in each tunnel. Due to the small amount of baseflow relative to the peak flow from the 1,000-year, 24-hour design storm, the precise baseflow in each of the tunnels is insignificant.
- The shape and size of the drainage tunnel underneath the railroad and Highway 1 is estimated from the 1912 Oceanshore Railroad Co. map. The tunnel is assumed to be in good condition structurally and clear of debris, and it is assumed that the 24-inch-diameter reinforced concrete pipe connects the tunnel to the end of Tunnel B.

- It is assumed that the internal cement plant conveyance system is properly maintained, and inlets are protected from unwanted sediment and debris that could be flushed into the conveyance system and cause significant blockage or flow restrictions.
- Tunnels A and C and associated drainage areas do not receive stormwater from the North CKD area landfill, however, they direct portions of the cement plant area drainage system into Tunnel B and were included in the model for storage and stormwater flow conveyance. Based on topographic contours, a low point on the ground surface above Tunnel A was included in the model as available shallow depression storage. Contributing drainage subbasins from Plant Area 2 are assumed to contribute half of the associated runoff to node 403 at the end of Tunnel A/beginning of Tunnel B and the other half of the associated runoff to node 403-TNL-A1 at the beginning of Tunnel A. It is assumed that the tunnels are in good condition structurally and clear of debris. It is assumed that the associated cement plant drainage area is effectively conveyed to Tunnel A during the design storm.
- Internal stormwater conveyance features that direct stormwater directly from the cement plant to Tunnel D after the Retention Pond do not receive stormwater from the North CKD area landfill and, therefore, the conveyances are not modeled. However, the contributions from the associated drainage area are accounted for with a defined subbasin that discharges into Tunnel D, a conveyance feature that is modeled. It is assumed that the associated cement plant drainage area is effectively conveyed to Tunnel D during the design storm.
- A storm drain adjacent to Highway 1 on the northern side of the entrance to the cement plant is approximately in line with the drainage under the Highway. There is no separate outfall on the western side of the highway, so the highway storm drain is assumed to connect to the 30-inch-diameter corrugated metal pipe at the connection with the drainage tunnel under the highway.
- Assessment and modeling of the drainage channel downstream from Outfall 001 to the Pacific Ocean is not included in this report.
- Ditches lined with rock fill and geocell bank stabilization measures are proposed in the Final Closure Plan. An evaluation of the stability of the proposed lining during peak flows is not included in this report.

6.0 HYDRAULIC MODEL SIMULATION RESULTS

A summary of hydrologic model input and stormwater runoff for the subbasins is provided in Table 1. Table 2 presents detailed results for node depth, link flow, and link velocity for the 1,000-year, 24-hour design storm. Additional detailed model inputs, results, and selected water surface profiles for peak flows are provided in Appendix F.

The peak flow from Outfall 001 is predicted to be approximately 155.9 cubic feet per second and the peak flow from the North Pond bypass pipe is predicted to be approximately 76.4 cubic feet per second (Table 2).

The overall performance represented by the CCC Model results indicates that the combination of the existing and proposed Final CKD Closure Plan conveyance systems draining to Outfall 001 has adequate capacity to convey 1,000-year, 24-hour storm event. Furthermore, the proposed 42-inch-diameter North Pond bypass pipe has sufficient capacity for both the 1,000-year, 24-hour design storm, as well.

Based on the CCC Model results, the maximum water elevations of the conveyance structures are not exceeded in any of the node junctions during the modeled 1,000-year, 24-hour event, with few exceptions:

- Model results at Nodes 404, 405, 406, 407, and 407A indicate that the energy grade line is higher than the existing ground surface elevation. The nodes in Tunnel B, the 24-inch-diameter reinforced concrete pipe, and the drainage tunnel under the railroad and Highway 1, are defined as junctions with no physical structures. This condition will result in a pressurized/surcharged conveyance of water in the tunnels and 24-inch-diameter reinforced concrete pipe. Since two 3-inch-diameter down drain connections and one 6-inch lateral connection in the vicinity of Node 405 are identified on the plans, it is possible that some minor ponding would occur in the vicinity of those connections at unknown locations on the ground surface for approximately 1 hour. However, ponding of water on the ground in a 1,000-year storm event is to be expected.
- The Node 403-TNL-A2 is at approximately the midpoint of Tunnel A, and the ground surface in the area of the defined node is topographically lower than the surrounding area. During the peak of the design storm, minor ponding of runoff will occur in the plant area over the tunnel and along a paved cement plant roadway for approximately 10 minutes. Because the area consists of a regional depression, it is expected that after the peak of the storm passes, the ponded water will flow into Tunnel A.

A significant portion of the flows contributing to the existing drainage system and Outfall 001 are from the cement plant. No conveyance improvements are proposed in this area, except the recommendation to maintain the existing stormwater collection and conveyance elements to maintain functionality.

Additionally, the CCC Model predicts that the seasonal ponds would fill up during the 1,000-year, 24-hour storm with water flowing into the French drain adjacent to the western perimeter ditch and overland to the west and into No-Name Creek. The overland flow to No-Name Creek through the grassy field is predicted to occur with a depth of approximately 0.17 feet and a velocity of approximately 1.4 feet per second (Table 2).

7.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the CCC Model scenarios and interpretation of results, the following conclusions and recommendations are proposed.

- The combination of existing drainage and the proposed conveyance system at the Site included as part of the Final Closure Plan has adequate capacity to convey 1,000-year, 24-hour design storm event. In order to convey the design storm, the Final Closure Plan includes the following improvements from the design presented in the Conceptual Final Closure Plan, as described below:
    - The drop inlet structures and stilling basins located on both the eastern and western perimeter ditches on each side of the North CKD area landfill are configured to withstand approach velocities and have sufficient weir overflow capacity for the peak approach flows.
    - The exits of both the eastern and western perimeter ditch drop structures are designed to provide a transition area for drop structure exit flows to be properly contained within the capacity of the drainage ditch.
    - The junction of the of the eastern and western perimeter ditches is designed to provide a gradual transition to reduce the potential for the exceedance of the ditch capacity.
    - The reconstructed Retention Pond will have a top-of-bank minimum elevation of 106.5 feet, and the riser structure will have a 36-inch-diameter orifice with an invert elevation of 99.00 feet in order to add nearly 7 feet of live storage below the riser overflow structure rim elevation of 103.95 feet. Incorporation of a backflow prevention check valve on the orifice will prevent backflow into the pond. The modifications will provide additional storage and improved hydraulic grade lines in the downstream tunnels and culverts.
    - A French drain outside of the western perimeter ditch will receive stormwater runoff from approximately 6.99 acres of farmland area with relatively well-drained soil. Installation of an intercepting drain filled with crushed rock (i.e., a French drain) will reduce significant run-on from this area and will reduce peak flows in the western perimeter ditch.
    - The North Pond Bypass Pipe also will intercept approximately 18 acres of farmland surface runoff, which will reduce significant run-on from this area flows to the eastern perimeter trench and seasonal ponds.
- The 24-inch-diameter reinforced concrete pipe is the chokepoint in the drainage system, which causes the pressurized flow in the pipes and tunnels. The capacity of the system is due to the size and depth of the drainage tunnels and the Retention Pond.

- Drainage system components should be maintained regularly to maintain functionality as part of the postclosure maintenance plan.
- The hydraulic analysis described in this report is valid only for the conditions described in this report, and in accordance with available data sources used as input for the CCC Model. Future redevelopment or alteration of the drainage system modeled in this report has the potential to affect the conclusions of this hydraulic analysis. The hydraulic analysis should be revised to address future Site changes or the discovery of new, more accurate information as input for the CCC Model.

8.0 REFERENCES

Adams Resource Consultants (ARC). 2017. *Conceptual Final CKD Closure Plan and Postclosure Monitoring and Maintenance Plan, North CKD Area.* April 13.

Albright et al. 2013. Field Hydrology of Landfill Final Covers with Composite Barrier Layers: ASCE Journal of Geotechnical and Geoenvironmental Engineering. January.

Central Coast Regional Water Quality Control Board (Water Board). 2017. Letter Regarding Land Disposal Program, CEMEX Davenport Cement Plant Inactive North CKD Area – Conceptual Final Closure Plan and Post-Closure Monitoring and Maintenance Plan Conditional Approval. From John M. Robertson. To Kori J. Andrews, CEMEX. August 24.

———. 2018. Email Regarding Draft Davenport CKD Closure Plan – Appendix: Hydraulic Analysis (EA Report). From Martin Fletcher. To Wayne Adams of Adams Resource Consultants Company. January 23.

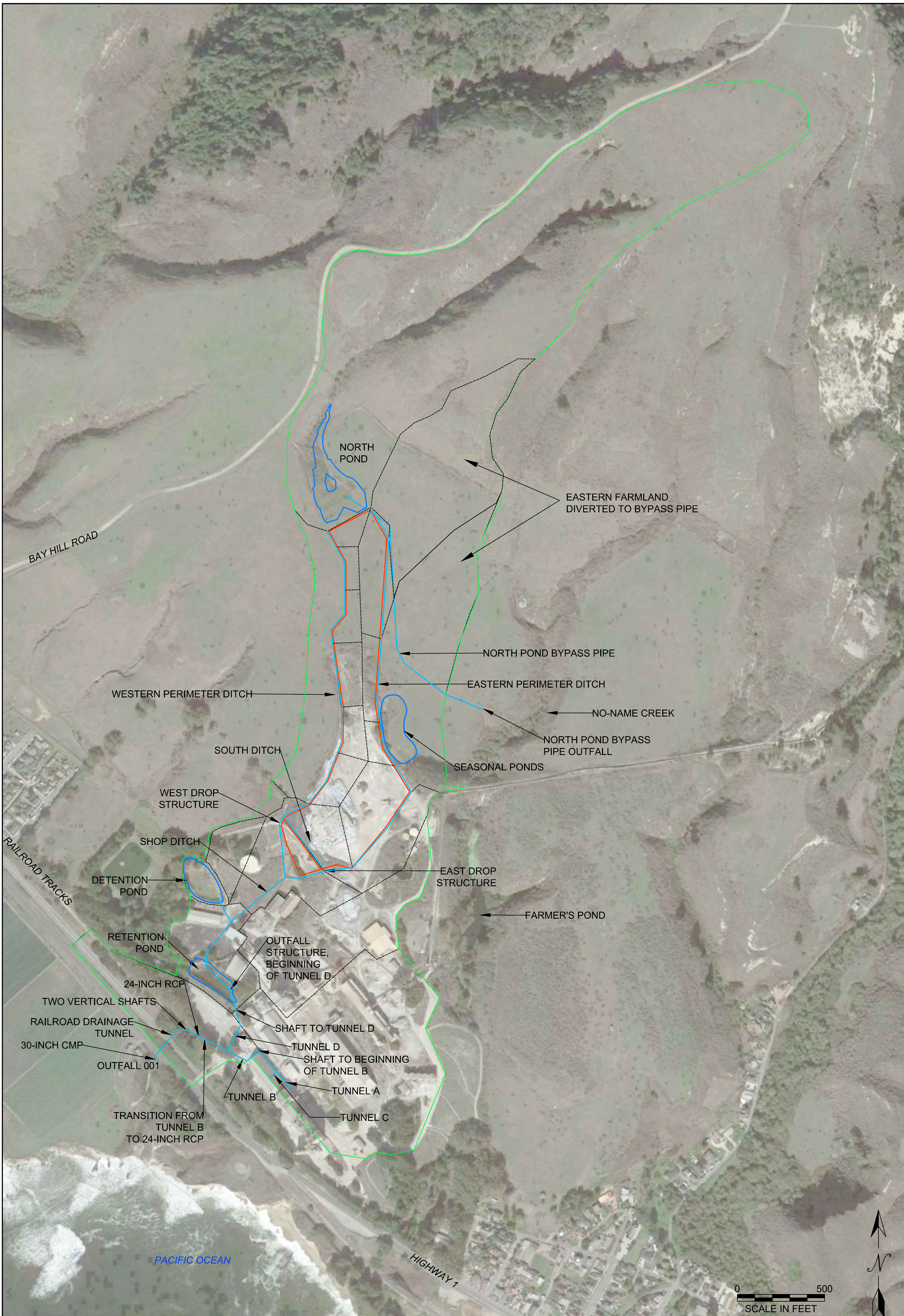
Rossman, L. and W. Huber. 2016. Storm Water Management Model Reference Manual Volume I, Hydrology. U.S. Environmental Protection Agency Office of Research and Development. January.

Rossman, L. 2017. Storm Water Management Model Reference Manual Volume II – Hydraulics. U.S. Environmental Protection Agency. May.

FIGURE

NORTH CKD AREA LANDFILL CLOSURE STORMWATER HYDRAULIC ANALYSIS
CEMEX Davenport Cement Plant
700 Highway 1
Davenport, California

Farallon PN: 1839-001



LEGEND

- MODELED SITE DRAINAGE BOUNDARY
- SUBBASIN BOUNDARY
- MODELED STORMWATER CONVEYANCE
- NORTH CKD WASTE PILE

NOTES

CMP = CORRUGATED METAL PIPE

RCP = REINFORCED CONCRETE PIPE

CKD = CEMENT KILN DUST

FARALLON CONSULTING

Quality Service for Environmental Solutions | farallonconsulting.com

Washington: Issaquah | Bellingham | Seattle

Oregon: Portland | Bend | Baker City

California: Oakland | Sacramento | Irvine

FIGURE 1

DRAINAGE SITE MAP
CEMEX DAVENPORT CEMENT PLANT
700 HIGHWAY 1
DAVENPORT, CALIFORNIA

FARALLON PN: 1839-001

Drawn By: JJ | Checked By: MH | Date: 3/26/2018 | Disk Reference: 1839-001

R:\Projects\1839-001\CAD\1839-001.dwg, 3/26/2018 9:36:08 AM, DWG To PDF.pc3

TABLES

NORTH CKD AREA LANDFILL CLOSURE STORMWATER HYDRAULIC ANALYSIS
CEMEX Davenport Cement Plant
700 Highway 1
Davenport, California

Farallon PN: 1839-001

Table 1
Subbasin Summary Table
CEMEX Davenport Cement Plant
Davenport, California
Farallon PN: 1839-001

Subbasin	Total Precipitation (inches)	Area (acres)	Impervious (percent)	Weighted Curve Number	Total Infiltration (inches)	Total Runoff (inches)	Total Runoff (10^6 gallons)	Peak Runoff (cubic feet per second)	Runoff Coefficient
CONVEYOR-AREA	11.58	2.93	40%	87.2	0.8	10.53	0.84	18.63	0.909
DETENTION-POND	11.58	1.64	10%	81.8	1.7	9.45	0.42	6.86	0.815
ED1	11.58	2.19	100%	90.0	0.0	11.52	0.68	19.29	0.994
ED2	11.58	1.08	100%	90.0	0.0	11.51	0.34	9.47	0.994
ED3	11.58	0.57	100%	90.0	0.0	11.52	0.18	5.06	0.995
ED4	11.58	3.17	100%	90.0	0.0	11.5	0.99	27.75	0.993
ED-FARM	11.58	0.47	40%	89.0	2.1	9.13	0.12	2.31	0.789
ED-FARM-BYPASS	11.58	12.30	0%	83.0	1.7	8.98	3	27.78	0.775
HIGHWAY-PLANT	11.58	8.19	40%	87.2	0.8	9.88	2.2	26.04	0.853
NORTH-POND	11.58	58.38	0%	83.0	1.7	8.8	13.95	107.00	0.760
PLANT-AREA-1	11.58	10.55	75%	93.5	0.2	10.99	3.15	47.43	0.949
PLANT-AREA-2	11.58	10.61	75%	93.5	0.2	10.53	3.03	28.05	0.909
PLANT-AREA-2A	11.58	10.61	75%	93.5	0.2	10.65	3.07	32.40	0.919
RETENTION-POND	11.58	5.08	80%	94.4	0.1	11.14	1.54	26.21	0.962
SD1	11.58	7.39	100%	90.0	0.0	11.51	0.67	18.74	0.994
SD-INLET	11.58	2.13	25%	84.5	1.4	9.46	0.49	5.71	0.816
SEA-PONDS-BASIN	11.58	5.16	10%	85.0	1.4	9.7	1.36	20.69	0.838
SEAS-POND-BYPASS	11.58	1.91	0%	80.0	2.1	8.79	1.76	19.02	0.759
SHOP-DITCH	11.58	5.05	35%	86.3	0.9	10.37	1.42	30.11	0.896
WD1	11.58	0.66	100%	90.0	0.0	11.52	0.21	5.82	0.994
WD2	11.58	0.51	100%	90.0	0.0	11.52	0.16	4.53	0.994
WD3	11.58	0.85	100%	90.0	0.0	11.51	0.27	7.52	0.994
WD4	11.58	1.21	100%	90.0	0.0	11.47	0.38	9.82	0.990
WD5	11.58	0.93	100%	90.0	0.0	11.52	0.29	8.23	0.995
WD6	11.58	1.15	100%	90.0	0.0	11.47	0.36	9.37	0.990
WD-FARM	11.58	6.99	0%	39.0	6.7	4.4	0.84	7.07	0.380

Table 2
Node Depth and Link Flow Summary Table
CEMEX Davenport Cement Plant
Davenport, California
Farallon PN: 1839-001

NODE SUMMARY						LINK SUMMARY						
Description of Nodes	**Node**	**Type**	**Rim Elevation (feet)**	**Maximum HGL (feet)**	**Hour of Maximum Depth**	**Link**	**Type**	**Maximum Flow (cubic feet per second)**	**Hour of Maximum Flow**	**Maximum Velocity (feet per second)**	**Max/Full Flow**	**Max/Full Depth**
North Pond Storage	001-NORTH-POND	STORAGE	290.00	282.07	12:03	001-002	CONDUIT	58.84	13:11	7.16	0.78	1
MH #B1 Bypass Pipe	002	STORAGE	286.00	280.07	11:43	002-003	CONDUIT	68.71	12:13	7.14	0.94	1
MH #B2 Bypass Pipe	003	STORAGE	275.00	274.89	11:06	003-004	CONDUIT	76.44	11:02	7.95	1.02	1
MH #B3 Bypass Pipe	004	JUNCTION	275.30	272.98	11:06	004-005	CONDUIT	76.44	11:02	8.19	0.99	1
MH #B4 Bypass Pipe	005	JUNCTION	273.50	269.56	11:06	005-006-SB	CONDUIT	76.44	11:02	7.95	0.64	1
MH #B5 Bypass Pipe	006_SB	STORAGE	267.50	266.52	11:07	006_SB-Outfall	CONDUIT	76.44	11:02	4.73	0.42	0.48
Outfall to No-Name Creek	BYPASS_OUTFALL	OUTFALL	267.40	266.29	11:07							
West Perimeter Ditch	101	JUNCTION	286.50	285.5	10:00	101-102	CONDUIT	5.82	10:00	3.26	0.03	0.26
	102	JUNCTION	282.50	278.29	9:59	102-103	CONDUIT	10.35	10:00	4.45	0.08	0.31
	103	JUNCTION	276.61	272.29	10:00	103-104	CONDUIT	10.33	10:00	2.69	0.07	0.43
	104	JUNCTION	274.18	270.02	10:00	104-105	CONDUIT	17.64	10:00	3.63	0.22	0.49
	105	JUNCTION	263.85	266.57	10:00	105-105a	CONDUIT	27.06	10:00	6.12	0.15	0.46
	105a	JUNCTION	258.85	259.47	10:00	105a-106	CONDUIT	26.85	10:01	5.47	0.21	0.5
	106	JUNCTION	251.34	254.84	10:00	106-107	CONDUIT	48.49	10:00	9.93	0.34	0.62
MH #W1 West Drop Structure	107	STORAGE	245.90	241.56	10:00	107-108	CONDUIT	48.55	10:00	14.19	0.45	0.6
MH #W2 West Drop Structure	108	STORAGE	230.50	223.73	10:00	108-109	CONDUIT	66.9	10:00	21.03	0.29	0.56
MH #W3 West Drop Structure	109	JUNCTION	219.00	213.43	10:01	109-110	CONDUIT	66.88	10:00	16.2	0.31	0.69
MH #W4 West Drop Structure	110	STORAGE	145.50	144.19	10:01	110-302	CONDUIT	168.33	10:00	13.45	0.3	0.59
South Ditch #1	111	JUNCTION	237.50	236.09	10:00	111-108	CONDUIT	18.62	10:00	5.35	0.34	0.62
East Perimeter Ditch	201	JUNCTION	287.14	286.21	9:57	201-202	CONDUIT	19.29	10:00	5.28	0.12	0.43
	202	JUNCTION	284.50	280.67	10:00	202-203	CONDUIT	20.82	10:00	3.93	0.19	0.52
	203	JUNCTION	273.66	269.43	10:00	203-204	CONDUIT	29.19	10:00	4.5	0.27	0.59
	204	JUNCTION	271.60	267.43	10:00	204-205	CONDUIT	33.52	10:00	3.88	0.32	0.7
	205	JUNCTION	268.19	264.68	10:00	205-205a	CONDUIT	60.08	10:00	4.65	0.57	0.88
	205a	JUNCTION	264.95	262.13	10:01	205a-206	CONDUIT	55.79	10:01	4.43	0.84	0.86
MH #E1 East Drop Structure	206	STORAGE	257.80	251.28	10:01	206-207	CONDUIT	57.59	10:01	14.58	0.2	0.67
MH #E2 East Drop Structure	207	JUNCTION	239.00	235.56	10:01	207-208	CONDUIT	74.27	10:02	12.73	0.47	0.62
MH #E3 East Drop Structure	208	JUNCTION	234.00	228.82	10:01	208-209	CONDUIT	74.27	10:02	19.22	0.2	0.65
MH #E4 East Drop Structure	209	STORAGE	160.50	158.64	10:01	209-110	CONDUIT	74.27	10:02	21.49	0.04	0.26
MH #S1 Culvert to Retention Pond	302	STORAGE	121.50	119.62	10:04	302-303	CONDUIT	173.28	10:02	10.9	0.88	1
Detention Pond	DET-POND	STORAGE	142.60	133.55	10:15	Orf-Det-Outlet-302	ORIFICE	4.91	10:15	1		
MH Inlet #S2 Culvert to Retention Pond	303	JUNCTION	120.50	114	10:04	303-RET-POND	CONDUIT	173.29	10:02	12.91	0.63	0.79
Retention Pond	RET-POND	STORAGE	107.00	105.22	10:13	Ret-Orifice-1	ORIFICE	79.76	10:11	1		
						Ret-Outlet	WEIR	50.49	10:11	0.42		
Retention Pond Riser	401	STORAGE	107.00	100.49	10:35	401-401A	CONDUIT	131.41	10:10	8.48	0.24	1
Existing MH on Tunnel D	401A	JUNCTION	105.55	100.41	10:35	401A-402	CONDUIT	170.02	10:11	10.77	0.27	1
Deflection Point on Tunnel D	402	JUNCTION	102.91	100.32	10:35	402-405	CONDUIT	170.6	10:08	10.99	0.32	1
Drop Structure at Tunnel B Beginning	403	STORAGE	102.00	100.26	10:35	403-404	CONDUIT	113.81	10:02	3.88	0.04	1
Tunnel A Beginning	403-TNL-A1	JUNCTION	102.00	100.26	10:35	A1-A2	CONDUIT	48.67	10:19	3.88	0.06	1
24-inch Drop Connection on Tunnel A	403-TNL-A2	JUNCTION	100.00	100.26	10:35	A2-403	CONDUIT	74.94	10:13	3.85	0.07	1
Tunnel C Beginning	403-TNL-C	JUNCTION	106.00	100.26	10:35	C-A2	CONDUIT	61.99	10:19	0.86	0.03	1
Deflection Point on Tunnel B	404	JUNCTION	100.00	100.26	10:35	404-405	CONDUIT	75.38	10:03	1.79	0.22	1

Table 2
Node Depth and Link Flow Summary Table
CEMEX Davenport Cement Plant
Davenport, California
Farallon PN: 1839-001

NODE SUMMARY							LINK SUMMARY						
Description of Nodes	**Node**	**Type**	**Rim Elevation (feet)**	**Maximum HGL (feet)**	**Hour of Maximum Depth**		**Link**	**Type**	**Maximum Flow (cubic feet per second)**	**Hour of Maximum Flow**	**Maximum Velocity (feet per second)**	**Max/Full Flow**	**Max/Full Depth**
Confluence Point of Tunnels B and D	405	JUNCTION	97.88	100.23	10:35		405-406	CONDUIT	159.05	10:02	4.13	0.04	1
End of Tunnel B	406	JUNCTION	97.87	100.22	10:35		406-407	CONDUIT	142.99	10:38	>50.00	0.94	1
Begin Existing Tunnel Below Railroad	407	JUNCTION	80.57	71.81	10:33		407-407A	CONDUIT	142.99	10:38	0.92	0.04	1
Highway Drainage Connection to Existing Tunnel	407B	JUNCTION	92.00	87.57	10:06		CALTRANS-INLT	CONDUIT	26.04	10:06	20.02	0.17	0.69
End Existing Tunnel Below Highway 1	407A	JUNCTION	75.00	71.8	10:33		407a-OUTFAL001	CONDUIT	155.87	10:36	31.75	1.51	1
Outfall 001	OUTFALL-001	OUTFALL	34.50	34.5	9:52								
Seasonal Ponds Overflow Point to No-Name Creek	SEA-OUTFALL	OUTFALL	264.00	263.12	10:09		SeaFD-206	CONDUIT	1.88	0.423611	6.94	1.05	1
Seasonal Ponds	SEA-PONDS	STORAGE	265	264.72	10:09		EA-OVERFLOW-CHNN	CONDUIT	18.68	10:06	1.37	0.05	0.17

NOTES:

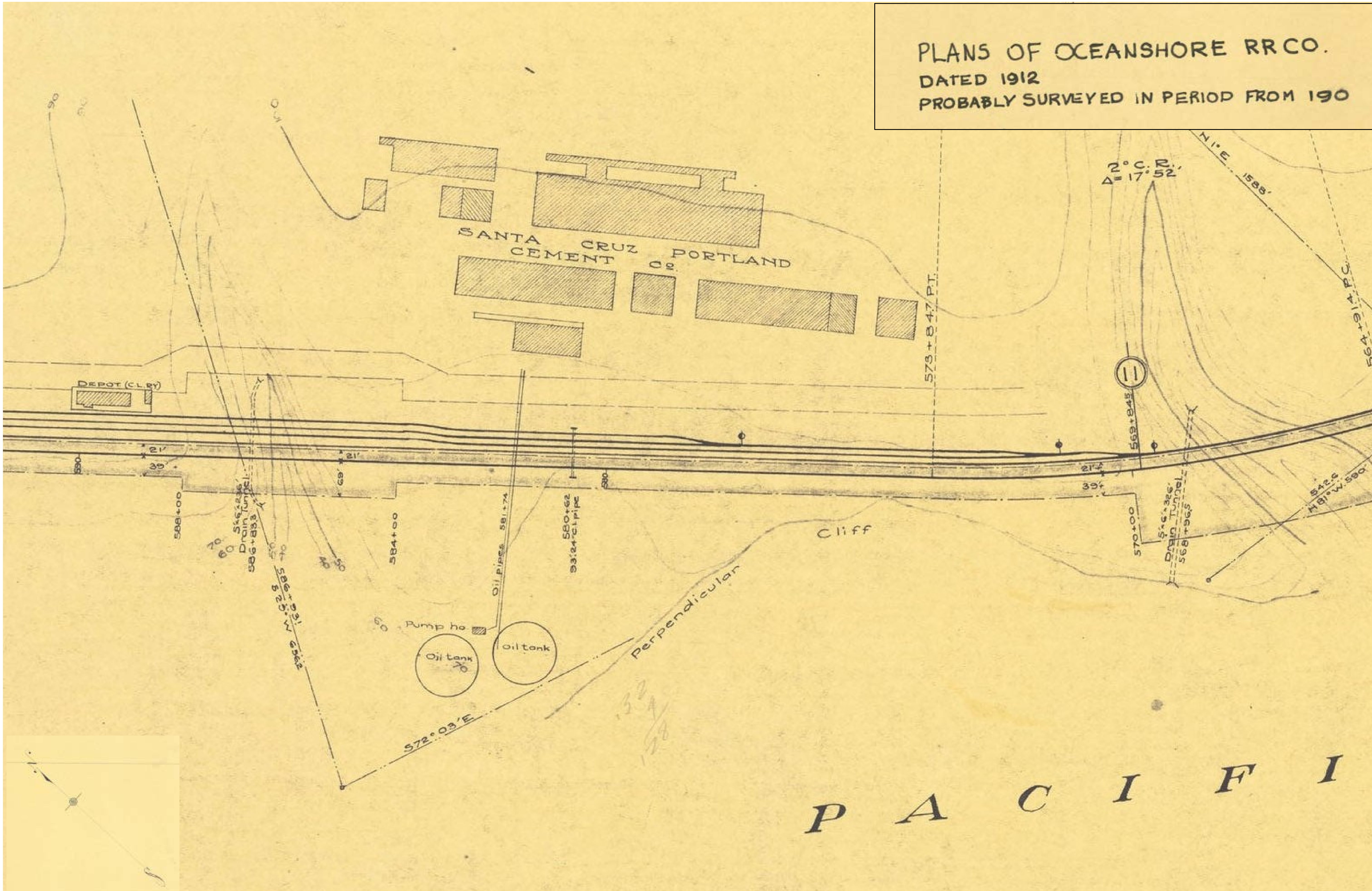
HGL = hydraulic grade line

MH = manhole

APPENDIX A
HISTORICAL DRAINAGE SYSTEM DRAWINGS

NORTH CKD AREA LANDFILL CLOSURE STORMWATER HYDRAULIC ANALYSIS
CEMEX Davenport Cement Plant
700 Highway 1
Davenport, California

Farallon PN: 1839-001



PLANS OF OCEANSHORE RR CO.
DATED 1912
PROBABLY SURVEYED IN PERIOD FROM 190
SANTA CRUZ PORTLAND
CEMENT Co.
DEPOT (C.L.RY)
573+84.7 P.T.
2° C.R.
Δ= 17°52'
564+91.4 P.C.
588+00
584+00
570+00
Drain Tunnel
Oil pipes
Pump ho
Oil tank
oil tank
Cliff
Perpendicular
S72°03'E
P A C I F I

INDEX OF SHEETS

Sheet No. 1 Title Sheet
" " 2 Typical Cross Section of Improvement
" " 3-20 Plan and Profile
" " 21 - Scott Creek Channel Change
" " 22-24 Standard Structures
" " 1-13 Bridge Plans
" " 1-201 Cross Sections

STATE OF CALIFORNIA

DEPARTMENT OF PUBLIC WORKS

DIVISION OF HIGHWAYS

PLAN AND PROFILE OF STATE HIGHWAY

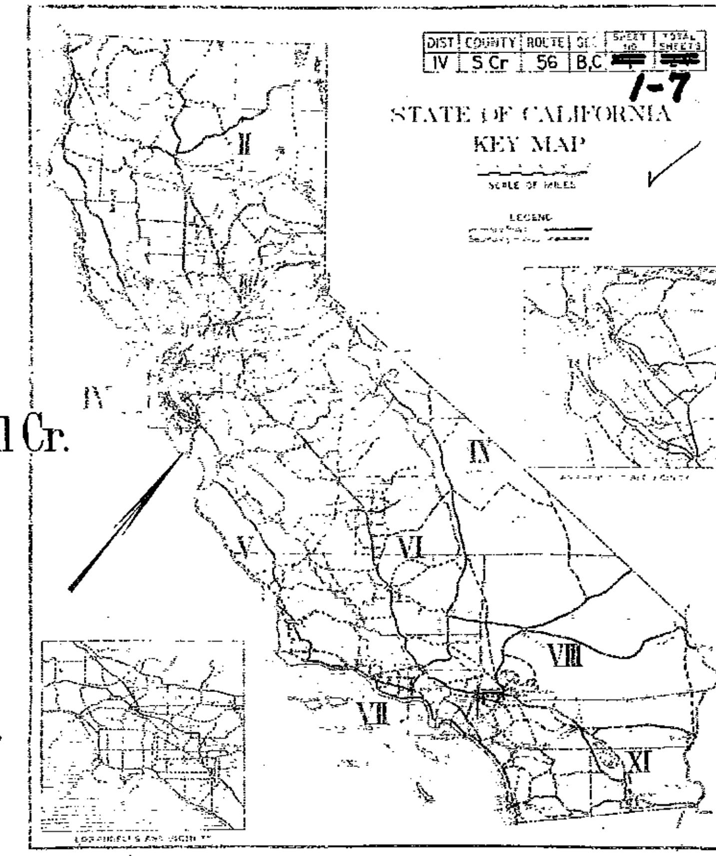
In Santa Cruz County, between One Half Mile South of Davenport and Waddell Cr.

