Priority Project
Preliminary Water Quality Management Plan
(PWQMP)

Project Name: Brea Mall Expansion

Planning Application No. PLN-2021-00008

Address: 1065 Brea Mall, Brea CA 92821

APNs: 319-101-37, 319-101-63, 319-101-76, 319-101-73

Prepared for:

Simon Property Group

Mark Lingelbach

225 West Washington Street

Indianapolis, IN 46204-3438

(317) 263-7992

Prepared by:

R.A. Smith Inc.

Colby Nennig, P.E.

8911 Research Drive

Irvine, CA 92618

(949) 242-8043

Date: October 26, 2022

Project Owner's Certification			
Planning Application No. (If applicable)	PLN-2021-00008	Grading Permit No.	
Tract/Parcel Map and Lot(s) No.	PM 38394 Book 139, Pages 12-16, Parcel 3	Building Permit No.	
Address of Project Site and APN (If no address, specify Tract/Parcel Map and Lot Numbers)			1065 Brea Mall Brea, CA 92821 APNs: 319-101-37 319-101-63 319-101-76 319-101-73

This Preliminary Water Quality Management Plan (WQMP) has been prepared for Simon Property Group by R.A. Smith, Inc. The WQMP is intended to comply with the requirements of the County of Orange NPDES Stormwater Program requiring the preparation of the plan.

The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan , including the ongoing operation and maintenance of all best management practices (BMPs), and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with the current Orange County Drainage Area Management Plan (DAMP) and the intent of the non-point source NPDES Permit for Waste Discharge Requirements for the County of Orange, Orange County Flood Control District and the incorporated Cities of Orange County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors-in-interest shall bear the aforementioned responsibility to implement and amend the WQMP. An appropriate number of approved and signed copies of this document shall be available on the subject site in perpetuity.

Owner: Simon Property Group, Jocelyn Gubler			
Title	Vice President, Development		
Company	Simon Property Group		
Address	225 West Washington Street, Indianapolis, IN 46204-3438		
Email	JGubler@Simon.com		
Telephone #	317.795.9113		
I understand my responsibility to implement the provisions of this WQMP including the ongoing operation and maintenance of the best management practices (BMPs) described herein.			
Owner Signature		Date	

Preparer (Engineer):			
Title	Senior Project Engineer (Colby Nennig)	PE Registration #	C 86771
Company	R.A. Smith, Inc.		
Address	8911 Research Drive, Irvine, CA 92618		
Email	Colby.Nennig@raSmith.com		
Telephone #	(949) 242-8043		
I hereby certify that this Water Quality Management Plan is in compliance with, and meets the requirements set forth in, Order No. R8-2009-0030/NPDES No. CAS618030, of the Santa Ana Regional Water Quality Control Board.			
Preparer Signature		Date	10.26.22
Place Stamp Here	LICENSED PROFESSIONAL ENGINEER COLBY J. NENNIG C 86771 EXP. 3/31/23 CIVIL STATE OF CALIFORNIA		

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Attachments

Section I Permit(s) and Water Quality Conditions of Approval or Issuance

Provide discretionary or grading/building permit information and water quality conditions of approval, or permit issuance, applied to the project. If conditions are unknown, please request applicable conditions from staff. *Refer to Section 2.1 in the Technical Guidance Document (TGD) available on the OC Planning website (ocplanning.net).*

Project Infomation			
Permit/Application No. (If applicable)	PLN-2021-00008	Grading or Building Permit No. (If applicable)	
Address of Project Site (or Tract Map and Lot Number if no address) and APN	1065 Brea Mall Brea, CA 92821 APN: 319-101-37, 319-101-63, 319-101-76, 319-101-73		

Water Quality Conditions of Approval or Issuance	
Water Quality Conditions of Approval or Issuance applied to this project. (Please list verbatim.)	Not Applicable

Conceptual WQMP	
Was a Conceptual Water Quality Management Plan previously approved for this project?	No – this Report serves as the Preliminary/Conceptual WQMP for the Project.

Watershed-Based Plan Conditions	
Provide applicable conditions from watershed - based plans including WIHMPs and TMDLS.	The receiving waters for the project site are Coyote Creek, San Gabriel River Reach 1, San Gabriel River Estuary, and San Pedro Bay. A WIHMP has been developed for the Coyote Creek-San Gabriel River Watershed and has been submitted to the Executive Officer for approval, but has not yet been approved. Coyote Creek TMDLS – Metals (Copper, Lead, Zinc) San Gabriel TMDLS – Metals (Copper, Lead, Zinc), Selenium

Section II Project Description

II.1 Project Description

Provide a detailed project description including:

- Project areas;
- Land uses;
- Land cover;
- Design elements;
- A general description not broken down by drainage management areas (DMAs).

Include attributes relevant to determining applicable source controls. *Refer to Section 2.2 in the Technical Guidance Document (TGD) for information that must be included in the project description.*

Description of Proposed Project	
Development Category (From Model WQMP, Table 7.11-2; or -3):	• Restaurants where the land area of development is 5,000 square feet or more including parking area. This category is defined as facilities that sell prepared foods and drinks for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption (SIC code 5812). • Parking lots 5,000 square feet or more including associated drive aisle, and potentially exposed to urban stormwater runoff. A parking lot is defined as a land area or facility for the temporary parking or storage of motor vehicles used personally, for business, or for commerce. • All significant redevelopment projects, where significant redevelopment is defined as the addition or replacement of 5,000 or more square feet of impervious surface on an already developed site. Redevelopment does not include routine maintenance activities that are conducted to maintain original line and grade, hydraulic capacity, original purpose of the facility, or emergency redevelopment activity required to protect public health and safety.

Project Area (ft^2): 642,302	Number of Dwelling Units: 383		SIC Code: 5812, 5311	
Project Area	Pervious		Impervious	
	Area (acres or sq ft)	Percentage	Area (acres or sq ft)	Percentage
Pre-Project Conditions	35,327	5.5	606,975	94.5
Post-Project Conditions	143,845	22.4	498,457	77.6
Drainage Patterns/Connections	In both the existing and proposed conditions there is essentially a lower level (westerly) and an upper level (easterly) that provide access to the different mall tenants. The primary drainage pattern for the lower level is from Northeast to Southwest and the primary drainage patterns for the upper level is North to South. In the existing condition the lower level (west) sheet flows to existing storm drain inlets and discharges to the public storm drain within Randolph Avenue. The proposed project maintains the existing drainage patterns in that the runoff is captured via storm drain inlets, conveyed to the proposed Barracuda Hydrodynamic Separator for pretreatment, and ultimately the ADS Chamber System for infiltration. In storm events greater than the design storm, the runoff overflows to the public storm drain within Randolph Avenue. The "lower level" is a part of the overall Drainage Management Area (DMA) of the project. In the existing condition the upper level (east) sheet flows to existing storm drain inlets and discharges to the private storm drain adjacent to State College Boulevard within the inner ring road of the Mall. The runoff is then conveyed south of the existing Cheesecake Factory and ultimately conveyed west to the public storm drain with Randolph Avenue. The proposed project maintains the existing drainage pattern in that the runoff is captured via storm drain inlets, conveyed to proposed Barracuda Hydrodynamic Separator for pretreatment, the ADS Chamber System for infiltration, and overflows to Randolph Avenue. As such, the existing drainage patterns are generally maintained with the only modification being the proposed infiltration of the design storm event.			

Narrative Project Description: (Use as much space as necessary.)	The existing development consists of a portion of the existing Brea Mall including the existing Sears Department Store, A.C. Pavement parking lot, concrete sidewalk for pedestrian access, and existing utilities. The Brea Mall Expansion Redevelopment is proposing to demolish the existing Sears Building and associated pedestrian access. Additionally, the existing A.C. Parking lot is proposed to be demolished. The existing utilities servicing the Sears Building are proposed to be removed, and utilities that are passing through the existing parking lot are proposed to be re-routed adjacent to the proposed redevelopment. The redevelopment has both a residential and retail component. The Westernmost building is a proposed Fitness Center, which includes outdoor pool area(s). The Fitness Center is serviced by a proposed at grade loading area with access from the proposed ring road. This service road also provides access to the covered trash enclosure for waste management. On the westerly side of the Fitness Center, adjacent to Randolph Avenue, there is an existing landscape area that drains onto the project site. To mitigate this area a proposed concrete v-ditch is provided to capture this run-on and discharge it to the existing public storm drain within Randolph Avenue via the existing drain inlet to remain. This existing inlet is located within the existing parking lot to be demolished. The area draining to this swale is entirely pervious landscaping within the landscape setback adjacent to Randolph Avenue. The southernmost building is a multi-level building with 383 proposed residential dwelling units and three parking levels. There is access to the lowest parking level from the Southwest (residential parking only), to the middle parking level from the North (retail parking only), and to the upper parking level from the East (residential only). All ingress/egress to the parking levels will be made from the proposed ring road. The proposed Residential Trash enclosure will be located on the interior of the parking levels. As such it will be covered by the building and prevent run-on to the trash enclosure. The proposed buildings on the Northeasterly side of the redevelopment (within the exiting Sears footprint) consist of a Sporting Goods Store on the upper level, and a series of retail/restaurants on the lower level. There is a proposed truck dock on the on the upper level for service to the proposed Sporting Goods Store located Southwest of the proposed store. There is a proposed at-grade loading area located Northeast of the proposed Sporting Goods building for service to the existing mall. A new covered trash enclosure and/or compactor will be located within this proposed service area. There is a proposed at-grade service area on the Northeasterly side of Retail B which will contain a new covered trash enclosure or trash compactor. There is a proposed at-grade service area on the Southerly side of Retail D, and there is a proposed service/loading area located on the Westerly side of Retail A. Both of these loading/service areas will be at-grade and contain covered trash compactors.

The existing ring road will be reconfigured with a new A.C. Pavement ring road that provides vehicular access to the proposed Fitness Center, Restaurants/Retail Shops, Sporting Goods Store and Residential Complex. The existing ring road to the south and west of the of the redevelopment will be utilized for new utilities and/or utility re-routing. As such, there will be new A.C. Pavement within these trenching locations and this area has been included in the total disturbed areas. This new ring road will maintain the existing grades at the exterior of the redevelopment, and grades will be revised to drain towards the new curb and gutter along the ring road. A new inlet will be proposed to capture this runoff and drain to the chamber system for infiltration.

There is a proposed paseo containing hardscape, softscape, and landscaping between Retail Buildings A-D. This area will provide a place for pedestrians to lounge, walk and provides access between the different uses.

The disturbed area of the project site is approximately 638,312sf (14.65ac). There is a portion of the disturbed area (23,415sf) that will not be treated in lieu of treating a larger portion of the existing parking lot run-on (27,405sf). The hydrologic area for the WQMP and Hydrology Report is 642,302sf (14.75ac) as denoted in the subsequent Exhibits and Calculations. The mitigated area consists of AC parking lot, which is the same use as the disturbed area not treated (parking lot and landscaping).

There are no outdoor material storage areas; there are no activities to be conducted outdoors other than vehicular/pedestrian access to the proposed buildings; and there aren't any proposed areas of vehicular maintenance, repair, washing, cleaning, or fueling islands.

New utility services (electrical, gas, water, fire, sanitary sewer, and storm roof drains) will be provided to each proposed building. The ADS Chamber system is provided for both water quality treatment/infiltration and hydromodification.

II.2 Potential Stormwater Pollutants

Determine and list expected stormwater pollutants based on land uses and site activities. *Refer to Section 2.2.2 and Table 2.1 in the Technical Guidance Document (TGD) for guidance.*

Pollutants of Concern			
Pollutant	Check One for each: E=Expected to be of concern N=Not Expected to be of concern		Additional Information and Comments
Suspended-Solid/ Sediment	E ☒	N ☐	Residential Development, Commercial Development, Restaurants and uncovered parking lots
Nutrients	E ☒	N ☐	Residential Development, Commercial Development, Restaurants and uncovered parking lots
Heavy Metals	E ☒	N ☐	Commercial Development, Restaurants, Uncovered Parking Lots
Pathogens (Bacteria/Virus)	E ☒	N ☐	Residential Development, Commercial Development, Restaurants, uncovered parking lots
Pesticides	E ☒	N ☐	Residential Development, Commercial Development, Restaurants, uncovered parking lots
Oil and Grease	E ☒	N ☐	Residential Development, Commercial Development, Restaurants, uncovered parking lots
Toxic Organic Compounds	E ☒	N ☐	Commercial Development, uncovered parking lots
Trash and Debris	E ☒	N ☐	Residential Development, Commercial Development, Restaurants, parking lots

II.3 Hydrologic Conditions of Concern

Determine if streams located downstream from the project area are potentially susceptible to hydromodification impacts. *Refer to Section 2.2.3.1 in the Technical Guidance Document (TGD) for North Orange County or Section 2.2.3.2 for South Orange County.*

☐ No – Show map

☒ Yes – Describe applicable hydrologic conditions of concern below.

Per the Susceptibility Analysis performed by PACE, and Figure 1 "Susceptibility Analysis San Gabriel-Coyote Creek" in the TGD the project is located with a Potential Area of Erosion, Habitat, & Physical Structure Susceptibility.

Per Section 2.2.3.1 the project is required to:

- Reduce Post-development runoff volume for the 2-yr, 24-hr storm to less than 5 percent increase from the pre-development condition.
- Increase Post-development time of concentration to within 95% or greater than pre-development condition.

The methodology discussed in the Technical Guidance Document (TGD) and Orange County Hydrology Manual (WinTR-55) was used to satisfy the requirements below:

- Reduce Peak Runoff Volume to less than 5% increase of the pre-development condition
- Increase Time of Concentration to match the pre-development condition
- Reduce Peak Flows to less than 10% increase from pre-development condition

See WinTR-55 Output in Attachment 1 herein. A summary of the results is provided below. See

Summary of Raw Results

Hydromodification Summary		
2-yr, 24-hr Storm	Runoff Volume (cf)	Time of Concentration (hr)
Pre-Development	92,010	0.100
Post-Development	97,523	0.133

Runoff Volume (cf):

$$(V_{2\text{-yr,POST}} / V_{2\text{-yr,PRE}}) \leq 1.05$$

Raw Data: (97,523 cf / 92,010 cf) = **1.06 > 1.05**

Infiltration Chamber Sizing = 35,331 cf

Total retained on-site = 35,331 cf

Actual Runoff Volume in Post-Condition = 97,523 cf – 35,331 cf = 61,192 cf

Accounting for Chamber System: (61,192 cf / 92,010 cf) = 0.67 < 1.05

Time of Concentration (hr):

$$(Tc_{2\text{-yr,PRE}} / Tc_{2\text{-yr,POST}}) = \leq 1.05$$

(0.100hr / 0.133hr) = 0.75 ≤ 1.05

Peak Flow (cfs):

$$(Q_{2\text{-yr,POST}} / Q_{2\text{-yr,PRE}}) \leq 1.10$$

(19.54 cfs / 19.70 cfs) = 0.99 ≤ 1.10

As shown, the project successfully satisfies the abovementioned requirements and an HCOC does not exist. Note that this hydromodification summary is utilizing an impervious value of 100% so results are conservative.

II.4 Post Development Drainage Characteristics

Describe post development drainage characteristics. *Refer to Section 2.2.4 in the Technical Guidance Document (TGD).*

In both the existing and proposed conditions there is essentially a lower level (westerly) and an upper level (easterly) that provide access to the different mall levels. The primary drainage pattern for the lower level is from Northeast to Southwest and the primary drainage patterns for the upper level is North to South.

In the existing condition the lower level (west) sheet flows to existing storm drain inlets and discharges to the public storm drain within Randolph Avenue. The proposed project maintains the existing drainage patterns in that the runoff is captured via storm drain inlets, conveyed to the proposed ADS Chamber System for infiltration, and overflows to the public storm drain within Randolph Avenue. See WQMP Exhibit in Section VI for reference.

In the existing condition the upper level (east) sheet flows to existing storm drain inlets and discharges to the private storm drain adjacent to State College Boulevard within the inner ring road of the Mall. The runoff is then conveyed south of the existing Cheesecake Factory and is ultimately conveyed westerly to the public storm drain with Randolph Avenue. The proposed project maintains the existing drainage patterns in that the runoff is captured via storm drain inlets, conveyed to the proposed ADS Chamber System for infiltration, and overflows to Randolph Avenue. As discussed above the runoff will be conveyed westerly via the private storm drain and connection to the existing public storm drain within Randolph Avenue.

Both the “lower” and “upper” levels as described above are considered DMA #1 as they both drain to the proposed ADS Chamber System for infiltration, and their combined overflow drains to the public storm drain in Randolph Avenue.

From the public storm drain system within Randolph the stormwater runoff will be conveyed to the receiving waters for the project:

- Coyote Creek
- San Gabriel River Reach 1
- San Gabriel River Estuary
- San Pedro Bay

II.5 Property Ownership/Management

Describe property ownership/management. *Refer to Section 2.2.5 in the Technical Guidance Document (TGD).*

The affected properties are owned by Simon Property Group. BMP Maintenance and Management will be provided by Simon Property Group. There will be no storm drain infrastructure that will be transferred to public agencies.

Section III Site Description

III.1 Physical Setting

Fill out table with relevant information. *Refer to Section 2.3.1 in the Technical Guidance Document (TGD).*

Name of Planned Community/Planning Area (if applicable)	Precise Development (PD)
Location/Address	1065 Brea Mall
	Brea, California
General Plan Land Use Designation	Regional Commercial
Zoning	Major Shopping Center (CC)
Acreage of Project Site	14.65ac (disturbed); **14.75ac (DMA)** Note 14.75ac is used for calculations.
Predominant Soil Type	Per Geotechnical Engineering Report Addendum No. 1, prepared by Terracon dated July 7, 2022, there was a boring taken at the exact location of the infiltration chamber system. The subsurface profile at this boring consisted of a 3” AC pavement on top of a 10” aggregate base course. The profile consists of Clayey Sand to a depth of 5’; Silty Clayey Sand from 5’-10’; Poorly Graded Sand from 10’-15’, and clayey sand from 15’ to 30’ deep. Groundwater was not encountered in this boring. A Percolation Test was taken at the bottom of the infiltration chamber (±10’ deep) that yielded an infiltration rate of 2.4in/hr. The Geotechnical Engineer recommended a design factor of safety of 3, consistent with this Preliminary WQMP. The design infiltration rate used for design is 0.80in/hr.