Scales {Plan: 1 In. = 100 Ft.
Profile: Hor. 1 In. = 100 Ft. Vert. 1 In. = 10 Ft.

(being the detail plans of a portion of the route for the State highway adopted by the California Highway Commission August 5, 1938)

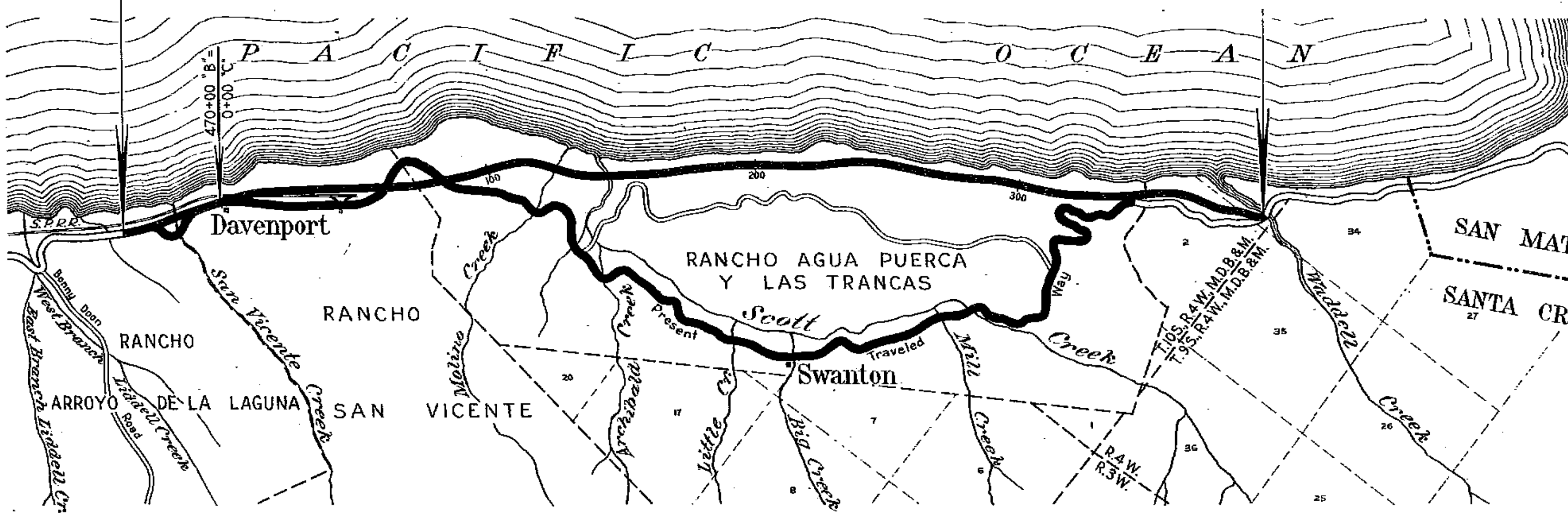
RIGHT OF WAY SHOWN IN RED
RELINQUISHED TO
THE COUNTY OF SANTA CRUZ
BY RESOLUTION OF THE
CALIFORNIA HIGHWAY COMMISSION
PASSED DECEMBER 30, 1939
Approved December 18, 1939
JNO. H. SKEGGS
District Engineer

Map No. 13
File No. 291



Beginning of Project
Station 432+50.00

End of Project
Station 394+03.30



291
FILED
January 12, 1940
at 31 min. past 8 o'clock A.M.
at request of
Jno. H. Skeggs, District Engineer
SANTA CRUZ COUNTY RECORDS
Belle Lindsay
RECORDER
By Myra Faneuf
DEPUTY

CONVENTIONAL SIGNS

County Line	Bank or Retaining Wall
City or Town Limits	Levee
Township Line / Section Line / Grant Line (Note whether Township, Section or Grant)	Culverts
Fence	Drop Inlet
Guard Rail	Trolley Pole
Unfenced Property	Power Pole
Right of Way Line	Power Tower
Base or Survey Line	Telegraph or Telephone Pole
Traveled Way	
Railway Tracks	Marsh

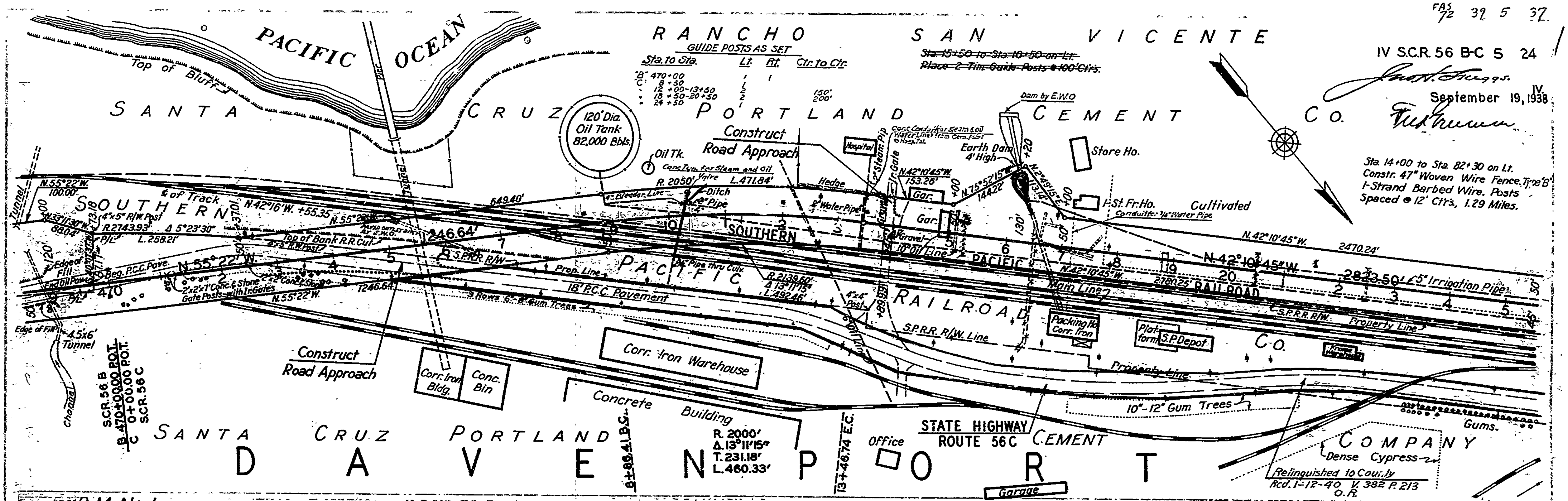
Scale in Feet
0 5000 10000

Length of project - 43,155.30 feet = 8.17 miles

September 17, 1938
[signature]
District Engineer

Approved September 19, 1938
C.H. PURCELL
State Highway Engineer
by [signature]
Asst. State Highway Engineer
Civil Engineer License No 2084
[signature]
Director of Public Works

September 19, 1938



B.M. No. 1
R.R. Spike in Root 24" Cypress
7.9' Rt. Sta. 469+85
Elev. 97.96

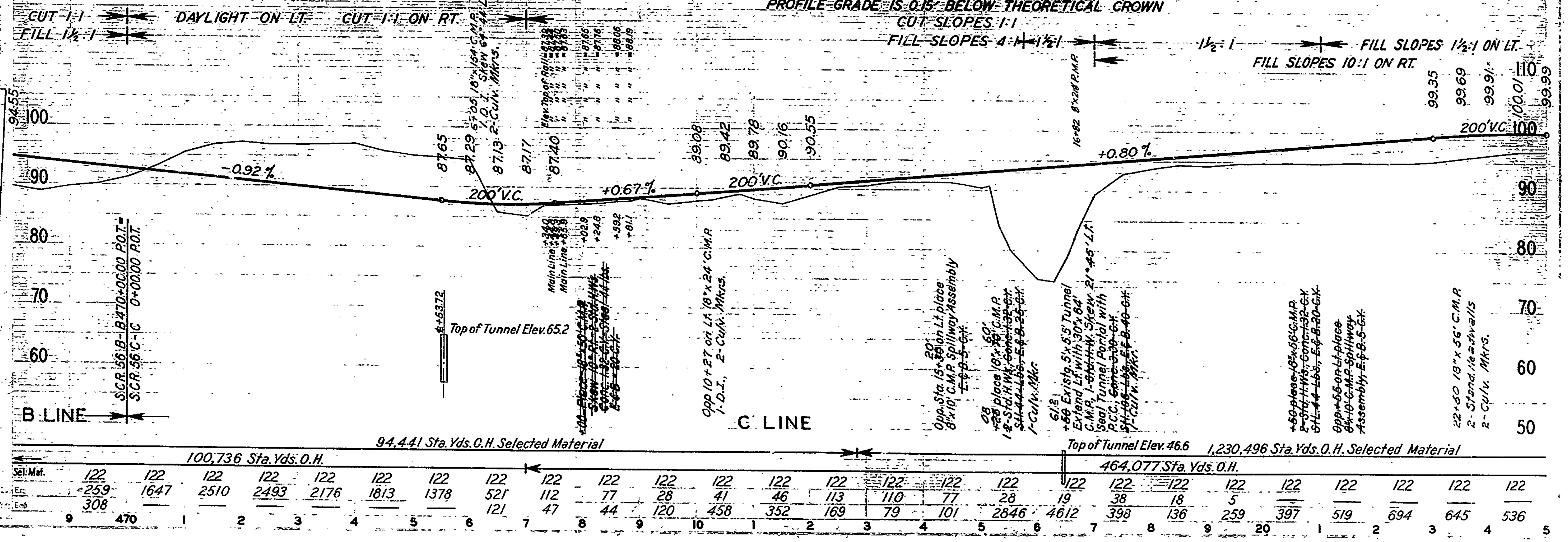
Road Intersections

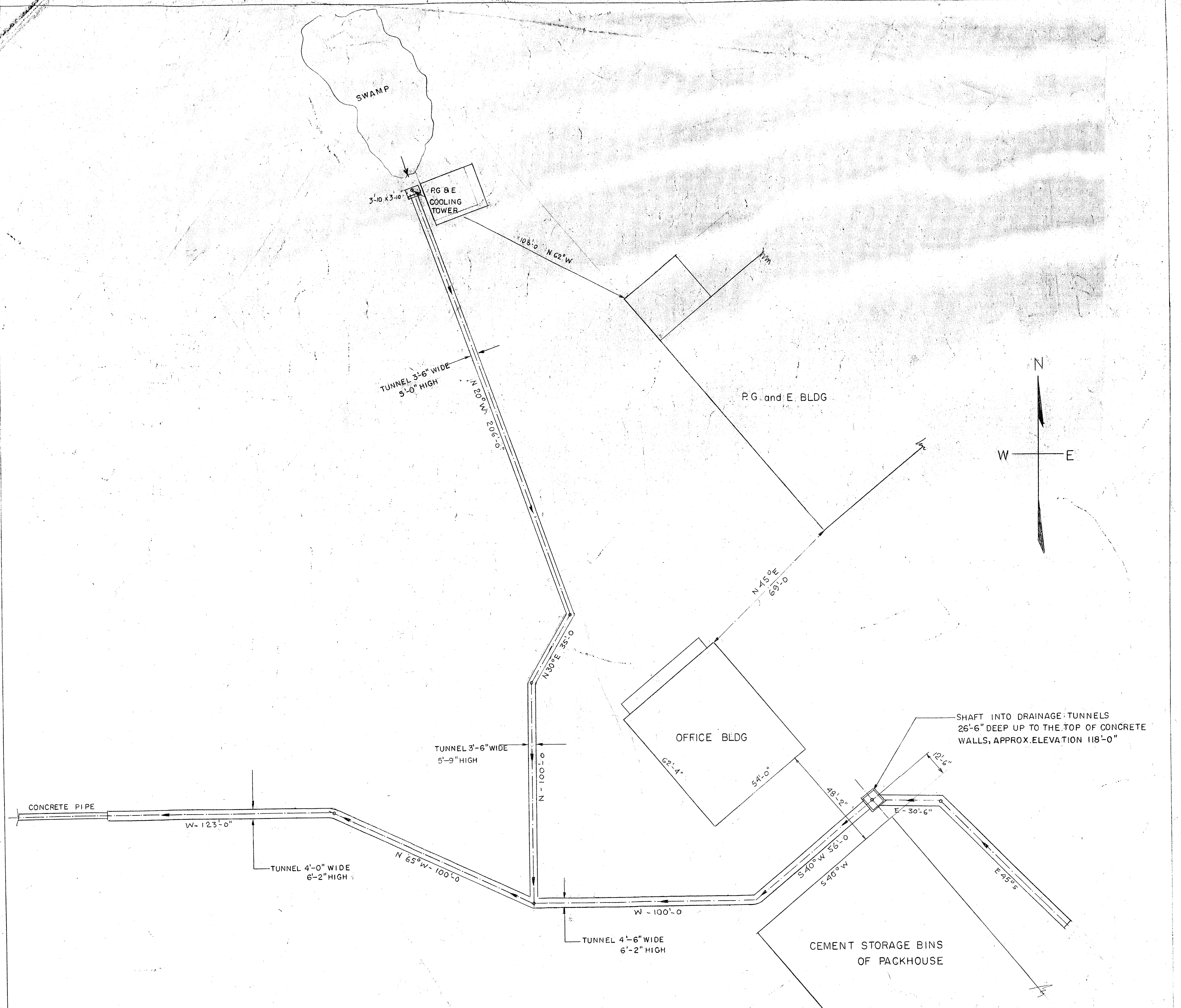
Station	Loc'n	Exc. C.Y.	SC1-A Tons	RGMC-3 Tons	90-95 Tons	Road Mix Sq. Yds.	Min. Agg. Sd. Mr. Surf. C.Y.	Min. Agg. Shlds. C.Y.	Screenings Tons
5+00	Rt.	1900	0.83	5.60	0.59	700	60	—	5.3
13+90	Lt.	—	0.08	—	0.07	—	—	0.9	0.5

B.M. No. 2
Mark "O" on South end
Conc. H.W. on R.R. Prop.
76' Rt. Sta. 10+18
Elev. 87.72

B.M. No. 3
U.S.C.&G.S. B.M. No. N212
At Davenport R.R. Sta.
173' Rt. Sta. 20+45
C.H.C. & U.S.C.&G.S. Elev. 98.702

WIDTH OF ROADBED 36 FEET
PROFILE GRADE IS 0.15' BELOW THEORETICAL CROWN
CUT SLOPES 1:1

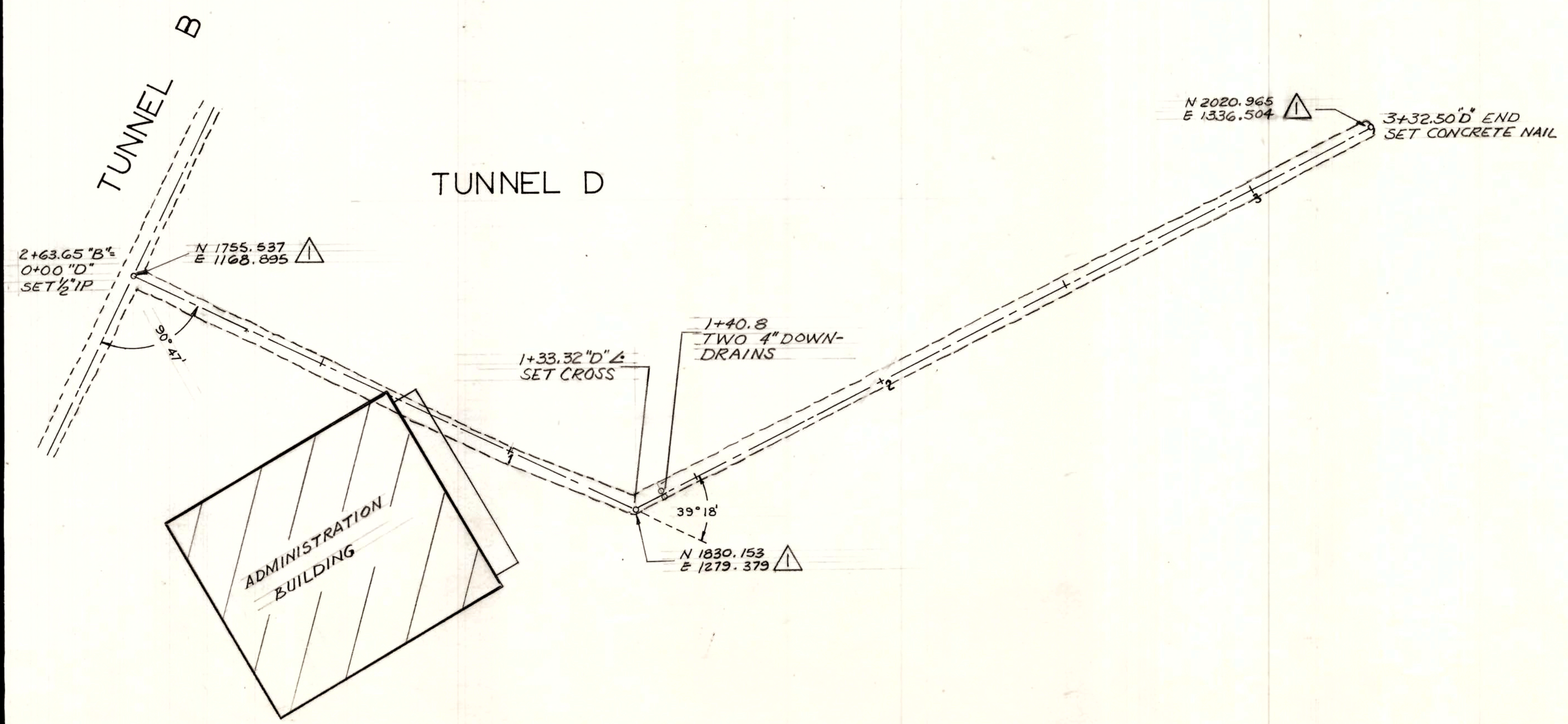




DRAINAGE TUNNELS			
AT PLANT			
SANTA CRUZ PORTLAND CEMENT ENGINEERING DEPT. DAVENPORT, CALIF.			
	MADE BY:	TRACED BY:	CHECKED BY:
	A.I.L.		
11 095	DATE	SCALE:	DRAWING No.
	6-4-58	1/20" = 1'-0	2-219

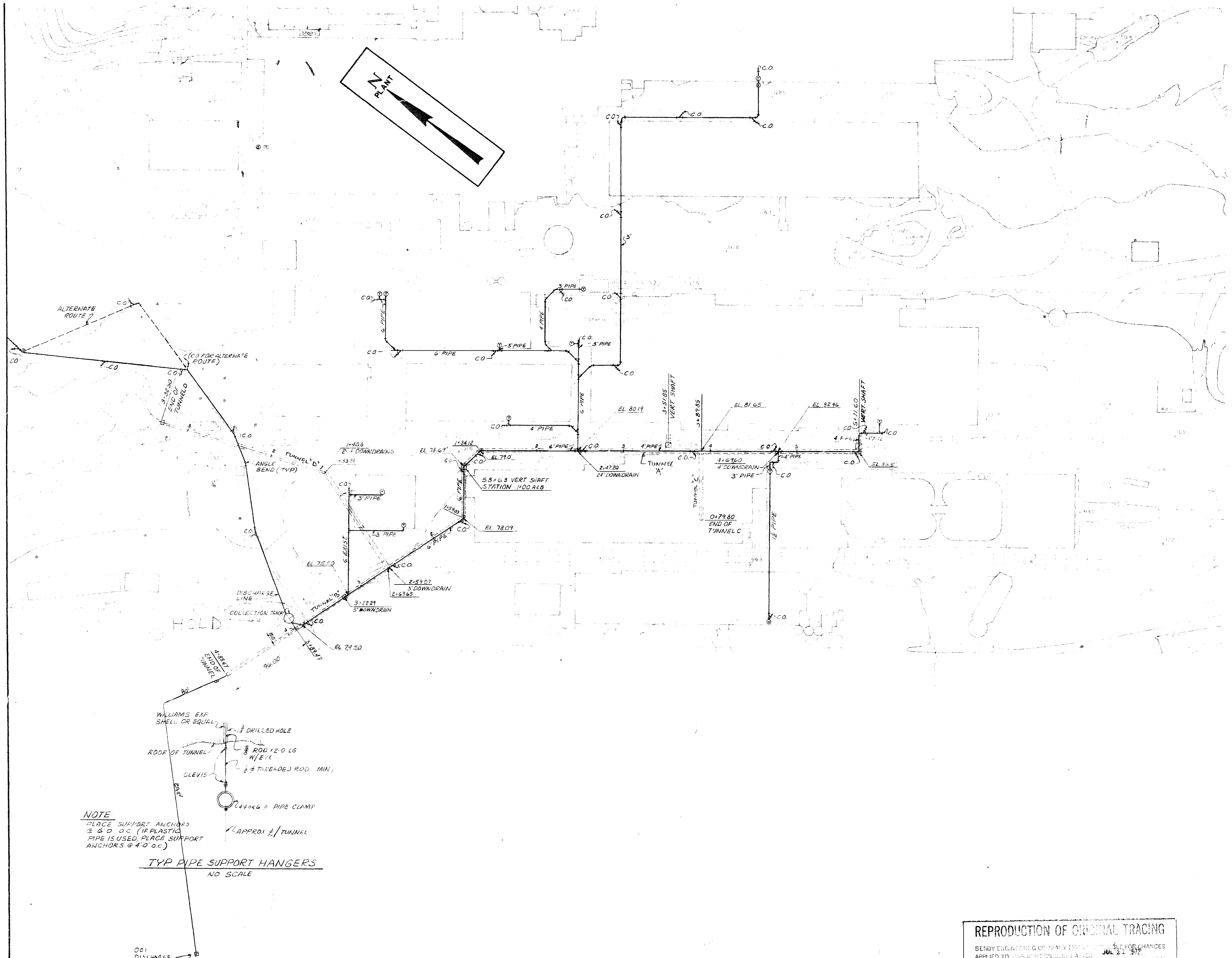

1" Pipe drain IE = 93.38
3" lateral IE = 96.87
1.5 x 2.5 box drain IE = 97.18
4" lateral IE = 98.77
102.03
100
80
60
TUNNEL B
SEE SHEET 2
1+00 A = 1+00 B
3/4" ROD IN FLOOR
ELEV = 75.97
80.93
∠ 1+34.12
82.14
2" downdrain
82.46
3+51.86 SPUR 100.83
83.64
3+89.85 A = 0+00 C 100.86
83.99
85.15
100.67
∠ 4+09.25
4+69.60 inspection tunnel 100.08
and 4" downdrain 83.62
101.99
84.92
∠ 5+71.60
ELEVATIONS ARE TAKEN ON TUNNEL CEILING, FLOOR AS SHOWN IS APPROXIMATE
Ground El 101.83
POINT DESIGNATED BY PCA OFFICIALS ELEV. 95.75
31°57'
22.4 Slope distance 62.368%
STA 5+63
84.92
83.90
19.0'
21.23'
SECTION A-A
1" = 4'
GRADE FOR BORING DRAIN LINE
STA 5+63, 21.23 RIGHT
TUNNEL A
SET CROSS ON SURFACE
SET CROSS ON SURFACE 1+34.12
N 1643.112
E 1309.146
49.17
2+47.20
24" downdrain
vertical shaft w/ sealed top
SET 1/2" I.P. ON SURFACE 3+51.85
SET 1/2" I.P. ON SURFACE 3+89.85 = 0+00
180°12'20"
∠ 4+09.25
SET 1/2" I.P. ON SURFACE
inspection tunnel
4+69.60
SET 1/2" I.P. ON SURFACE
N 1205.033
E 1310.006
vertical shaft w/ sealed top
∠ 5+71.60
SET CROSS ON SURFACE
4" lateral
2.5 x 1.5 DRAIN
3" lateral
21.75
12.89
275.13
N 1367.983
E 1310.053
22.66
22.64
4" downdrain
60.35
67.59
PROPOSED DRAIN LINE 5+63
25' PARALLEL OFF SET
5.8' x 6.3' vertical shaft
1+00 A = 1+00 B
SET 3/4" ROD IN TUNNEL FLOOR AT BASE OF SHAFT
N 1667.501
E 1285.285
NE CORNER OF SHAFT CURBING
ELEV. 101.91 GROUND IS 0.00 TO 0.35 LOWER (SEE FIELD NOTES)
SEE SHEET 2
TUNNEL B
STOCK HOUSE
0+43.23
1.0 x 0.5 lateral
TUNNEL C
0+79.80
1.0 x 0.5 lateral
0+79.80
END TUNNEL C
SET CROSS ON SURFACE
BAG HOUSE
BENCHMARK
BRASS CAP IN CONC, BASE LINE № 1 NEAR MILL FOREMAN'S SHED ELEV. = 119.05
INDICATES SPAD SET IN TUNNEL CEILING UNLESS OTHERWISE NOTED, ALSO POINT SET ON SURFACE AS SHOWN ON PLAN
REVISED
COORDINATES ADDED JUNE 14, 1979
BOWMAN AND WILLIAMS
REGISTERED CIVIL ENGINEERS
1011 CEDAR STREET
SANTA CRUZ
R. F. Thomas RCE 11875
REGISTERED CIVIL ENGINEER NO. 6270
PLAN & PROFILE
EXISTING TUNNEL
CEMENT MILL
DAVENPORT
SANTA CRUZ COUNTY
CALIFORNIA
SCALE H 1"=20 V 1"=8'
DATE AUG 1971
DRAWN G.R.D.
CHECKED RFT
TRACED DRS
JOB NO. 16765-1
FILE NO. 16765
SHEET 1 OF 4