III.2 Site Characteristics

Fill out table with relevant information and include information regarding BMP sizing, suitability, and feasibility, as applicable. *Refer to Section 2.3.2 in the Technical Guidance Document (TGD).*

Site Characteristics	
Precipitation Zone	0.90 inches
Topography	As the existing site is developed the general topography is relatively flat with the exception of the sloped berm that separates the lower level parking area from the upper level parking areas. This berm is removed in the proposed condition with a new A.C. Pavement ring road proposed at a maximum slope of 5%. In the existing and proposed condition the westerly lower level (DMA #1) primarily slopes from Northeast to Southwest at gentle slopes between 1% and 5%. In the proposed condition the easterly upper level (DMA #1) primarily slopes from North to South at gentle slopes between 2%-5%.
Drainage Patterns/Connections	In both the existing and proposed conditions there is essentially a lower level (westerly) and an upper level (easterly) that provide access to the different mall levels. The primary drainage pattern for the lower level is from Northeast to Southwest and the primary drainage patterns for the upper level is North to South as discussed above. In the existing condition the lower level (west) sheet flows to existing storm drain inlets and discharges to the public storm drain within Randolph Avenue. There are no existing BMPs on the project site. The proposed project maintains the existing drainage patterns in that the runoff is captured via storm drain inlets, conveyed to the proposed hydrodynamic separator for pretreatment, ADS Chamber System for infiltration, and overflows to the public storm drain within Randolph Avenue. This Lower Level is considered to be within DMA #1 for the purposes of this report.

	In the existing condition the upper level (east) sheet flows to existing storm drain inlets and discharges to the private storm drain adjacent to State College Boulevard within the inner ring road of the Mall. The runoff is then conveyed south of the existing Cheesecake Factory and ultimately conveyed west to the public storm drain with Randolph Avenue. There are no existing BMPs on the project site. The proposed project maintains the existing drainage patterns in that the runoff is captured via storm drain inlets, conveyed to the proposed hydrodynamic separator for pretreatment, ADS Chamber System for infiltration, and overflows to Randolph Avenue.
Soil Type, Geology, and Infiltration Properties	Per Geotechnical Engineering Report Addendum No. 1 (Attachment 2), prepared by Terracon dated July 7, 2022, there was a boring taken at the exact location of the infiltration chamber system. The subsurface profile at this boring consisted of a 3" AC pavement on top of a 10" aggregate base course. The profile consists of Clayey Sand to a depth of 5'; Silty Clayey Sand from 5'-10'; Poorly Graded Sand from 10'-15', and clayey sand from 15' to 30' deep. Groundwater was not encountered in this boring. A Percolation Test was taken at the bottom of the infiltration chamber (±10' deep) that yielded an infiltration rate of 2.4in/hr. The Geotechnical Engineer recommended a design factor of safety of 3, consistent with this Preliminary WQMP. The design infiltration rate used for design is 0.80in/hr.
Hydrogeologic (Groundwater) Conditions	Per Geotechnical Report prepared by Terracon, groundwater depths range from 28 to 45 feet bgs. As discussed above, the boring taken at the location of the infiltration chamber did not encounter any groundwater to a depth of 30 feet bgs. The Geotechnical Engineer also prepared a Groundwater Mounding Analysis per the City of Brea request. Based on the analysis it was determined that the maximum groundwater mounding beneath the center of the infiltration system is 6'. Per their findings, the seasonal high groundwater mounded depth is at an elevation of 22 feet bgs. As such, the infiltration chamber will be set at a maximum depth of 12' deep to provide the required 10' separation. Note that the maximum depth of the system is set at 12' deep. See also Worksheet I in Attachment 4.

Geotechnical Conditions (relevant to infiltration)	The proposed Chamber System is located within the area that infiltration rates and soil conditions are favorable. There is no language in the Geotechnical Report that would prohibit infiltration at the project site. See also Attachment 4 "Infiltration BMP Feasibility Worksheet" for reference.
Off-Site Drainage	There is an existing parking lot east of the Residential Building on the "upper" level that will follow existing drainage patterns. A new valley gutter and inlet is proposed to capture these flows and drain them to the Infiltration Chamber. This area is used to mitigate the runoff from the disturbed areas that are not proposed to be treated. The abovementioned areas total 27,405sf of existing surfaces draining to the proposed Infiltration Chamber. These areas are identified in the proposed WQMP Exhibit. There is also existing run-on from the landscape slope adjacent to Randolph Avenue. This run-on is proposed to be capture by a new concrete v-ditch and discharged directly to the existing storm drain inlet downstream, which discharges to the public storm drain in Randolph Avenue. The total area disturbed (primarily existing AC parking lot within the new chamber footprint) that does not drain to the new Infiltration Chamber is 23,415sf, whereas the existing area draining to the Infiltration Chamber is 27,405sf. As such, this untreated disturbed area is effectively mitigated.
Utility and Infrastructure Information	The project also consists of new utilities within the ring road and paseo areas: • New Domestic Water Service for each building • New Irrigation Service for the lower level (utilize existing service for the upper level) • New Fire Loop within the prosed paseo area and new hydrants for fire protection • New Sanitary Sewer Service to each building • New Dry Utilities (Electric, Gas, Telecommunications) for each building

III.3 Watershed Description

Fill out table with relevant information and include information regarding BMP sizing, suitability, and feasibility, as applicable. *Refer to Section 2.3.3 in the Technical Guidance Document (TGD).*

Receiving Waters	Coyote Creek San Gabriel River Reach 1 San Gabriel River Estuary San Pedro Bay
303(d) Listed Impairments	Coyote Creek: Ammonia, Dissolved Copper, Diazinon, Indicator Bacteria, Lead, pH, Toxicity San Gabriel River Reach 1: Coliform Bacteria, pH San Gabriel River Estuary: Copper, Dioxin, Nickel, Dissolved Oxygen
Applicable TMDLs	Coyote Creek: Metals (Copper, Lead, Zinc) San Gabriel: Metals (Copper, Lead, Zinc), Selenium
Pollutants of Concern for the Project	Metals, Toxic Organic Compounds, Indicator Bacteria (Pathogens)
Environmentally Sensitive and Special Biological Significant Areas	Not Applicable, project is not located within and Environmentally Sensitive Area or Special Biological Significant Area. Also, runoff from the project discharges directly to an existing public storm drain line.

Section IV Best Management Practices (BMPs)

IV. 1 Project Performance Criteria

Describe project performance criteria. Several steps must be followed in order to determine what performance criteria will apply to a project. These steps include:

- If the project has an approved WIHMP or equivalent, then any watershed specific criteria must be used and the project can evaluate participation in the approved regional or sub-regional opportunities. (Please ask your assigned planner or plan checker regarding whether your project is part of an approved WIHMP or equivalent.)
- Determine applicable hydromodification control performance criteria. *Refer to Section 7.II-2.4.2.2 of the Model WQMP.*
- Determine applicable LID performance criteria. *Refer to Section 7.II-2.4.3 of the Model WQMP.*
- Determine applicable treatment control BMP performance criteria. *Refer to Section 7.II-*3.2.2 *of the Model WQMP.*
- Calculate the LID design storm capture volume for the project. *Refer to Section 7.II-2.4.3 of the Model WQMP.*

(NOC Permit Area only) Is there an approved WIHMP or equivalent for the project area that includes more stringent LID feasibility criteria or if there are opportunities identified for implementing LID on regional or sub-regional basis?	YES ☐	NO ☒
If yes, describe WIHMP feasibility criteria or regional/sub-regional LID opportunities.	Not Applicable - A WIHMP has been developed for the Coyote Creek-San Gabriel River Watershed and has been submitted to the Executive Officer for approval but has not yet been approved.	

Project Performance Criteria	
If HCOC exists, list applicable hydromodification control performance criteria (Section 7.II-2.4.2.2 in MWQMP)	For proposed projects within the North County permit area that may have an HCOC, each Priority Project proponent must determine the impact of the proposed development on the downstream hydrologic characteristics. The evaluation of potential impacts is based on the following for a two-year frequency storm event: • Increases in runoff volume; • Decreases in infiltration; • Changes in time of concentration; • Potential for increases in post development downstream erosion; and, • Potential for adverse downstream impacts on physical structure, aquatic and riparian habitat. A project does not have an HCOC if either of the following conditions is met: • The volumes and time of concentration of stormwater runoff for the post-development condition do not significantly exceed those of the predevelopment condition for a two-year frequency storm event (a difference of five percent or less is considered insignificant). • The site infiltrates at least the runoff from a two-year storm event. If a hydrologic condition of concern (HCOC) exists, priority projects shall implement onsite or regional hydromodification controls such that: • Post-development runoff volume for the two-year frequency storm does not exceed that of the predevelopment condition by more than five percent, and • Time of concentration of post-development runoff for the two-year storm event is not less than that for the predevelopment condition by more than five percent.
List applicable LID performance criteria (Section 7.II-2.4.3 from MWQMP)	The following performance criteria for LID implementation are stated in both permits: • Priority Projects must infiltrate, harvest and use, evapotranspire, or biotreat/biofilter, the 85th percentile, 24-hour storm event (Design Capture Volume).

List applicable treatment control BMP performance criteria (Section 7.II-3.2.2 from MWQMP)	Not Applicable. Project proposes to infiltrate the full DCV and thus satisfies this treatment control performance criteria
Calculate LID design storm capture volume for Project.	**<u>Design Capture Volume Calculations (Infiltration Chamber):</u>** DCV = C * d * A * 43,560sf/ac * 1/12in/ft (Equation III.1) Where: DCV = runoff volume during the design storm event, cu-ft C = runoff coefficient = (0.75 × imp + 0.15) imp = impervious fraction of drainage area (ranges from 0 to 1) d = storm depth (inches) A = tributary area (acres) **<u>Total Disturbed Area / DMA #1</u>** C = (0.75 * 0.776 + 0.15) = 0.732 DCV = (0.732) * (0.9in) * (14.75ac) * (43,560sf/ac) * (1/12in/ft) = 35,264 cf Chamber Volume = 35,331 cf

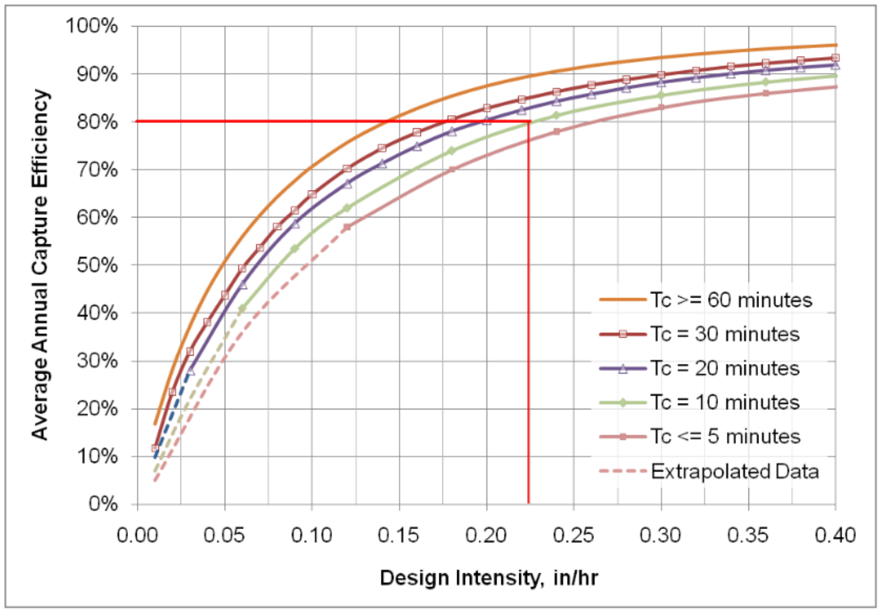
<u>Flow-based BMP Calculations (Hydrodynamic Separator):</u>

<u>Per Section III.3.3 of Technical Guidance Document</u>

Step 1 – TC = 10.06min (See Preliminary Hydrology Report)

Step 2 – I1 = 0.225in/hr

Figure III.4. Capture Efficiency Nomograph for Off-line Flow-based Systems in Orange County



Step 3 – No Upstream BMP = 0

Step 4 – I2 = 0

Step 5 – I1 – I2 = 0.225in/hr

Step 6 -Q = C * I * A = (0.732) * (0.225in/hr) * (14.75ac) = **<u>2.43cfs</u>**

Therefore, proposed Barracuda Hydrodynamic Separator is designed for a pretreatment flow rate of 2.43cfs or greater.

IV.2. Site Design and Drainage

Describe site design and drainage including

- A narrative of site design practices utilized or rationale for not using practices;
- A narrative of how site is designed to allow BMPs to be incorporated to the MEP
- A table of DMA characteristics and list of LID BMPs proposed in each DMA.
  See subsequent Project Specific WQMP Summary Report in Attachment 5.
- Reference to the WQMP "BMP Exhibit."
- Calculation of Design Capture Volume (DCV) for each drainage area.
- A listing of GIS coordinates for LID and Treatment Control BMPs.

Refer to Section 2.4.2 in the Technical Guidance Document (TGD).

DMA #1

DMA #1 is 642,302sf and consists of both the lower level of the redevelopment, the upper level of redevelopment and a small portion of the existing upper level to mitigate the untreated disturbed areas (primarily the existing AC parking lot within the proposed chamber footprint). This DMA consists of the proposed roofs of the Fitness Center, Retail/Restaurant Buildings, Sporting Goods Store and Residential Complex. This DMA also consists of the new A.C. ring road/parking areas, new AC service road, a small portion of the existing A.C. parking lot, and the proposed hardscape/softscape areas throughout the redevelopment. As discussed previously, the impervious area is taken as 77.6%.

The proposed DMA has multiple gutters and inlets within the proposed ring road, as well as inlets within the paseos to capture the storm drain runoff. All inlets are designed with trash full capture device as required by the State of California. All runoff will be piped to the proposed Barracuda Hydrodynamic Separator for pretreatment, and Infiltration Chamber System as shown in the WQMP Exhibit. The proposed infiltration chamber is located at approximately 33°54'46"N, -117°53'20"W.

The Chamber System has a footprint of 11,908sf and will accommodate a volume of 35,331cf which is greater than the DCV of 35,264 cf. See DCV and Drawdown calculations below.

Total Disturbed Area / DMA #1

DCV = (0.732) * (0.9in) * (14.75ac) * (43,560sf/ac) * (1/12in/ft) = 35,264 cf

Chamber Volume = 35,331 cf

Drawdown Calculations

Chamber Footprint = 11,908 sf

Chamber Volume = 35,331 cf

Design Infiltration Rate = 0.80 in/hr

Depth of Ponding = 30-inches (2.5 feet)

Drawdown Time = (2.5 feet * 12in/ft) / (0.80 in/hr) = 37.50hr

37.50 hr < 48 hr

The chamber system is designed for full infiltration of the DCV. However, in a storm event greater than the design storm there is an overflow provided to the public main within Randolph Avenue. See WQMP Exhibit Sheets WQ-01, WQ-02 and WQ-03 for more information.

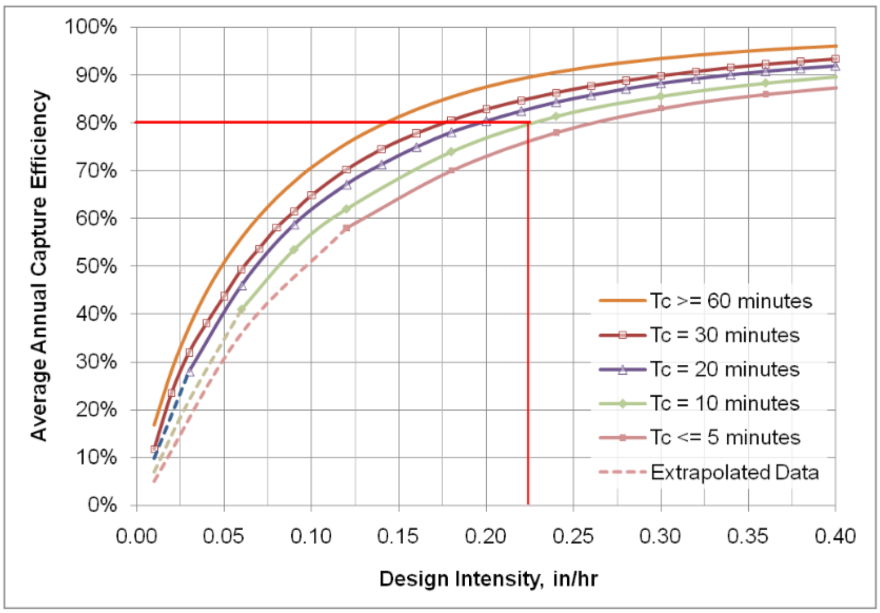
Flow-based BMP Calculations (Hydrodynamic Separator):

Per Section III.3.3 of Technical Guidance Document

Step 1 – TC = 10.06min (See Preliminary Hydrology Report)

Step 2 – I1 = 0.225in/hr

Figure III.4. Capture Efficiency Nomograph for Off-line Flow-based Systems in Orange County



Step 3 – No Upstream BMP = 0

Step 4 – I2 = 0

Step 5 – I1 – I2 = 0.225in/hr

Step 6 -Q = C * I * A = (0.732) * (0.225in/hr) * (14.75ac) = **2.43cfs**

Therefore, proposed Barracuda Hydrodynamic Separator is designed for a pretreatment flow rate of 2.43cfs or greater.