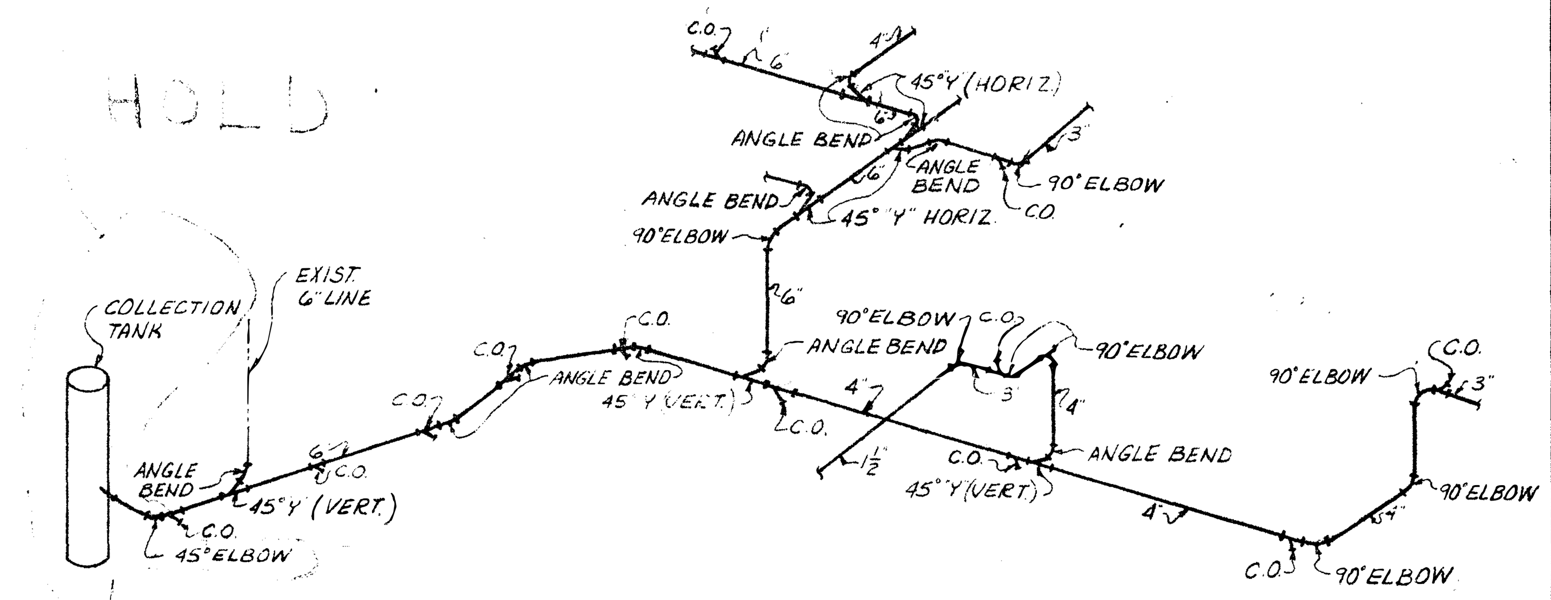
100
80
60
84.29
83.94
83.99
1.0×0.5 lateral
IE = 79.3
1.0×0.5 lateral
IE = 78.8
0+00 C =
3+89.85 A
95.24
97.88
99.19
73.51
75.76
77.01
3" downdrain
76.89
78.07 SPUR
78.01
3" downdrain
79.08
80.09
6" lateral
81.00
TUNNEL A
SEE SHEET 1
TUNNEL D
SEE SHEET 3
24" RCP
IE = 67.57
ELEVATIONS TAKEN ON TUNNEL CEILING, FLOOR AS SHOWN IS APPROXIMATE
℄ 1+59.03
6" lateral
IE = 79.82
1+00 B = 1+00 A
3/4" ROD IN FLOOR
ELEV = 75.97
1
0
5
4
3
2
1
TUNNEL C
℄ 3+51.85 A
1.0×0.5 lateral
0+79.80
1.0×0.5 lateral
0+43.23
END TUNNEL C
0+79.80
SET CROSS
ON SURFACE
0+00 C =
3+89.85 A
℄ 4+09.25 A
STOCK HOUSE
BAG HOUSE
TUNNEL B
24" RCP
SET 1¼" I.P.
ON SURFACE
4+85.47 END
TUNNEL B
BEGIN 24" R.C.P.
N 1941.042
E 1047.272
GATE POST
3+22.29
3" downdrain
N 1755.537
E 1168.895
2+59.07
3" downdrain
SET 1¼" I.P.
ON SURFACE
2+63.65 B =
0+00 D
SEE SHEET 3
GATE POST
ADMINISTRATION
BUILDING
SET PK SPIKE ON
SURFACE NOTHING
IN TUNNEL
1+89.10
SET 1¼" I.P.
ON SURFACE
℄ 1+89.03
25' PARALLEL OFFSET
N 1668.045
E 1226.257
SET CROSS
ON SURFACE
5.8'×6.3' vertical shaft
1+00 B = 1+00 A
SET 3/4" ROD IN
TUNNEL FLOOR AT
BASE OF SHAFT
SEE SHEET 1
TUNNEL A
N 1667.501
E 1285.285
1+22.78
6" lateral
1+59.03
6" lateral
STOCK HOUSE
COORDINATES ADDED JUNE 14, 1979
BOWMAN AND WILLIAMS
REGISTERED CIVIL ENGINEERS
SANTA CRUZ
R. F. Thomas RCE 11875
for REGISTERED CIVIL ENGINEER NO. 6270
PLAN & PROFILE.
EXISTING TUNNEL
CEMENT MILL
DAVENPORT
SANTA CRUZ COUNTY
CALIFORNIA
SCALE H 1"=20 V 1"=8'
DRAWN G.R.D.
JOB NO. 16765-1
DATE AUG. 1971
CHECKED RFT
TRACED DRS
FILE NO. 16765
SHEET 2 OF 4



REVISED	⚠ COORDINATES ADDED JUNE 14, 1979
BOWMAN AND WILLIAMS REGISTERED CIVIL ENGINEERS 1011 CEDAR STREET SANTA CRUZ 408-426-3560	PLAN & PROFILE EXISTING TUNNEL CEMENT MILL
R. F. Thomas RCE 11875 for REGISTERED CIVIL ENGINEER NO. 6210	DAVENPORT SANTA CRUZ COUNTY CALIFORNIA
SCALE H 1"=20 V 1"=8	DRAWN G.R.D
DATE SEPT 1971	CHECKED RFT
DESIGN	TRACED G.RD
JOB NO. 16765-4	SHEET 3 OF 4
INDEX	
FILE NO. 16765	

REVISED			
BOWMAN AND WILLIAMS REGISTERED CIVIL ENGINEERS 1011 CEDAR STREET SANTA CRUZ 408-426-3560		CROSS SECTIONS EXISTING TUNNEL CEMENT MILL	
R. F. Thomas RCE 11875 for REGISTERED CIVIL ENGINEER NO. 6270		DAVENPORT SANTA CRUZ COUNTY CALIFORNIA	
SCALE H&V 1" = 2'	DRAWN GRD	JOB NO. 16765-1	SHEET
DATE AUG 1971	CHECKED R.F.T.	INDEX	4
DESIGN	TRACED DRS	FILE NO. 16765	OF 4





ISOMETRIC OF DRAINAGE LINE
NO SCALE

NOTES:

1. PIPE ELEVATIONS SHOWN ON THE PLAN ARE APPROXIMATE AND ARE TO THE CENTERLINE OF PIPE.
2. MAIN COLLECTION LINE IS SLOPED AT 1.02 % WHICH IS NEARLY THE SAME SLOPE AS THE TUNNEL. SINCE THIS IS LESS THAN 1/4" PER FT, APPROVAL BY THE PROPER ADMINISTRATIVE AUTHORITY SHOULD BE OBTAINED BEFORE BEGINNING CONSTRUCTION
3. VENTING. EACH WATER CLOSET TRAP SHALL BE VENTED WITH A 1½ ϕ PIPE WHICH SHALL TERMINATE 6" ABOVE THE ROOF IF THIS PIPE SHOULD EXCEED 60' IN LENGTH A 2"ϕ PIPE SHALL BE USED FOR VENTING. WASH BASIN TRAPS SHALL BE VENTED WITH A 1¼ ϕ PIPE TERMINATING 6" ABOVE THE ROOF
4. CLEANOUTS. PROVIDE CLEANOUTS FOR EVERY 100 FT. OR FRACTION THEREOF. UNLESS OTHERWISE SHOWN ON DRAWINGS, CLEANOUTS SHALL BE 45° "Y" FITTINGS WITH BRASS PLUGS OR AN APPROVED PLUG IF PLASTIC PIPE IS USED. EXTEND CLEANOUTS ABOVE FLOOR OR GRADE. CLEANOUTS FOR PIPING IN TUNNEL SHALL BE ACCESSIBLE FROM BELOW. ALL CLEANOUTS SHALL HAVE 18 INCHES CLEARANCE IN FRONT OF CLEANOUT.
5. UNLESS OTHERWISE NOTED, ALL MATERIALS, WORKMANSHIP, INSPECTIONS AND TESTS SHALL CONFORM WITH THE "UNIFORM PLUMBING CODE," 1970 EDITION.

11 220

RELEASED FOR CONSTRUCTION
BY J.E. Rogan DATE 6/2/72

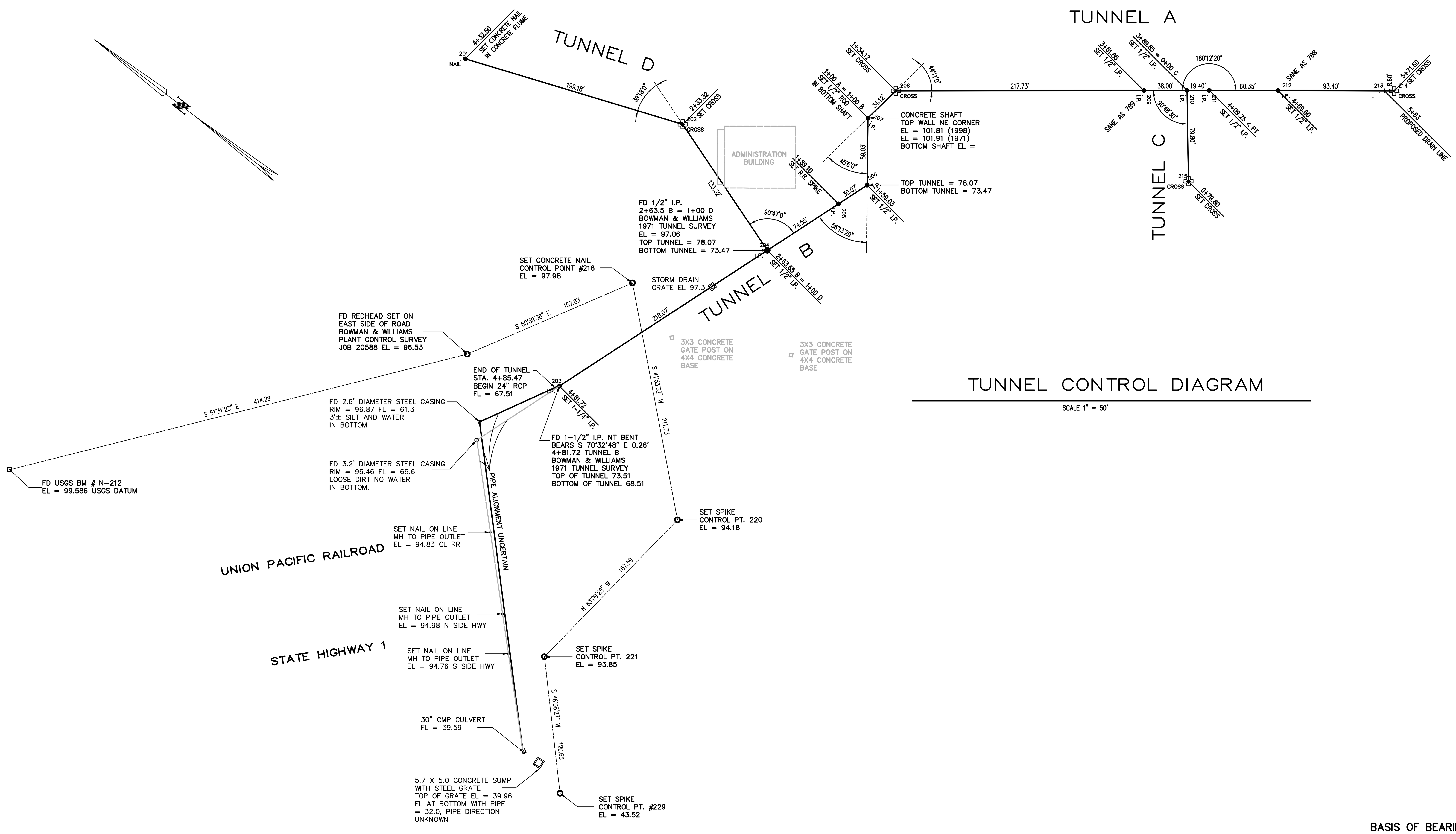
BENDY ENGINEERING COMPANY
1530 PAGE INDUSTRIAL BOULEVARD · ST. LOUIS, MISSOURI 63132 · PHONE (314) 429-7911

LONE STAR INDUSTRIES, INC.
PACIFIC CEMENT & AGGREGATE DIV.

PLAN OF SEWAGE COLLECTION SYSTEM
1972 MODIFICATIONS

DESIGNED: J.E. ROGAN	SCALE: 1" = 50'	JOB NO. 7131

11	10	9	8	7	6	5	4	3	2	1
	DATE	DATE	DATE	DATE	DATE	DATE	DATE	DATE	DATE	DATE



TUNNEL CONTROL DIAGRAM

SCALE 1" = 50'

BASIS OF BEARINGS

BASIS OF BEARINGS FOR THIS MAP IS THE GRID BEARING BETWEEN P.G. & E #6 AND U.S.C. & G.S. TRIANGULATION STATION "JARRO 2" AS SHOWN ON THE MAP ENTITILED "RECORD OF SURVEY" OF SECOND ORDER CONTROL SURVEY, DAVENPORT, SANTA CRUZ COUNTY CALIFORNIA" FILED FOR RECORD IN VOLUME 53 OF MAPS AT PAGE 17 SANTA CRUZ COUNTY RECORDS = N 49°51'39" W.

BENCHMARK

PROJECT BENCHMARK IS U.S.G.S. BM # N-212, AT DAVENPORT, 69' NORTH OF NW CORNER OF SOUTHERN PACIFIC CO. RAILROAD STATION (NOW GONE) , AT MILE POST 90.68, 84' NORTH OF CENTERLINE OF MAIN TRACK AND 22' SOUTH OF THE CENTER OF THE OLD PAVED HIGHWAY, 2' WEST OF A WITNESS POST. ELEVATION = 99.586' U.S.G.S. DATUM.

APN 58-071-01

REVISED

BOWMAN & WILLIAMS
CONSULTING CIVIL ENGINEERS
1011 CEDAR STREET
SANTA CRUZ, CA 95060
(408) 426-3560

LICENSED LAND SURVEYOR NO. 5513

TUNNEL & PIPE ALIGNMENTS IN THE VICINITY OF ADMINISTRATION BUILDING

AT R. M. C. LONESTAR
PLANT SITE
SITUATE IN
DAVENPORT, CALIFORNIA

SCALE 1" = 50'	DRAWN PLOTTER	JOB NO. 21358	SHEET 1
DATE AUGUST 28, 1998	CHECKED	INDEX SAN VICENTE	
DESIGN DRS	DWG NAME 21358	FILE NO. 21358	OF 1

J:\B&W\21200\21228\21228FIL.DWG Thu Nov 05 09:45:57 1998

PT. NO.	DESCRIPTION	COORDINATES NORTH	COORDINATES EAST	ELEVATION
2	6×6 CONCRETE MONUMENT	1,500.00	1,500.00	119.05
3	LEAD PLUG	1,500.013	1,514.211	
4	3/4" I.P.	1,737.171	1,514.199	117.27
5	3/4" I.P.	1,737.191	1,935.996	
6	2×2 STA 2+18.85 PROFILE B	1687.190	1908.283	182.20
7	2×2 STA 5+13.43 PROFILE B	1687.204	2202.874	233.95
8	TEMPORARY POINT	1366.005	2202.236	
9	TEMPORARY POINT	925.353	1987.527	
10	CROSS IN CONCRETE	766.280	1514.850	
11	~~6×6 CONCRETE MONUMENT~~	766.267	1500.840	
18	NE CORNER OF CONCRETE BUILDING	1594.206	2201.889	
19	SE CORNER OF CONCRETE BUILDING	1546.206	2201.594	
25	CROSS IN CONCRETE	1,545.403	1514.208	
26	LEAD PLUG	1,849.071	1614.193	115.90
27	COLUMN	1849.075	1609.194	
28	COLUMN 1.24' 0.6'	1905.075	1609.191	
29	COLUMN CO-ORD.	1704.999	1644.637	
30	COLUMN	1705.157	1763.676	
31	2×2 STA 1+00 PROFILE B	1687.184	1789.411	
36	NAIL STA 2+46.19 PROFILE B	1687.191	1935.623	
37	CONVEYOR TUNNEL PORTAL 20.37' RT OF 36	1666.821	1935.624	FLOOR = 180.65
38	NAIL	1140.710	1500.331	
39	COLUMN COORD 1.00 0.52 COORD CTR E. FACE	1083.938	1456.916	
40	CONCRETE WALL	1131.284	1490.863	
41	CONCRETE WALL	1171.185	1491.178	
42	N.E CORNER METAL BUILDING WITH CONCRETE FLOOR	1505.448	1608.426	
43	S.E. CORNER METAL BUILDING WITH CONCRETE FLOOR	1505.428	1693.496	
44	3/4" I.P.	1620.963	1514.205	118.10
45	COLUMN SAME AS 27-30	1620.968	1609.205	
46	PAINT MARK	1737.176	1631.919	129.97
47	PAINT MARK	1737.180	1699.379	
48	NAIL	1737.184	1789.409	
49	CORNER OF CONCRETE BLOCK BUILDING	1693.381	1854.750	
50	COLUMN SAME AS 39, COORD CTR OF S. FACE	1708.786	1851.298	
51	CORNER OF CONCRETE BLOCK BUILDING	1709.434	1854.815	
52	COLUMN SAME AS 39, COORDCTR OF S FACE	1708.842	1867.278	

Bowman and Williams
Consulting Civil Engineers
Undated Map
Drawing File 21358

APPENDIX B
SUBDYNAMIC DRAINAGE ASSESSMENT PHOTOLOG

NORTH CKD AREA LANDFILL CLOSURE STORMWATER HYDRAULIC ANALYSIS
CEMEX Davenport Cement Plant
700 Highway 1
Davenport, California

Farallon PN: 1839-001

SITE PHOTOGRAPHS

Subdynamic Locating Services Video Inspection
CEMEX Davenport Cement Plant
Davenport, California
Farallon PN: 1839-001

Photograph 1: Interior view of Highway 1 culvert, approximately 28 feet from Outfall.

Photograph 2: Exterior view of Highway 1 culvert, Outfall 001.

Photograph 3: Interior view of the western shaft at transition to Highway 1 culvert.

Photograph 4: Exterior view of the western shaft with lid at transition to Highway 1 culvert.

Photograph 5: Interior view of the eastern shaft at transition to Highway 1 culvert.

Photograph 6: Exterior view of the eastern shaft at transition to Highway 1 culvert.

Photograph 7: Interior view of shaft at the northern end of Tunnel D adjacent to the retention pond.

Photograph 8: Exterior view of shaft with lid at the northern end of Tunnel D adjacent to the retention pond.

Photograph 9: Interior view of water in the bottom of the shaft at the eastern end of Tunnel B.

Photograph 10: Exterior view of the surface of the shaft at the eastern end of Tunnel B.

Photograph 1: Interior view of Highway 1 culvert, approximately 28 feet from Outfall.

Photograph 2: Exterior view of Highway 1 culvert, Outfall 001.

Photograph 3: Interior view of the western shaft at transition to Highway 1 culvert.

Photograph 4: Exterior view of the western shaft with lid at transition to Highway 1 culvert.

Photograph 5: Interior view of the eastern shaft at transition to Highway 1 culvert.

Photograph 6: Exterior view of the eastern shaft at transition to Highway 1 culvert.

SITE PHOTOGRAPHS (continued)
Subdynamic Locating Services Video Inspection
Cennex Davenport Cement Plant
Davenport, California

Photograph 7: Interior view of shaft at the northern end of Tunnel D adjacent to the retention pond.

Photograph 8: Exterior view of shaft with lid at the northern end of Tunnel D adjacent to the retention pond.

Photograph 9: Interior view of water in the bottom of the shaft at the eastern end of Tunnel B.

Photograph 10: Exterior view of the surface of the shaft at the eastern end of Tunnel B.

APPENDIX C
EASTON GEOLOGY INSPECTIONOF DRAINING TUNNELS AND VERTICAL ASINGS ABOVE TUNNEL ALIGNMENT

NORTH CKD AREA LANDFILL CLOSURE STORMWATER HYDRAULIC ANALYSIS
CEMEX Davenport Cement Plant
700 Highway 1
Davenport, California

Farallon PN: 1839-001

Easton Geology, Inc.
P.O. Box 3533, Santa Cruz, CA 95063
831.247.4317 info@eastongeology.com

20 March 2018

Kenneth O'Connell
Plant Superintendent – Cement Operations
CEMEX Cement Plant
700 Highway 1
Davenport, CA 95017

Job No. G18001

Re: Inspection of Drainage Tunnels and
Vertical Casings above Tunnel Alignment
CEMEX Cement Plant
700 Highway 1
Davenport, California

Dear Mr. O'Connell:

As requested, and as required by the California Central Coast Regional Water Quality Control Board (order No. R3-2018-0001), we have inspected two drainage tunnels which run beneath the cement plant. We understand that as part of the closure of the North Cement Kiln Dust (CKD) Landfill, an inspection of the drainage tunnels downstream of the landfill is required to help assess the capability of the tunnel system to adequately handle storm runoff. We have met with you at the site and had discussions with Matt Hillyard of Farallon Consulting and Raj Naidu of Naidu Engineering regarding our inspection and preliminary results. Specifically, we inspected drainage Tunnels B and D at the site. We also inspected two vertical shafts along the tunnel alignment. This letter report summarizes our inspection.

Scope

Our scope of work for this assessment included: 1) review of maps or reports relevant to the drainage tunnel area; 2) an inspection of Tunnels B and D; 3) inspection of Shafts 1 and 2; 4) analysis of collected data; 5) coordination with the project team; and 6) preparation of this letter report summarizing our findings.

Site Background

The cement plant operated for approximately 100 years. During its existence, the plant disposed of CKD in the middle reaches of two drainages which trend south-southwesterly through the site. A retention pond in the lower reach of the westernmost drainage, downstream of the North CKD Landfill, overflows into a drainage tunnel (Tunnel D) excavated through the underlying siltstone bedrock. Tunnel D trends southerly for approximately 330 feet to where it merges with Tunnel B (Figure 1). Tunnel B is a similar bedrock drainage tunnel which also receives drainage from Tunnels A and C which convey surface runoff from the eastern portion of the plant. From its junction with Tunnel D, Tunnel B trends westerly for 220 feet, at which point the tunnel is backfilled and drainage enters a 24-inch reinforced concrete pipe (rcp). It is likely that Tunnel B originally discharged into the western drainage gully, which is now infilled. A second bedrock drainage tunnel, depicted on the Oceanshore Railroad survey (1912), trends from the opposite side of the infilled western gully, beneath the railroad alignment, and discharges into the western gully near its mouth (Figure 1). It appears that the western drainage gully was infilled between the retention pond and the outlet of the second bedrock drainage tunnel after the 1912 survey. In order to convey drainage across the infilled gully, it is likely that the 24-inch rcp was placed between the two tunnel bores and backfilled. During construction of Highway 1, a 30-inch rcp was placed in the discharge end of the second bedrock tunnel bore, which was then sealed with concrete (State of California, 1938).

We note that there are many locations along the coastline north of Santa Cruz where gullies crossed by the railroad were infilled and a bedrock tunnel excavated to convey drainage around the railroad fill and release it seaward of the railroad (Oceanshore Railroad, 1912).

Findings

We inspected Tunnels B and D on 1 February 2018. Figures 2 through 6 show features observed during our inspection. The tunnels were free of large debris such as trash or large rock (rock larger than cobble size). The ceiling and walls of the inspected tunnels were relatively smooth, although the moderately to highly fractured bedrock is loose in areas and prone to small spalls. The bedrock floors of the tunnels were in places covered with small angular siltstone clasts. In many places, the tunnel floor was coated with a calcium precipitate, derived from cement kiln dust or limestone processing, which has formed a crust over the bedrock and lightly cements debris. From probing the tunnel floors in several locations, we estimate that the precipitate is generally up to six inches thick, when present.

The walls and ceiling of tunnel D, which drains directly from the retention pond below the North CKD Landfill, were very smooth and showed no signs of significant spalling. We compared the profile of tunnel D, as surveyed by the project surveyor in 1971, with our recent measurements: the 1971 survey depicts a tunnel height of approximately 4 feet, 200 feet upstream from Tunnel B (Bowman & Williams, 1971). We were not able to inspect the entire length of tunnel D as the ceiling became quite low (3.25 feet high, 200 feet upstream from Tunnel B), thus hindering our passage (Figure 4). This apparent lowering of the tunnel ceiling is likely the result of a buildup of precipitate on the tunnel floor. We note, however, that the 1971 survey depicts only approximate tunnel heights.

Tunnel B had noticeably more debris in the form of small angular bedrock debris, but less extensive precipitate. This was not surprising as tunnel B is lengthy and receives drainage (and potentially debris) from tunnels A, C, and D upstream, whereas Tunnel D receives runoff directly from the retention pond below the North CKD landfill. We noted that anchors in the tunnel ceiling from which pipes are suspended along much of the alignment of tunnel B appeared in good condition (Figure 2). At the inspected downstream end of Tunnel B, a 24-inch rcp has been laid in the tunnel bore and the tunnel opening backfilled with rubble around the rcp (Figure 5). Approximately three feet of the rcp is visible in the tunnel bore and appeared to be in good condition. We sighted down the interior of the pipe about 20 feet, noting that the slope of the pipe appeared to steepen compared with the relatively gentle gradient of the bedrock tunnel.

Aside from the upstream floor of Tunnel D having a noticeable buildup of precipitate, the overall shape and profile of Tunnels B and D do not appear to have changed significantly since the 1971 survey.