IV.3 LID BMP Selection and Project Conformance Analysis

Each sub-section below documents that the proposed design features conform to the applicable project performance criteria via check boxes, tables, calculations, narratives, and/or references to worksheets. *Refer to Section 2.4.2.3 in the Technical Guidance Document (TGD) for selecting LID BMPs and Section 2.4.3 in the Technical Guidance Document (TGD) for conducting conformance analysis with project performance criteria.*

IV.3.1 Hydrologic Source Controls (HSCs)

If required HSCs are included, fill out applicable check box forms. If the retention criteria are otherwise met with other LID BMPs, include a statement indicating HSCs not required.

HSCs not required. Retention Criteria is met with the proposed ADS Chamber System.

Name	Included?
Localized on-lot infiltration	☐
Impervious area dispersion (e.g. roof top disconnection)	☐
Street trees (canopy interception)	☐
Residential rain barrels (not actively managed)	☐
Green roofs/Brown roofs	☐
Blue roofs	☐
Impervious area reduction (e.g. permeable pavers, site design)	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐

IV.3.2 Infiltration BMPs

Identify infiltration BMPs to be used in project. If design volume cannot be met, state why.

Name	Included?
Bioretention without underdrains	☐
Rain gardens	☐
Porous landscaping	☐
Infiltration planters	☐
Retention swales	☐
Infiltration trenches	☐
Infiltration basins	☐
Drywells	☐
INF-7 Subsurface infiltration galleries	☒
French drains	☐
Permeable asphalt	☐
Permeable concrete	☐
Permeable concrete pavers	☐
Other:	☐
Other:	☐

Show calculations below to demonstrate if the LID Design Strom Capture Volume can be met with infiltration BMPs. If not, document how much can be met with infiltration and document why it is not feasible to meet the full volume with infiltration BMPs.

Total Disturbed Area / DMA #1

DCV = (0.732) * (0.9in) * (14.75ac) * (43,560sf/ac) * (1/12in/ft) = 35,264 cf

Chamber Volume = 35,331 cf

Drawdown Calculations

Chamber Footprint = 11,908 sf

Chamber Volume = 35,331 cf

Design Infiltration Rate = 0.80 in/hr

Depth of Ponding = 30-inches (2.5 feet)

Drawdown Time = (2.5 feet * 12in/ft) / (0.80 in/hr) = 37.50hr

IV.3.3 Evapotranspiration, Rainwater Harvesting BMPs

If the full Design Storm Capture Volume cannot be met with infiltration BMPs, describe any evapotranspiration and/or rainwater harvesting BMPs included.

Not Applicable – Full DCV infiltrated

Name	Included?
All HSCs; *See Section IV.3.1*	☐
Surface-based infiltration BMPs	☐
Biotreatment BMPs	☐
Above-ground cisterns and basins	☐
Underground detention	☐
Other:	☐
Other:	☐
Other:	☐

Show calculations below to demonstrate if the LID Design Storm Capture Volume can be met with evapotranspiration and/or rainwater harvesting BMPs in combination with infiltration BMPs. If not, document below how much can be met with either infiltration BMPs, evapotranspiration, rainwater harvesting BMPs, or a combination, and document why it is not feasible to meet the full volume with these BMP categories.

Not Applicable – Full DCV infiltrated

IV.3.4 Biotreatment BMPs

If the full Design Storm Capture Volume cannot be met with infiltration BMPs, and/or evapotranspiration and rainwater harvesting BMPs, describe biotreatment BMPs included. Include sections for selection, suitability, sizing, and infeasibility, as applicable.

Name	Included?
Bioretention with underdrains	☐
Stormwater planter boxes with underdrains	☐
Rain gardens with underdrains	☐
Constructed wetlands	☐
Vegetated swales	☐
Vegetated filter strips	☐
Proprietary vegetated biotreatment systems	☐
Wet extended detention basin	☐
Dry extended detention basins	☐
Other:	☐
Other:	☐

Show calculations below to demonstrate if the LID Design Storm Capture Volume can be met with infiltration, evapotranspiration, rainwater harvesting and/or biotreatment BMPs. If not, document how much can be met with either infiltration BMPs, evapotranspiration, rainwater harvesting BMPs, or a combination, and document why it is not feasible to meet the full volume with these BMP categories.

Not Applicable – Full DCV infiltrated

IV.3.5 Hydromodification Control BMPs

Describe hydromodification control BMPs. *See Section 5 of the Technical Guidance Document (TGD).* Include sections for selection, suitability, sizing, and infeasibility, as applicable. Detail compliance with Prior Conditions of Approval (if applicable).***The ADS Chamber System's function is twofold. It will provide treatment and infiltration of the full DCV, while also providing storage and retention to mitigate peak flows, increase time of concentration, and decrease runoff volume. See Attachment 1 for reference.***

Hydromodification Control BMPs	
BMP Name	**BMP Description**

IV.3.6 Regional/Sub-Regional LID BMPs

Describe regional/sub-regional LID BMPs in which the project will participate. *Refer to Section 7.II-2.4.3.2 of the Model WQMP*.

Regional/Sub-Regional LID BMPs
Not Applicable

IV.3.7 Treatment Control BMPs

Treatment control BMPs can only be considered if the project conformance analysis indicates that it is not feasible to retain the full design capture volume with LID BMPs. Describe treatment control BMPs including sections for selection, sizing, and infeasibility, as applicable.

Treatment Control BMPs	
BMP Name	**BMP Description**
Barracuda Hydrodynamic Separator	Hydrodynamic Separator will be provided for pretreatment of runoff prior to discharging into the proposed ADS Chamber System. The Barracuda System will provide pretreatment of the runoff and is on the *Certified Full Capture System List of Trash Treatment Control Devices* per the State Water Resources Control Board.
Bio Clean Trash Full Capture Filter	Trash Full Capture Filters will be provided at each proposed and existing inlet (to remain) within the project limits. Filter will provide trash full capture and is on the *Certified Full Capture System List of Trash Treatment Control Devices* per the State Water Resources Control Board.

IV.3.8 Non-structural Source Control BMPs

Fill out non-structural source control check box forms or provide a brief narrative explaining if non-structural source controls were not used.

Non-Structural Source Control BMPs				
Identifier	**Name**	**Check One**		**If not applicable, state brief reason**
		Included	**Not Applicable**	
N1	Education for Property Owners, Tenants and Occupants	☒	☐	
N2	Activity Restrictions	☒	☐	
N3	Common Area Landscape Management	☒	☐	
N4	BMP Maintenance	☒	☐	
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	No Hazardous Materials Stored on-site.
N6	Local Industrial Permit Compliance	☐	☒	Not an Industrial Project
N7	Spill Contingency Plan	☐	☒	No Hazardous Materials Stored on-site.
N8	Underground Storage Tank Compliance	☐	☒	No Underground Storage Tanks proposed (i.e. no harvest and use)
N9	Hazardous Materials Disclosure Compliance	☐	☒	No Hazardous Materials Stored on-site.
N10	Uniform Fire Code Implementation	☒	☐	
N11	Common Area Litter Control	☒	☐	
N12	Employee Training	☒	☐	
N13	Housekeeping of Loading Docks	☒	☐	
N14	Common Area Catch Basin Inspection	☒	☐	
N15	Street Sweeping Private Streets and Parking Lots	☒	☐	
N16	Retail Gasoline Outlets	☐	☒	Not a retail gasoline outlet.

IV.3.9 Structural Source Control BMPs

Fill out structural source control check box forms or provide a brief narrative explaining if structural source controls were not used.

Structural Source Control BMPs				
Identifier	**Name**	**Check One**		**If not applicable, state brief reason**
		Included	**Not Applicable**	
S1	Provide storm drain system stenciling and signage	☒	☐	
S2	Design and construct outdoor material storage areas to reduce pollution introduction	☐	☒	There are no proposed outdoor storage areas
S3	Design and construct trash and waste storage areas to reduce pollution introduction	☒	☐	
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	☒	☐	
S5	Protect slopes and channels and provide energy dissipation	☒	☐	
	Incorporate requirements applicable to individual priority project categories (from SDRWQCB NPDES Permit)	☐	☐	
S6	Dock areas	☒	☐	
S7	Maintenance bays	☐	☒	No proposed maintenance bays
S8	Vehicle wash areas	☐	☒	No proposed vehicle wash areas
S9	Outdoor processing areas	☐	☒	No proposed outdoor processing
S10	Equipment wash areas	☐	☒	No proposed equipment wash areas
S11	Fueling areas	☐	☒	No proposed fueling areas
S12	Hillside landscaping	☐	☒	No proposed hillside landscaping
S13	Wash water control for food preparation areas	☒	☐	
S14	Community car wash racks	☐	☒	No proposed car wash racks

IV.4 Alternative Compliance Plan (If Applicable)

Describe an alternative compliance plan (if applicable). Include alternative compliance obligations (i.e., gallons, pounds) and describe proposed alternative compliance measures. *Refer to Section 7.II 3.0 in the WQMP.*

This Section is Not Applicable to the Project.

IV.4.1 Water Quality Credits

Determine if water quality credits are applicable for the project. *Refer to Section 3.1 of the Model WQMP for description of credits and Appendix VI of the Technical Guidance Document (TGD) for calculation methods for applying water quality credits.*

<table>
<tr><th colspan="6">Description of Proposed Project</th></tr>
<tr><td colspan="6">Project Types that Qualify for Water Quality Credits (Select all that apply):</td></tr>
<tr><td>☐Redevelopment projects that reduce the overall impervious footprint of the project site.</td><td colspan="3">☐Brownfield redevelopment, meaning redevelopment, expansion, or reuse of real property which may be complicated by the presence or potential presence of hazardous substances, pollutants or contaminants, and which have the potential to contribute to adverse ground or surface WQ if not redeveloped.</td><td colspan="2">☐ Higher density development projects which include two distinct categories (credits can only be taken for one category): those with more than seven units per acre of development (lower credit allowance); vertical density developments, for example, those with a Floor to Area Ratio (FAR) of 2 or those having more than 18 units per acre (greater credit allowance).</td></tr>
<tr><td colspan="2">☐ Mixed use development, such as a combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that can demonstrate environmental benefits that would not be realized through single use projects (e.g. reduced vehicle trip traffic with the potential to reduce sources of water or air pollution).</td><td colspan="3">☐ Transit-oriented developments, such as a mixed use residential or commercial area designed to maximize access to public transportation; similar to above criterion, but where the development center is within one half mile of a mass transit center (e.g. bus, rail, light rail or commuter train station). Such projects would not be able to take credit for both categories, but may have greater credit assigned</td><td>☐ Redevelopment projects in an established historic district, historic preservation area, or similar significant city area including core City Center areas (to be defined through mapping).</td></tr>
<tr><td>☐Developments with dedication of undeveloped portions to parks, preservation areas and other pervious uses.□</td><td>☐ Developments in a city center area.□</td><td>☐ Developments in historic districts or historic preservation areas.□</td><td colspan="2">☐ Live-work developments, a variety of developments designed to support residential and vocational needs together – similar to criteria to mixed use development; would not be able to take credit for both categories.</td><td>☐In-fill projects, the conversion of empty lots and other underused spaces into more beneficially used spaces, such as residential or commercial areas.</td></tr>
</table>

Calculation of Water Quality Credits (if applicable)	This project has **not** taken into account any Water Quality Credits.

IV.4.2 Alternative Compliance Plan Information

Describe an alternative compliance plan (if applicable). Include alternative compliance obligations (i.e., gallons, pounds) and describe proposed alternative compliance measures. *Refer to Section 7.II 3.0 in the Model WQMP.*

Not Applicable

Section V Inspection/Maintenance Responsibility for BMPs

Fill out information in table below. Prepare and attach an Operation and Maintenance Plan. Identify the funding mechanism through which BMPs will be maintained. Inspection and maintenance records must be kept for a minimum of five years for inspection by the regulatory agencies. *Refer to Section 7.II 4.0 in the Model WQMP.*

See Operation and Maintenance Plan in Attachment 6. Simon Property Group will be the Owner of all BMPs listed and will be responsible for the Operation and Maintenance of said BMPs into perpetuity.

Owner information below:

Simon Property Group

Jocelyn Gubler

Vice President, Development

225 West Washington Street

Indianapolis, IN 46204

Phone: 317.795.9113

Email: JGubler@Simon.com

Section VI BMP Exhibit (Site Plan)

VI.1 BMP Exhibit (Site Plan)

Include a BMP Exhibit (Site Plan), at a size no less than 24" by 36," which includes the following minimum information:

- Insert in the title block (lower right hand corner) of BMP Exhibit: the WQMP Number (assigned by staff) and the grading/building or Planning Application permit numbers
- Project location (address, tract/lot number(s), etc.)
- Site boundary
- Land uses and land covers, as applicable
- Suitability/feasibility constraints
- Structural BMP locations
- Drainage delineations and flow information
- Delineate the area being treated by each structural BMP
- GIS coordinates for LID and Treatment Control BMPs
- Drainage connections
- BMP details
- Preparer name and stamp

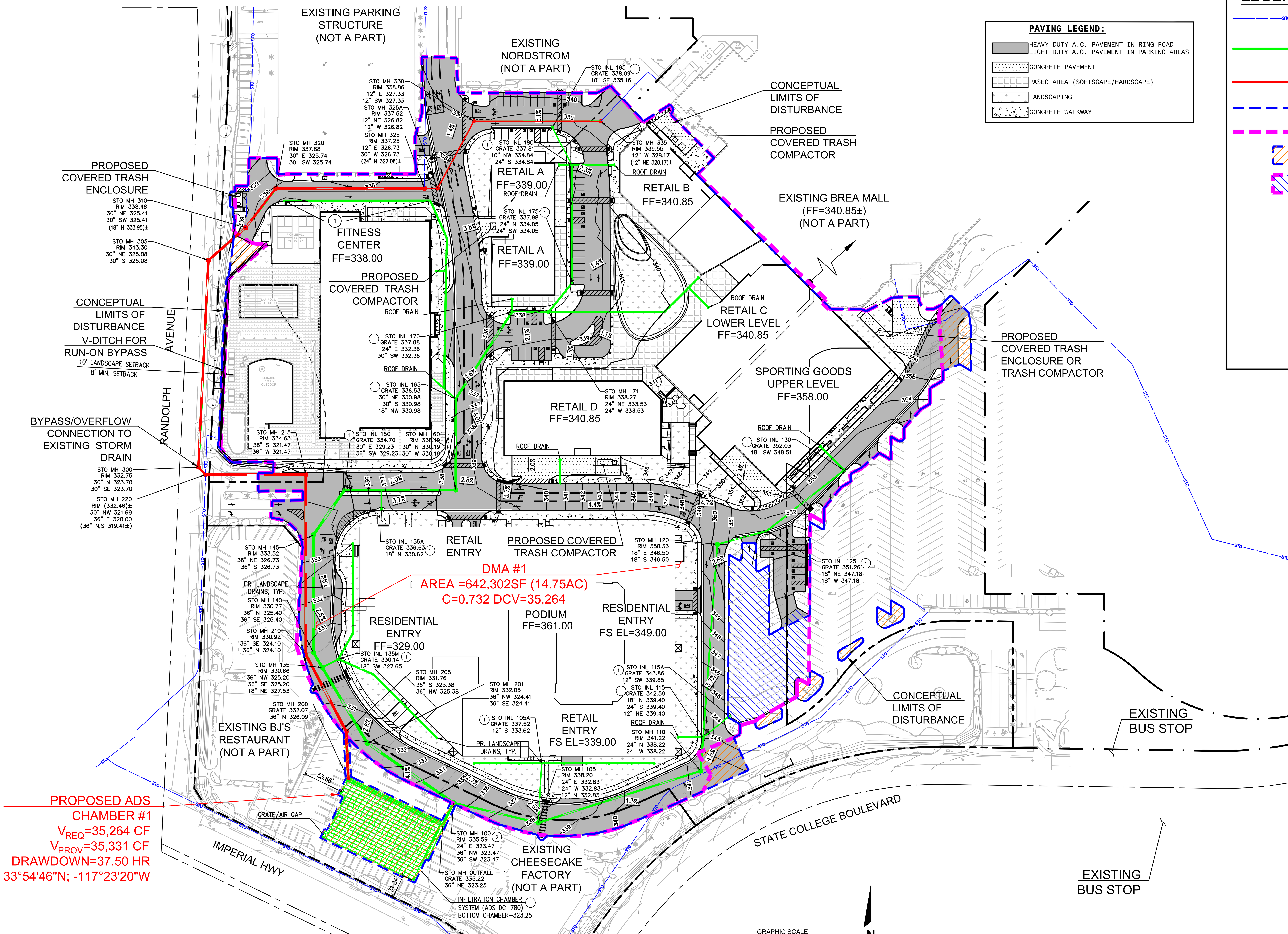
Please do not include any areas outside of the project area or any information not related to drainage or water quality. The approved BMP Exhibit (Site Plan) shall be submitted as a plan sheet on all grading and building plan sets submitted for plan check review and approval. The BMP Exhibit shall be at the same size as the rest of the plan sheets in the submittal and shall have an approval stamp and signature prior to plan check submittal.

Note: As this is the Preliminary WQMP, Grading Plans are not provided at this time, but will be provided for the final WQMP.

VI.2 Submittal and Recordation of Water Quality Management Plan

Following approval of the Final Project-Specific WQMP, three copies of the approved WQMP (including BMP Exhibit, Operations and Maintenance (O&M) Plan, and Appendices) shall be submitted. In addition, these documents shall be submitted in a PDF format.

Each approved WQMP (including BMP Exhibit, Operations and Maintenance (O&M) Plan, and Appendices) shall be recorded in the Orange County Clerk-Recorder's Office, prior to close-out of grading and/or building permit. Educational Materials are not required to be included.



LEGEND:

- EXISTING STORM DRAIN
- PROPOSED STORM DRAIN (TO CHAMBER SYSTEM)
- PROPOSED STORM DRAIN (RUN-OFF DRAINS OFF-SITE)
- DISTURBED AREA (14.65AC)
- DRAINAGE MANAGEMENT AREA (14.75AC)
- DISTURBED AREA UNTREATED (23,415SF)
- EXISTING AREA MITIGATED BY BMP (27,405SF)
- 1 INSTALL BIOCLEAN INLET FILTER & STORM DRAIN STENCIL AT PROPOSED INLET (SEE DETAIL ON SHEET WQ-03)
- 2 INSTALL ADS CHAMBER SYSTEM FOR FULL INFILTRATION OF DESIGN STORM (SEE DETAILS ON SHEETS WQ-02 & WQ-03.
- 3 INSTALL BARRACUDA HYDRODYNAMIC SEPARATOR FOR PRETREATMENT (SEE DETAILS ON SHEET WQ-03) TREATMENT FLOW RATE REQ.=2.43CFS TREATMENT FLOW RATE PROV.=3.40CFS

NOTE:
1. ADS CHAMBER SYSTEM IS SIZED FOR 78% IMPERVIOUS IN THE PROPOSED CONDITION (NORTH ORANGE COUNTY TECHNICAL GUIDANCE DOCUMENT)
2. ALL MEASURED INFILTRATION RATES HAVE A FACTOR OF SAFETY OF 3 APPLIED PER TGD REQUIREMENTS AND GEOTECHNICAL REPORT. IN THIS LOCATION THE MEASURED INFILTRATION RATE IS 2.4 IN/HR, WITH A DEIGN INFILTRATION RATE OF 0.80IN/HR
3. GROUNDWATER DEPTH = 28'-45' DEEP PER GEOTECHNICAL REPORT
4. FULL INFILTRATION OF THE DCV IS FEASIBLE
5. DISTURBED AREA = 638,312 SF; TREATED AREA = 642,302 SF
6. DCV = 35,264CF, INFILTRATION DESIGN VOLUME = 35,331CF, DRAWDOWN = 37.50 HR
7. ALL STORM DRAIN INLETS TO BE STENCILED "ONLY RAIN DOWN THE STORM DRAIN" OR APPROVED EQUAL.
8. TRASH FULL CAPTURE DEVICES SHALL BE INSTALLED IN ALL STORM DRAIN INLETS PER THE CALIFORNIA WATER BOARD "CERTIFIED FULL CAPTURE SYSTEM LIST OF TRASH TREATMENT CONTROL DEVICES".

SELF-CERTIFICATIONS FROM A STATE LICENSED PROFESSIONAL ENGINEER OR THIRD-PARTY CERTIFICATIONS ARE REQUIRED OF ALL BMPs CONSTRUCTED ON THIS PLAN OR FINAL CERTIFICATE OF OCCUPANCY WILL NOT BE GRANTED FROM THE CITY.

NOT FOR CONSTRUCTION

RAS JOB NO. 3180011.03
PROJECT MANAGER: CHRIS T. BRATTY
DESIGNED BY: CJN
CHECKED BY: RMK

BREA MALL AND RESIDENCES AT BREA

1065 Brea Mall, Brea, CA 92821

WQMP EXHIBIT

raSmith
CREATIVITY BEYOND ENGINEERING
8911 Research Drive
Irvine, CA 92618-4237
(949) 872-2378
rasmith.com

WQ-01

Scale 1" = 60'
Job No. 2018-170
Date 8/22/22

PROJECT INFORMATION	
ENGINEERED PRODUCT MANAGER	
ADS SALES REP	
PROJECT NO.	

Advanced Drainage Systems, Inc.

SiteAssist® FOR STORMTECH INSTALLATION INSTRUCTIONS VISIT OUR APP

BREA MALL

BREA, CA

DC-780 STORMTECH CHAMBER SPECIFICATIONS

1. CHAMBERS SHALL BE STORMTECH DC-780.
2. CHAMBERS SHALL BE ARCH-SHAPED AND SHALL BE MANUFACTURED FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
3. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
4. CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORTS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
5. THE STRUCTURAL DESIGN OF THE CHAMBERS, THE STRUCTURAL BACKFILL, AND THE INSTALLATION REQUIREMENTS SHALL ENSURE THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET FOR: 1) LONG-DURATION DEAD LOADS AND 2) SHORT-DURATION LIVE LOADS, BASED ON THE AASHTO DESIGN TRUCK WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.
6. CHAMBERS SHALL BE DESIGNED, TESTED AND ALLOWABLE LOAD CONFIGURATIONS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS". LOAD CONFIGURATIONS SHALL INCLUDE: 1) INSTANTANEOUS (<1 MIN) AASHTO DESIGN TRUCK LIVE LOAD ON MINIMUM COVER 2) MAXIMUM PERMANENT (75-YR) COVER LOAD AND 3) ALLOWABLE COVER WITH PARKED (1-WEEK) AASHTO DESIGN TRUCK.
7. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 2".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT SHALL BE GREATER THAN OR EQUAL TO 550 LBS/FT/%. THE ASC IS DEFINED IN SECTION 6.2.8 OF ASTM F2418. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.
8. ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. UPON REQUEST BY THE SITE DESIGN ENGINEER OR OWNER, THE CHAMBER MANUFACTURER SHALL SUBMIT A STRUCTURAL EVALUATION FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE AS FOLLOWS:
   - THE STRUCTURAL EVALUATION SHALL BE SEALED BY A REGISTERED PROFESSIONAL ENGINEER.
   - THE STRUCTURAL EVALUATION SHALL DEMONSTRATE THAT THE SAFETY FACTORS ARE GREATER THAN OR EQUAL TO 1.95 FOR DEAD LOAD AND 1.75 FOR LIVE LOAD, THE MINIMUM REQUIRED BY ASTM F2787 AND BY SECTIONS 3 AND 12.12 OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS FOR THERMOPLASTIC PIPE.
   - THE TEST DERIVED CREEP MODULUS AS SPECIFIED IN ASTM F2418 SHALL BE USED FOR PERMANENT DEAD LOAD DESIGN EXCEPT THAT IT SHALL BE THE 75-YEAR MODULUS USED FOR DESIGN.
9. CHAMBERS AND END CAPS SHALL BE PRODUCED AT AN ISO 9001 CERTIFIED MANUFACTURING FACILITY.

IMPORTANT - NOTES FOR THE BIDDING AND INSTALLATION OF THE DC-780 CHAMBER SYSTEM

1. STORMTECH DC-780 CHAMBERS SHALL NOT BE INSTALLED UNTIL THE MANUFACTURER'S REPRESENTATIVE HAS COMPLETED A PRE-CONSTRUCTION MEETING WITH THE INSTALLERS.
2. STORMTECH DC-780 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH SC-310/SC-740/DC-780 CONSTRUCTION GUIDE".
3. CHAMBERS ARE NOT TO BE BACKFILLED WITH A DOZER OR AN EXCAVATOR SITUATED OVER THE CHAMBERS. STORMTECH RECOMMENDS 3 BACKFILL METHODS:
   - STONESHOOTER LOCATED OFF THE CHAMBER BED.
   - BACKFILL AS ROWS ARE BUILT USING AN EXCAVATOR ON THE FOUNDATION STONE OR SUBGRADE.
   - BACKFILL FROM OUTSIDE THE EXCAVATION USING A LONG BOOM HOE OR EXCAVATOR.
4. THE FOUNDATION STONE SHALL BE LEVELED AND COMPACTED PRIOR TO PLACING CHAMBERS.
5. JOINTS BETWEEN CHAMBERS SHALL BE PROPERLY SEATED PRIOR TO PLACING STONE.
6. MAINTAIN MINIMUM - 6" (150 mm) SPACING BETWEEN THE CHAMBER ROWS.
7. EMBEDMENT STONE SURROUNDING CHAMBERS MUST BE A CLEAN, CRUSHED, ANGULAR STONE 3/4-2" (20-50 mm).
8. THE CONTRACTOR MUST REPORT ANY DISCREPANCIES WITH CHAMBER FOUNDATION MATERIALS BEARING CAPACITIES TO THE SITE DESIGN ENGINEER.
9. ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUBSURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

NOTES FOR CONSTRUCTION EQUIPMENT

1. STORMTECH DC-780 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH SC-310/SC-740/DC-780 CONSTRUCTION GUIDE".
2. THE USE OF CONSTRUCTION EQUIPMENT OVER DC-780 CHAMBERS IS LIMITED:
   - NO EQUIPMENT IS ALLOWED ON BARE CHAMBERS.
   - NO RUBBER TIRED LOADERS, DUMP TRUCKS, OR EXCAVATORS ARE ALLOWED UNTIL PROPER FILL DEPTHS ARE REACHED IN ACCORDANCE WITH THE "STORMTECH SC-310/SC-740/DC-780 CONSTRUCTION GUIDE".
   - WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT CAN BE FOUND IN THE "STORMTECH SC-310/SC-740/DC-780 CONSTRUCTION GUIDE".
3. FULL 36" (900 mm) OF STABILIZED COVER MATERIALS OVER THE CHAMBERS IS REQUIRED FOR DUMP TRUCK TRAVEL OR DUMPING.

USE OF A DOZER TO PUSH EMBEDMENT STONE BETWEEN THE ROWS OF CHAMBERS MAY CAUSE DAMAGE TO THE CHAMBERS AND IS NOT AN ACCEPTABLE BACKFILL METHOD. ANY CHAMBERS DAMAGED BY THE "DUMP AND PUSH" METHOD ARE NOT COVERED UNDER THE STORMTECH STANDARD WARRANTY.

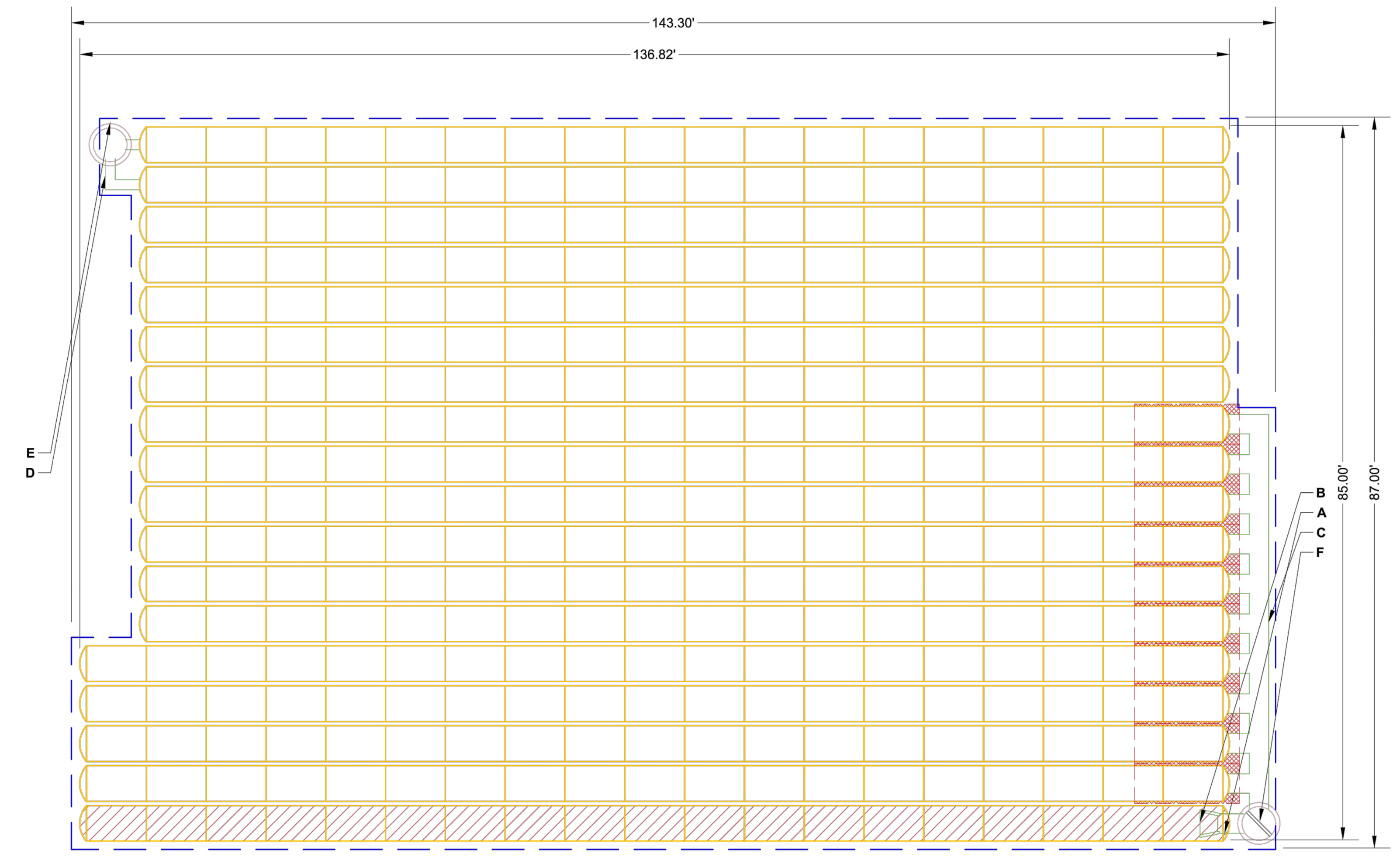
CONTACT STORMTECH AT 1-888-892-2694 WITH ANY QUESTIONS ON INSTALLATION REQUIREMENTS OR WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT.

PROPOSED LAYOUT	
329	STORMTECH DC-780 CHAMBERS
36	STORMTECH DC-780 END CAPS
12	STONE ABOVE (in)
24	STONE BELOW (in)
40	STONE VOID
35331	INSTALLED SYSTEM VOLUME (CF) (PERIMETER STONE INCLUDED) (COVER STONE INCLUDED) (BASE STONE INCLUDED)
11908	SYSTEM AREA (SF)
468.1	SYSTEM PERIMETER (ft)

CONCEPTUAL ELEVATIONS	
MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED):	16.50
MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC):	6.50
MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC):	6.00
MINIMUM ALLOWABLE GRADE (TOP OF RIGID CONCRETE PAVEMENT):	6.00
MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT):	6.00
TOP OF STONE:	5.50
TOP OF DC-780 CHAMBER:	4.50
12" x 12" BOTTOM MANIFOLD INVERT:	2.10
12" BOTTOM CONNECTION INVERT:	2.10
24" x 24" BOTTOM MANIFOLD INVERT:	2.01
24" ISOLATOR ROW PLUS INVERT:	2.01
BOTTOM OF DC-780 CHAMBER:	2.00
BOTTOM OF STONE:	0.00

*INVERT ABOVE BASE OF CHAMBER

PART TYPE	ITEM ON LAYOUT	DESCRIPTION	INVERT*	MAX FLOW
PREFABRICATED EZ END CAP	A	24" BOTTOM PREFABRICATED EZ END CAP, PART#: SC740ECEZ / TYP OF ALL 24" BOTTOM CONNECTIONS AND ISOLATOR PLUS ROWS	0.10"	
FLAMP	B	INSTALL FLAMP ON 24" ACCESS PIPE / PART#: SC74024RAMP		
MANIFOLD	C	24" x 24" BOTTOM MANIFOLD, ADS N-12	0.10"	
MANIFOLD	D	12" x 12" BOTTOM MANIFOLD, ADS N-12	1.20"	
CONCRETE STRUCTURE	E	OCS (DESIGN BY ENGINEER / PROVIDED BY OTHERS)		
CONCRETE STRUCTURE W/WEIR	F	(DESIGN BY ENGINEER / PROVIDED BY OTHERS)		



ISOLATOR ROW PLUS (SEE DETAIL)

PLACE MINIMUM 12.50' OF ADSPLUS125 WOVEN GEOTEXTILE OVER BEDDING STONE AND UNDERNEATH CHAMBER FEET FOR SCOUR PROTECTION AT ALL CHAMBER INLET ROWS

BED LIMITS

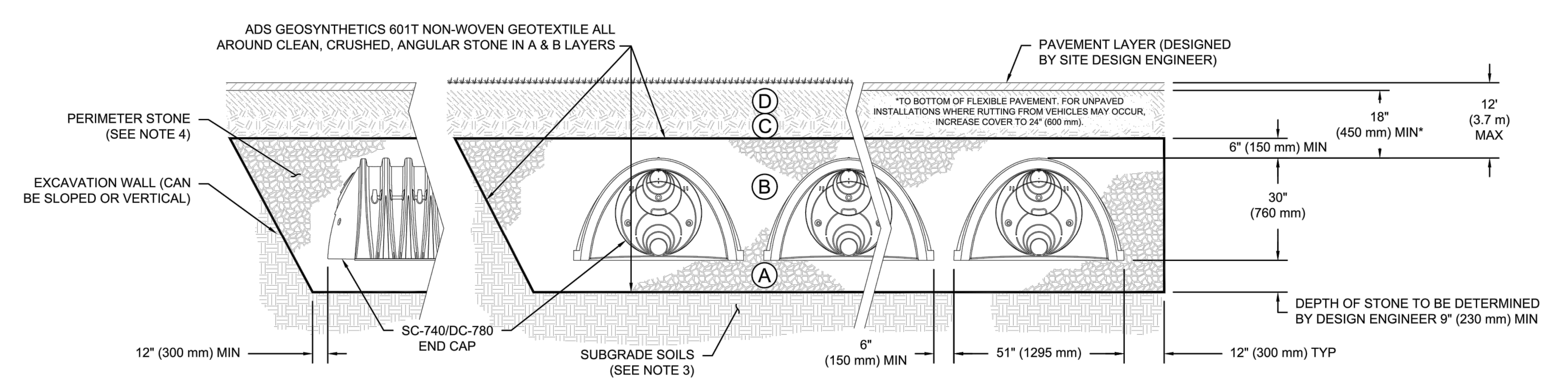
NOTES

- MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER. SEE TECH NOTE #6.32 FOR MANIFOLD SIZING GUIDANCE.
- DUE TO THE ADAPTATION OF THIS CHAMBER SYSTEM TO SPECIFIC SITE AND DESIGN CONSTRAINTS, IT MAY BE NECESSARY TO CUT AND COUPLE ADDITIONAL PIPE TO STANDARD MANIFOLD COMPONENTS IN THE FIELD.
- THE SITE DESIGN ENGINEER MUST REVIEW ELEVATIONS AND IF NECESSARY ADJUST GRADING TO ENSURE THE CHAMBER COVER REQUIREMENTS ARE MET.
- THIS CHAMBER SYSTEM WAS DESIGNED WITHOUT SITE-SPECIFIC INFORMATION ON SOIL CONDITIONS OR BEARING CAPACITY. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR DETERMINING THE SUITABILITY OF THE SOIL AND PROVIDING THE BEARING CAPACITY OF THE INSITU SOILS. THE BASE STONE DEPTH MAY BE INCREASED OR DECREASED ONCE THIS INFORMATION IS PROVIDED.
- **NOT FOR CONSTRUCTION:** THIS LAYOUT IS FOR DIMENSIONAL PURPOSES ONLY TO PROVE CONCEPT & THE REQUIRED STORAGE VOLUME CAN BE ACHIEVED ON SITE.