Shafts 1 and 2 appear to be situated above the alignment of the 24-inch rcp near the assumed inlet to the second bedrock tunnel (Figure 1). Shafts 1 and 2 are 30 and 36 inches diameter, about 34 and 30 feet deep, respectively, and are lined with steel casings. The casings have occasional small holes, and seams between sections, but are otherwise solid and continuous. Loose soil and debris can be seen behind the holes and seams, and the floors of the shafts have a layer of detritus and sediment of unknown thickness (Figure 6). We inspected the vertical shafts on 1 and 28 February 2018. Water, assumed to be groundwater, in the shafts was observed at approximately 21 feet below grade on the days inspected. To inspect the shafts below the level of groundwater, we mounted a GoPro camera and two waterproof headlamps to a length of pvc pipe and, while recording video, lowered the assembly to the bottom of each shaft. We raised the pipe about a foot at a time and the camera assembly was rotated through the annular space of the shaft each lift. Our inspection of the observable portions of the shafts indicates the casings extend to the sedimented floor of each shaft and that there were no visible connections to drainage pipes or tunnels. The water elevation in the shafts likely reflects the local groundwater elevation. The presence of a continuous casing in the shafts suggests that no bedrock exists to the depth explored – consistent with an infilled gully. Based on the elevations of the shafts, their respective depths, and the 1971 survey, the shafts may extend to or below the projected elevation of the 24-inch rcp. The purpose of the shafts is unknown.

Conclusions

The surveyed drainage tunnels show little to no change in their profile since being surveyed in 1971 and are in acceptable condition. We saw no significant spalling, loose rock, or obstructions within the drainage tunnels during our inspection that would hinder their ability to convey storm runoff.

There is no indication that the vertical shafts are directly connected to the subsurface drainage system from the CEMEX cement plant.

It has been a pleasure working with you; please contact us if you have any questions regarding this letter or other geologic aspect of this project.

Sincerely,

EASTON GEOLOGY, INC.

PROFESSIONAL GEOLOGIST
GREGORY EASTON
No. 2502
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Gregory Easton
Principal Geologist
C.E.G. No. 2502

Copies: addressee (3 and pdf)
Farallon Consulting, attn: Matt Hillyard (pdf)

Attachments: Figure 1: Drainage Inspection Map
Figure 2: Image of Drainage Tunnel B
Figure 3: Image of Drainage Tunnel D at Tunnel B
Figure 4: Image of Drainage Tunnel D
Figure 5: Image of Drainage Tunnel B at RCP
Figure 6: Images of Bottom of Shaft 1 and Shaft 2

References:

Maps and Reports

Bowman & Williams, 1971, Plan & Profile, Existing Tunnel Cement Mill, Davenport, Santa Cruz County, California, Job No. 16765, 4 sheets dated 1971, revised June 14, 1979 (1st revision).

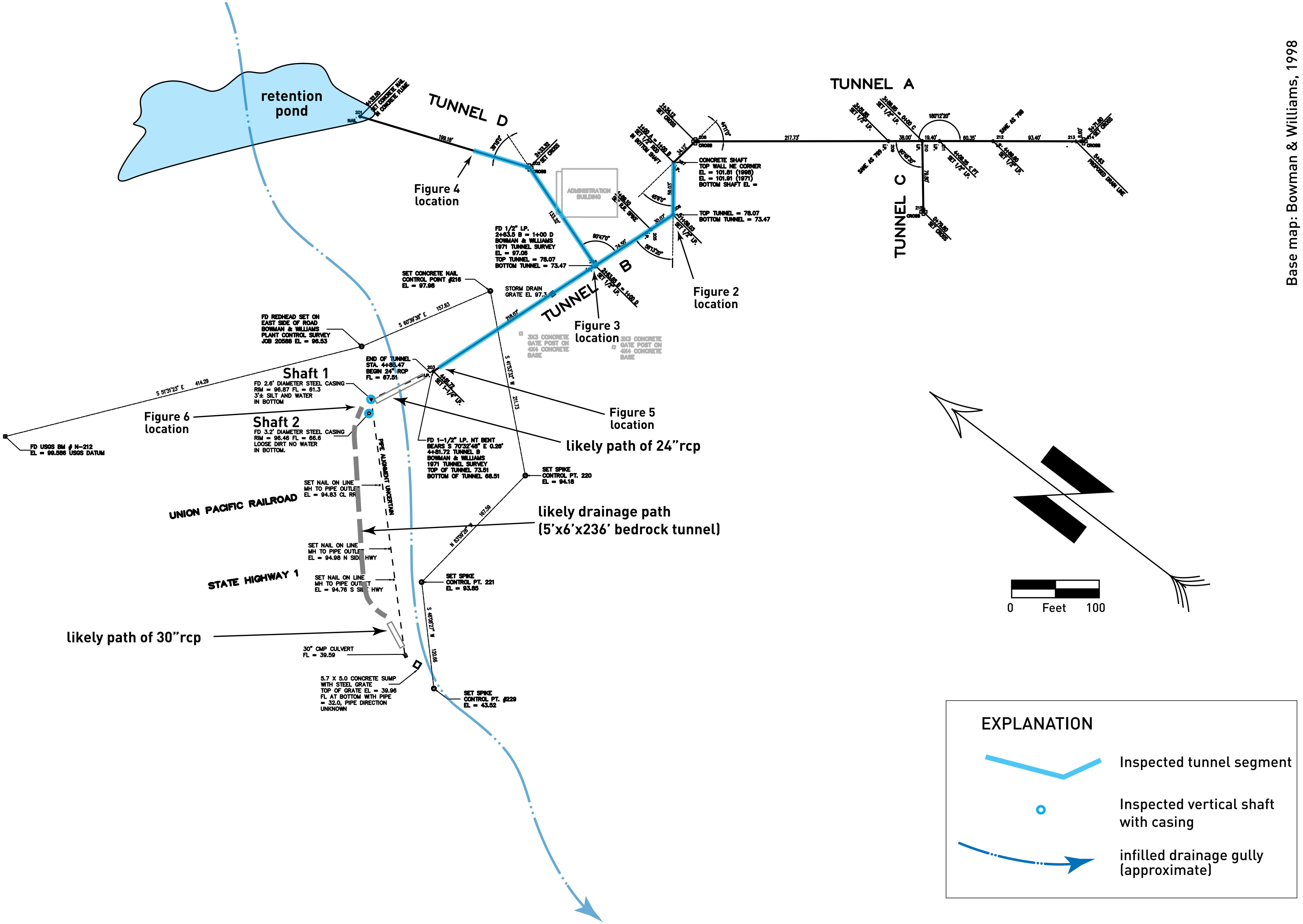
Bowman & Williams, 1998, Tunnel & Pipe Alignments in the Vicinity of Administration Building, at R.M.C. Lonestar Plant Site Situate in Davenport, California, Job No. 21358, 1 sheet dated August 28, 1998.

County of Santa Cruz, 2017, Final Technical Background Report, Davenport Cement Plant

Oceanshore Railroad Co., 1912, Plans of Oceanshore RR Co., 1 sheet dated 1912.

Santa Cruz County Geographic Information System, http://gis.co.santa-cruz.ca.us/PublicGISWeb/, accessed 1 March 2018.

State of California, Department of Public Works, Division of Highways, 1938, Plan and Profile of State Highway in Santa Cruz County, between One Half Mile South of Davenport and Waddell Cr., 21 sheets dated August 5, 1938.

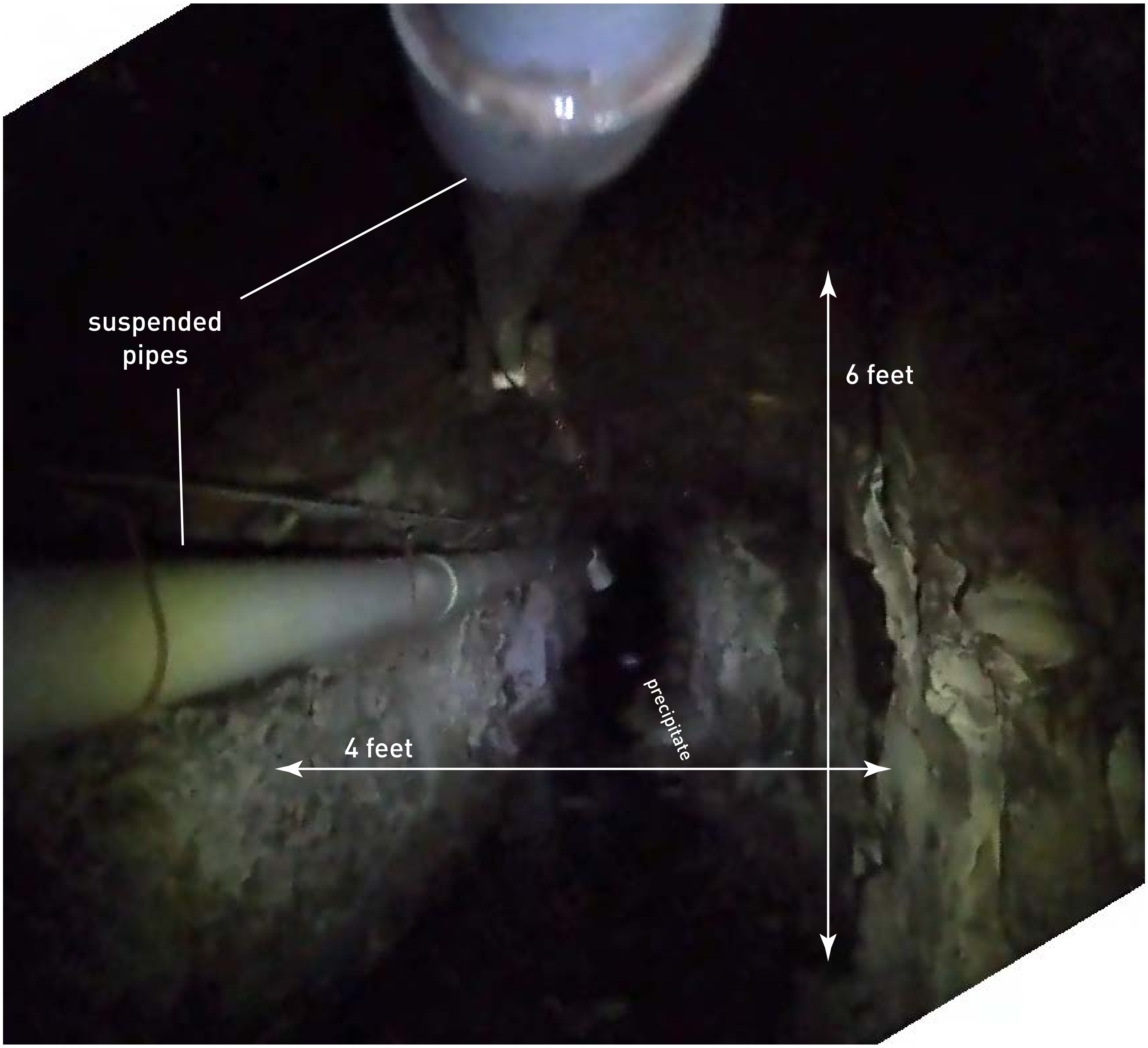


Base map: Bowman & Williams, 1998

Drawing # Figure 1
Project # G18001
Date: 3/20/18
Revised:
Scale: 1" = 100'
Drawn By: GFE, gfe

DRAINAGE INSPECTION MAP
CEMEX Cement Plant
1000 Highway 1
Davenport, California

EASTON GEOLOGY, INC.
P.O. Box 3533
Santa Cruz, California 95063
831.247.4317

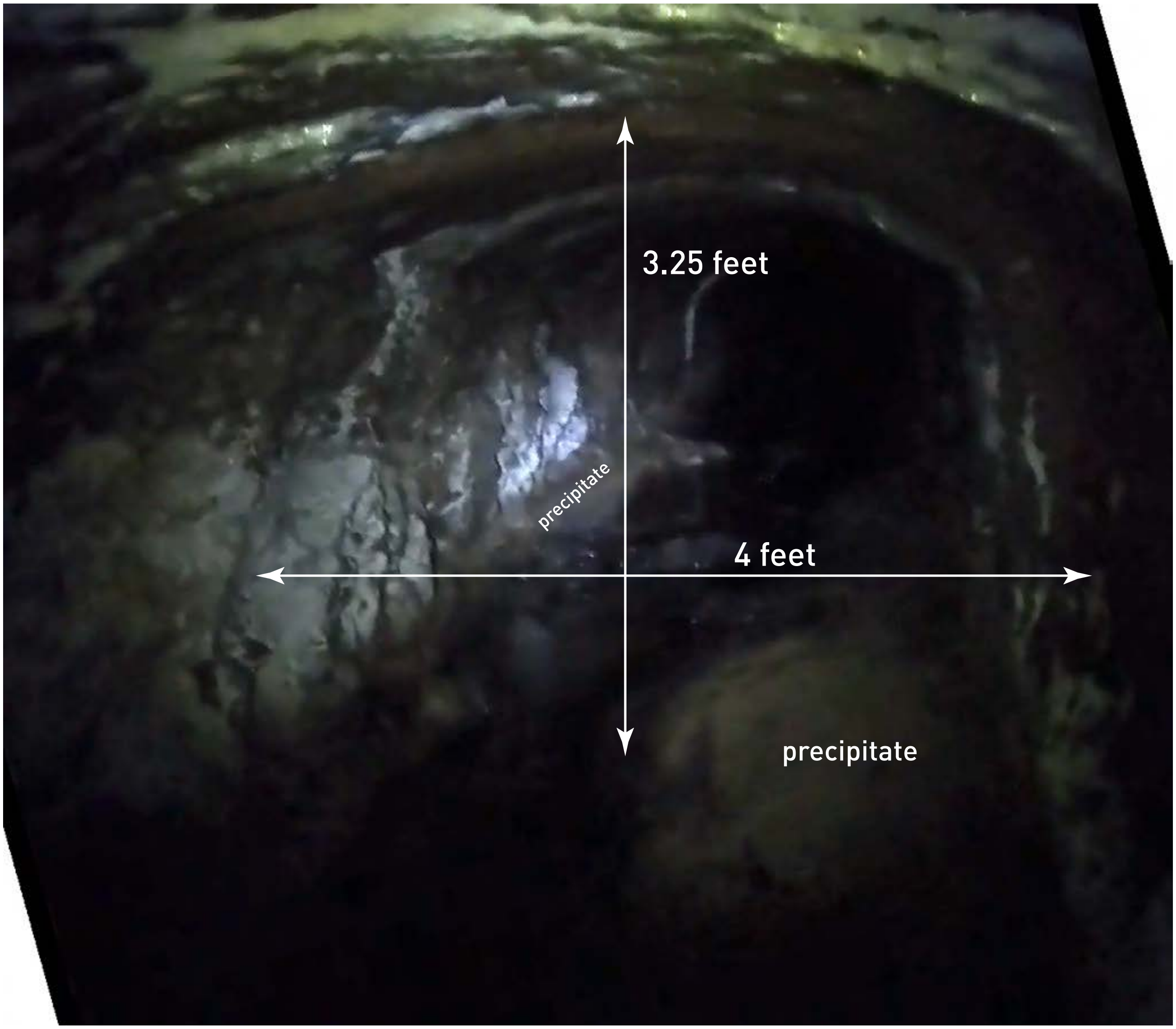


Drainage Tunnel B at bend - view is downstream.

EASTON GEOLOGY, INC. P.O. Box 3533 Santa Cruz, California 95063 831.247.4317	IMAGE of DRAINAGE TUNNEL B CEMEX Cement Plant 1000 Highway 1 Davenport, California	FIGURE # 2 JOB # G18001

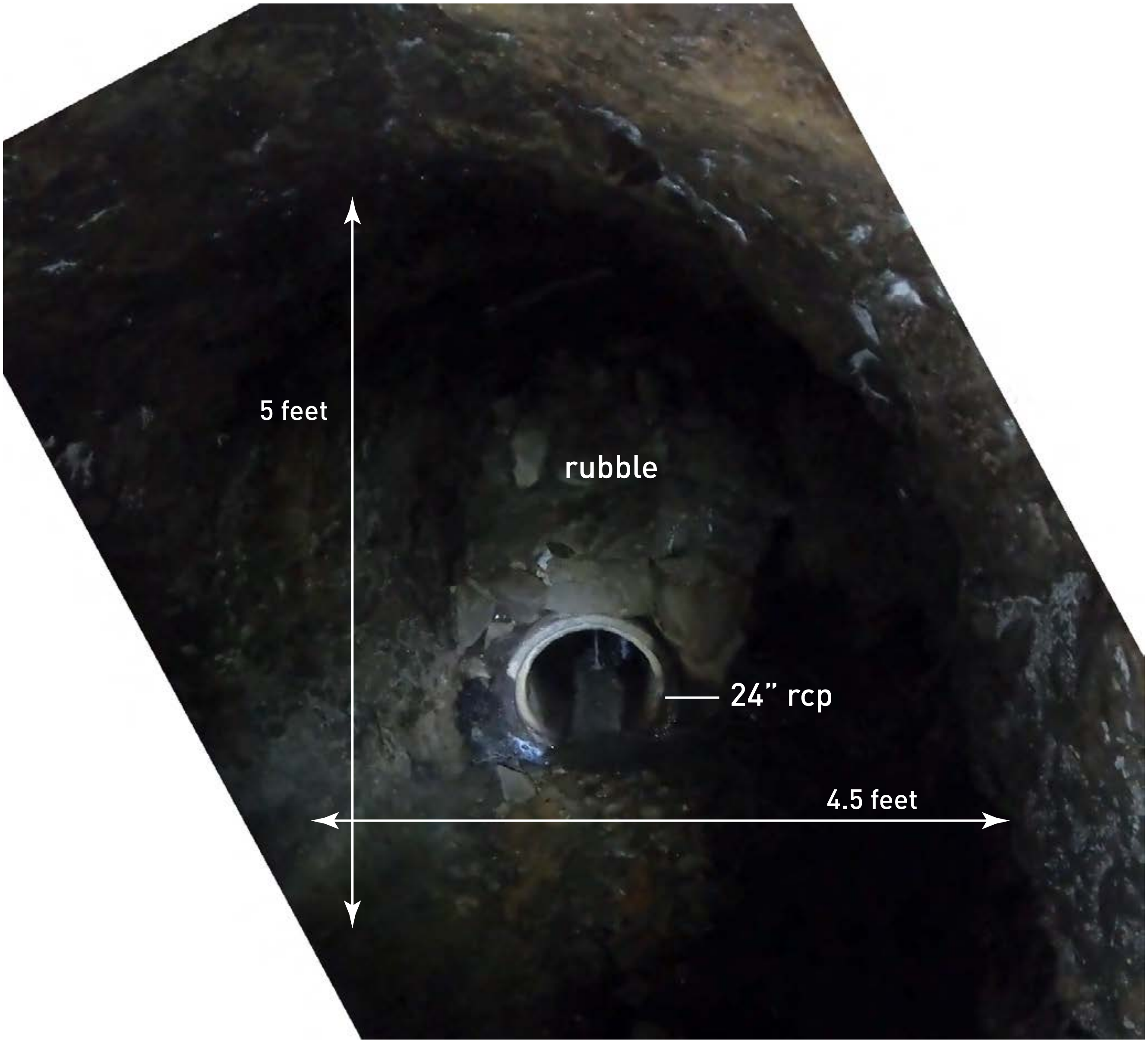
Drainage Tunnel D at Junction with Tunnel B - view is upstream.

EASTON GEOLOGY, INC. P.O. Box 3533 Santa Cruz, California 95063 831.247.4317	IMAGE of DRAINAGE TUNNEL D at TUNNEL B CEMEX Cement Plant 1000 Highway 1 Davenport, California	FIGURE # 3 JOB # G18001



Drainage Tunnel D, 200 Feet Upstream of Tunnel B - view is upstream.

EASTON GEOLOGY, INC. P.O. Box 3533 Santa Cruz, California 95063 831.247.4317	IMAGE of DRAINAGE TUNNEL D CEMEX Cement Plant 1000 Highway 1 Davenport, California	FIGURE # 4 JOB # G18001



Drainage Tunnel B at Reinforced Concrete Pipe - view is downstream.

EASTON GEOLOGY, INC. P.O. Box 3533 Santa Cruz, California 95063 831.247.4317	IMAGE of DRAINAGE TUNNEL B at RCP CEMEX Cement Plant 1000 Highway 1 Davenport, California	FIGURE # 5 JOB # G18001

Floor of Shaft 1: 32.5 feet below grade.

Floor of Shaft 2: 28.3 feet below grade.

EASTON GEOLOGY, INC. P.O. Box 3533 Santa Cruz, California 95063 831.247.4317	IMAGES of BOTTOM of SHAFT 1 and SHAFT 2 CEMEX Cement Plant 1000 Highway 1 Davenport, California	FIGURE # **6** JOB # G18001

APPENDIX D
HYDROLOGIC DATA AND USGS SOIL SURVEY SUMMARY

NORTH CKD AREA LANDFILL CLOSURE STORMWATER HYDRAULIC ANALYSIS
CEMEX Davenport Cement Plant
700 Highway 1
Davenport, California

Farallon PN: 1839-001

Soil Map—Santa Cruz County, California
(Cemex-Davenport, CA)

Map Scale: 1:8,350 if printed on B portrait (11" x 17") sheet.

Meters: 0 100 200 400 600

Feet: 0 400 800 1600 2400

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Santa Cruz County, California
Survey Area Data: Version 11, Sep 13, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 26, 2010—Sep 17, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
109	Beaches	0.3	0.1%
116	Bonnydoon loam, 5 to 50 percent slopes, MLRA 4B	81.4	26.8%
117	Bonnydoon loam, 30 to 50 percent slopes	16.5	5.4%
118	Bonnydoon-Rock outcrop complex, 50 to 85 percent slopes	88.0	28.9%
133	Elkhorn sandy loam, 2 to 9 percent slopes	13.2	4.3%
159	Pfeiffer gravelly sandy loam, 15 to 30 percent slopes	31.0	10.2%
177	Watsonville loam, 2 to 15 percent slopes	50.1	16.5%
179	Watsonville loam, thick surface, 2 to 15 percent slopes	23.7	7.8%
Totals for Area of Interest		**304.2**	**100.0%**

NOAA Atlas 14, Volume 6, Version 2
Location name: Davenport, California, USA*
Latitude: 37.0163°, Longitude: -122.1982°
Elevation: 174.14 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.183** (0.164-0.206)	**0.223** (0.199-0.251)	**0.276** (0.246-0.313)	**0.321** (0.283-0.368)	**0.385** (0.324-0.461)	**0.435** (0.356-0.537)	**0.488** (0.387-0.623)	**0.545** (0.416-0.721)	**0.625** (0.452-0.874)	**0.689** (0.476-1.01)
10-min	**0.263** (0.235-0.296)	**0.319** (0.286-0.360)	**0.396** (0.353-0.449)	**0.460** (0.406-0.527)	**0.551** (0.464-0.661)	**0.624** (0.511-0.770)	**0.700** (0.555-0.893)	**0.781** (0.596-1.03)	**0.896** (0.647-1.25)	**0.988** (0.683-1.45)
15-min	**0.318** (0.285-0.358)	**0.386** (0.345-0.436)	**0.479** (0.427-0.543)	**0.557** (0.491-0.638)	**0.667** (0.561-0.799)	**0.754** (0.617-0.931)	**0.847** (0.671-1.08)	**0.945** (0.721-1.25)	**1.08** (0.783-1.51)	**1.20** (0.826-1.75)
30-min	**0.441** (0.395-0.497)	**0.536** (0.480-0.605)	**0.665** (0.593-0.754)	**0.773** (0.682-0.886)	**0.926** (0.780-1.11)	**1.05** (0.858-1.29)	**1.18** (0.932-1.50)	**1.31** (1.00-1.74)	**1.50** (1.09-2.10)	**1.66** (1.15-2.43)
60-min	**0.623** (0.558-0.702)	**0.757** (0.678-0.855)	**0.940** (0.838-1.06)	**1.09** (0.963-1.25)	**1.31** (1.10-1.57)	**1.48** (1.21-1.83)	**1.66** (1.32-2.12)	**1.85** (1.42-2.45)	**2.13** (1.54-2.97)	**2.35** (1.62-3.43)
2-hr	**0.932** (0.836-1.05)	**1.12** (1.00-1.26)	**1.38** (1.23-1.56)	**1.60** (1.41-1.83)	**1.91** (1.61-2.29)	**2.16** (1.77-2.67)	**2.42** (1.92-3.09)	**2.71** (2.07-3.58)	**3.10** (2.24-4.34)	**3.42** (2.36-5.00)
3-hr	**1.18** (1.06-1.33)	**1.41** (1.26-1.59)	**1.74** (1.55-1.97)	**2.01** (1.77-2.30)	**2.40** (2.02-2.88)	**2.72** (2.23-3.36)	**3.06** (2.42-3.90)	**3.42** (2.61-4.52)	**3.92** (2.83-5.48)	**4.32** (2.99-6.32)
6-hr	**1.67** (1.50-1.88)	**2.01** (1.80-2.27)	**2.47** (2.21-2.80)	**2.87** (2.53-3.29)	**3.43** (2.89-4.12)	**3.89** (3.18-4.80)	**4.37** (3.46-5.57)	**4.88** (3.73-6.46)	**5.61** (4.05-7.84)	**6.19** (4.27-9.04)
12-hr	**2.21** (1.98-2.49)	**2.72** (2.43-3.07)	**3.41** (3.04-3.86)	**3.98** (3.51-4.57)	**4.80** (4.04-5.75)	**5.44** (4.45-6.71)	**6.11** (4.84-7.79)	**6.82** (5.20-9.02)	**7.79** (5.63-10.9)	**8.57** (5.92-12.5)
24-hr	**2.83** (2.59-3.15)	**3.58** (3.27-4.00)	**4.59** (4.18-5.14)	**5.42** (4.89-6.12)	**6.56** (5.70-7.70)	**7.45** (6.32-8.96)	**8.36** (6.89-10.3)	**9.30** (7.43-11.9)	**10.6** (8.07-14.2)	**11.6** (8.50-16.1)
2-day	**3.60** (3.29-4.01)	**4.63** (4.24-5.17)	**6.00** (5.47-6.72)	**7.12** (6.43-8.05)	**8.64** (7.50-10.1)	**9.80** (8.31-11.8)	**11.0** (9.06-13.6)	**12.2** (9.74-15.6)	**13.8** (10.5-18.5)	**15.1** (11.1-21.0)
3-day	**4.11** (3.77-4.58)	**5.34** (4.88-5.96)	**6.96** (6.34-7.79)	**8.27** (7.46-9.34)	**10.0** (8.71-11.8)	**11.4** (9.65-13.7)	**12.7** (10.5-15.8)	**14.1** (11.3-18.0)	**16.0** (12.2-21.4)	**17.4** (12.8-24.3)
4-day	**4.55** (4.17-5.07)	**5.93** (5.42-6.62)	**7.74** (7.05-8.66)	**9.20** (8.31-10.4)	**11.2** (9.71-13.1)	**12.7** (10.7-15.2)	**14.2** (11.7-17.5)	**15.7** (12.6-20.1)	**17.8** (13.6-23.8)	**19.4** (14.2-27.0)
7-day	**5.62** (5.14-6.26)	**7.30** (6.67-8.15)	**9.52** (8.68-10.7)	**11.3** (10.2-12.8)	**13.8** (11.9-16.1)	**15.6** (13.2-18.8)	**17.5** (14.4-21.6)	**19.3** (15.5-24.7)	**21.9** (16.7-29.3)	**23.8** (17.4-33.1)
10-day	**6.26** (5.73-6.98)	**8.14** (7.44-9.08)	**10.6** (9.67-11.9)	**12.6** (11.4-14.2)	**15.3** (13.3-18.0)	**17.3** (14.7-20.8)	**19.4** (16.0-24.0)	**21.4** (17.1-27.4)	**24.2** (18.4-32.4)	**26.3** (19.2-36.6)
20-day	**8.04** (7.36-8.96)	**10.5** (9.62-11.8)	**13.7** (12.5-15.4)	**16.3** (14.7-18.4)	**19.7** (17.1-23.1)	**22.2** (18.8-26.7)	**24.7** (20.4-30.5)	**27.2** (21.7-34.7)	**30.4** (23.1-40.7)	**32.7** (24.0-45.5)
30-day	**9.73** (8.91-10.8)	**12.8** (11.7-14.2)	**16.6** (15.1-18.6)	**19.6** (17.7-22.2)	**23.6** (20.5-27.7)	**26.5** (22.5-31.9)	**29.4** (24.2-36.4)	**32.2** (25.7-41.1)	**35.7** (27.2-47.8)	**38.3** (28.1-53.3)
45-day	**12.0** (11.0-13.4)	**15.7** (14.4-17.5)	**20.3** (18.5-22.7)	**23.9** (21.6-27.0)	**28.5** (24.8-33.5)	**31.9** (27.1-38.4)	**35.1** (29.0-43.5)	**38.3** (30.6-48.9)	**42.2** (32.2-56.5)	**45.0** (33.0-62.6)
60-day	**14.3** (13.1-16.0)	**18.6** (17.0-20.8)	**23.9** (21.7-26.7)	**27.9** (25.2-31.5)	**33.1** (28.7-38.9)	**36.8** (31.2-44.3)	**40.4** (33.3-50.0)	**43.8** (35.0-55.9)	**48.0** (36.6-64.3)	**50.9** (37.3-70.9)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