ACCEPTABLE FILL MATERIALS: STORMTECH DC-780 CHAMBER SYSTEMS

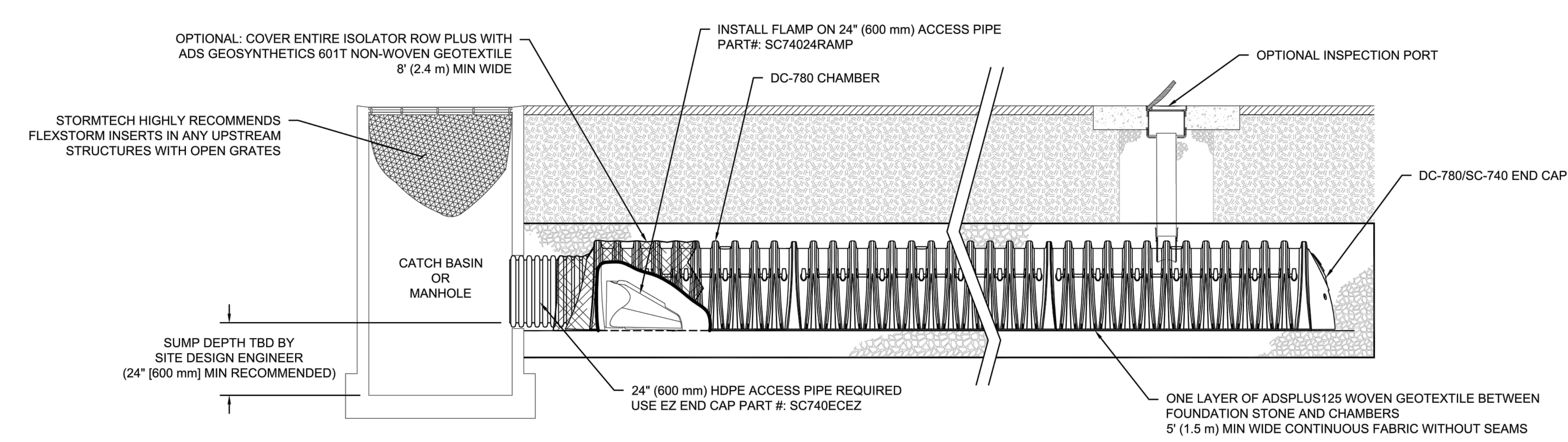
MATERIAL LOCATION		DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	**FINAL FILL:** FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUBBASE MAY BE PART OF THE 'D' LAYER	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	**INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 18" (450 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUBBASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145[1] A-1, A-2-4, A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS AFTER 12" (300 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 6" (150 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS. ROLLER GROSS VEHICLE WEIGHT NOT TO EXCEED 12,000 lbs (53 kN). DYNAMIC FORCE NOT TO EXCEED 20,000 lbs (89 kN).
B	**EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57	NO COMPACTION REQUIRED.
A	**FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE.[2,3]

PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 9" (230 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.
4. ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUBBASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.



NOTES:

1. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
2. DC-780 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
3. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUBGRADE SOILS AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS.
4. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
5. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 2".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT SHALL BE GREATER THAN OR EQUAL TO 550 LBS/FT/%. THE ASC IS DEFINED IN SECTION 6.2.8 OF ASTM F2418. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.



DC-780 ISOLATOR ROW PLUS DETAIL

NTS

INSPECTION & MAINTENANCE

STEP 1) INSPECT ISOLATOR ROW PLUS FOR SEDIMENT
- A. INSPECTION PORTS (IF PRESENT)
  - A.1. REMOVE/OPEN LID ON NYLOPLAST INLINE DRAIN
  - A.2. REMOVE AND CLEAN FLEXSTORM FILTER IF INSTALLED
  - A.3. USING A FLASHLIGHT AND STADIA ROD, MEASURE DEPTH OF SEDIMENT AND RECORD ON MAINTENANCE LOG
  - A.4. LOWER A CAMERA INTO ISOLATOR ROW PLUS FOR VISUAL INSPECTION OF SEDIMENT LEVELS (OPTIONAL)
  - A.5. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.
- B. ALL ISOLATOR PLUS ROWS
  - B.1. REMOVE COVER FROM STRUCTURE AT UPSTREAM END OF ISOLATOR ROW PLUS
  - B.2. USING A FLASHLIGHT, INSPECT DOWN THE ISOLATOR ROW PLUS THROUGH OUTLET PIPE
    - i) MIRRORS ON POLES OR CAMERAS MAY BE USED TO AVOID A CONFINED SPACE ENTRY
    - ii) FOLLOW OSHA REGULATIONS FOR CONFINED SPACE ENTRY IF ENTERING MANHOLE
  - B.3. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.

STEP 2) CLEAN OUT ISOLATOR ROW PLUS USING THE JETVAC PROCESS
- A. A FIXED CULVERT CLEANING NOZZLE WITH REAR FACING SPREAD OF 45" (1.1 m) OR MORE IS PREFERRED
- B. APPLY MULTIPLE PASSES OF JETVAC UNTIL BACKFLUSH WATER IS CLEAN
- C. VACUUM STRUCTURE SUMP AS REQUIRED

STEP 3) REPLACE ALL COVERS, GRATES, FILTERS, AND LIDS; RECORD OBSERVATIONS AND ACTIONS.

STEP 4) INSPECT AND CLEAN BASINS AND MANHOLES UPSTREAM OF THE STORMTECH SYSTEM.

NOTES

1. INSPECT EVERY 6 MONTHS DURING THE FIRST YEAR OF OPERATION. ADJUST THE INSPECTION INTERVAL BASED ON PREVIOUS OBSERVATIONS OF SEDIMENT ACCUMULATION AND HIGH WATER ELEVATIONS.
2. CONDUCT JETTING AND VACTORING ANNUALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.

BREA MALL, BREA, CA — DATE: — DRAWN: CN — PROJECT #: — CHECKED: N/A

StormTech® Chamber System — 4640 TRUEMAN BLVD, HILLIARD, OH 43026, 1-800-733-7473 — 888-892-2694 | WWW.STORMTECH.COM

SHEET 2 OF 5 — SHEET 3 OF 5 — SHEET 4 OF 5

NOT FOR CONSTRUCTION

RAS JOB NO. 3180011.03

PROJECT MANAGER: CHRIS T. BRATTY

DESIGNED BY: CJN

CHECKED BY: RMK

BREA MALL AND RESIDENCES AT BREA

1065 Brea Mall, Brea, CA 92821

ADS CHAMBER DETAILS

OPTION 1

raSmith — CREATIVITY BEYOND ENGINEERING — 8911 Research Drive, Irvine, CA 92618-4237, (949) 872-2378, rasmith.com

WQ-02

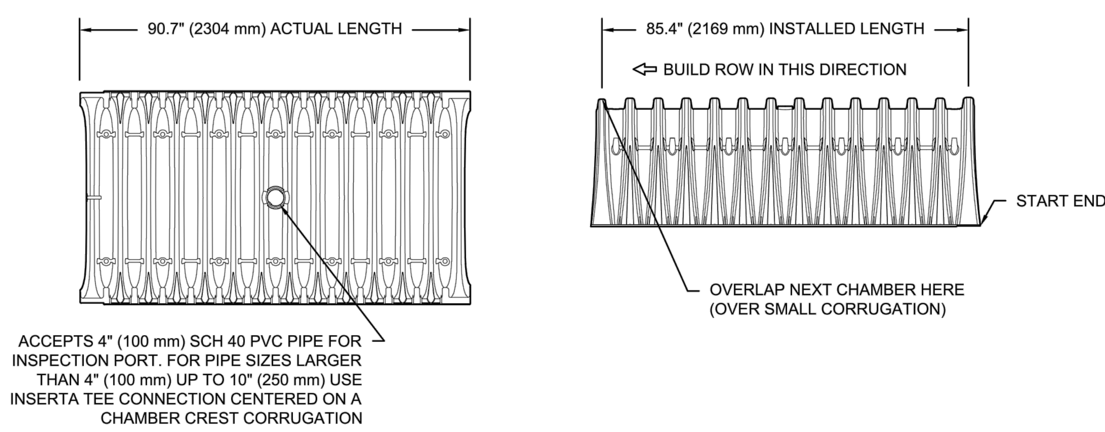
Scale AS SHOWN

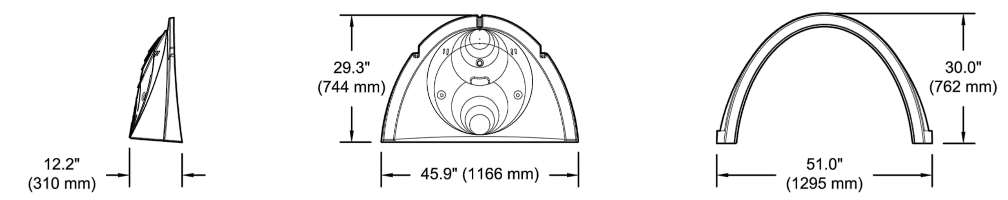
Job No. 2018-170

Date 8/22/22

DC-780 TECHNICAL SPECIFICATION

NTS

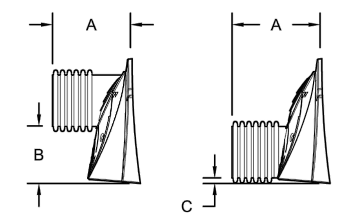




NOMINAL CHAMBER SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	51.0" X 30.0" X 85.4"	(1295 mm X 762 mm X 2169 mm)
CHAMBER STORAGE	46.2 CUBIC FEET	(1.30 m³)
MINIMUM INSTALLED STORAGE*	78.4 CUBIC FEET	(2.20 m³)
WEIGHT	75.0 lbs.	(33.6 kg)

*ASSUMES 6" (152 mm) STONE ABOVE, 9" (229 mm) BELOW, AND 6" (152 mm) BETWEEN CHAMBERS



STUBS AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "B"
STUBS AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "T"

PART #	STUB	A	B	C
SC740EPE06T / SC740EPE06TPC	6" (150 mm)	10.9" (277 mm)	18.5" (470 mm)	---
SC740EPE06B / SC740EPE06BPC			---	0.5" (13 mm)
SC740EPE08T / SC740EPE08TPC	8" (200 mm)	12.2" (310 mm)	16.5" (419 mm)	---
SC740EPE08B / SC740EPE08BPC			---	0.6" (15 mm)
SC740EPE10T / SC740EPE10TPC	10" (250 mm)	13.4" (340 mm)	14.5" (368 mm)	---
SC740EPE10B / SC740EPE10BPC			---	0.7" (18 mm)
SC740EPE12T / SC740EPE12TPC	12" (300 mm)	14.7" (373 mm)	12.5" (318 mm)	---
SC740EPE12B / SC740EPE12BPC			---	1.2" (30 mm)
SC740EPE15T / SC740EPE15TPC	15" (375 mm)	18.4" (467 mm)	9.0" (229 mm)	---
SC740EPE15B / SC740EPE15BPC			---	1.3" (33 mm)
SC740EPE18T/ SC740EPE18TPC	18" (450 mm)	19.7" (500 mm)	5.0" (127 mm)	---
SC740EPE18B / SC740EPE18BPC			---	1.6" (41 mm)
SC740ECEZ*	24" (600 mm)	18.5" (470 mm)	---	0.1" (3 mm)

ALL STUBS, EXCEPT FOR THE SC740ECEZ ARE PLACED AT BOTTOM OF END CAP SUCH THAT THE OUTSIDE DIAMETER OF THE STUB IS FLUSH WITH THE BOTTOM OF THE END CAP. FOR ADDITIONAL INFORMATION CONTACT STORMTECH AT 1-888-892-2694.

* FOR THE SC740ECEZ THE 24" (600 mm) STUB LIES BELOW THE BOTTOM OF THE END CAP APPROXIMATELY 1.75" (44 mm). BACKFILL MATERIAL SHOULD BE REMOVED FROM BELOW THE N-12 STUB SO THAT THE FITTING SITS LEVEL.

NOTE: ALL DIMENSIONS ARE NOMINAL

BREA MALL
BREA, CA

DATE: | DRAWN: CN | CHECKED: N/A | PROJECT #:
DATE | DRW | CHK | DESCRIPTION

StormTech®
Chamber System

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HILLIARD, OH 43026
1-800-733-7473

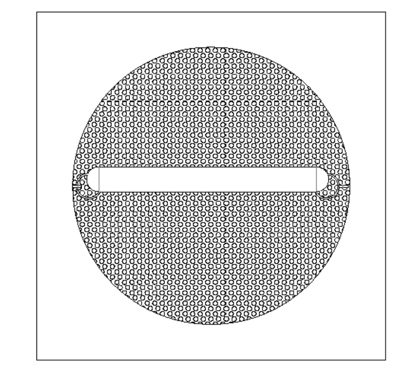
888-892-2694 | WWW.STORMTECH.COM

ADS

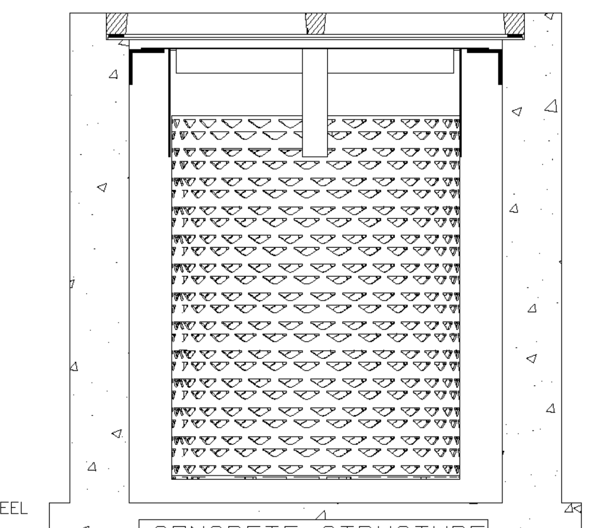
SHEET
5 OF 5

BIO CLEAN FULL CAPTURE FILTER

FOR USE IN GRATE INLETS



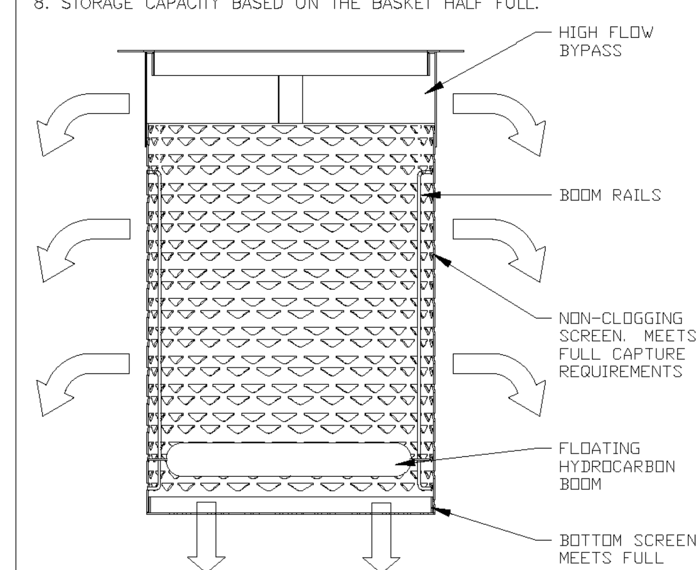
TOP VIEW



CONCRETE STRUCTURE

NOTES:

1. ALL HARDWARE, FLANGE, FRAME, SCREENS SHALL BE STAINLESS STEEL
2. HYDROCARBON BOOM SHALL BE 2" DIAMETER AND CONNECTED, MECHANICALLY TO THE FILTER FRAME WITH RAILS ALLOWING IT TO FLOAT ON THE WATER SURFACE REGARDLESS OF HEIGHT
3. SEE PERFORMANCE REPORTS IN MANUFACTURES SPECIFICATIONS
4. OTHER STANDARD AND CUSTOM MODEL SIZES AVAILABLE – CONTACT BIO CLEAN FOR MORE INFORMATION.
5. BASED ON 37% OPEN AREA.
6. CONSIDERS A SAFETY FACTOR OF 2.0.
7. CONSIDERS A LOCAL DEPRESSION PONDIING DEPTH OF 6 INCHES.
8. STORAGE CAPACITY BASED ON THE BASKET HALF FULL.



FLOW SCHEMATIC

MODEL #	TREATMENT FLOW (CFS)	BYPASS FLOW (CFS)	SOLIDS STORAGE CAPACITY (CF)
BC-GRATE-FC 12-12-12	1.55	1.55	0.27
BC-GRATE-FC 18-18-18	4.32	3.68	1.05
BC-GRATE-FC 24-24-24	7.67	4.83	2.41
BC-GRATE-FC 30-30-24	12.97	6.21	3.98
BC-GRATE-FC 25-38-24	13.53	6.59	4.16
BC-GRATE-FC 36-36-24	19.64	7.60	5.94
BC-GRATE-FC 48-48-18	25.59	10.13	7.92

DRAWING: BIO CLEAN GRATE INLET FILTER DETAILS		MEETS FULL CAPTURE REQUIREMENTS	
TYPICAL MODEL DETAIL			
WARRANTY: 5 YEAR MANUFACTURERS		PROJECT:	
BIO CLEAN ENVIRONMENTAL SERVICES, INC. 398 VIA EL CENTRO, OCEANSIDE CA 92058 PHONE: 760-433-7640 FAX: 760-433-3176		REVISIONS:	DATE:
		REVISIONS:	DATE:
DATE: 10/12/17	SCALE: SF = 15	REVISIONS:	DATE:
DRAFTER: M.C.P.	UNITS = INCHES	REVISIONS:	DATE:

Bio Clean
A Forterra Company

PAGE 1

NOTE:

ALL DRAIN INLETS THAT DISCHARGE INTO AN EXISTING OR PROPOSED STORM DRAIN MUST BE LABELED TO DISCOURAGE ILLEGAL DUMPING OF POLLUTANTS WITH THE STENCIL ABOVE IN A VISIBLE AREA. 2 COATS MINIMUM.

BAYSAVER BARRACUDA SPECIFICATIONS

MATERIALS AND DESIGN

CONCRETE STRUCTURES: DESIGNED FOR H-20 TRAFFIC LOADING AND APPLICABLE SOIL LOADS OR AS OTHERWISE DETERMINED BY A LICENSED PROFESSIONAL ENGINEER. THE MATERIALS AND STRUCTURAL DESIGN OF THE DEVICES SHALL BE PER ASTM C857 AND ASTM C858.

48" HP MANHOLE STRUCTURES: MADE FROM AN IMPACT MODIFIED COPOLYMER POLYPROPYLENE MEETING THE MATERIAL REQUIREMENTS OF ASTM F2764. THE ECCENTRIC CONE REDUCER SHALL BE MANUFACTURED FROM POLYETHYLENE MATERIAL MEETING ASTM D3350 CELL CLASS 213320C. GASKETS SHALL BE MADE OF MATERIAL MEETING THE REQUIREMENTS OF ASTM F477.

SEPARATOR INTERNALS SHALL BE SUBSTANTIALLY CONSTRUCTED OF STAINLESS STEEL, POLYETHYLENE, OR OTHER THERMOPLASTIC MATERIAL APPROVED BY THE MANUFACTURER.

PERFORMANCE

THE STORMWATER TREATMENT UNIT SHALL BE AN INLINE UNIT CAPABLE OF CONVEYING 100% OF THE DESIGN PEAK FLOW. IF PEAK FLOW RATES EXCEED MAXIMUM HYDRAULIC RATE, THE UNIT SHALL BE INSTALLED OFFLINE.

THE STORMWATER TREATMENT UNIT INTERNALS SHALL CONSIST OF(1)SEPARATOR CONE ASSEMBLY, AND (1)SUMP ASSEMBLY WHICH INCLUDES(4) LEGS WITH "TEETH".

THE BARRACUDA UNIT SHALL BE DESIGNED TO REMOVE AT LEAST 80% OF THE SUSPENDED SOLIDS ON AN ANNUAL AGGREGATE REMOVAL BASIS. SAID REMOVAL SHALL BE BASED ON FULL-SCALE THIRD PARTY TESTING USING OK-110 MEDIA GRADATION OR EQUIVALENT AND 300 mg/L INFLUENT CONCENTRATION. SAID FULL SCALE TESTING SHALL HAVE INCLUDED SEDIMENT CAPTURE BASED ON ACTUAL TOTAL MASS COLLECTED BY THE STORMWATER TREATMENT UNIT.

-OR -

THE BARRACUDA UNIT SHALL BE DESIGNED TO REMOVE AT LEAST 50% OF TSS USING A MEDIA MIX WITH d_{50}=75 MICRON AND 200 MG/L INFLUENT CONCENTRATION.

-OR -

THE BARRACUDA UNIT SHALL BE DESIGNED TO REMOVE AT LEAST 50% OF TSS PER CURRENT NJDEP/NJCAT HDS PROTOCOL .

MANUFACTURER

EACH STORMWATER TREATMENT SYSTEM SHALL BE A BARRACUDA SYSTEM AS MANUFACTURED BY BAYSAVER, LLC, 1030 DEER HOLLOW DR., MOUNT AIRY, MD 21771, PHONE (301) 829-6470, FAX (301) 829-3747, TOLL FREE 1-800-229-7283 (1-800-BAYSAVER), EMAIL INFO@BAYSAVER.COM

BARRACUDA MAINTENANCE

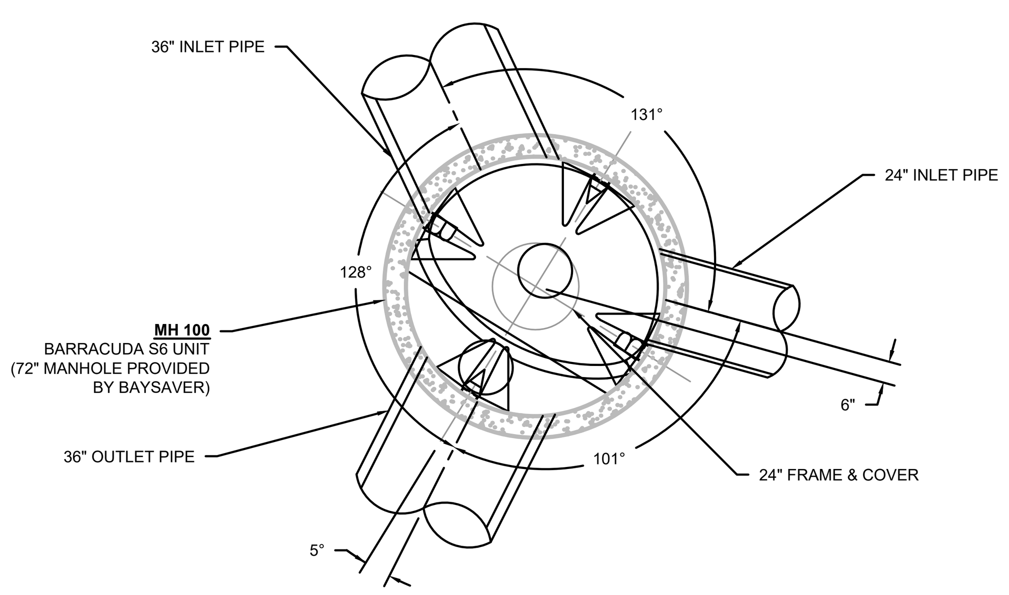
BARRACUDA SYSTEMS MUST BE INSPECTED AND MAINTAINED PERIODICALLY. INSPECTION IS MADE BY CHECKING THE DEPTH OF SEDIMENT IN EACH MANHOLE WITH A GRADE STICK OR SIMILAR DEVICE. MAINTENANCE IS REQUIRED WHEN THE SEDIMENT DEPTH IN EXCEEDS 20 INCHES. MINIMUM INSPECTION IS RECOMMENDED TWICE A YEAR TO MAINTAIN OPERATION AND FUNCTION OF THE UNIT.

MAINTENANCE INSTRUCTIONS

1. REMOVE THE MANHOLE COVER TO PROVIDE ACCESS TO THE POLLUTANT STORAGE. POLLUTANTS ARE STORED IN THE SUMP, BELOW THE BOWL ASSEMBLY VISIBLE FROM THE SURFACE. YOU'LL ACCESS THIS AREA THROUGH THE 10" DIAMETER ACCESS CYLINDER.
2. USE A VACUUM TRUCK OR OTHER SIMILAR EQUIPMENT TO REMOVE ALL WATER, DEBRIS, OILS AND SEDIMENT.
3. USE A HIGH PRESSURE HOSE TO CLEAN THE MANHOLE OF ALL THE REMAINING SEDIMENT AND DEBRIS. THEN, USE THE VACUUM TRUCK TO REMOVE THE WATER.
4. FILL THE CLEANED MANHOLE WITH WATER UNTIL THE LEVEL REACHES THE INVERT OF THE OUTLET PIPE.
5. REPLACE THE MANHOLE COVER.
6. DISPOSE OF THE POLLUTED WATER, OILS, SEDIMENT AND TRASH AT AN APPROVED FACILITY.
   - LOCAL REGULATIONS PROHIBIT THE DISCHARGE OF SOLID MATERIAL INTO THE SANITARY SYSTEM. CHECK WITH THE LOCAL SEWER AUTHORITY FOR AUTHORITY TO DISCHARGE THE LIQUID.
   - SOME LOCALITIES TREAT THE POLLUTANTS AS LEACHATE. CHECK WITH LOCAL REGULATORS ABOUT DISPOSAL REQUIREMENTS.
   - ADDITIONAL LOCAL REGULATIONS MAY APPLY TO THE MAINTENANCE PROCEDURE.

BARRACUDA INSTALLATION NOTES

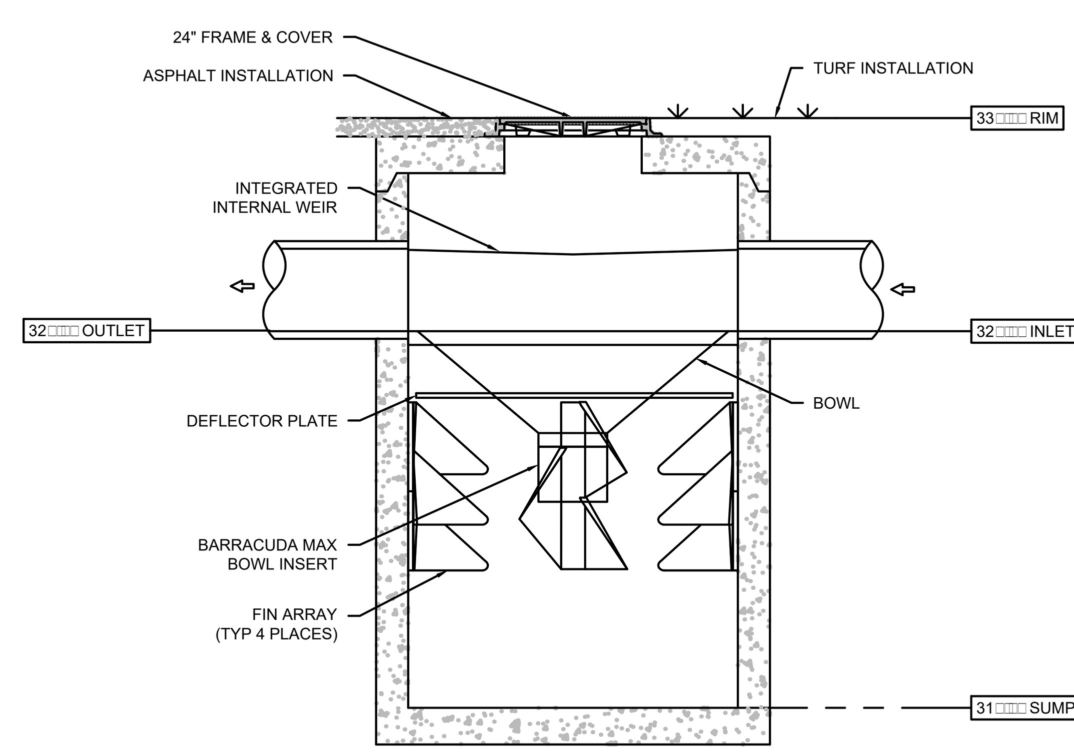
INSTALLATION OF THE STORMWATER TREATMENT UNIT(S) SHALL BE PERFORMED PER MANUFACTURER'S INSTALLATION INSTRUCTIONS. SUCH INSTRUCTIONS CAN BE OBTAINED BY CALLING ADVANCED DRAINAGE SYSTEMS AT (800) 821-6710 OR BY LOGGING ON TO WWW.ADS-PIPE.COM OR WWW.BAYSAVER.COM.



PLAN VIEW

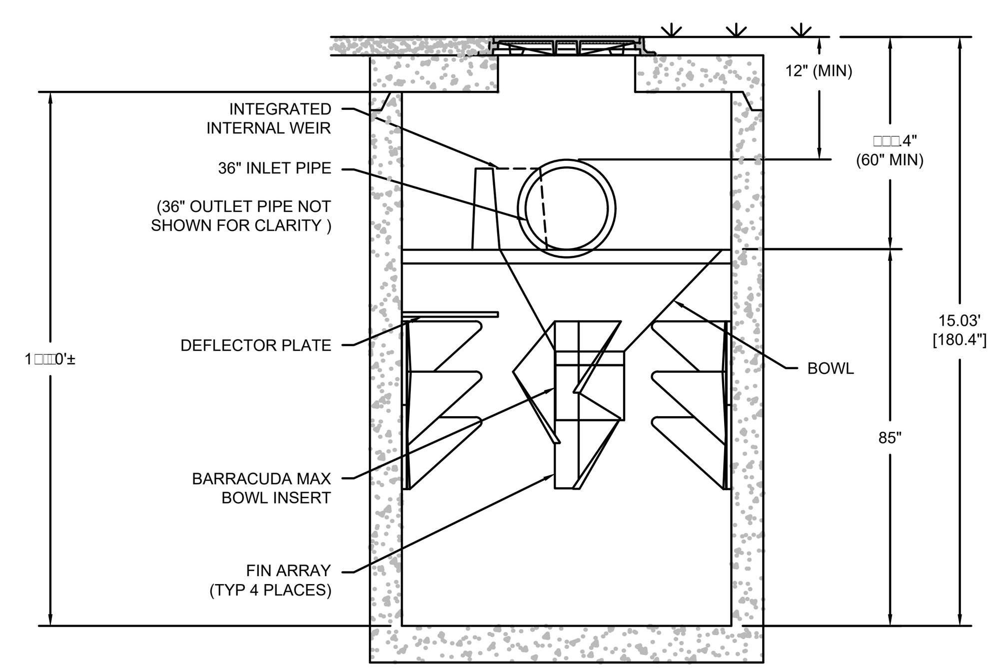
NTS

BARRACUDA MAX S6	
UNIT ID	MH 100
PEAK FLOW RATE (CFS)	
TREATMENT FLOW RATE (CFS)	3.40



SECTION VIEW A-A

NTS



SECTION VIEW B-B

NTS

NOT FOR CONSTRUCTION

RAS JOB NO. 3180011.03

PROJECT MANAGER:
CHRIS T. BRATTY

DESIGNED BY: CJN

CHECKED BY: RMK

BREA MALL AND RESIDENCES AT BREA

1065 Brea Mall, Brea, CA 92821

ADS CHAMBER, FILTER AND BARRACUDA DETAILS

raSmith
CREATIVITY BEYOND ENGINEERING

8911 Research Drive
Irvine, CA 92618-4237
(949) 872-2378
rasmith.com

WQ-03

Scale	AS SHOWN
Job No.	2018-170
Date	8/22/22

Section VII Educational Materials

Refer to the Orange County Stormwater Program (ocwatersheds.com) for a library of materials available. Please only attach the educational materials specifically applicable to this project. Other materials specific to the project may be included as well and must be attached.

Education Materials			
Residential Material (http://www.ocwatersheds.com)	**Check If Applicable**	**Business Material (http://www.ocwatersheds.com)**	**Check If Applicable**
The Ocean Begins at Your Front Door	[x]	Tips for the Automotive Industry	[ ]
Tips for Car Wash Fund-raisers	[ ]	Tips for Using Concrete and Mortar	[ ]
Tips for the Home Mechanic	[ ]	Tips for the Food Service Industry	[ ]
Homeowners Guide for Sustainable Water Use	[ ]	Proper Maintenance Practices for Your Business	[x]
Household Tips	[ ]	**Other Material**	**Check If Attached**
Proper Disposal of Household Hazardous Waste	[ ]		
Recycle at Your Local Used Oil Collection Center (North County)	[ ]	INF-7 Underground Infiltration	[x]
Recycle at Your Local Used Oil Collection Center (Central County)	[ ]	SC-11 Spill Prevention, Control & Cleanup	[x]
Recycle at Your Local Used Oil Collection Center (South County)	[ ]	SC-43 Parking / Storage Area	[x]
Tips for Maintaining a Septic Tank System	[ ]	SC-70 Road and Street Maintenance	[x]
Responsible Pest Control	[ ]	SC-73 Landscape Maintenance	[x]
Sewer Spill	[ ]	SC-74 Drainage System Maintenance	[x]
Tips for the Home Improvement Projects	[ ]	SD-12 Efficient Irrigation	[x]
Tips for Horse Care	[ ]	SD-13 Storm Drain Signage	[x]
Tips for Landscaping and Gardening	[ ]	SD-31 Maintenance Bays and Docks	[x]
Tips for Pet Care	[ ]	SD-32 Trash and Storage Areas	[x]
Tips for Pool Maintenance	[ ]		
Tips for Residential Pool, Landscape and Hardscape Drains	[ ]		
Tips for Projects Using Paint	[ ]		

INF-7: Underground Infiltration

Underground infiltration is a vault or chamber with an open bottom that used to store runoff and percolate into the subsurface. A number of vendors offer proprietary infiltration products that allow for similar or enhanced rates of infiltration and subsurface storage while offering durable prefrabricated structures. There are many varieties of proprietary infiltration BMPs that can be used for roads and parking lots, parks and open spaces, single and multi-family residential, or mixed-use and commercial uses.