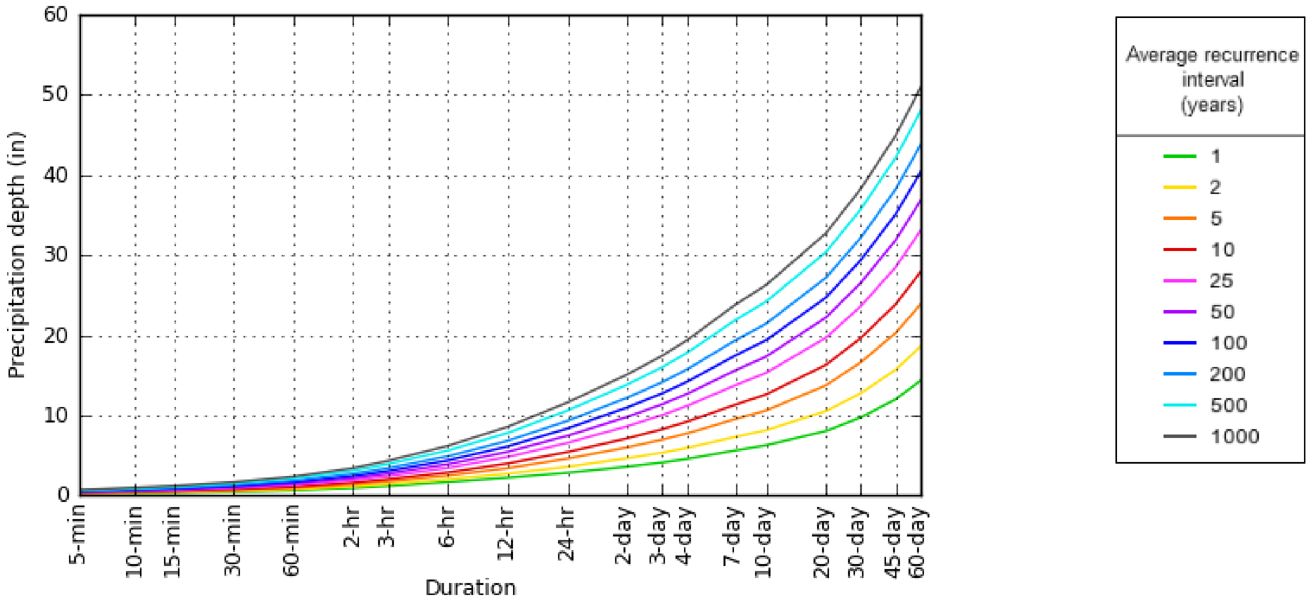
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

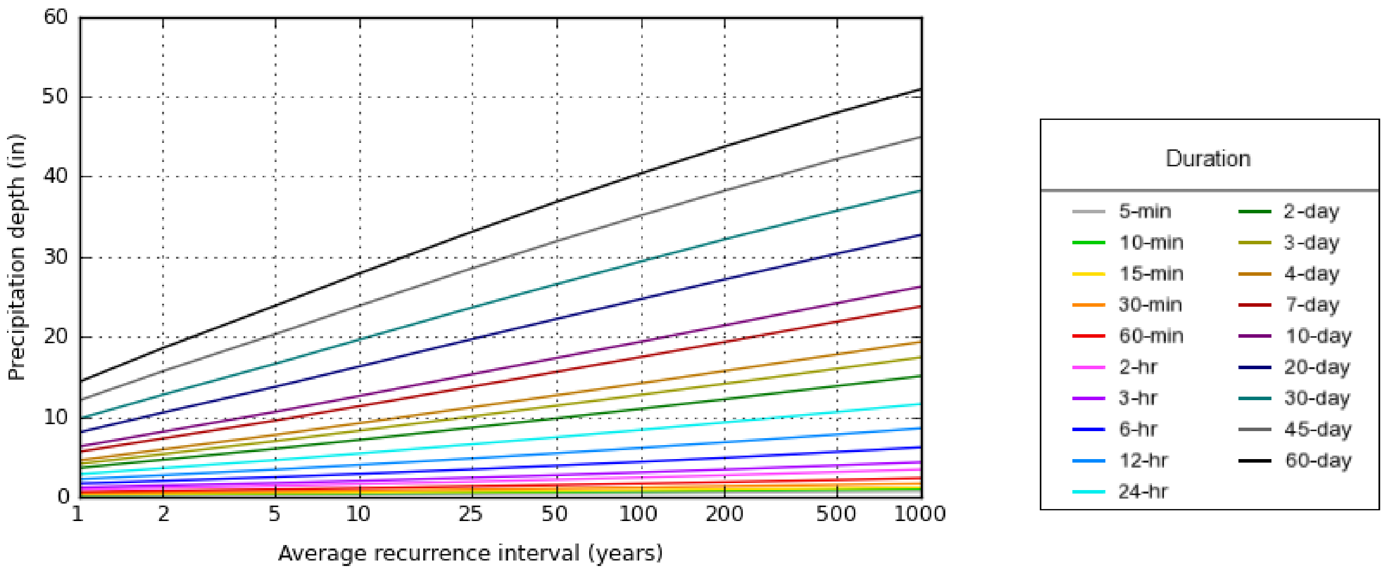
Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 37.0163°, Longitude: -122.1982°





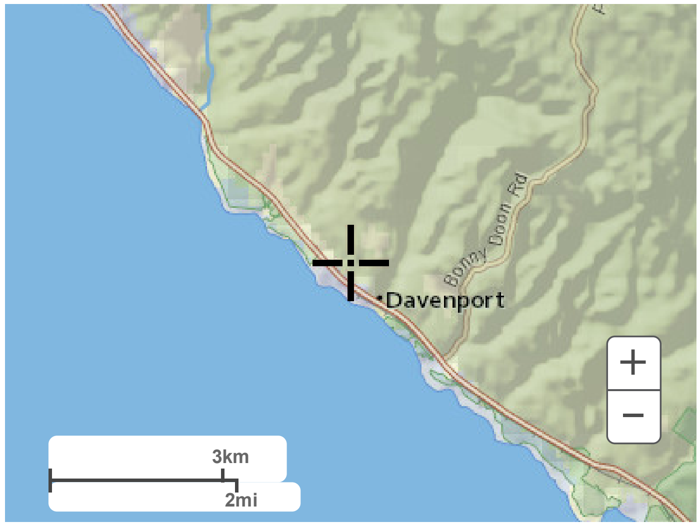
NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Thu Apr 20 23:56:32 2017

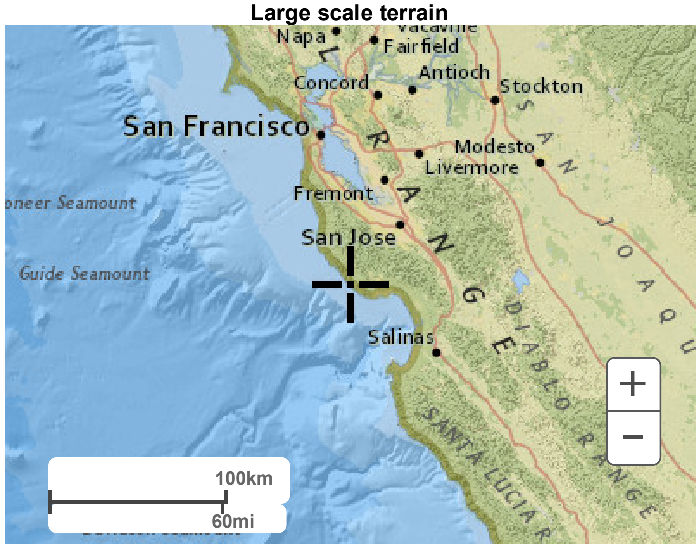
Back to Top

Maps & aerials

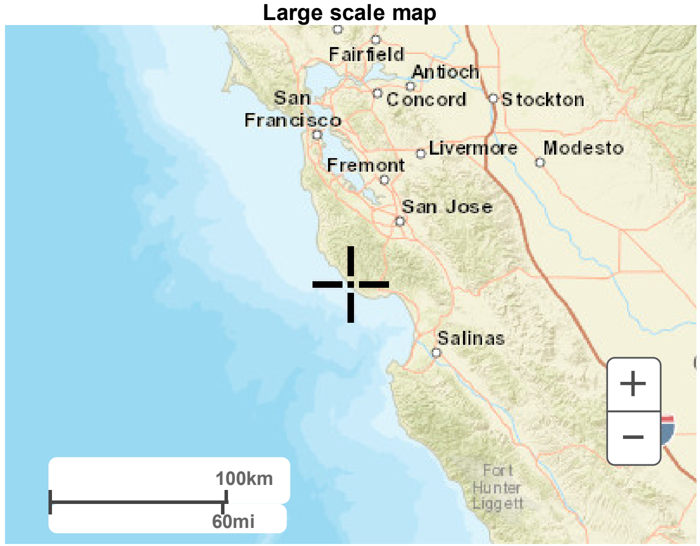
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Standard 24-hour NRCS rainfall distributions

6-minute interval

https://www.wcc.nrcs.usda.gov/ftpref/wntsc/H&H/rainDist/SCSstandardRainfallDistributions.xlsx

CEMEX - Davenport, CA

Rain Gage Data of CCC-SWMM 5.1 Model

							MRI	25	50	100	500	1000
	type I						P, Inches	6.56	7.45	8.36	10.6	11.6
time	24-hour			Type I Hyetograph								
(hours)	Cumulative	Incremental		Time	Rainfall		Time	25yr MRI	50yr MRI	100yr MRI	500yr MRI	1000yr MRI
0.0	0.00000	0.00000		0.0	0.00000		0.0	0	0	0	0	0
0.1	0.00174	0.00174		0.1	0.00174		0.1	0.0114144	0.012963	0.0145464	0.018444	0.020184
0.2	0.00348	0.00174		0.2	0.00174		0.2	0.0114144	0.012963	0.0145464	0.018444	0.020184
0.3	0.00522	0.00174		0.3	0.00174		0.3	0.0114144	0.012963	0.0145464	0.018444	0.020184
0.4	0.00697	0.00175		0.4	0.00175		0.4	0.01148	0.0130375	0.01463	0.01855	0.0203
0.5	0.00871	0.00174		0.5	0.00174		0.5	0.0114144	0.012963	0.0145464	0.018444	0.020184
0.6	0.01046	0.00175		0.6	0.00175		0.6	0.01148	0.0130375	0.01463	0.01855	0.0203
0.7	0.01220	0.00174		0.7	0.00174		0.7	0.0114144	0.012963	0.0145464	0.018444	0.020184
0.8	0.01395	0.00175		0.8	0.00175		0.8	0.01148	0.0130375	0.01463	0.01855	0.0203
0.9	0.01570	0.00175		0.9	0.00175		0.9	0.01148	0.0130375	0.01463	0.01855	0.0203
1.0	0.01745	0.00175		1.0	0.00175		1.0	0.01148	0.0130375	0.01463	0.01855	0.0203
1.1	0.01920	0.00175		1.1	0.00175		1.1	0.01148	0.0130375	0.01463	0.01855	0.0203
1.2	0.02095	0.00175		1.2	0.00175		1.2	0.01148	0.0130375	0.01463	0.01855	0.0203
1.3	0.02270	0.00175		1.3	0.00175		1.3	0.01148	0.0130375	0.01463	0.01855	0.0203
1.4	0.02446	0.00176		1.4	0.00176		1.4	0.0115456	0.013112	0.0147136	0.018656	0.020416
1.5	0.02621	0.00175		1.5	0.00175		1.5	0.01148	0.0130375	0.01463	0.01855	0.0203
1.6	0.02797	0.00176		1.6	0.00176		1.6	0.0115456	0.013112	0.0147136	0.018656	0.020416
1.7	0.02972	0.00175		1.7	0.00175		1.7	0.01148	0.0130375	0.01463	0.01855	0.0203
1.8	0.03148	0.00176		1.8	0.00176		1.8	0.0115456	0.013112	0.0147136	0.018656	0.020416
1.9	0.03324	0.00176		1.9	0.00176		1.9	0.0115456	0.013112	0.0147136	0.018656	0.020416
2.0	0.03500	0.00176		2.0	0.00176		2.0	0.0115456	0.013112	0.0147136	0.018656	0.020416
2.1	0.03677	0.00177		2.1	0.00177		2.1	0.0116112	0.0131865	0.0147972	0.018762	0.020532
2.2	0.03858	0.00181		2.2	0.00181		2.2	0.0118736	0.0134845	0.0151316	0.019186	0.020996
2.3	0.04041	0.00183		2.3	0.00183		2.3	0.0120048	0.0136335	0.0152988	0.019398	0.021228
2.4	0.04227	0.00186		2.4	0.00186		2.4	0.0122016	0.013857	0.0155496	0.019716	0.021576
2.5	0.04416	0.00189		2.5	0.00189		2.5	0.0123984	0.0140805	0.0158004	0.020034	0.021924
2.6	0.04608	0.00192		2.6	0.00192		2.6	0.0125952	0.014304	0.0160512	0.020352	0.022272
2.7	0.04803	0.00195		2.7	0.00195		2.7	0.012792	0.0145275	0.016302	0.02067	0.02262
2.8	0.05001	0.00198		2.8	0.00198		2.8	0.0129888	0.014751	0.0165528	0.020988	0.022968
2.9	0.05201	0.00200		2.9	0.00200		2.9	0.01312	0.0149	0.01672	0.0212	0.0232
3.0	0.05405	0.00204		3.0	0.00204		3.0	0.0133824	0.015198	0.0170544	0.021624	0.023664
3.1	0.05611	0.00206		3.1	0.00206		3.1	0.0135136	0.015347	0.0172216	0.021836	0.023896
3.2	0.05821	0.00210		3.2	0.00210		3.2	0.013776	0.015645	0.017556	0.02226	0.02436
3.3	0.06033	0.00212		3.3	0.00212		3.3	0.0139072	0.015794	0.0177232	0.022472	0.024592
3.4	0.06248	0.00215		3.4	0.00215		3.4	0.014104	0.0160175	0.017974	0.02279	0.02494
3.5	0.06466	0.00218		3.5	0.00218		3.5	0.0143008	0.016241	0.0182248	0.023108	0.025288
3.6	0.06687	0.00221		3.6	0.00221		3.6	0.0144976	0.0164645	0.0184756	0.023426	0.025636
3.7	0.06911	0.00224		3.7	0.00224		3.7	0.0146944	0.016688	0.0187264	0.023744	0.025984
3.8	0.07138	0.00227		3.8	0.00227		3.8	0.0148912	0.0169115	0.0189772	0.024062	0.026332
3.9	0.07367	0.00229		3.9	0.00229		3.9	0.0150224	0.0170605	0.0191444	0.024274	0.026564
4.0	0.07600	0.00233		4.0	0.00233		4.0	0.0152848	0.0173585	0.0194788	0.024698	0.027028
4.1	0.07835	0.00235		4.1	0.00235		4.1	0.015416	0.0175075	0.019646	0.02491	0.02726
4.2	0.08070	0.00235		4.2	0.00235		4.2	0.015416	0.0175075	0.019646	0.02491	0.02726
4.3	0.08307	0.00237		4.3	0.00237		4.3	0.0155472	0.0176565	0.0198132	0.025122	0.027492
4.4	0.08545	0.00238		4.4	0.00238		4.4	0.0156128	0.017731	0.0198968	0.025228	0.027608
4.5	0.08784	0.00239		4.5	0.00239		4.5	0.0156784	0.0178055	0.0199804	0.025334	0.027724
4.6	0.09024	0.00240		4.6	0.00240		4.6	0.015744	0.01788	0.020064	0.02544	0.02784
4.7	0.09265	0.00241		4.7	0.00241		4.7	0.0158096	0.0179545	0.0201476	0.025546	0.027956
4.8	0.09507	0.00242		4.8	0.00242		4.8	0.0158752	0.018029	0.0202312	0.025652	0.028072

Standard 24-hour NRCS rainfall distributions

6-minute interval

https://www.wcc.nrcs.usda.gov/ftpref/wntsc/H&H/rainDist/SCSstandardRainfallDistributions.xlsx

CEMEX - Davenport, CA

Rain Gage Data of CCC-SWMM 5.1 Model

							MRI	25	50	100	500	1000
	type I						P, Inches	6.56	7.45	8.36	10.6	11.6
time	24-hour			Type I Hyetograph								
(hours)	Cumulative	Incremental		Time	Rainfall		Time	25yr MRI	50yr MRI	100yr MRI	500yr MRI	1000yr MRI
4.9	0.09751	0.00244		4.9	0.00244		4.9	0.0160064	0.018178	0.0203984	0.025864	0.028304
5.0	0.09995	0.00244		5.0	0.00244		5.0	0.0160064	0.018178	0.0203984	0.025864	0.028304
5.1	0.10241	0.00246		5.1	0.00246		5.1	0.0161376	0.018327	0.0205656	0.026076	0.028536
5.2	0.10487	0.00246		5.2	0.00246		5.2	0.0161376	0.018327	0.0205656	0.026076	0.028536
5.3	0.10735	0.00248		5.3	0.00248		5.3	0.0162688	0.018476	0.0207328	0.026288	0.028768
5.4	0.10984	0.00249		5.4	0.00249		5.4	0.0163344	0.0185505	0.0208164	0.026394	0.028884
5.5	0.11234	0.00250		5.5	0.00250		5.5	0.0164	0.018625	0.0209	0.0265	0.029
5.6	0.11485	0.00251		5.6	0.00251		5.6	0.0164656	0.0186995	0.0209836	0.026606	0.029116
5.7	0.11737	0.00252		5.7	0.00252		5.7	0.0165312	0.018774	0.0210672	0.026712	0.029232
5.8	0.11990	0.00253		5.8	0.00253		5.8	0.0165968	0.0188485	0.0211508	0.026818	0.029348
5.9	0.12245	0.00255		5.9	0.00255		5.9	0.016728	0.0189975	0.021318	0.02703	0.02958
6.0	0.12500	0.00255		6.0	0.00255		6.0	0.016728	0.0189975	0.021318	0.02703	0.02958
6.1	0.12761	0.00261		6.1	0.00261		6.1	0.0171216	0.0194445	0.0218196	0.027666	0.030276
6.2	0.13034	0.00273		6.2	0.00273		6.2	0.0179088	0.0203385	0.0228228	0.028938	0.031668
6.3	0.13317	0.00283		6.3	0.00283		6.3	0.0185648	0.0210835	0.0236588	0.029998	0.032828
6.4	0.13610	0.00293		6.4	0.00293		6.4	0.0192208	0.0218285	0.0244948	0.031058	0.033988
6.5	0.13915	0.00305		6.5	0.00305		6.5	0.020008	0.0227225	0.025498	0.03233	0.03538
6.6	0.14230	0.00315		6.6	0.00315		6.6	0.020664	0.0234675	0.026334	0.03339	0.03654
6.7	0.14557	0.00327		6.7	0.00327		6.7	0.0214512	0.0243615	0.0273372	0.034662	0.037932
6.8	0.14894	0.00337		6.8	0.00337		6.8	0.0221072	0.0251065	0.0281732	0.035722	0.039092
6.9	0.15241	0.00347		6.9	0.00347		6.9	0.0227632	0.0258515	0.0290092	0.036782	0.040252
7.0	0.15600	0.00359		7.0	0.00359		7.0	0.0235504	0.0267455	0.0300124	0.038054	0.041644
7.1	0.15966	0.00366		7.1	0.00366		7.1	0.0240096	0.027267	0.0305976	0.038796	0.042456
7.2	0.16334	0.00368		7.2	0.00368		7.2	0.0241408	0.027416	0.0307648	0.039008	0.042688
7.3	0.16706	0.00372		7.3	0.00372		7.3	0.0244032	0.027714	0.0310992	0.039432	0.043152
7.4	0.17082	0.00376		7.4	0.00376		7.4	0.0246656	0.028012	0.0314336	0.039856	0.043616
7.5	0.17460	0.00378		7.5	0.00378		7.5	0.0247968	0.028161	0.0316008	0.040068	0.043848
7.6	0.17842	0.00382		7.6	0.00382		7.6	0.0250592	0.028459	0.0319352	0.040492	0.044312
7.7	0.18226	0.00384		7.7	0.00384		7.7	0.0251904	0.028608	0.0321024	0.040704	0.044544
7.8	0.18614	0.00388		7.8	0.00388		7.8	0.0254528	0.028906	0.0324368	0.041128	0.045008
7.9	0.19006	0.00392		7.9	0.00392		7.9	0.0257152	0.029204	0.0327712	0.041552	0.045472
8.0	0.19400	0.00394		8.0	0.00394		8.0	0.0258464	0.029353	0.0329384	0.041764	0.045704
8.1	0.19817	0.00417		8.1	0.00417		8.1	0.0273552	0.0310665	0.0348612	0.044202	0.048372
8.2	0.20275	0.00458		8.2	0.00458		8.2	0.0300448	0.034121	0.0382888	0.048548	0.053128
8.3	0.20775	0.00500		8.3	0.00500		8.3	0.0328	0.03725	0.0418	0.053	0.058
8.4	0.21317	0.00542		8.4	0.00542		8.4	0.0355552	0.040379	0.0453112	0.057452	0.062872
8.5	0.21900	0.00583		8.5	0.00583		8.5	0.0382448	0.0434335	0.0487388	0.061798	0.067628
8.6	0.22523	0.00623		8.6	0.00623		8.6	0.0408688	0.0464135	0.0520828	0.066038	0.072268
8.7	0.23185	0.00662		8.7	0.00662		8.7	0.0434272	0.049319	0.0553432	0.070172	0.076792
8.8	0.23885	0.00700		8.8	0.00700		8.8	0.04592	0.05215	0.05852	0.0742	0.0812
8.9	0.24623	0.00738		8.9	0.00738		8.9	0.0484128	0.054981	0.0616968	0.078228	0.085608
9.0	0.25400	0.00777		9.0	0.00777		9.0	0.0509712	0.0578865	0.0649572	0.082362	0.090132
9.1	0.26233	0.00833		9.1	0.00833		9.1	0.0546448	0.0620585	0.0696388	0.088298	0.096628
9.2	0.27139	0.00906		9.2	0.00906		9.2	0.0594336	0.067497	0.0757416	0.096036	0.105096
9.3	0.28119	0.00980		9.3	0.00980		9.3	0.064288	0.07301	0.081928	0.10388	0.11368
9.4	0.29173	0.01054		9.4	0.01054		9.4	0.0691424	0.078523	0.0881144	0.111724	0.122264
9.5	0.30300	0.01127		9.5	0.01127		9.5	0.0739312	0.0839615	0.0942172	0.119462	0.130732
9.6	0.31942	0.01642		9.6	0.01642		9.6	0.1077152	0.122329	0.1372712	0.174052	0.190472
9.7	0.34542	0.02600		9.7	0.02600		9.7	0.17056	0.1937	0.21736	0.2756	0.3016

Standard 24-hour NRCS rainfall distributions

6-minute interval

https://www.wcc.nrcs.usda.gov/ftpref/wntsc/H&H/rainDist/SCSstandardRainfallDistributions.xlsx

CEMEX - Davenport, CA

Rain Gage Data of CCC-SWMM 5.1 Model

							MRI	25	50	100	500	1000
	type I						P, Inches	6.56	7.45	8.36	10.6	11.6
time	24-hour			Type I Hyetograph								
(hours)	Cumulative	Incremental		Time	Rainfall		Time	25yr MRI	50yr MRI	100yr MRI	500yr MRI	1000yr MRI
9.8	0.38784	0.04242		9.8	0.04242		9.8	0.2782752	0.316029	0.3546312	0.449652	0.492072
9.9	0.46316	0.07532		9.9	0.07532		9.9	0.4940992	0.561134	0.6296752	0.798392	0.873712
10.0	0.51500	0.05184		10.0	0.05184		10.0	0.3400704	0.386208	0.4333824	0.549504	0.601344
10.1	0.53220	0.01720		10.1	0.01720		10.1	0.112832	0.12814	0.143792	0.18232	0.19952
10.2	0.54760	0.01540		10.2	0.01540		10.2	0.101024	0.11473	0.128744	0.16324	0.17864
10.3	0.56120	0.01360		10.3	0.01360		10.3	0.089216	0.10132	0.113696	0.14416	0.15776
10.4	0.57300	0.01180		10.4	0.01180		10.4	0.077408	0.08791	0.098648	0.12508	0.13688
10.5	0.58300	0.01000		10.5	0.01000		10.5	0.0656	0.0745	0.0836	0.106	0.116
10.6	0.59188	0.00888		10.6	0.00888		10.6	0.0582528	0.066156	0.0742368	0.094128	0.103008
10.7	0.60032	0.00844		10.7	0.00844		10.7	0.0553664	0.062878	0.0705584	0.089464	0.097904
10.8	0.60832	0.00800		10.8	0.00800		10.8	0.05248	0.0596	0.06688	0.0848	0.0928
10.9	0.61588	0.00756		10.9	0.00756		10.9	0.0495936	0.056322	0.0632016	0.080136	0.087696
11.0	0.62300	0.00712		11.0	0.00712		11.0	0.0467072	0.053044	0.0595232	0.075472	0.082592
11.1	0.62982	0.00682		11.1	0.00682		11.1	0.0447392	0.050809	0.0570152	0.072292	0.079112
11.2	0.63648	0.00666		11.2	0.00666		11.2	0.0436896	0.049617	0.0556776	0.070596	0.077256
11.3	0.64298	0.00650		11.3	0.00650		11.3	0.04264	0.048425	0.05434	0.0689	0.0754
11.4	0.64932	0.00634		11.4	0.00634		11.4	0.0415904	0.047233	0.0530024	0.067204	0.073544
11.5	0.65550	0.00618		11.5	0.00618		11.5	0.0405408	0.046041	0.0516648	0.065508	0.071688
11.6	0.66152	0.00602		11.6	0.00602		11.6	0.0394912	0.044849	0.0503272	0.063812	0.069832
11.7	0.66738	0.00586		11.7	0.00586		11.7	0.0384416	0.043657	0.0489896	0.062116	0.067976
11.8	0.67308	0.00570		11.8	0.00570		11.8	0.037392	0.042465	0.047652	0.06042	0.06612
11.9	0.67862	0.00554		11.9	0.00554		11.9	0.0363424	0.041273	0.0463144	0.058724	0.064264
12.0	0.68400	0.00538		12.0	0.00538		12.0	0.0352928	0.040081	0.0449768	0.057028	0.062408
12.1	0.68925	0.00525		12.1	0.00525		12.1	0.03444	0.0391125	0.04389	0.05565	0.0609
12.2	0.69440	0.00515		12.2	0.00515		12.2	0.033784	0.0383675	0.043054	0.05459	0.05974
12.3	0.69945	0.00505		12.3	0.00505		12.3	0.033128	0.0376225	0.042218	0.05353	0.05858
12.4	0.70440	0.00495		12.4	0.00495		12.4	0.032472	0.0368775	0.041382	0.05247	0.05742
12.5	0.70925	0.00485		12.5	0.00485		12.5	0.031816	0.0361325	0.040546	0.05141	0.05626
12.6	0.71400	0.00475		12.6	0.00475		12.6	0.03116	0.0353875	0.03971	0.05035	0.0551
12.7	0.71865	0.00465		12.7	0.00465		12.7	0.030504	0.0346425	0.038874	0.04929	0.05394
12.8	0.72320	0.00455		12.8	0.00455		12.8	0.029848	0.0338975	0.038038	0.04823	0.05278
12.9	0.72765	0.00445		12.9	0.00445		12.9	0.029192	0.0331525	0.037202	0.04717	0.05162
13.0	0.73200	0.00435		13.0	0.00435		13.0	0.028536	0.0324075	0.036366	0.04611	0.05046
13.1	0.73625	0.00425		13.1	0.00425		13.1	0.02788	0.0316625	0.03553	0.04505	0.0493
13.2	0.74040	0.00415		13.2	0.00415		13.2	0.027224	0.0309175	0.034694	0.04399	0.04814
13.3	0.74445	0.00405		13.3	0.00405		13.3	0.026568	0.0301725	0.033858	0.04293	0.04698
13.4	0.74840	0.00395		13.4	0.00395		13.4	0.025912	0.0294275	0.033022	0.04187	0.04582
13.5	0.75225	0.00385		13.5	0.00385		13.5	0.025256	0.0286825	0.032186	0.04081	0.04466
13.6	0.75600	0.00375		13.6	0.00375		13.6	0.0246	0.0279375	0.03135	0.03975	0.0435
13.7	0.75965	0.00365		13.7	0.00365		13.7	0.023944	0.0271925	0.030514	0.03869	0.04234
13.8	0.76320	0.00355		13.8	0.00355		13.8	0.023288	0.0264475	0.029678	0.03763	0.04118
13.9	0.76665	0.00345		13.9	0.00345		13.9	0.022632	0.0257025	0.028842	0.03657	0.04002
14.0	0.77000	0.00335		14.0	0.00335		14.0	0.021976	0.0249575	0.028006	0.03551	0.03886
14.1	0.77329	0.00329		14.1	0.00329		14.1	0.0215824	0.0245105	0.0275044	0.034874	0.038164
14.2	0.77656	0.00327		14.2	0.00327		14.2	0.0214512	0.0243615	0.0273372	0.034662	0.037932
14.3	0.77981	0.00325		14.3	0.00325		14.3	0.02132	0.0242125	0.02717	0.03445	0.0377
14.4	0.78304	0.00323		14.4	0.00323		14.4	0.0211888	0.0240635	0.0270028	0.034238	0.037468
14.5	0.78625	0.00321		14.5	0.00321		14.5	0.0210576	0.0239145	0.0268356	0.034026	0.037236
14.6	0.78944	0.00319		14.6	0.00319		14.6	0.0209264	0.0237655	0.0266684	0.033814	0.037004