Also known as:

- *Infiltration vault*
- *Recharge vault*

Underground Infiltration

Source: http://www.contech-cpi.com

Feasibility Screening Considerations

- Infiltration bains shall pass infeasible screening criteria to be considered for use.
- Underground infiltration galleries pose a potential risk of groundwater contamination; pretreatment should be used.

Opportunity Criteria

- Soils are adequate for infiltration or can be amended to provide an adequate infiltration rate.
- Appropriate for sites with limited surface space.
- Can be placed beneath roads, parking lots, parks, and athletic fields.
- Potential for groundwater contamination can be mitigated through isolation of pollutant sources, pretreatment of inflow, and/or demonstration of adequate treatment capacity of underlying soils.
- Infiltration is into native soil, or depth of engineered fill is ≤ 5 feet from the bottom of the facility to native material and infiltration into fill is approved by a geotechnical professional.
- Tributary area land uses include mixed-use and commercial, sngle-family and multi-family, roads and parking lots, and parks and open spaces. High pollutant land uses should not be tributary to infiltration BMPs.

OC-Specific Design Criteria and Considerations

- [ ] Placement of BMPs should observe geotechnical recommendations with respect to geological hazards (e.g. landslides, liquefaction zones, erosion, etc.) and set-backs (e.g., foundations, utilities, roadways, etc.)
- [ ] Minimum separation to mounded seasonally high groundwater of 10 feet shall be observed.
- [ ] Minimum pretreatment should be provided upstream of the infiltration facility, and water bypassing pretreatment should not be directed to the facility.
- [ ] Underground infiltration should not be used for drainage areas with high sediment production potential unless preceded by full treatment control with a BMP effective for sediment removal.
- [ ] Design infiltration rate should be determined as described in **Appendix VII**.
- [ ] Inspection ports or similar design features shall be provided to verify continued system performance and identify need for major maintenance.

☐ For infiltration facilities beneath roads and parking areas, structural requirements should meet H-20 load requirements.

Computing Underground Infiltration Device Size

Underground infiltration devices vary by design and by proprietary designs. The sizing method selected for use must be based on the BMP type it most strongly resembles.

- For underground infiltration devices with open pore volume (e.g., vaults, crates, pipe sections, etc), sizing will be most similar to infiltration basins.
- For underground infiltration devices with pore space (e.g., aggregate reservoirs), sizing will be most similar to permeable pavement.

Additional References for Design Guidance

- Los Angeles Unified School District (LAUSD) Stormwater Technical Manual, Chapter 5: http://www.laschools.org/employee/design/fs-studies-and-reports/download/white_paper_report_material/Storm_Water_Technical_Manual_2009-opt-red.pdf?version_id=76975850

Preventing water pollution at your commercial/industrial site

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many landscape and building maintenance activities can lead to water pollution if you're not careful. Paint, chemicals, plant clippings and other materials can be blown or washed into storm drains that flow to the ocean. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never pour soap or fertilizers into the ocean, so why would you let them enter the storm drains? Follow these easy tips to help prevent water pollution.

Some types of industrial facilities are required to obtain coverage under the State General Industrial Permit. For more information visit: **www.swrcb.ca.gov/stormwater/industrial.html**

For more information,
please call the
Orange County Stormwater Program
at **1-877-89-SPILL** (1-877-897-7455)
or visit
www.ocwatersheds.com

To report a spill,
call the
Orange County 24-Hour Water Pollution Problem Reporting Hotline
at **1-877-89-SPILL** (1-877-897-7455).

For emergencies, dial 911.

RECYCLE USED OIL

Printed on Recycled Paper

Help Prevent Ocean Pollution:

Proper Maintenance Practices for Your Business

The Ocean Begins at Your Front Door

PROJECT POLLUTION PREVENTION

Proper Maintenance Practices for your Business

Landscape Maintenance

- Compost grass clippings, leaves, sticks and other vegetation, or dispose of it at a permitted landfill or in green waste containers. Do not dispose of these materials in the street, gutter or storm drain.
- Irrigate slowly and inspect the system for leaks, overspraying and runoff. Adjust automatic timers to avoid overwatering.
- Follow label directions for the use and disposal of fertilizers and pesticides.
- Do not apply pesticides or fertilizers if rain is expected within 48 hours or if wind speeds are above 5 mph.
- Do not spray pesticides within 100 feet of waterways.
- Fertilizers should be worked into the soil rather than dumped onto the surface.
- If fertilizer is spilled on the pavement or sidewalk, sweep it up immediately and place it back in the container.

Building Maintenance

- Never allow washwater, sweepings or sediment to enter the storm drain.
- Sweep up dry spills and use cat litter, towels or similar materials to absorb wet spills. Dispose of it in the trash.
- If you wash your building, sidewalk or parking lot, you **must** contain the water. Use a shop vac to collect the water and contact your city or sanitation agency for proper disposal information. Do not let water enter the street, gutter or storm drain.
- Use drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of materials in the trash.
- Use a ground cloth or oversized tub for mixing paint and cleaning tools.
- Use a damp mop or broom to clean floors.
- Cover dumpsters to keep insects, animals, rainwater and sand from entering. Keep the area around the dumpster clear of trash and debris. Do not overfill the dumpster.
- Call your trash hauler to replace leaking dumpsters.
- Do not dump any toxic substance or liquid waste on the pavement, the ground, or near a storm drain. Even materials that seem harmless such as latex paint or biodegradable cleaners can damage the environment.

NEVER DISPOSE OF ANYTHING IN THE STORM DRAIN.

- Recycle paints, solvents and other materials. For more information about recycling and collection centers, visit **www.oclandfills.com**.
- Store materials indoors or under cover and away from storm drains.
- Use a construction and demolition recycling company to recycle lumber, paper, cardboard, metals, masonry, carpet, plastic, pipes, drywall, rocks, dirt, and green waste. For a listing of construction and demolition recycling locations in your area, visit **www.ciwmb.ca.gov/recycle.**
- Properly label materials. Familiarize employees with Material Safety Data Sheets.

PROJECT POLLUTION PREVENTION

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	
Nutrients	
Trash	
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Description

Many activities that occur at an industrial or commercial site have the potential to cause accidental or illegal spills. Preparation for accidental or illegal spills, with proper training and reporting systems implemented, can minimize the discharge of pollutants to the environment.

Spills and leaks are one of the largest contributors of stormwater pollutants. Spill prevention and control plans are applicable to any site at which hazardous materials are stored or used. An effective plan should have spill prevention and response procedures that identify potential spill areas, specify material handling procedures, describe spill response procedures, and provide spill clean-up equipment. The plan should take steps to identify and characterize potential spills, eliminate and reduce spill potential, respond to spills when they occur in an effort to prevent pollutants from entering the stormwater drainage system, and train personnel to prevent and control future spills.

Approach

Pollution Prevention

- Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.

- Develop a Spill Prevention Control and Countermeasure (SPCC) Plan. The plan should include:

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CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Description of the facility, owner and address, activities and chemicals present
- Facility map
- Notification and evacuation procedures
- Cleanup instructions
- Identification of responsible departments
- Identify key spill response personnel

■ Recycle, reclaim, or reuse materials whenever possible. This will reduce the amount of process materials that are brought into the facility.

Suggested Protocols (including equipment needs)

Spill Prevention

■ Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.

■ If consistent illegal dumping is observed at the facility:

- Post "No Dumping" signs with a phone number for reporting illegal dumping and disposal. Signs should also indicate fines and penalties applicable for illegal dumping.
- Landscaping and beautification efforts may also discourage illegal dumping.
- Bright lighting and/or entrance barriers may also be needed to discourage illegal dumping.

■ Store and contain liquid materials in such a manner that if the tank is ruptured, the contents will not discharge, flow, or be washed into the storm drainage system, surface waters, or groundwater.

■ If the liquid is oil, gas, or other material that separates from and floats on water, install a spill control device (such as a tee section) in the catch basins that collects runoff from the storage tank area.

■ Routine maintenance:

- Place drip pans or absorbent materials beneath all mounted taps, and at all potential drip and spill locations during filling and unloading of tanks. Any collected liquids or soiled absorbent materials must be reused/recycled or properly disposed.
- Store and maintain appropriate spill cleanup materials in a location known to all near the tank storage area; and ensure that employees are familiar with the site's spill control plan and/or proper spill cleanup procedures.
- Sweep and clean the storage area monthly if it is paved, *do not hose down the area to a storm drain.*

  - Check tanks (and any containment sumps) daily for leaks and spills. Replace tanks that are leaking, corroded, or otherwise deteriorating with tanks in good condition. Collect all spilled liquids and properly dispose of them.

- Label all containers according to their contents (e.g., solvent, gasoline).

- Label hazardous substances regarding the potential hazard (corrosive, radioactive, flammable, explosive, poisonous).

- Prominently display required labels on transported hazardous and toxic materials (per US DOT regulations).

- Identify key spill response personnel.

Spill Control and Cleanup Activities

- Follow the Spill Prevention Control and Countermeasure Plan.

- Clean up leaks and spills immediately.

- Place a stockpile of spill cleanup materials where it will be readily accessible (e.g., near storage and maintenance areas).

- On paved surfaces, clean up spills with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste. Physical methods for the cleanup of dry chemicals include the use of brooms, shovels, sweepers, or plows.

- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.

- Chemical cleanups of material can be achieved with the use of adsorbents, gels, and foams. Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.

- For larger spills, a private spill cleanup company or Hazmat team may be necessary.

Reporting

- Report spills that pose an immediate threat to human health or the environment to the Regional Water Quality Control Board.

- Federal regulations require that any oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hour).

- Report spills to local agencies, such as the fire department; they can assist in cleanup.

- Establish a system for tracking incidents. The system should be designed to identify the following:

  - Types and quantities (in some cases) of wastes

  - Patterns in time of occurrence (time of day/night, month, or year)

- Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)

- Responsible parties

Training

- Educate employees about spill prevention and cleanup.

- Well-trained employees can reduce human errors that lead to accidental releases or spills:

  - The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.

  - Employees should be familiar with the Spill Prevention Control and Countermeasure Plan.

- Employees should be educated about aboveground storage tank requirements. Employees responsible for aboveground storage tanks and liquid transfers should be thoroughly familiar with the Spill Prevention Control and Countermeasure Plan and the plan should be readily available.

- Train employees to recognize and report illegal dumping incidents.

Other Considerations (Limitations and Regulations)

- A Spill Prevention Control and Countermeasure Plan (SPCC) is required for facilities that are subject to the oil pollution regulations specified in Part 112 of Title 40 of the Code of Federal Regulations or if they have a storage capacity of 10,000 gallons or more of petroleum. (Health and Safety Code 6.67)

- State regulations also exist for storage of hazardous materials (Health & Safety Code Chapter 6.95), including the preparation of area and business plans for emergency response to the releases or threatened releases.

- Consider requiring smaller secondary containment areas (less than 200 sq. ft.) to be connected to the sanitary sewer, prohibiting any hard connections to the storm drain.

Requirements

Costs (including capital and operation & maintenance)

- Will vary depending on the size of the facility and the necessary controls.

- Prevention of leaks and spills is inexpensive. Treatment and/or disposal of contaminated soil or water can be quite expensive.

Maintenance (including administrative and staffing)

- This BMP has no major administrative or staffing requirements. However, extra time is needed to properly handle and dispose of spills, which results in increased labor costs.

Supplemental Information

Further Detail of the BMP

Reporting

Record keeping and internal reporting represent good operating practices because they can increase the efficiency of the facility and the effectiveness of BMPs. A good record keeping system helps the facility minimize incident recurrence, correctly respond with appropriate cleanup activities, and comply with legal requirements. A record keeping and reporting system should be set up for documenting spills, leaks, and other discharges, including discharges of hazardous substances in reportable quantities. Incident records describe the quality and quantity of non-stormwater discharges to the storm sewer. These records should contain the following information:

- Date and time of the incident
- Weather conditions
- Duration of the spill/leak/discharge
- Cause of the spill/leak/discharge
- Response procedures implemented
- Persons notified
- Environmental problems associated with the spill/leak/discharge

Separate record keeping systems should be established to document housekeeping and preventive maintenance inspections, and training activities. All housekeeping and preventive maintenance inspections should be documented. Inspection documentation should contain the following information:

- The date and time the inspection was performed
- Name of the inspector
- Items inspected
- Problems noted
- Corrective action required
- Date corrective action was taken

Other means to document and record inspection results are field notes, timed and dated photographs, videotapes, and drawings and maps.

Aboveground Tank Leak and Spill Control

Accidental releases of materials from aboveground liquid storage tanks present the potential for contaminating stormwater with many different pollutants. Materials spilled, leaked, or lost from tanks may accumulate in soils or on impervious surfaces and be carried away by stormwater runoff.

The most common causes of unintentional releases are:

- Installation problems
- Failure of piping systems (pipes, pumps, flanges, couplings, hoses, and valves)
- External corrosion and structural failure
- Spills and overfills due to operator error
- Leaks during pumping of liquids or gases from truck or rail car to a storage tank or vice versa

Storage of reactive, ignitable, or flammable liquids should comply with the Uniform Fire Code and the National Electric Code. Practices listed below should be employed to enhance the code requirements:

- Tanks should be placed in a designated area.
- Tanks located in areas where firearms are discharged should be encapsulated in concrete or the equivalent.
- Designated areas should be impervious and paved with Portland cement concrete, free of cracks and gaps, in order to contain leaks and spills.
- Liquid materials should be stored in UL approved double walled tanks or surrounded by a curb or dike to provide the volume to contain 10 percent of the volume of all of the containers or 110 percent of the volume of the largest container, whichever is greater. The area inside the curb should slope to a drain.
- For used oil or dangerous waste, a dead-end sump should be installed in the drain.
- All other liquids should be drained to the sanitary sewer if available. The drain must have a positive control such as a lock, valve, or plug to prevent release of contaminated liquids.
- Accumulated stormwater in petroleum storage areas should be passed through an oil/water separator.

Maintenance is critical to preventing leaks and spills. Conduct routine inspections and:

- Check for external corrosion and structural failure.
- Check for spills and overfills due to operator error.
- Check for failure of piping system (pipes, pumps, flanger, coupling, hoses, and valves).
- Check for leaks or spills during pumping of liquids or gases from truck or rail car to a storage facility or vice versa.

- Visually inspect new tank or container installation for loose fittings, poor welding, and improper or poorly fitted gaskets.
- Inspect tank foundations, connections, coatings, and tank walls and piping system. Look for corrosion, leaks, cracks, scratches, and other physical damage that may weaken the tank or container system.
- Frequently relocate accumulated stormwater during the wet season.
- Periodically conduct integrity testing by a qualified professional.

Vehicle Leak and Spill Control

Major spills on roadways and other public areas are generally handled by highly trained Hazmat teams from local fire departments or environmental health departments. The measures listed below pertain to leaks and smaller spills at vehicle maintenance shops.

In addition to implementing the spill prevention, control, and clean up practices above, use the following measures related to specific activities:

Vehicle and Equipment Maintenance

- Perform all vehicle fluid removal or changing inside or under cover to prevent the run-on of stormwater and the runoff of spills.
- Regularly inspect vehicles and equipment for leaks, and repair immediately.
- Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allow leaking vehicles or equipment onsite.
- Always use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- Immediately drain all fluids from wrecked vehicles.
- Store wrecked vehicles or damaged equipment under cover.
- Place drip pans or absorbent materials under heavy equipment when not in use.
- Use adsorbent materials on small spills rather than hosing down the spill.
- Remove the adsorbent materials promptly and dispose of properly.
- Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.
- Oil filters disposed of in trashcans or dumpsters can leak oil and contaminate stormwater. Place the oil filter in a funnel over a waste oil recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters.

- Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries, even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

Vehicle and Equipment Fueling

- Design the fueling area to prevent the run-on of stormwater and the runoff of spills:
  - Cover fueling area if possible.
  - Use a perimeter drain or slope pavement inward with drainage to a sump.
  - Pave fueling area with concrete rather than asphalt.
- If dead-end sump is not used to collect spills, install an oil/water separator.
- Install vapor recovery nozzles to help control drips as well as air pollution.
- Discourage "topping-off' of fuel tanks.
- Use secondary containment when transferring fuel from the tank truck to the fuel tank.
- Use adsorbent materials on small spills and general cleaning rather than hosing down the area. Remove the adsorbent materials promptly.
- Carry out all Federal and State requirements regarding underground storage tanks, or install above ground tanks.
- Do not use mobile fueling of mobile industrial equipment around the facility; rather, transport the equipment to designated fueling areas.
- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Train employees in proper fueling and cleanup procedures.

Industrial Spill Prevention Response

For the purposes of developing a spill prevention and response program to meet the stormwater regulations, facility managers should use information provided in this fact sheet and the spill prevention/response portions of the fact sheets in this handbook, for specific activities. The program should:

- Integrate with existing emergency response/hazardous materials programs (e.g., Fire Department)
- Develop procedures to prevent/mitigate spills to storm drain systems
- Identify responsible departments
- Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures
- Address spills at municipal facilities, as well as public areas

- Provide training concerning spill prevention, response and cleanup to all appropriate personnel

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Stormwater Managers Resource Center http://www.stormwatercenter.net/

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

Targeted Constituents

Sediment	✓
Nutrients	
Trash	
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Description

Outside process equipment operations and maintenance can contaminate stormwater runoff. Activities, such as grinding, painting, coating, sanding, degreasing or parts cleaning, landfills and waste piles, solid waste treatment and disposal, are examples of process operations that can lead to contamination of stormwater runoff. Source controls for outdoor process equipment operations and maintenance include reducing the amount of waste created, enclosing or covering all or some of the equipment, installing secondary containment, and training employees.

Approach

Pollution Prevention

- Perform the activity during dry periods.
- Use non-toxic chemicals for maintenance and minimize or eliminate the use of solvents.