Standard 24-hour NRCS rainfall distributions

6-minute interval

https://www.wcc.nrcs.usda.gov/ftpref/wntsc/H&H/rainDist/SCSstandardRainfallDistributions.xlsx

CEMEX - Davenport, CA

Rain Gage Data of CCC-SWMM 5.1 Model

							MRI	25	50	100	500	1000
	type I						P, Inches	6.56	7.45	8.36	10.6	11.6
time	24-hour			Type I Hyetograph								
(hours)	Cumulative	Incremental		Time	Rainfall		Time	25yr MRI	50yr MRI	100yr MRI	500yr MRI	1000yr MRI
14.7	0.79261	0.00317		14.7	0.00317		14.7	0.0207952	0.0236165	0.0265012	0.033602	0.036772
14.8	0.79576	0.00315		14.8	0.00315		14.8	0.020664	0.0234675	0.026334	0.03339	0.03654
14.9	0.79889	0.00313		14.9	0.00313		14.9	0.0205328	0.0233185	0.0261668	0.033178	0.036308
15.0	0.80200	0.00311		15.0	0.00311		15.0	0.0204016	0.0231695	0.0259996	0.032966	0.036076
15.1	0.80509	0.00309		15.1	0.00309		15.1	0.0202704	0.0230205	0.0258324	0.032754	0.035844
15.2	0.80816	0.00307		15.2	0.00307		15.2	0.0201392	0.0228715	0.0256652	0.032542	0.035612
15.3	0.81121	0.00305		15.3	0.00305		15.3	0.020008	0.0227225	0.025498	0.03233	0.03538
15.4	0.81424	0.00303		15.4	0.00303		15.4	0.0198768	0.0225735	0.0253308	0.032118	0.035148
15.5	0.81725	0.00301		15.5	0.00301		15.5	0.0197456	0.0224245	0.0251636	0.031906	0.034916
15.6	0.82024	0.00299		15.6	0.00299		15.6	0.0196144	0.0222755	0.0249964	0.031694	0.034684
15.7	0.82321	0.00297		15.7	0.00297		15.7	0.0194832	0.0221265	0.0248292	0.031482	0.034452
15.8	0.82616	0.00295		15.8	0.00295		15.8	0.019352	0.0219775	0.024662	0.03127	0.03422
15.9	0.82909	0.00293		15.9	0.00293		15.9	0.0192208	0.0218285	0.0244948	0.031058	0.033988
16.0	0.83200	0.00291		16.0	0.00291		16.0	0.0190896	0.0216795	0.0243276	0.030846	0.033756
16.1	0.83489	0.00289		16.1	0.00289		16.1	0.0189584	0.0215305	0.0241604	0.030634	0.033524
16.2	0.83776	0.00287		16.2	0.00287		16.2	0.0188272	0.0213815	0.0239932	0.030422	0.033292
16.3	0.84061	0.00285		16.3	0.00285		16.3	0.018696	0.0212325	0.023826	0.03021	0.03306
16.4	0.84344	0.00283		16.4	0.00283		16.4	0.0185648	0.0210835	0.0236588	0.029998	0.032828
16.5	0.84625	0.00281		16.5	0.00281		16.5	0.0184336	0.0209345	0.0234916	0.029786	0.032596
16.6	0.84904	0.00279		16.6	0.00279		16.6	0.0183024	0.0207855	0.0233244	0.029574	0.032364
16.7	0.85181	0.00277		16.7	0.00277		16.7	0.0181712	0.0206365	0.0231572	0.029362	0.032132
16.8	0.85456	0.00275		16.8	0.00275		16.8	0.01804	0.0204875	0.02299	0.02915	0.0319
16.9	0.85729	0.00273		16.9	0.00273		16.9	0.0179088	0.0203385	0.0228228	0.028938	0.031668
17.0	0.86000	0.00271		17.0	0.00271		17.0	0.0177776	0.0201895	0.0226556	0.028726	0.031436
17.1	0.86269	0.00269		17.1	0.00269		17.1	0.0176464	0.0200405	0.0224884	0.028514	0.031204
17.2	0.86536	0.00267		17.2	0.00267		17.2	0.0175152	0.0198915	0.0223212	0.028302	0.030972
17.3	0.86801	0.00265		17.3	0.00265		17.3	0.017384	0.0197425	0.022154	0.02809	0.03074
17.4	0.87064	0.00263		17.4	0.00263		17.4	0.0172528	0.0195935	0.0219868	0.027878	0.030508
17.5	0.87325	0.00261		17.5	0.00261		17.5	0.0171216	0.0194445	0.0218196	0.027666	0.030276
17.6	0.87584	0.00259		17.6	0.00259		17.6	0.0169904	0.0192955	0.0216524	0.027454	0.030044
17.7	0.87841	0.00257		17.7	0.00257		17.7	0.0168592	0.0191465	0.0214852	0.027242	0.029812
17.8	0.88096	0.00255		17.8	0.00255		17.8	0.016728	0.0189975	0.021318	0.02703	0.02958
17.9	0.88349	0.00253		17.9	0.00253		17.9	0.0165968	0.0188485	0.0211508	0.026818	0.029348
18.0	0.88600	0.00251		18.0	0.00251		18.0	0.0164656	0.0186995	0.0209836	0.026606	0.029116
18.1	0.88849	0.00249		18.1	0.00249		18.1	0.0163344	0.0185505	0.0208164	0.026394	0.028884
18.2	0.89096	0.00247		18.2	0.00247		18.2	0.0162032	0.0184015	0.0206492	0.026182	0.028652
18.3	0.89341	0.00245		18.3	0.00245		18.3	0.016072	0.0182525	0.020482	0.02597	0.02842
18.4	0.89584	0.00243		18.4	0.00243		18.4	0.0159408	0.0181035	0.0203148	0.025758	0.028188
18.5	0.89825	0.00241		18.5	0.00241		18.5	0.0158096	0.0179545	0.0201476	0.025546	0.027956
18.6	0.90064	0.00239		18.6	0.00239		18.6	0.0156784	0.0178055	0.0199804	0.025334	0.027724
18.7	0.90301	0.00237		18.7	0.00237		18.7	0.0155472	0.0176565	0.0198132	0.025122	0.027492
18.8	0.90536	0.00235		18.8	0.00235		18.8	0.015416	0.0175075	0.019646	0.02491	0.02726
18.9	0.90769	0.00233		18.9	0.00233		18.9	0.0152848	0.0173585	0.0194788	0.024698	0.027028
19.0	0.91000	0.00231		19.0	0.00231		19.0	0.0151536	0.0172095	0.0193116	0.024486	0.026796
19.1	0.91229	0.00229		19.1	0.00229		19.1	0.0150224	0.0170605	0.0191444	0.024274	0.026564
19.2	0.91456	0.00227		19.2	0.00227		19.2	0.0148912	0.0169115	0.0189772	0.024062	0.026332
19.3	0.91681	0.00225		19.3	0.00225		19.3	0.01476	0.0167625	0.01881	0.02385	0.0261
19.4	0.91904	0.00223		19.4	0.00223		19.4	0.0146288	0.0166135	0.0186428	0.023638	0.025868
19.5	0.92125	0.00221		19.5	0.00221		19.5	0.0144976	0.0164645	0.0184756	0.023426	0.025636

Standard 24-hour NRCS rainfall distributions

6-minute interval

https://www.wcc.nrcs.usda.gov/ftpref/wntsc/H&H/rainDist/SCSstandardRainfallDistributions.xlsx

CEMEX - Davenport, CA

Rain Gage Data of CCC-SWMM 5.1 Model

							MRI	25	50	100	500	1000
	type I						P, Inches	6.56	7.45	8.36	10.6	11.6
time	24-hour			Type I Hyetograph								
(hours)	Cumulative	Incremental		Time	Rainfall		Time	25yr MRI	50yr MRI	100yr MRI	500yr MRI	1000yr MRI
19.6	0.92344	0.00219		19.6	0.00219		19.6	0.0143664	0.0163155	0.0183084	0.023214	0.025404
19.7	0.9	0.00217		19.7	0.00217		19.7	0.0142352	0.0161665	0.0181412	0.023002	0.025172
19.8	0.92776	0.00215		19.8	0.00215		19.8	0.014104	0.0160175	0.017974	0.02279	0.02494
19.9	0.92989	0.00213		19.9	0.00213		19.9	0.0139728	0.0158685	0.0178068	0.022578	0.024708
20.0	0.93200	0.00211		20.0	0.00211		20.0	0.0138416	0.0157195	0.0176396	0.022366	0.024476
20.1	0.93409	0.00209		20.1	0.00209		20.1	0.0137104	0.0155705	0.0174724	0.022154	0.024244
20.2	0.93616	0.00207		20.2	0.00207		20.2	0.0135792	0.0154215	0.0173052	0.021942	0.024012
20.3	0.93821	0.00205		20.3	0.00205		20.3	0.013448	0.0152725	0.017138	0.02173	0.02378
20.4	0.94024	0.00203		20.4	0.00203		20.4	0.0133168	0.0151235	0.0169708	0.021518	0.023548
20.5	0.94225	0.00201		20.5	0.00201		20.5	0.0131856	0.0149745	0.0168036	0.021306	0.023316
20.6	0.94424	0.00199		20.6	0.00199		20.6	0.0130544	0.0148255	0.0166364	0.021094	0.023084
20.7	0.94621	0.00197		20.7	0.00197		20.7	0.0129232	0.0146765	0.0164692	0.020882	0.022852
20.8	0.94816	0.00195		20.8	0.00195		20.8	0.012792	0.0145275	0.016302	0.02067	0.02262
20.9	0.95009	0.00193		20.9	0.00193		20.9	0.0126608	0.0143785	0.0161348	0.020458	0.022388
21.0	0.95200	0.00191		21.0	0.00191		21.0	0.0125296	0.0142295	0.0159676	0.020246	0.022156
21.1	0.95389	0.00189		21.1	0.00189		21.1	0.0123984	0.0140805	0.0158004	0.020034	0.021924
21.2	0.95576	0.00187		21.2	0.00187		21.2	0.0122672	0.0139315	0.0156332	0.019822	0.021692
21.3	0.95761	0.00185		21.3	0.00185		21.3	0.012136	0.0137825	0.015466	0.01961	0.02146
21.4	0.95944	0.00183		21.4	0.00183		21.4	0.0120048	0.0136335	0.0152988	0.019398	0.021228
21.5	0.96125	0.00181		21.5	0.00181		21.5	0.0118736	0.0134845	0.0151316	0.019186	0.020996
21.6	0.96304	0.00179		21.6	0.00179		21.6	0.0117424	0.0133355	0.0149644	0.018974	0.020764
21.7	0.96481	0.00177		21.7	0.00177		21.7	0.0116112	0.0131865	0.0147972	0.018762	0.020532
21.8	0.96656	0.00175		21.8	0.00175		21.8	0.01148	0.0130375	0.01463	0.01855	0.0203
21.9	0.96829	0.00173		21.9	0.00173		21.9	0.0113488	0.0128885	0.0144628	0.018338	0.020068
22.0	0.97000	0.00171		22.0	0.00171		22.0	0.0112176	0.0127395	0.0142956	0.018126	0.019836
22.1	0.97169	0.00169		22.1	0.00169		22.1	0.0110864	0.0125905	0.0141284	0.017914	0.019604
22.2	0.97336	0.00167		22.2	0.00167		22.2	0.0109552	0.0124415	0.0139612	0.017702	0.019372
22.3	0.97501	0.00165		22.3	0.00165		22.3	0.010824	0.0122925	0.013794	0.01749	0.01914
22.4	0.97664	0.00163		22.4	0.00163		22.4	0.0106928	0.0121435	0.0136268	0.017278	0.018908
22.5	0.97825	0.00161		22.5	0.00161		22.5	0.0105616	0.0119945	0.0134596	0.017066	0.018676
22.6	0.97984	0.00159		22.6	0.00159		22.6	0.0104304	0.0118455	0.0132924	0.016854	0.018444
22.7	0.98141	0.00157		22.7	0.00157		22.7	0.0102992	0.0116965	0.0131252	0.016642	0.018212
22.8	0.98296	0.00155		22.8	0.00155		22.8	0.010168	0.0115475	0.012958	0.01643	0.01798
22.9	0.98449	0.00153		22.9	0.00153		22.9	0.0100368	0.0113985	0.0127908	0.016218	0.017748
23.0	0.98600	0.00151		23.0	0.00151		23.0	0.0099056	0.0112495	0.0126236	0.016006	0.017516
23.1	0.98749	0.00149		23.1	0.00149		23.1	0.0097744	0.0111005	0.0124564	0.015794	0.017284
23.2	0.98896	0.00147		23.2	0.00147		23.2	0.0096432	0.0109515	0.0122892	0.015582	0.017052
23.3	0.99041	0.00145		23.3	0.00145		23.3	0.009512	0.0108025	0.012122	0.01537	0.01682
23.4	0.99184	0.00143		23.4	0.00143		23.4	0.0093808	0.0106535	0.0119548	0.015158	0.016588
23.5	0.99325	0.00141		23.5	0.00141		23.5	0.0092496	0.0105045	0.0117876	0.014946	0.016356
23.6	0.99464	0.00139		23.6	0.00139		23.6	0.0091184	0.0103555	0.0116204	0.014734	0.016124
23.7	0.99601	0.00137		23.7	0.00137		23.7	0.0089872	0.0102065	0.0114532	0.014522	0.015892
23.8	0.99736	0.00135		23.8	0.00135		23.8	0.008856	0.0100575	0.011286	0.01431	0.01566
23.9	0.99869	0.00133		23.9	0.00133		23.9	0.0087248	0.0099085	0.0111188	0.014098	0.015428
24.0	1.0000	0.00131		24.0	0.00131		24.0	0.0085936	0.0097595	0.0109516	0.013886	0.015196

Manning's n - Open Channels

Channel Type	Manning n
Lined Channels	
- Asphalt	0.013 - 0.017
- Brick	0.012 - 0.018
- Concrete	0.011 - 0.020
- Rubble or riprap	0.020 - 0.035
- Vegetal	0.030 - 0.40
Excavated or dredged	
- Earth, straight and uniform	0.020 - 0.030
- Earth, winding, fairly uniform	0.025 - 0.040
- Rock	0.030 - 0.045
- Unmaintained	0.050 - 0.140
Natural channels (minor streams, top width at flood stage < 100 ft)	
- Fairly regular section	0.030 - 0.070
- Irregular section with pools	0.040 - 0.100

Source: ASCE (1982). *Gravity Sanitary Sewer Design and Construction*, ASCE Manual of Practice No. 60, New York, NY.

Manning's n - Closed Conduits

Conduit Material	Manning n
Asbestos-cement pipe	0.011 - 0.015
Brick	0.013 - 0.017
Cast iron pipe	
- Cement-lined & seal coated	0.011 - 0.015
Concrete (monolithic)	
- Smooth forms	0.012 - 0.014
- Rough forms	0.015 - 0.017
Concrete pipe	0.011 - 0.015
Corrugated-metal pipe (1/2-in. x 2-2/3-in. corrugations)	
- Plain	0.022 - 0.026
- Paved invert	0.018 - 0.022
- Spun asphalt lined	0.011 - 0.015
Plastic pipe (smooth)	0.011 - 0.015
Vitrified clay	
- Pipes	0.011 - 0.015
- Liner plates	0.013 - 0.017

Source: ASCE (1982). *Gravity Sanitary Sewer Design and Construction*, ASCE Manual of Practice No. 60, New York, NY.

Manning's n - Overland Flow

Surface	n
Smooth asphalt	0.011
Smooth concrete	0.012
Ordinary concrete lining	0.013
Good wood	0.014
Brick with cement mortar	0.014
Vitrified clay	0.015
Cast iron	0.015
Corrugated metal pipes	0.024
Cement rubble surface	0.024
Fallow soils (no residue)	0.05
Cultivated soils	
Residue cover < 20%	0.06
Residue cover > 20%	0.17
Range (natural)	0.13
Grass	
Short, prarie	0.15
Dense	0.24
Bermuda grass	0.41
Woods	
Light underbrush	0.40
Dense underbrush	0.80

Source: McCuen, R. et al. (1996), *Hydrology*, FHWA-SA-96-067, Federal Highway Administration, Washington, DC

Typical Depression Storage Values

Impervious surfaces	0.05 - 0.10 inches
Lawns	0.10 - 0.20 inches
Pasture	0.20 inches
Forest litter	0.30 inches

(Source: ASCE,(1992), *Design & Construction of Urban Stormwater Management Systems*, New York, NY)

Typical Depression Storage Values

Impervious surfaces	0.05 - 0.10 inches
Lawns	0.10 - 0.20 inches
Pasture	0.20 inches
Forest litter	0.30 inches

(Source: ASCE,(1992), *Design & Construction of Urban Stormwater Management Systems*, New York, NY)

SCS Runoff Curve Numbers (Antecedent moisture condition II)
[1]

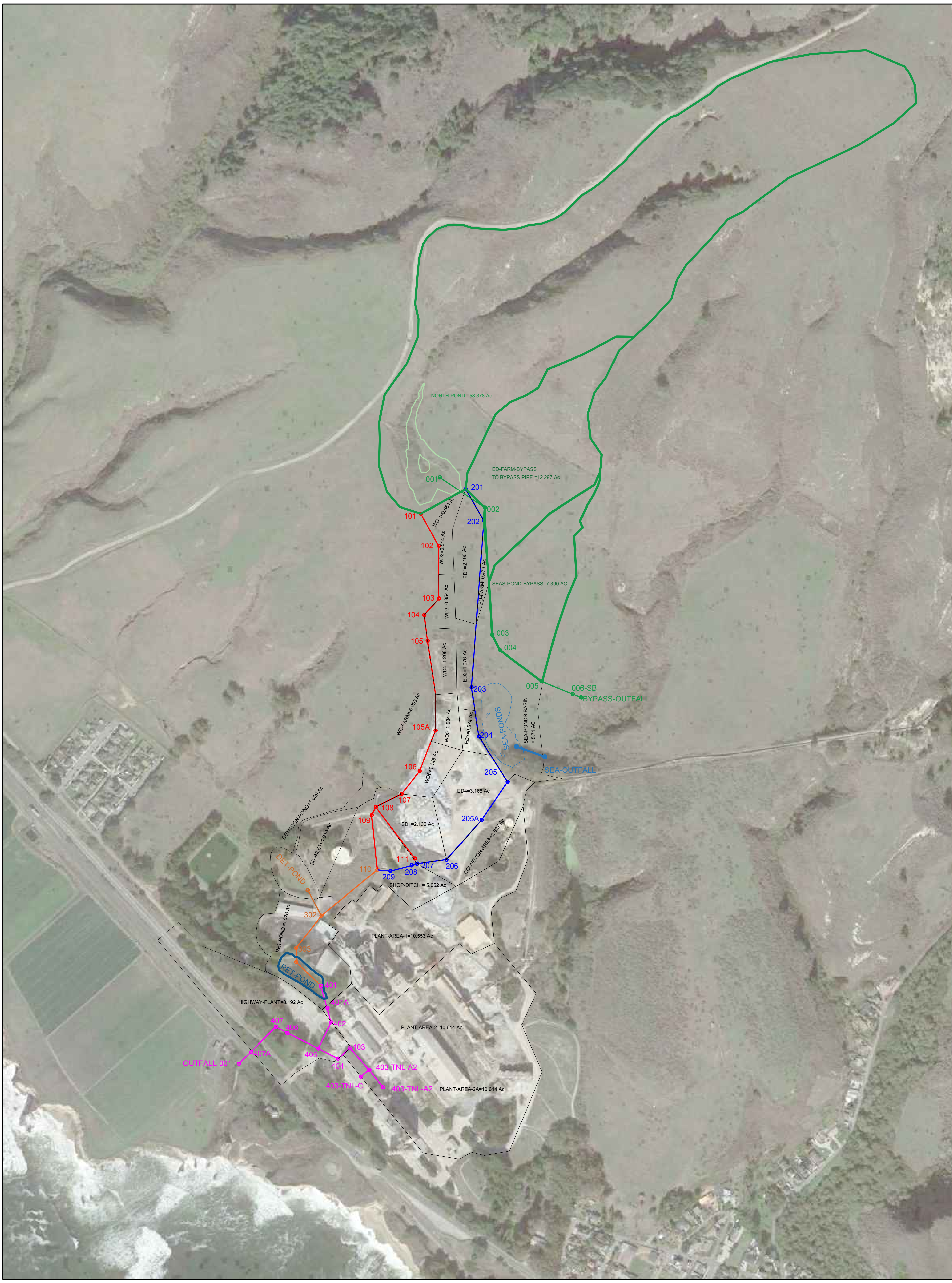
	Hydrologic Soil Group			
Land Use Description	**A**	**B**	**C**	**D**
Cultivated land				
Without conservation treatment	72	81	88	91
With conservation treatment	62	71	78	81
Pasture or range land				
Poor condition	68	79	86	89
Good condition	39	61	74	80
Meadow				
Good condition	30	58	71	78
Wood or forest land				
Thin stand, poor cover, no mulch	45	66	77	83
Good cover[2]	25	55	70	77
Open spaces, lawns, parks, golf courses, cemeteries, etc.				
Good condition: grass cover on 75% or more of the area	39	61	74	80
Fair condition: grass cover on 50 - 75% of the area	49	69	79	84
Commercial and business areas (85% impervious)	89	92	94	95
Industrial districts (72% impervious)	81	88	91	93
Residential[3]				
Average lot size (% Impervious[4])				
1/8 ac or less (65)	77	85	90	92
1/4 ac (38)	61	75	83	87
1/3 ac (30)	57	72	81	86
1/2 ac (25)	54	70	80	85
1 ac (20)	51	68	79	84
Paved parking lots, roofs, driveways, etc.[5]	98	98	98	98
Streets and roads				
Paved with curbs and storm sewers[5]	98	98	98	98
Gravel	76	85	89	91
Dirt	72	82	87	89

1. Source: *SCS Urban Hydrology for Small Watersheds*, 2nd Ed., (TR-55), June 1986.
2. Good cover is protected from grazing and litter and brush cover soil.
3. Curve numbers are computed assuming that the runoff from the house and driveway is directed toward the street with a minimum of roof water directed to lawns where additional infiltration could occur.
4. The remaining pervious areas (lawn) are considered to be in good pasture condition for these curve numbers.
5. In some warmer climates of the country a curve number of 95 may be used.

APPENDIX E
DRAINAGE BASIN AND NODE NETWORK MAP

NORTH CKD AREA LANDFILL CLOSURE STORMWATER HYDRAULIC ANALYSIS
CEMEX Davenport Cement Plant
700 Highway 1
Davenport, California

Farallon PN: 1839-001



N

250 0 250 500

1"= 500 Scale Feet

DRAINAGE BASINS AND NODE NETWORK MAP

APPENDIX F
MODEL INPUT AND SIMULATION RESULTS

NORTH CKD AREA LANDFILL CLOSURE STORMWATER HYDRAULIC ANALYSIS
CEMEX Davenport Cement Plant
700 Highway 1
Davenport, California

Farallon PN: 1839-001

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)

CEMEX-Davenport, CA
SWMM5.1 H&H Model for Hydraulic Analysis; 24 hour-100 year (Final Design Submittal)
Developed by: Raj Naidu, PE; Naidu Engineering LLC

****
Element Count
****
Number of rain gages 1
Number of subcatchments ... 26
Number of nodes 49
Number of links 48
Number of pollutants 0
Number of land uses 0

****
Raingage Summary
****

Name	Data Source	Data Type	Recording Interval
Davenport	1000yr-24hr	VOLUME	6 min.

****
Subcatchment Summary
****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
NORTH-POND	58.38	450.00	0.00	5.0000	Davenport	001-NORTH-POND
ED-FARM-BYPASS	12.30	300.00	0.00	1.0000	Davenport	002
PLANT-AREA-2	10.61	75.00	75.00	0.5000	Davenport	403
DETENTION-POND	1.64	120.00	10.00	1.0000	Davenport	DET-POND
WD1	0.66	150.00	100.00	13.0000	Davenport	101
WD2	0.51	150.00	100.00	13.0000	Davenport	102
WD3	0.85	150.00	100.00	13.3000	Davenport	104
WD4	1.21	150.00	100.00	0.5000	Davenport	105
SD1	2.13	250.00	100.00	13.3000	Davenport	111
WD5	0.93	300.00	100.00	13.3000	Davenport	106
WD6	1.15	150.00	100.00	0.5000	Davenport	106
ED1	2.19	500.00	100.00	13.3000	Davenport	201
ED2	1.08	150.00	100.00	13.3000	Davenport	203
ED3	0.57	150.00	100.00	13.3000	Davenport	204
ED4	3.17	300.00	100.00	13.3000	Davenport	205
CONVEYOR-AREA	2.93	200.00	40.00	2.0000	Davenport	207
SHOP-DITCH	5.05	200.00	35.00	5.0000	Davenport	110
SD-INLET	1.91	75.00	10.00	0.5000	Davenport	302
RETENTION-POND	5.08	75.00	80.00	0.5000	Davenport	RET-POND
PLANT-AREA-1	10.55	75.00	75.00	1.0000	Davenport	401A
SEAS-POND-BYPASS	7.39	250.00	0.00	1.0000	Davenport	003
ED-FARM	0.47	55.00	0.00	2.0000	Davenport	202
WD-FARM	6.99	500.00	0.00	0.5000	Davenport	106
PLANT-AREA-2A	10.61	100.00	75.00	0.5000	Davenport	403-TNL-A1
HIGHWAY-PLANT	8.19	75.00	40.00	0.5000	Davenport	407B
SEA-PONDS-BASIN	5.16	150.00	10.00	4.0000	Davenport	SEA-PONDS

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
004	JUNCTION	267.80	7.50	0.0	
005	JUNCTION	265.50	8.00	0.0	
201	JUNCTION	285.24	2.50	0.0	

202	JUNCTION	279.48	2.50	0.0
203	JUNCTION	268.03	2.50	0.0
204	JUNCTION	265.90	2.50	0.0
205	JUNCTION	262.71	2.50	0.0
208	JUNCTION	228.00	6.00	0.0
101	JUNCTION	285.00	2.50	0.0
102	JUNCTION	277.50	2.50	0.0
103	JUNCTION	271.54	2.50	0.0
104	JUNCTION	268.64	2.50	0.0
105	JUNCTION	265.50	2.50	0.0
106	JUNCTION	253.61	2.50	0.0
109	JUNCTION	212.40	6.60	0.0
111	JUNCTION	235.00	2.50	0.0
303	JUNCTION	105.00	15.50	0.0
402	JUNCTION	75.41	27.50	0.0
404	JUNCTION	75.00	25.00	0.0
405	JUNCTION	73.47	24.41	0.0
406	JUNCTION	68.51	29.36	0.0
407	JUNCTION	45.00	35.57	0.0
401A	JUNCTION	78.30	27.25	0.0
205a	JUNCTION	259.64	2.50	0.0
105a	JUNCTION	258.22	2.50	0.0
407A	JUNCTION	40.00	35.00	0.0
403-TNL-A2	JUNCTION	79.50	20.50	24000.0
403-TNL-A1	JUNCTION	80.42	21.58	0.0
403-TNL-C	JUNCTION	82.00	24.00	0.0
407B	JUNCTION	87.00	5.00	0.0
BYPASS_OUTFALL	OUTFALL	265.40	2.00	0.0
OUTFALL-001	OUTFALL	32.00	2.50	0.0
SEA-OUTFALL	OUTFALL	263.00	1.00	0.0
RET-POND	STORAGE	97.00	10.00	0.0
DET-POND	STORAGE	129.60	13.00	0.0
001-NORTH-POND	STORAGE	270.00	20.00	0.0
209	STORAGE	150.50	10.00	0.0
110	STORAGE	139.50	6.00	0.0
107	STORAGE	240.30	8.04	0.0
108	STORAGE	221.80	8.70	0.0
206	STORAGE	250.40	7.40	0.0
302	STORAGE	109.50	12.00	0.0
002	STORAGE	273.50	12.50	0.0
403	STORAGE	75.97	26.03	0.0
003	STORAGE	268.50	6.50	0.0
401	STORAGE	79.75	27.25	0.0
006_SB	STORAGE	261.00	6.50	0.0
SEA-PONDS	STORAGE	255.00	10.00	0.0
207	STORAGE	232.00	7.50	0.0

****
Link Summary
****

Name	From Node	To Node	Type	Length	%Slope	Roughness
001-002	001-NORTH-POND	002	CONDUIT	338.0	0.7397	0.0150
002-003	002	003	CONDUIT	709.0	0.7052	0.0150
003-004	003	004	CONDUIT	95.0	0.7369	0.0150
004-005	004	005	CONDUIT	292.0	0.7877	0.0150
201-202	201	202	CONDUIT	203.1	2.8373	0.0300
202-203	202	203	CONDUIT	831.2	1.3776	0.0300
203-204	203	204	CONDUIT	158.4	1.3446	0.0300
204-205	204	205	CONDUIT	265.1	1.2032	0.0300
205-205a	205	205a	CONDUIT	250.3	1.2266	0.0300
206-207	206	207	CONDUIT	45.2	44.5797	0.0150
207-208	207	208	CONDUIT	119.6	3.3464	0.0150
208-209	208	209	CONDUIT	130.0	74.2528	0.0150
209-110	209	110	CONDUIT	22.3	88.0507	0.0300
101-102	101	102	CONDUIT	203.9	3.6813	0.0300
102-103	102	103	CONDUIT	294.6	2.0235	0.0300
103-104	103	104	CONDUIT	122.1	2.3766	0.0300
104-105	104	105	CONDUIT	452.8	0.6936	0.0300
105-105a	105	105a	CONDUIT	199.6	3.6503	0.0300

106-107	106	107	CONDUIT	161.1	6.5082	0.0300
111-108	111	108	CONDUIT	384.9	2.3495	0.0300
108-109	108	109	CONDUIT	33.5	29.2531	0.0150
109-110	109	110	CONDUIT	297.5	25.2721	0.0150
110-302	110	302	CONDUIT	370.0	6.7042	0.0300
302-303	302	303	CONDUIT	334.0	1.3474	0.0150
402-405	402	405	CONDUIT	113.3	1.7122	0.0170
403-404	403	404	CONDUIT	59.0	1.6435	0.0170
404-405	404	405	CONDUIT	74.5	2.0527	0.1700
405-406	405	406	CONDUIT	218.1	2.2751	0.0170
406-407	406	407	CONDUIT	77.0	32.0636	0.0110
005-006-SB	005	006_SB	CONDUIT	243.0	1.8522	0.0150
303-RET-POND	303	RET-POND	CONDUIT	76.0	2.6325	0.0150
401A-402	401A	402	CONDUIT	122.2	2.3660	0.0170
407a-OUTFAL001	407A	OUTFALL-001	CONDUIT	60.0	13.4535	0.0190
107-108	107	108	CONDUIT	282.8	6.5560	0.0150
401-401A	401	401A	CONDUIT	77.0	1.8835	0.0170
205a-206	205a	206	CONDUIT	551.8	0.4857	0.0300
105a-106	105a	106	CONDUIT	243.6	1.8926	0.0300
407-407A	407	407A	CONDUIT	236.0	2.1191	0.0170
A1-A2	403-TNL-A1	403-TNL-A2	CONDUIT	190.0	0.4842	0.0170
A2-403	403-TNL-A2	403	CONDUIT	350.0	1.0086	0.0170
C-A2	403-TNL-C	403-TNL-A2	CONDUIT	80.0	3.1265	0.0170
CALTRANS-INLT	407B	407A	CONDUIT	50.0	275.5189	0.0150
006_SB-Outfall	006_SB	BYPASS_OUTFALL	CONDUIT	20.0	0.5000	0.0300
SeaFD-206	SEA-PONDS	206	CONDUIT	680.0	1.8533	0.0120
SEA-OVERFLOW-CHNNL	SEA-PONDS	SEA-OUTFALL	CONDUIT	115.0	1.3045	0.0400
Orf-Det-Outlet-302	DET-POND	302	ORIFICE			
Ret-Orifice-1	RET-POND	401	ORIFICE			
Ret-Outlet	RET-POND	401	WEIR			

****
Cross Section Summary
****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
001-002	CIRCULAR	3.50	9.62	0.88	3.50	1	74.99
002-003	CIRCULAR	3.50	9.62	0.88	3.50	1	73.23
003-004	CIRCULAR	3.50	9.62	0.88	3.50	1	74.85
004-005	CIRCULAR	3.50	9.62	0.88	3.50	1	77.39
201-202	TRAPEZOIDAL	2.50	16.25	1.28	11.50	1	159.96
202-203	TRAPEZOIDAL	2.50	16.25	1.28	11.50	1	111.46
203-204	TRAPEZOIDAL	2.50	16.25	1.28	11.50	1	110.12
204-205	TRAPEZOIDAL	2.50	16.25	1.28	11.50	1	104.17
205-205a	TRAPEZOIDAL	2.50	16.25	1.28	11.50	1	105.17
206-207	CIRCULAR	2.67	5.59	0.67	2.67	1	282.02
207-208	CIRCULAR	3.50	9.62	0.88	3.50	1	159.51
208-209	CIRCULAR	2.67	5.59	0.67	2.67	1	363.97
209-110	TRAPEZOIDAL	3.00	27.00	1.64	15.00	1	1748.58
101-102	TRAPEZOIDAL	2.50	16.25	1.28	11.50	1	182.21
102-103	TRAPEZOIDAL	2.50	16.25	1.28	11.50	1	135.09
103-104	TRAPEZOIDAL	2.50	16.25	1.28	11.50	1	146.40
104-105	TRAPEZOIDAL	2.50	16.25	1.28	11.50	1	79.09
105-105a	TRAPEZOIDAL	2.50	16.25	1.28	11.50	1	181.44
106-107	TRAPEZOIDAL	2.00	11.00	1.05	9.50	1	143.89
111-108	TRAPEZOIDAL	1.75	7.88	0.89	8.00	1	55.41
108-109	CIRCULAR	2.67	5.59	0.67	2.67	1	228.45
109-110	CIRCULAR	2.67	5.59	0.67	2.67	1	212.34
110-302	TRAPEZOIDAL	3.00	30.00	1.72	16.00	1	552.88
302-303	CIRCULAR	4.50	15.90	1.13	4.50	1	197.83
402-405	Tunnel-D	3.25	39.82	1.25	13.00	1	528.39
403-404	Tunnel-B	6.00	154.62	2.39	27.00	1	3093.00
404-405	Tunnel-B	6.00	154.62	2.39	27.00	1	345.68
405-406	Tunnel-B	6.00	154.62	2.39	27.00	1	3639.15
406-407	CIRCULAR	2.00	3.14	0.50	2.00	1	151.39
005-006-SB	CIRCULAR	3.50	9.62	0.88	3.50	1	118.67
303-RET-POND	CIRCULAR	4.50	15.90	1.13	4.50	1	276.52
401A-402	Tunnel-D	3.25	39.82	1.25	13.00	1	621.14
407a-OUTFAL001	CIRCULAR	2.50	4.91	0.63	2.50	1	102.94

107-108	CIRCULAR	2.67	5.59	0.67	2.67	1	108.15
401-401A	Tunnel-D	3.25	39.82	1.25	13.00	1	554.19
205a-206	TRAPEZOIDAL	2.50	16.25	1.28	11.50	1	66.18
105a-106	TRAPEZOIDAL	2.50	16.25	1.28	11.50	1	130.64
407-407A	Tunnel-B	6.00	154.62	2.39	27.00	1	3512.19
A1-A2	Tunnel-A&C	4.50	86.97	1.79	20.25	1	779.56
A2-403	Tunnel-A&C	4.50	86.97	1.79	20.25	1	1125.11
C-A2	Tunnel-A&C	4.50	86.97	1.79	20.25	1	1980.90
CALTRANS-INLT	CIRCULAR	1.50	1.77	0.38	1.50	1	151.11
006_SB-Outfall	TRAPEZOIDAL	2.00	38.00	1.59	23.00	1	181.09
SeaFD-206	CIRCULAR	0.67	0.35	0.17	0.67	1	1.78
SEA-OVERFLOW-CHNNL	TRAPEZOIDAL	1.00	105.00	0.78	135.00	1	376.68

****
Shape Summary
****

Shape Tunnel-B

Area:

0.0210	0.0419	0.0629	0.0838	0.1048
0.1257	0.1467	0.1676	0.1886	0.2095
0.2305	0.2515	0.2724	0.2934	0.3143
0.3353	0.3562	0.3772	0.3981	0.4191
0.4400	0.4610	0.4820	0.5029	0.5239
0.5448	0.5658	0.5867	0.6077	0.6286
0.6496	0.6705	0.6915	0.7125	0.7334
0.7544	0.7753	0.7963	0.8172	0.8382
0.8591	0.8801	0.9010	0.9220	0.9430
0.9627	0.9790	0.9907	0.9977	1.0000

Hrad:

0.0499	0.0989	0.1470	0.1943	0.2409
0.2866	0.3316	0.3758	0.4193	0.4621
0.5042	0.5456	0.5863	0.6264	0.6659
0.7048	0.7430	0.7807	0.8178	0.8544
0.8904	0.9258	0.9608	0.9952	1.0291
1.0626	1.0955	1.1280	1.1601	1.1916
1.2228	1.2535	1.2838	1.3136	1.3431
1.3722	1.4009	1.4292	1.4571	1.4847
1.5119	1.5387	1.5652	1.5914	1.6172
1.5294	1.3558	1.2159	1.0995	1.0000

Width:

1.0000	1.0000	1.0000	1.0000	1.0000
1.0000	1.0000	1.0000	1.0000	1.0000
1.0000	1.0000	1.0000	1.0000	1.0000
1.0000	1.0000	1.0000	1.0000	1.0000
1.0000	1.0000	1.0000	1.0000	1.0000
1.0000	1.0000	1.0000	1.0000	1.0000
1.0000	1.0000	1.0000	1.0000	1.0000
1.0000	1.0000	1.0000	1.0000	1.0000
1.0000	1.0000	1.0000	1.0000	1.0000
0.8889	0.6667	0.4444	0.2222	0.0000

Shape Tunnel-D

Area:

0.0212	0.0424	0.0637	0.0849	0.1061
0.1273	0.1485	0.1698	0.1910	0.2122
0.2334	0.2546	0.2759	0.2971	0.3183
0.3395	0.3607	0.3820	0.4032	0.4244
0.4456	0.4668	0.4881	0.5093	0.5305
0.5517	0.5729	0.5942	0.6154	0.6366
0.6578	0.6790	0.7003	0.7215	0.7427
0.7639	0.7851	0.8064	0.8276	0.8488
0.8700	0.8912	0.9125	0.9337	0.9549
0.9735	0.9867	0.9947	0.9987	1.0000

Hrad:

0.0515	0.1020	0.1515	0.2001	0.2477
0.2944	0.3403	0.3853	0.4295	0.4729
0.5155	0.5573	0.5984	0.6388	0.6785
0.7175	0.7558	0.7935	0.8306	0.8670
0.9028	0.9380	0.9727	1.0068	1.0404

```
            1.0734     1.1059     1.1379     1.1694     1.2004
            1.2310     1.2611     1.2907     1.3199     1.3486
            1.3770     1.4049     1.4324     1.4595     1.4863
            1.5126     1.5386     1.5642     1.5895     1.6144
            1.4036     1.2402     1.1081     1.0525     1.0000
Width:
            1.0000     1.0000     1.0000     1.0000     1.0000
            1.0000     1.0000     1.0000     1.0000     1.0000
            1.0000     1.0000     1.0000     1.0000     1.0000
            1.0000     1.0000     1.0000     1.0000     1.0000
            1.0000     1.0000     1.0000     1.0000     1.0000
            1.0000     1.0000     1.0000     1.0000     1.0000
            1.0000     1.0000     1.0000     1.0000     1.0000
            1.0000     1.0000     1.0000     1.0000     1.0000
            1.0000     1.0000     1.0000     1.0000     1.0000
            0.7500     0.5000     0.2500     0.1250     0.0000

Shape Tunnel-A&C
Area:
            0.0210     0.0419     0.0629     0.0838     0.1048
            0.1257     0.1467     0.1676     0.1886     0.2095
            0.2305     0.2515     0.2724     0.2934     0.3143
            0.3353     0.3562     0.3772     0.3981     0.4191
            0.4400     0.4610     0.4820     0.5029     0.5239
            0.5448     0.5658     0.5867     0.6077     0.6286
            0.6496     0.6705     0.6915     0.7125     0.7334
            0.7544     0.7753     0.7963     0.8172     0.8382
            0.8591     0.8801     0.9010     0.9220     0.9430
            0.9627     0.9790     0.9907     0.9977     1.0000
Hrad:
            0.0499     0.0989     0.1470     0.1943     0.2409
            0.2866     0.3316     0.3758     0.4193     0.4621
            0.5042     0.5456     0.5863     0.6264     0.6659
            0.7048     0.7430     0.7807     0.8178     0.8544
            0.8904     0.9258     0.9608     0.9952     1.0291
            1.0626     1.0955     1.1280     1.1601     1.1916
            1.2228     1.2535     1.2838     1.3136     1.3431
            1.3722     1.4009     1.4292     1.4571     1.4847
            1.5119     1.5387     1.5652     1.5914     1.6172
            1.5294     1.3558     1.2159     1.0995     1.0000
Width:
            1.0000     1.0000     1.0000     1.0000     1.0000
            1.0000     1.0000     1.0000     1.0000     1.0000
            1.0000     1.0000     1.0000     1.0000     1.0000
            1.0000     1.0000     1.0000     1.0000     1.0000
            1.0000     1.0000     1.0000     1.0000     1.0000
            1.0000     1.0000     1.0000     1.0000     1.0000
            1.0000     1.0000     1.0000     1.0000     1.0000
            1.0000     1.0000     1.0000     1.0000     1.0000
            1.0000     1.0000     1.0000     1.0000     1.0000
            0.8889     0.6667     0.4444     0.2222     0.0000


*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
```

```
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Starting Date ............ 01/01/2017 00:00:00
Ending Date .............. 01/01/2017 23:59:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:00:01
Wet Time Step ............ 00:00:01
Dry Time Step ............ 00:00:01
Routing Time Step ........ 0.50 sec
Variable Time Step ....... YES
Maximum Trials ........... 20
Number of Threads ........ 2
Head Tolerance ........... 0.005000 ft


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......       156.095        11.582
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........        18.113         1.344
Surface Runoff ...........       127.961         9.495
Final Storage ............        10.021         0.744
Continuity Error (%) .....        -0.000


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......       127.960        41.698
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........       120.478        39.259
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         1.970         0.642
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         5.528         1.801
Continuity Error (%) .....        -0.012


***************************
Time-Step Critical Elements
***************************
None


********************************
Highest Flow Instability Indexes
********************************
Link 303-RET-POND (37)
Link 407a-OUTFAL001 (1)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :      0.50 sec
Average Time Step           :      0.50 sec
Maximum Time Step           :      0.50 sec
Percent in Steady State     :      0.00
Average Iterations per Step :      2.04
Percent Not Converging      :      0.05


***************************
Subcatchment Runoff Summary
***************************
```

Subcatchment	Total Precip in	Total Runon in	Total Evap in	Total Infil in	Total Runoff in	Total Runoff 10^6 gal	Peak Runoff CFS	Runoff Coeff
NORTH-POND	11.58	0.00	0.00	1.74	8.80	13.95	107.00	0.760
ED-FARM-BYPASS	11.58	0.00	0.00	1.74	8.98	3.00	27.78	0.775
PLANT-AREA-2	11.58	0.00	0.00	0.16	10.53	3.03	28.05	0.909
DETENTION-POND	11.58	0.00	0.00	1.68	9.45	0.42	6.86	0.815
WD1	11.58	0.00	0.00	0.00	11.52	0.21	5.82	0.994
WD2	11.58	0.00	0.00	0.00	11.52	0.16	4.53	0.994
WD3	11.58	0.00	0.00	0.00	11.51	0.27	7.52	0.994
WD4	11.58	0.00	0.00	0.00	11.47	0.38	9.82	0.990
SD1	11.58	0.00	0.00	0.00	11.51	0.67	18.74	0.994
WD5	11.58	0.00	0.00	0.00	11.52	0.29	8.23	0.995
WD6	11.58	0.00	0.00	0.00	11.47	0.36	9.37	0.990
ED1	11.58	0.00	0.00	0.00	11.52	0.68	19.29	0.994
ED2	11.58	0.00	0.00	0.00	11.51	0.34	9.47	0.994
ED3	11.58	0.00	0.00	0.00	11.52	0.18	5.06	0.995
ED4	11.58	0.00	0.00	0.00	11.50	0.99	27.75	0.993
CONVEYOR-AREA	11.58	0.00	0.00	0.78	10.53	0.84	18.63	0.909
SHOP-DITCH	11.58	0.00	0.00	0.91	10.37	1.42	30.11	0.896
SD-INLET	11.58	0.00	0.00	1.43	9.46	0.49	5.71	0.816
RETENTION-POND	11.58	0.00	0.00	0.11	11.14	1.54	26.21	0.962
PLANT-AREA-1	11.58	0.00	0.00	0.16	10.99	3.15	47.43	0.949
SEAS-POND-BYPASS	11.58	0.00	0.00	2.06	8.79	1.76	19.02	0.759
ED-FARM	11.58	0.00	0.00	2.06	9.13	0.12	2.31	0.789
WD-FARM	11.58	0.00	0.00	6.65	4.40	0.84	7.07	0.380
PLANT-AREA-2A	11.58	0.00	0.00	0.16	10.65	3.07	32.40	0.919
HIGHWAY-PLANT	11.58	0.00	0.00	0.78	9.88	2.20	26.04	0.853
SEA-PONDS-BASIN	11.58	0.00	0.00	1.38	9.70	1.36	20.69	0.838

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days	Time of Max Occurrence hr:min	Reported Max Depth Feet
004	JUNCTION	1.66	5.18	272.98	0	11:02	5.18
005	JUNCTION	1.30	4.06	269.56	0	11:02	4.06
201	JUNCTION	0.19	0.97	286.21	0	10:00	0.97
202	JUNCTION	0.25	1.19	280.67	0	10:00	1.19
203	JUNCTION	0.31	1.40	269.43	0	10:00	1.40
204	JUNCTION	0.34	1.53	267.43	0	10:00	1.53
205	JUNCTION	0.46	1.97	264.68	0	10:00	1.97
208	JUNCTION	0.22	0.82	228.82	0	10:02	0.82
101	JUNCTION	0.09	0.50	285.50	0	10:00	0.50
102	JUNCTION	0.15	0.79	278.29	0	09:59	0.79
103	JUNCTION	0.14	0.75	272.29	0	10:00	0.75
104	JUNCTION	0.31	1.38	270.02	0	10:00	1.38
105	JUNCTION	0.22	1.07	266.57	0	10:00	1.07
106	JUNCTION	0.31	1.23	254.84	0	10:00	1.23
109	JUNCTION	0.25	1.03	213.43	0	10:00	1.03
111	JUNCTION	0.24	1.09	236.09	0	10:00	1.09
303	JUNCTION	1.42	9.00	114.00	0	10:03	8.97
402	JUNCTION	1.13	24.91	100.32	0	10:37	24.91
404	JUNCTION	1.39	25.26	100.26	0	10:37	25.26
405	JUNCTION	1.21	26.76	100.23	0	10:37	26.76
406	JUNCTION	1.98	31.71	100.22	0	10:37	31.71
407	JUNCTION	1.98	26.81	71.81	0	10:36	26.81
401A	JUNCTION	0.90	22.11	100.41	0	10:37	22.11
205a	JUNCTION	0.72	2.49	262.13	0	10:01	2.49
105a	JUNCTION	0.27	1.25	259.47	0	10:00	1.25
407A	JUNCTION	4.51	31.80	71.80	0	10:36	31.80
403-TNL-A2	JUNCTION	0.69	20.76	100.26	0	10:37	20.76
403-TNL-A1	JUNCTION	0.66	19.84	100.26	0	10:37	19.84

403-TNL-C	JUNCTION	0.47	18.26	100.26	0	10:37	18.26
407B	JUNCTION	0.15	0.57	87.57	0	10:06	0.57
BYPASS_OUTFALL	OUTFALL	0.37	0.89	266.29	0	11:02	0.89
OUTFALL-001	OUTFALL	0.91	2.50	34.50	0	09:54	2.50
SEA-OUTFALL	OUTFALL	0.01	0.12	263.12	0	10:06	0.12
RET-POND	STORAGE	3.28	8.22	105.22	0	10:11	8.22
DET-POND	STORAGE	2.32	3.95	133.55	0	10:15	3.95
001-NORTH-POND	STORAGE	5.60	12.07	282.07	0	12:02	12.07
209	STORAGE	7.41	8.14	158.64	0	10:03	8.14
110	STORAGE	3.30	4.69	144.19	0	10:00	4.69
107	STORAGE	0.33	1.26	241.56	0	10:00	1.26
108	STORAGE	0.29	1.93	223.73	0	10:00	1.93
206	STORAGE	0.22	0.88	251.28	0	10:02	0.88
302	STORAGE	0.80	10.12	119.62	0	10:02	10.12
002	STORAGE	1.74	6.57	280.07	0	11:41	6.57
403	STORAGE	0.94	24.29	100.26	0	10:37	24.29
003	STORAGE	1.98	6.39	274.89	0	11:02	6.39
401	STORAGE	0.81	20.74	100.49	0	10:37	20.74
006_SB	STORAGE	4.01	5.52	266.52	0	11:02	5.52
SEA-PONDS	STORAGE	8.79	9.72	264.72	0	10:06	9.72
207	STORAGE	0.55	3.56	235.56	0	10:02	3.56

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
004	JUNCTION	0.00	76.44	0 11:02	0	16.8	0.025
005	JUNCTION	0.00	76.44	0 11:02	0	16.8	0.024
201	JUNCTION	19.29	19.29	0 10:00	0.685	0.685	0.009
202	JUNCTION	2.31	21.39	0 10:00	0.117	0.802	0.135
203	JUNCTION	9.47	30.23	0 10:00	0.336	1.14	0.132
204	JUNCTION	5.06	34.02	0 10:00	0.18	1.32	0.059
205	JUNCTION	27.75	61.01	0 10:00	0.989	2.3	0.034
208	JUNCTION	0.00	74.27	0 10:02	0	3.86	0.005
101	JUNCTION	5.82	5.82	0 10:00	0.207	0.207	0.028
102	JUNCTION	4.53	10.35	0 10:00	0.161	0.367	0.072
103	JUNCTION	0.00	10.35	0 10:00	0	0.367	0.069
104	JUNCTION	7.52	17.85	0 10:00	0.267	0.634	0.106
105	JUNCTION	9.82	27.43	0 10:00	0.376	1.01	0.068
106	JUNCTION	22.83	49.02	0 10:00	1.48	2.49	0.040
109	JUNCTION	0.00	66.90	0 10:00	0	3.16	0.010
111	JUNCTION	18.74	18.74	0 10:00	0.666	0.666	0.083
303	JUNCTION	0.00	173.28	0 10:02	0	9.32	0.364
402	JUNCTION	0.00	170.02	0 10:11	0	13.6	0.010
404	JUNCTION	0.00	113.81	0 10:02	0	6.44	0.047
405	JUNCTION	0.00	203.26	0 10:04	0	19.9	0.008
406	JUNCTION	0.00	159.05	0 10:02	0	19.7	0.038
407	JUNCTION	0.00	142.99	0 10:38	0	19.7	0.011
401A	JUNCTION	47.43	171.74	0 10:10	3.15	13.6	0.008
205a	JUNCTION	0.00	60.08	0 10:00	0	2.3	0.274
105a	JUNCTION	0.00	27.06	0 10:00	0	1.01	0.047
407A	JUNCTION	0.00	155.87	0 10:36	0	21.9	0.205
403-TNL-A2	JUNCTION	0.00	99.84	0 10:17	0	3.26	-0.022
403-TNL-A1	JUNCTION	32.40	54.42	0 10:18	3.07	3.08	-0.003
403-TNL-C	JUNCTION	0.00	61.99	0 10:19	0	0.0302	-2.910
407B	JUNCTION	26.04	26.04	0 10:06	2.2	2.2	0.001
BYPASS_OUTFALL	OUTFALL	0.00	76.44	0 11:02	0	16.8	0.000
OUTFALL-001	OUTFALL	0.00	155.87	0 10:36	0	21.8	0.000
SEA-OUTFALL	OUTFALL	0.00	18.68	0 10:06	0	0.635	0.000
RET-POND	STORAGE	26.21	198.48	0 10:02	1.54	10.8	-0.255
DET-POND	STORAGE	6.86	6.86	0 10:06	0.42	0.42	0.030
001-NORTH-POND	STORAGE	107.00	107.00	0 10:12	13.9	13.9	0.020
209	STORAGE	0.00	74.27	0 10:02	0	3.86	0.188
110	STORAGE	30.11	168.54	0 10:00	1.42	8.43	0.139

107	STORAGE	0.00	48.49	0	10:00	0	2.49	0.011
108	STORAGE	0.00	67.03	0	10:00	0	3.16	0.006
206	STORAGE	0.00	57.60	0	10:01	0	3.02	0.006
302	STORAGE	5.71	177.83	0	10:00	0.491	9.33	0.006
002	STORAGE	27.78	69.88	0	10:07	3	15.1	0.070
403	STORAGE	28.05	103.70	0	10:11	3.03	6.4	0.049
003	STORAGE	19.02	76.45	0	11:00	1.76	16.8	0.067
401	STORAGE	0.00	130.25	0	10:11	0	10.4	0.006
006_SB	STORAGE	0.00	76.44	0	11:02	0	16.8	0.075
SEA-PONDS	STORAGE	20.69	20.69	0	10:06	1.36	1.36	0.042
207	STORAGE	18.63	74.53	0	10:01	0.837	3.86	0.008

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
004	JUNCTION	4.33	1.682	2.318
005	JUNCTION	3.82	0.561	3.939
303	JUNCTION	0.33	4.504	6.496
402	JUNCTION	1.59	21.661	2.589
404	JUNCTION	1.33	19.260	0.000
405	JUNCTION	1.51	20.763	0.000
406	JUNCTION	1.92	25.713	0.000
407	JUNCTION	2.17	20.808	8.762
401A	JUNCTION	1.27	18.859	5.141
407A	JUNCTION	3.65	25.797	3.203
403-TNL-A2	JUNCTION	0.92	16.263	0.000
403-TNL-A1	JUNCTION	0.86	15.344	1.736
403-TNL-C	JUNCTION	0.79	13.763	5.737

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days	hr:min	Maximum Outflow CFS
RET-POND	65.000	25	0	0	203.712	77	0	10:11	130.25
DET-POND	0.049	0	0	0	1.778	1	0	10:15	4.91
001-NORTH-POND	153.240	15	0	5	445.688	43	0	12:02	61.07
209	0.209	74	0	0	0.230	81	0	10:03	74.27
110	0.093	55	0	0	0.133	78	0	10:00	168.33
107	0.009	4	0	0	0.036	16	0	10:00	48.55
108	0.008	3	0	0	0.055	22	0	10:00	66.90
206	0.006	3	0	0	0.025	12	0	10:02	57.59
302	0.023	7	0	0	0.286	84	0	10:02	173.28
002	0.049	14	0	0	0.186	53	0	11:41	68.71
403	0.034	4	0	0	0.888	93	0	10:37	113.81
003	0.056	31	0	0	0.181	98	0	11:02	76.44
401	0.009	3	0	0	0.221	76	0	10:37	131.41
006_SB	0.113	62	0	0	0.156	85	0	11:02	76.44
SEA-PONDS	0.116	78	0	0	0.140	94	0	10:06	20.49
207	0.016	7	0	0	0.101	47	0	10:02	74.27

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
BYPASS_OUTFALL	76.92	33.81	76.44	16.793
OUTFALL-001	97.62	34.62	155.87	21.828
SEA-OUTFALL	44.74	2.20	18.68	0.635
System	73.09	70.63	240.70	39.257

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
001-002	CONDUIT	58.84	0	13:11	7.16	0.78	1.00
002-003	CONDUIT	68.71	0	12:13	7.14	0.94	1.00
003-004	CONDUIT	76.44	0	11:02	7.95	1.02	1.00
004-005	CONDUIT	76.44	0	11:02	8.19	0.99	1.00
201-202	CONDUIT	19.29	0	10:00	5.28	0.12	0.43
202-203	CONDUIT	20.82	0	10:00	3.93	0.19	0.52
203-204	CONDUIT	29.19	0	10:00	4.50	0.27	0.59
204-205	CONDUIT	33.52	0	10:00	3.88	0.32	0.70
205-205a	CONDUIT	60.08	0	10:00	4.65	0.57	0.88
206-207	CONDUIT	57.59	0	10:01	14.58	0.20	0.67
207-208	CONDUIT	74.27	0	10:02	12.73	0.47	0.62
208-209	CONDUIT	74.27	0	10:02	19.22	0.20	0.65
209-110	CONDUIT	74.27	0	10:02	21.49	0.04	0.26
101-102	CONDUIT	5.82	0	10:00	3.26	0.03	0.26
102-103	CONDUIT	10.35	0	10:00	4.45	0.08	0.31
103-104	CONDUIT	10.33	0	10:00	2.69	0.07	0.43
104-105	CONDUIT	17.64	0	10:00	3.63	0.22	0.49
105-105a	CONDUIT	27.06	0	10:00	6.12	0.15	0.46
106-107	CONDUIT	48.49	0	10:00	9.93	0.34	0.62
111-108	CONDUIT	18.62	0	10:00	5.35	0.34	0.62
108-109	CONDUIT	66.90	0	10:00	21.03	0.29	0.56
109-110	CONDUIT	66.88	0	10:00	16.20	0.31	0.69
110-302	CONDUIT	168.33	0	10:00	13.45	0.30	0.59
302-303	CONDUIT	173.28	0	10:02	10.90	0.88	1.00
402-405	CONDUIT	170.60	0	10:08	10.99	0.32	1.00
403-404	CONDUIT	113.81	0	10:02	3.88	0.04	1.00
404-405	CONDUIT	75.38	0	10:03	1.79	0.22	1.00
405-406	CONDUIT	159.05	0	10:02	4.13	0.04	1.00
406-407	CONDUIT	142.99	0	10:38	>50.00	0.94	1.00
005-006-SB	CONDUIT	76.44	0	11:02	7.95	0.64	1.00
303-RET-POND	CONDUIT	173.29	0	10:02	12.91	0.63	0.79
401A-402	CONDUIT	170.02	0	10:11	10.77	0.27	1.00
407a-OUTFAL001	CONDUIT	155.87	0	10:36	31.75	1.51	1.00
107-108	CONDUIT	48.55	0	10:00	14.19	0.45	0.60
401-401A	CONDUIT	131.41	0	10:10	8.48	0.24	1.00
205a-206	CONDUIT	55.79	0	10:01	4.43	0.84	0.86
105a-106	CONDUIT	26.85	0	10:01	5.47	0.21	0.50
407-407A	CONDUIT	142.99	0	10:38	0.92	0.04	1.00
A1-A2	CONDUIT	48.67	0	10:19	3.88	0.06	1.00
A2-403	CONDUIT	74.94	0	10:13	3.85	0.07	1.00
C-A2	CONDUIT	61.99	0	10:19	0.86	0.03	1.00
CALTRANS-INLT	CONDUIT	26.04	0	10:06	20.02	0.17	0.69
006_SB-Outfall	CONDUIT	76.44	0	11:02	4.73	0.42	0.48
SeaFD-206	CONDUIT	1.88	0	10:10	6.94	1.05	1.00
SEA-OVERFLOW-CHNNL	CONDUIT	18.68	0	10:06	1.37	0.05	0.17

Orf-Det-Outlet-302	ORIFICE	4.91	0	10:15	1.00
Ret-Orifice-1	ORIFICE	79.76	0	10:11	1.00
Ret-Outlet	WEIR	50.49	0	10:11	0.42

****
Flow Classification Summary
****

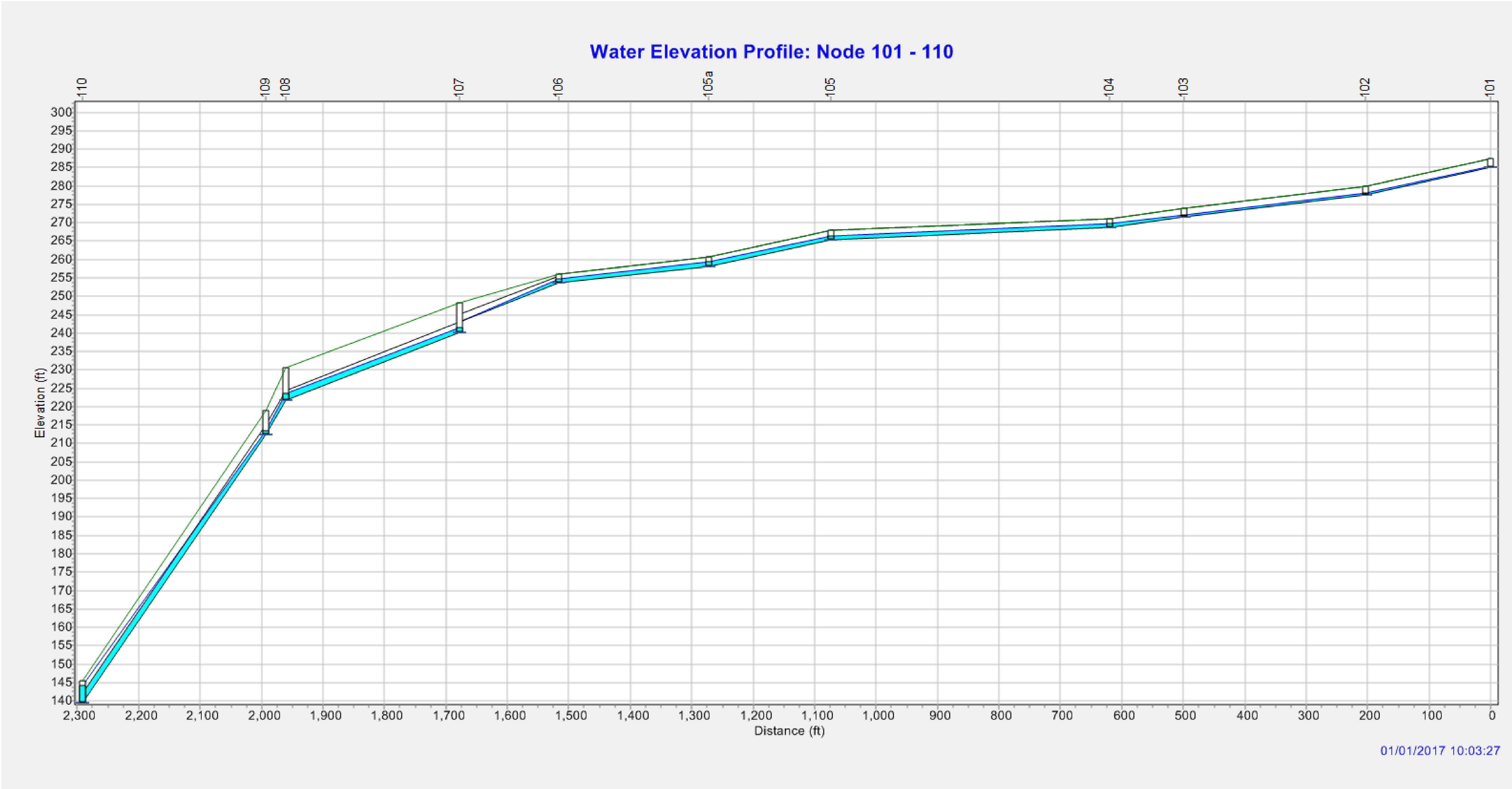
Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
001-002	1.00	0.15	0.25	0.00	0.30	0.30	0.00	0.00	0.02	0.00
002-003	1.00	0.15	0.00	0.00	0.85	0.00	0.00	0.00	0.61	0.00
003-004	1.00	0.15	0.00	0.00	0.71	0.14	0.00	0.00	0.00	0.00
004-005	1.00	0.15	0.00	0.00	0.24	0.60	0.00	0.00	0.00	0.00
201-202	1.00	0.01	0.00	0.00	0.97	0.02	0.00	0.00	0.98	0.00
202-203	1.00	0.01	0.00	0.00	0.98	0.00	0.00	0.00	0.98	0.00
203-204	1.00	0.00	0.01	0.00	0.99	0.00	0.00	0.00	0.99	0.00
204-205	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.98	0.00
205-205a	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.97	0.00
206-207	1.00	0.00	0.01	0.00	0.01	0.98	0.00	0.00	0.98	0.00
207-208	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
208-209	1.00	0.00	0.00	0.00	0.96	0.03	0.00	0.00	0.99	0.00
209-110	1.00	0.04	0.00	0.00	0.00	0.01	0.00	0.95	0.00	0.00
101-102	1.00	0.01	0.00	0.00	0.98	0.00	0.00	0.00	0.98	0.00
102-103	1.00	0.01	0.00	0.00	0.96	0.02	0.00	0.00	0.00	0.00
103-104	1.00	0.00	0.01	0.00	0.98	0.00	0.00	0.00	0.98	0.00
104-105	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
105-105a	1.00	0.01	0.00	0.00	0.32	0.67	0.00	0.00	0.97	0.00
106-107	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
111-108	1.00	0.01	0.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00
108-109	1.00	0.01	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.00
109-110	1.00	0.01	0.00	0.00	0.97	0.02	0.00	0.00	0.99	0.00
110-302	1.00	0.03	0.00	0.00	0.00	0.00	0.00	0.97	0.00	0.00
302-303	1.00	0.01	0.00	0.00	0.84	0.14	0.00	0.00	0.94	0.00
402-405	1.00	0.02	0.00	0.00	0.08	0.90	0.00	0.00	0.00	0.00
403-404	1.00	0.05	0.00	0.00	0.95	0.00	0.00	0.00	0.86	0.00
404-405	1.00	0.02	0.03	0.00	0.95	0.00	0.00	0.00	0.02	0.00
405-406	1.00	0.02	0.00	0.00	0.97	0.01	0.00	0.00	0.89	0.00
406-407	1.00	0.02	0.00	0.00	0.09	0.89	0.00	0.00	0.04	0.00
005-006-SB	1.00	0.15	0.00	0.00	0.85	0.00	0.00	0.00	0.58	0.00
303-RET-POND	1.00	0.02	0.00	0.00	0.02	0.00	0.00	0.97	0.00	0.72
401A-402	1.00	0.01	0.00	0.00	0.08	0.91	0.00	0.00	0.86	0.00
407a-OUTFAL001	1.00	0.02	0.00	0.00	0.09	0.89	0.00	0.00	0.00	0.89
107-108	1.00	0.01	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.00
401-401A	1.00	0.01	0.11	0.00	0.08	0.79	0.00	0.00	0.05	0.00
205a-206	1.00	0.02	0.00	0.00	0.00	0.00	0.00	0.98	0.00	0.00
105a-106	1.00	0.00	0.01	0.00	0.97	0.01	0.00	0.00	0.61	0.00
407-407A	1.00	0.02	0.02	0.00	0.97	0.00	0.00	0.00	0.79	0.00
A1-A2	1.00	0.05	0.00	0.00	0.94	0.01	0.00	0.00	0.00	0.00
A2-403	1.00	0.05	0.01	0.00	0.80	0.15	0.00	0.00	0.87	0.00
C-A2	1.00	0.05	0.87	0.00	0.07	0.00	0.00	0.00	0.52	0.00
CALTRANS-INLT	1.00	0.01	0.00	0.00	0.70	0.29	0.00	0.00	0.87	0.00
006_SB-Outfall	1.00	0.23	0.00	0.00	0.77	0.00	0.00	0.00	0.00	0.00
SeaFD-206	1.00	0.02	0.01	0.00	0.02	0.95	0.00	0.00	0.14	0.00
SEA-OVERFLOW-CHNNL	1.00	0.55	0.00	0.00	0.45	0.00	0.00	0.00	0.00	0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full Both Ends	Hours Full Upstream	Hours Full Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
001-002	4.13	4.13	4.82	0.01	0.01

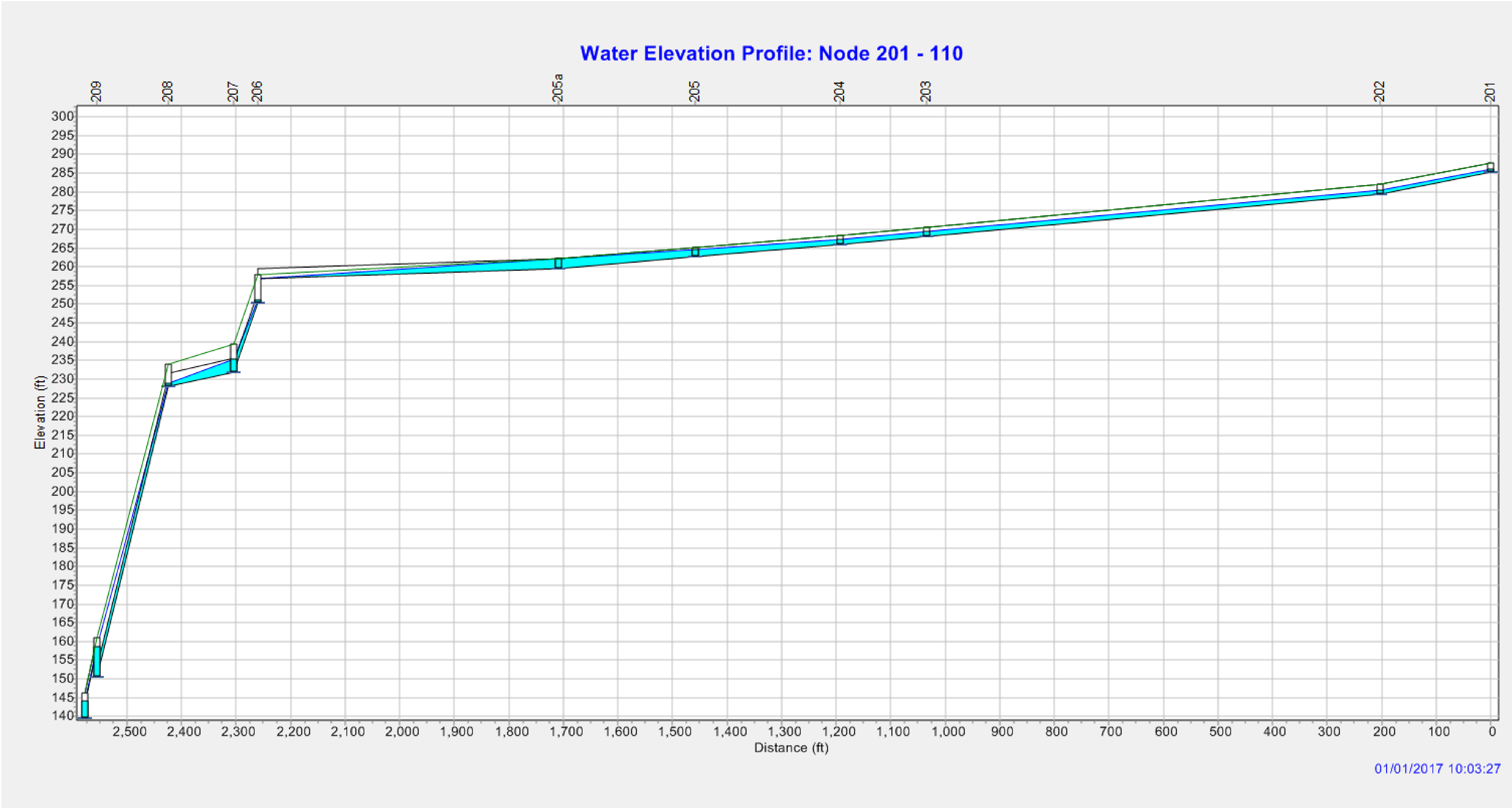
002-003	4.82	4.82	5.15	0.01	2.52
003-004	4.33	5.15	4.33	2.00	4.33
004-005	3.82	4.33	3.82	0.01	3.82
206-207	0.01	0.01	0.18	0.01	0.01
207-208	0.01	0.02	0.01	0.01	0.01
208-209	0.01	0.01	23.23	0.01	0.01
109-110	0.01	0.01	23.25	0.01	0.01
302-303	0.22	0.22	0.33	0.01	0.14
402-405	1.59	1.59	1.78	0.01	0.01
403-404	1.20	1.20	1.33	0.01	0.01
404-405	1.33	1.33	1.51	0.01	0.01
405-406	1.51	1.51	1.92	0.01	0.01
406-407	2.10	2.10	3.15	0.01	0.60
005-006-SB	3.82	3.82	18.58	0.01	0.01
303-RET-POND	0.01	0.33	0.01	0.01	0.01
401A-402	1.27	1.27	1.59	0.01	0.01
407a-OUTFAL001	2.16	11.91	2.16	2.16	2.16
401-401A	1.10	1.10	1.27	0.01	0.01
407-407A	2.17	2.17	3.65	0.01	0.01
A1-A2	0.86	0.86	0.92	0.01	0.01
A2-403	0.92	0.92	1.41	0.01	0.01
C-A2	0.79	0.79	0.92	0.01	0.01
CALTRANS-INLT	0.01	0.01	19.07	0.01	0.01
SeaFD-206	0.22	11.80	0.22	0.36	0.22

Analysis begun on: Fri Mar 30 11:16:08 2018
Analysis ended on: Fri Mar 30 11:16:20 2018
Total elapsed time: 00:00:12



LEGEND

Existing Ground/Finished Grade	
Hydraulic Grade Line (HGL)	
Energy Grade Line (EGL)	

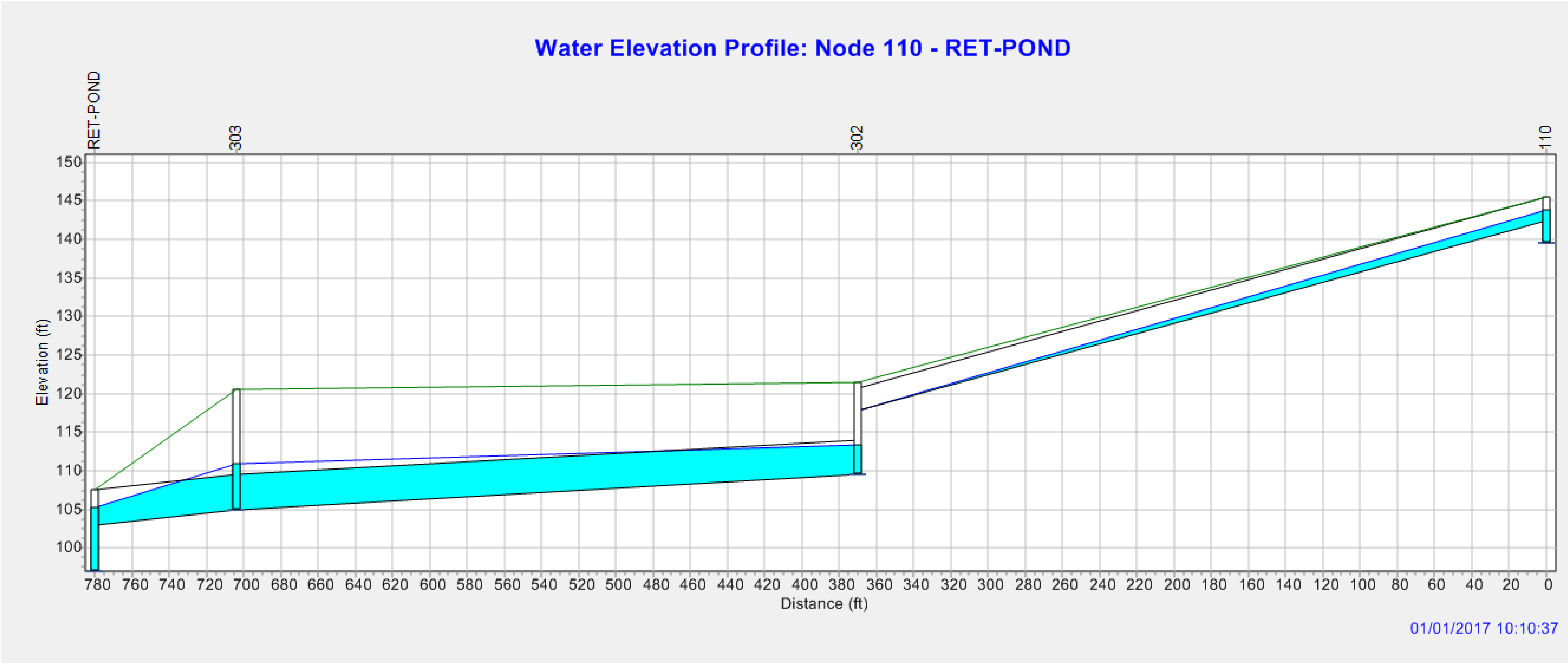


LEGEND

Existing Ground/Finished Grade

Hydraulic Grade Line (HGL)

Energy Grade Line (EGL)

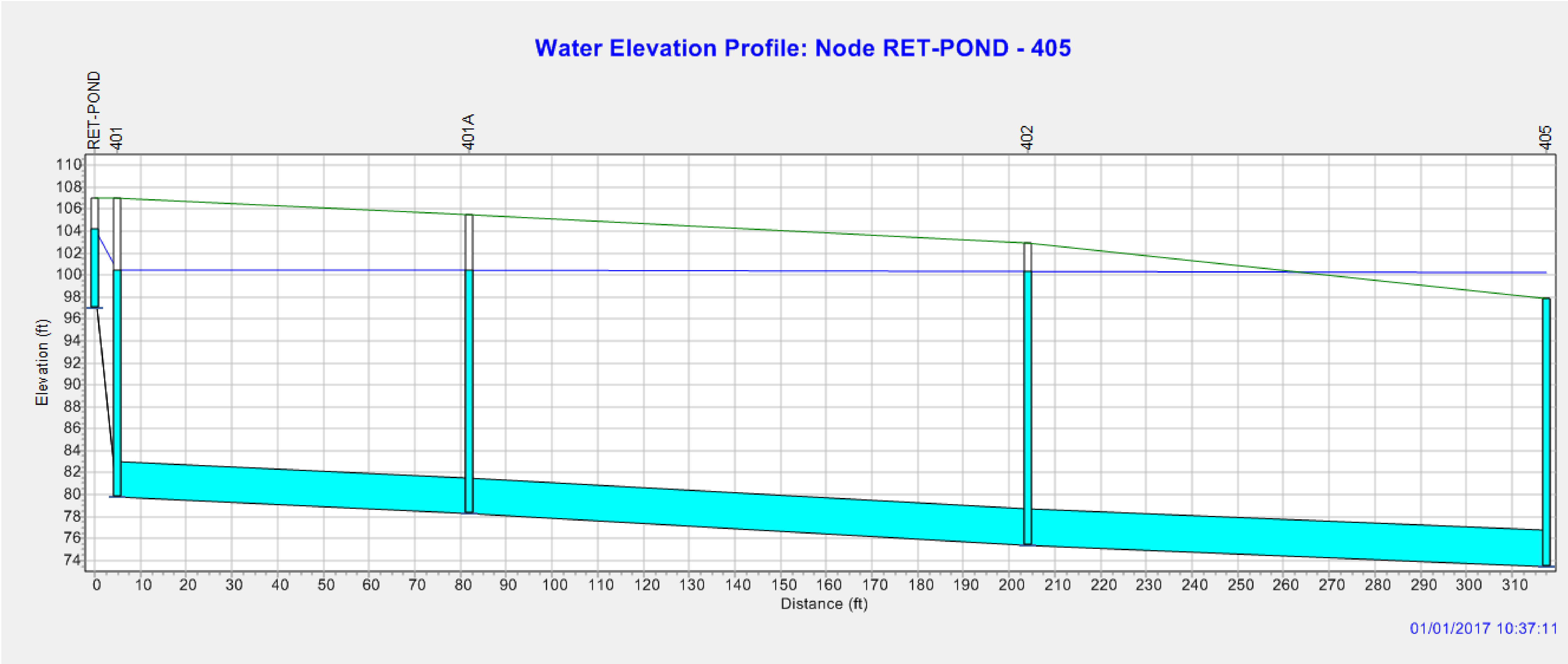


LEGEND

Existing Ground/Finished Grade

Hydraulic Grade Line (HGL)

Energy Grade Line (EGL)

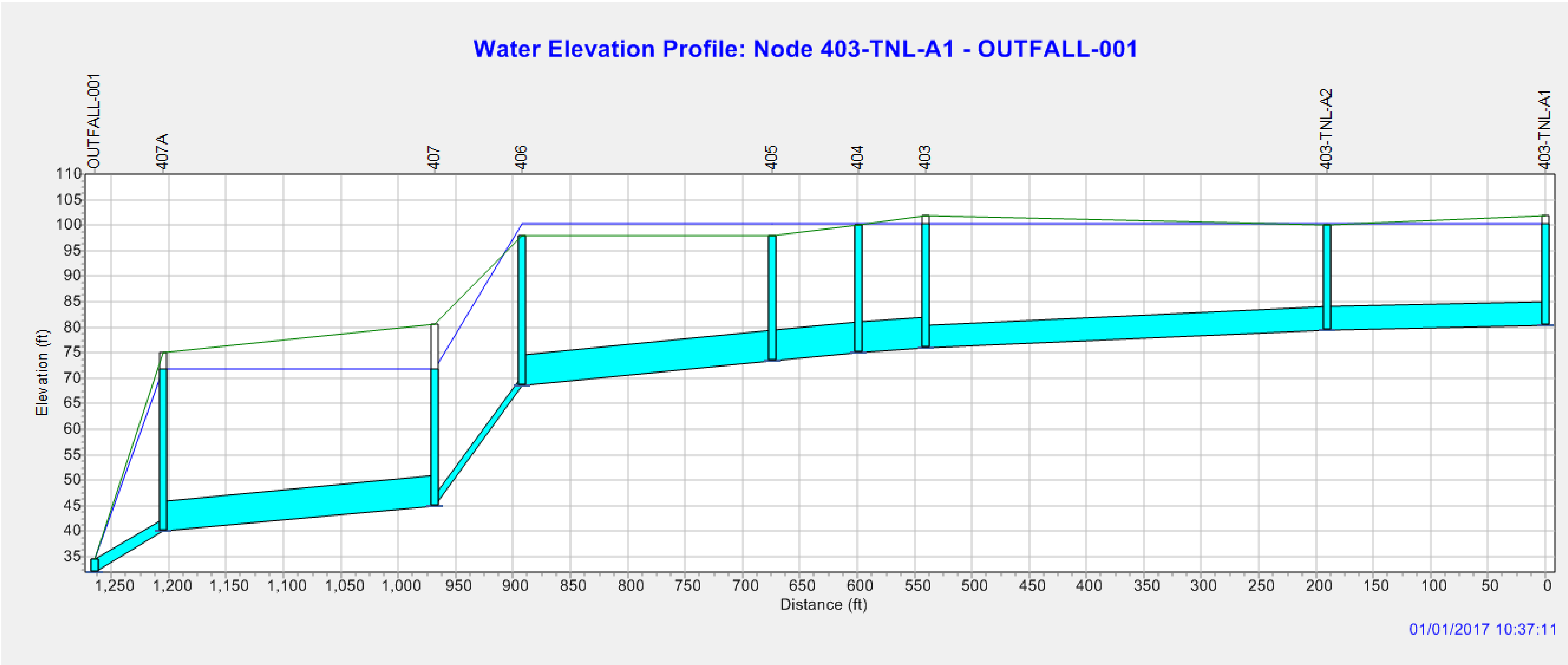


LEGEND

Existing Ground/Finished Grade

Hydraulic Grade Line (HGL)

Energy Grade Line (EGL)



LEGEND

Existing Ground/Finished Grade

Hydraulic Grade Line (HGL)

Energy Grade Line (EGL)