Suggested Protocols

- Consider enclosing the activity in a building and connecting the floor drains to the sanitary sewer.
- Cover the work area with a permanent roof if possible.
- Minimize contact of stormwater with outside process equipment operations through berming and drainage routing (run-on prevention). If possible, connect process equipment area to public sewer or facility wastewater treatment system. Some municipalities require that secondary containment areas be connected to the sanitary sewer, prohibiting any hard connections to the storm drain.
- Dry clean the work area regularly.

Training

- Train employees to perform the activity during dry periods only or substituting benign materials for more toxic ones.
- Train employee and contractors in proper techniques for spill containment and cleanup. Employees should have the tools and knowledge to immediately begin cleaning up a spill should one occur.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.

- Have employees trained in emergency spill cleanup procedures present when dangerous waste, liquid chemicals, or other wastes are delivered.

- Place a stockpile of spill cleanup materials where it will be readily accessible.

- Prevent operator errors by using engineering safe guards and thus reducing accidental releases of pollutant.

- Inspect storage areas regularly for leaks or spills. Also check for structural failure, spills and overfills due to operator error, and/or failure of piping system.

Other Considerations

- Providing cover may be expensive.

- Space limitations may preclude enclosing some equipment.

- Storage sheds often must meet building and fire code requirements.

Requirements

Costs

Costs vary depending on the complexity of the operation and the amount of control necessary for stormwater pollution control.

Maintenance

- Conduct routine preventive maintenance, including checking process equipment for leaks.

- Clean the storm drain system regularly.

Supplemental Information

Further Detail of the BMP

Hydraulic/Treatment Modifications

If stormwater becomes polluted, it should be captured and treated. If you do not have your own process wastewater treatment system, consider discharging to the public sewer system. Use of the public sewer might be allowed under the following conditions:

- If the activity area is very small (less than a few hundred square feet), the local sewer authority may be willing to allow the area to remain uncovered with the drain connected to the public sewer.

- It may be possible under unusual circumstances to connect a much larger area to the public sewer, as long as the rate of stormwater discharges does not exceed the capacity of the wastewater treatment plant. The stormwater could be stored during the storm and then transferred to the public sewer when the normal flow is low, such as at night.

Industries that generate large volumes of process wastewater typically have their own treatment system and corresponding permit. These industries have the discretion to use their wastewater treatment system to treat stormwater within the constraints of their permit requirements for process treatment. It may also be possible for the industry to discharge the stormwater directly to an effluent outfall without treatment as long as the total loading of the discharged process water and stormwater does not exceed the loading had a stormwater treatment device been used. This could be achieved by reducing the loading from the process wastewater treatment system. Check with your Regional Water Quality Control Board or local sewering agency, as this option would be subject to permit constraints and potentially regular monitoring.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Stormwater Managers Resource Center http://www.stormwatercenter.net

Parking/Storage Area Maintenance SC-43

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Description

Parking lots and storage areas can contribute a number of substances, such as trash, suspended solids, hydrocarbons, oil and grease, and heavy metals that can enter receiving waters through stormwater runoff or non-stormwater discharges. The protocols in this fact sheet are intended to prevent or reduce the discharge of pollutants from parking/storage areas and include using good housekeeping practices, following appropriate cleaning BMPs, and training employees.

Approach

The goal of this program is to ensure stormwater pollution prevention practices are considered when conducting activities on or around parking areas and storage areas to reduce potential for pollutant discharge to receiving waters. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Encourage alternative designs and maintenance strategies for impervious parking lots. (See New Development and Redevelopment BMP Handbook)
- Keep accurate maintenance logs to evaluate BMP implementation.

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Suggested Protocols

General

- Keep the parking and storage areas clean and orderly. Remove debris in a timely fashion.
- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low quantities.
- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.
- Discharge soapy water remaining in mop or wash buckets to the sanitary sewer through a sink, toilet, clean-out, or wash area with drain.

Controlling Litter

- Post "No Littering" signs and enforce anti-litter laws.
- Provide an adequate number of litter receptacles.
- Clean out and cover litter receptacles frequently to prevent spillage.
- Provide trash receptacles in parking lots to discourage litter.
- Routinely sweep, shovel, and dispose of litter in the trash.

Surface Cleaning

- Use dry cleaning methods (e.g., sweeping, vacuuming) to prevent the discharge of pollutants into the stormwater conveyance system if possible.
- Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.
- Sweep all parking lots at least once before the onset of the wet season.
- Follow the procedures below if water is used to clean surfaces:
  - Block the storm drain or contain runoff.
  - Collect and pump wash water to the sanitary sewer or discharge to a pervious surface. Do not allow wash water to enter storm drains.
  - Dispose of parking lot sweeping debris and dirt at a landfill.
- Follow the procedures below when cleaning heavy oily deposits:
  - Clean oily spots with absorbent materials.
  - Use a screen or filter fabric over inlet, then wash surfaces.

- Do not allow discharges to the storm drain.
- Vacuum/pump discharges to a tank or discharge to sanitary sewer.
- Appropriately dispose of spilled materials and absorbents.

Surface Repair

- Preheat, transfer or load hot bituminous material away from storm drain inlets.
- Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff.
- Cover and seal nearby storm drain inlets where applicable (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal.
- Use only as much water as necessary for dust control, to avoid runoff.
- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

Inspection

- Have designated personnel conduct inspections of parking facilities and stormwater conveyance systems associated with parking facilities on a regular basis.
- Inspect cleaning equipment/sweepers for leaks on a regular basis.

Training

- Provide regular training to field employees and/or contractors regarding cleaning of paved areas and proper operation of equipment.
- Train employees and contractors in proper techniques for spill containment and cleanup.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials where it will be readily accessible or at a central location.
- Clean up fluid spills immediately with absorbent rags or material.
- Dispose of spilled material and absorbents properly.

Other Considerations

Limitations related to sweeping activities at large parking facilities may include high equipment costs, the need for sweeper operator training, and the inability of current sweeper technology to remove oil and grease.

Requirements

Costs

Cleaning/sweeping costs can be quite large. Construction and maintenance of stormwater structural controls can be quite expensive as well.

Maintenance

- Sweep parking lot regularly to minimize cleaning with water.
- Clean out oil/water/sand separators regularly, especially after heavy storms.
- Clean parking facilities regularly to prevent accumulated wastes and pollutants from being discharged into conveyance systems during rainy conditions.

Supplemental Information

Further Detail of the BMP

Surface Repair

Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff. Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal. Only use only as much water as is necessary for dust control to avoid runoff.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	☑
Nutrients	
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑
Oxygen Demanding	☑

Description

Streets, roads, and highways are significant sources of pollutants in stormwater discharges, and operation and maintenance (O&M) practices, if not conducted properly, can contribute to the problem. Stormwater pollution from roadway and bridge maintenance should be addressed on a site-specific basis. Use of the procedures outlined below, that address street sweeping and repair, bridge and structure maintenance, and unpaved roads will reduce pollutants in stormwater.

Approach

Pollution Prevention

- Use the least toxic materials available (e.g. water based paints, gels or sprays for graffiti removal)
- Recycle paint and other materials whenever possible.
- Enlist the help of citizens to keep yard waste, used oil, and other wastes out of the gutter.

Suggested Protocols

Street Sweeping and Cleaning

- Maintain a consistent sweeping schedule. Provide minimum monthly sweeping of curbed streets.
- Perform street cleaning during dry weather if possible.

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- Avoid wet cleaning or flushing of street, and utilize dry methods where possible.
- Consider increasing sweeping frequency based on factors such as traffic volume, land use, field observations of sediment and trash accumulation, proximity to water courses, etc. For example:
  - Increase the sweeping frequency for streets with high pollutant loadings, especially in high traffic and industrial areas.
  - Increase the sweeping frequency just before the wet season to remove sediments accumulated during the summer.
  - Increase the sweeping frequency for streets in special problem areas such as special events, high litter or erosion zones.
- Maintain cleaning equipment in good working condition and purchase replacement equipment as needed. Old sweepers should be replaced with new technologically advanced sweepers (preferably regenerative air sweepers) that maximize pollutant removal.
- Operate sweepers at manufacturer requested optimal speed levels to increase effectiveness.
- To increase sweeping effectiveness consider the following:
  - Institute a parking policy to restrict parking in problematic areas during periods of street sweeping.
  - Post permanent street sweeping signs in problematic areas; use temporary signs if installation of permanent signs is not possible.
  - Develop and distribute flyers notifying residents of street sweeping schedules.
- Regularly inspect vehicles and equipment for leaks, and repair immediately.
- If available use vacuum or regenerative air sweepers in the high sediment and trash areas (typically industrial/commercial).
- Keep accurate logs of the number of curb-miles swept and the amount of waste collected.
- Dispose of street sweeping debris and dirt at a landfill.
- Do not store swept material along the side of the street or near a storm drain inlet.
- Keep debris storage to a minimum during the wet season or make sure debris piles are contained (e.g. by berming the area) or covered (e.g. with tarps or permanent covers).

Street Repair and Maintenance

Pavement marking

- Schedule pavement marking activities for dry weather.

- Develop paint handling procedures for proper use, storage, and disposal of paints.
- Transfer and load paint and hot thermoplastic away from storm drain inlets.
- Provide drop cloths and drip pans in paint mixing areas.
- Properly maintain application equipment.
- Street sweep thermoplastic grindings. Yellow thermoplastic grindings may require special handling as they may contain lead.
- Paints containing lead or tributyltin are considered a hazardous waste and must be disposed of properly.
- Use water based paints whenever possible. If using water based paints, clean the application equipment in a sink that is connected to the sanitary sewer.
- Properly store leftover paints if they are to be kept for the next job, or dispose of properly.

Concrete installation and repair

- Schedule asphalt and concrete activities for dry weather.
- Take measures to protect any nearby storm drain inlets and adjacent watercourses, prior to breaking up asphalt or concrete (e.g. place san bags around inlets or work areas).
- Limit the amount of fresh concrete or cement mortar mixed, mix only what is needed for the job.
- Store concrete materials under cover, away from drainage areas. Secure bags of cement after they are open. Be sure to keep wind-blown cement powder away from streets, gutters, storm drains, rainfall, and runoff.
- Return leftover materials to the transit mixer. Dispose of small amounts of hardened excess concrete, grout, and mortar in the trash.
- Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stockpile, or dispose in the trash.
- When making saw cuts in pavement, use as little water as possible and perform during dry weather. Cover each storm drain inlet completely with filter fabric or plastic during the sawing operation and contain the slurry by placing straw bales, sandbags, or gravel dams around the inlets. After the liquid drains or evaporates, shovel or vacuum the slurry residue from the pavement or gutter and remove from site. Alternatively, a small onsite vacuum may be used to pick up the slurry as this will prohibit slurry from reaching storm drain inlets.
- Wash concrete trucks off site or in designated areas on site designed to preclude discharge of wash water to drainage system.

Patching, resurfacing, and surface sealing

- Schedule patching, resurfacing and surface sealing for dry weather.

- Stockpile materials away from streets, gutter areas, storm drain inlets or watercourses. During wet weather, cover stockpiles with plastic tarps or berm around them if necessary to prevent transport of materials in runoff.

- Pre-heat, transfer or load hot bituminous material away from drainage systems or watercourses.

- Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and maintenance holes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and until all water from emulsified oil sealants has drained or evaporated. Clean any debris from covered maintenance holes and storm drain inlets when the job is complete.

- Prevent excess material from exposed aggregate concrete or similar treatments from entering streets or storm drain inlets. Designate an area for clean up and proper disposal of excess materials.

- Use only as much water as necessary for dust control, to avoid runoff.

- Sweep, never hose down streets to clean up tracked dirt. Use a street sweeper or vacuum truck. Do not dump vacuumed liquid in storm drains.

- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

Equipment cleaning maintenance and storage

- Inspect equipment daily and repair any leaks. Place drip pans or absorbent materials under heavy equipment when not in use.

- Perform major equipment repairs at the corporation yard, when practical.

- If refueling or repairing vehicles and equipment must be done onsite, use a location away from storm drain inlets and watercourses.

- Clean equipment including sprayers, sprayer paint supply lines, patch and paving equipment, and mud jacking equipment at the end of each day. Clean in a sink or other area (e.g. vehicle wash area) that is connected to the sanitary sewer.

Bridge and Structure Maintenance

Paint and Paint Removal

- Transport paint and materials to and from job sites in containers with secure lids and tied down to the transport vehicle.

- Do not transfer or load paint near storm drain inlets or watercourses.

- Test and inspect spray equipment prior to starting to paint. Tighten all hoses and connections and do not overfill paint container.
- Plug nearby storm drain inlets prior to starting painting where there is significant risk of a spill reaching storm drains. Remove plugs when job is completed.
- If sand blasting is used to remove paint, cover nearby storm drain inlets prior to starting work.
- Perform work on a maintenance traveler or platform, or use suspended netting or tarps to capture paint, rust, paint removing agents, or other materials, to prevent discharge of materials to surface waters if the bridge crosses a watercourse. If sanding, use a sander with a vacuum filter bag.
- Capture all clean-up water, and dispose of properly.
- Recycle paint when possible (e.g. paint may be used for graffiti removal activities). Dispose of unused paint at an appropriate household hazardous waste facility.

Graffiti Removal

- Schedule graffiti removal activities for dry weather.
- Protect nearby storm drain inlets prior to removing graffiti from walls, signs, sidewalks, or other structures needing graffiti abatement. Clean up afterwards by sweeping or vacuuming thoroughly, and/or by using absorbent and properly disposing of the absorbent.
- When graffiti is removed by painting over, implement the procedures under Painting and Paint Removal above.
- Direct runoff from sand blasting and high pressure washing (with no cleaning agents) into a landscaped or dirt area. If such an area is not available, filter runoff through an appropriate filtering device (e.g. filter fabric) to keep sand, particles, and debris out of storm drains.
- If a graffiti abatement method generates wash water containing a cleaning compound (such as high pressure washing with a cleaning compound), plug nearby storm drains and vacuum/pump wash water to the sanitary sewer.
- Consider using a waterless and non-toxic chemical cleaning method for graffiti removal (e.g. gels or spray compounds).

Repair Work

- Prevent concrete, steel, wood, metal parts, tools, or other work materials from entering storm drains or watercourses.
- Thoroughly clean up the job site when the repair work is completed.
- When cleaning guardrails or fences follow the appropriate surface cleaning methods (depending on the type of surface) outlined in SC-71 Plaza & Sidewalk Cleaning fact sheet.

- If painting is conducted, follow the painting and paint removal procedures above.
- If graffiti removal is conducted, follow the graffiti removal procedures above.
- If construction takes place, see the Construction Activity BMP Handbook.
- Recycle materials whenever possible.

Unpaved Roads and Trails

- Stabilize exposed soil areas to prevent soil from eroding during rain events. This is particularly important on steep slopes.
- For roadside areas with exposed soils, the most cost-effective choice is to vegetate the area, preferably with a mulch or binder that will hold the soils in place while the vegetation is establishing. Native vegetation should be used if possible.
- If vegetation cannot be established immediately, apply temporary erosion control mats/blankets; a comma straw, or gravel as appropriate.
- If sediment is already eroded and mobilized in roadside areas, temporary controls should be installed. These may include: sediment control fences, fabric-covered triangular dikes, gravel-filled burlap bags, biobags, or hay bales staked in place.

Non-Stormwater Discharges

Field crews should be aware of non-stormwater discharges as part of their ongoing street maintenance efforts.

- Refer to SC-10 Non-Stormwater Discharges
- Identify location, time and estimated quantity of discharges.
- Notify appropriate personnel.

Training

- Train employees regarding proper street sweeping operation and street repair and maintenance.
- Instruct employees and subcontractors to ensure that measures to reduce the stormwater impacts of roadway/bridge maintenance are being followed.
- Require engineering staff and/or consulting A/E firms to address stormwater quality in new bridge designs or existing bridge retrofits.
- Use a training log or similar method to document training.
- Train employees on proper spill containment and clean up, and in identifying non-stormwater discharges.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- Densely populated areas or heavily used streets may require parking regulations to clear streets for cleaning.
- No currently available conventional sweeper is effective at removing oil and grease. Mechanical sweepers are not effective at removing finer sediments.
- Limitations may arise in the location of new bridges. The availability and cost of land and other economic and political factors may dictate where the placement of a new bridge will occur. Better design of the bridge to control runoff is required if it is being placed near sensitive waters.

Requirements

Costs

- The maintenance of local roads and bridges is already a consideration of most community public works or transportation departments. Therefore, the cost of pollutant reducing management practices will involve the training and equipment required to implement these new practices.
- The largest expenditures for street sweeping programs are in staffing and equipment. The capital cost for a conventional street sweeper is between $60,000 and $120,000. Newer technologies might have prices approaching $180,000. The average useful life of a conventional sweeper is about four years, and programs must budget for equipment replacement. Sweeping frequencies will determine equipment life, so programs that sweep more often should expect to have a higher cost of replacement.
- A street sweeping program may require the following.
  - Sweeper operators, maintenance, supervisory, and administrative personnel are required.
  - Traffic control officers may be required to enforce parking restrictions.
  - Skillful design of cleaning routes is required for program to be productive.
  - Arrangements must be made for disposal of collected wastes.

- If investing in newer technologies, training for operators must be included in operation and maintenance budgets. Costs for public education are small, and mostly deal with the need to obey parking restrictions and litter control. Parking tickets are an effective reminder to obey parking rules, as well as being a source of revenue.

Maintenance

- Not applicable

Supplemental Information

Further Detail of the BMP

Street sweeping

There are advantages and disadvantages to the two common types of sweepers. The best choice depends on your specific conditions. Many communities find it useful to have a compliment of both types in their fleet.

Mechanical Broom Sweepers - More effective at picking up large debris and cleaning wet streets. Less costly to purchase and operate. Create more airborne dust.

Vacuum Sweepers - More effective at removing fine particles and associated heavy metals. Ineffective at cleaning wet streets. Noisier than mechanical broom sweepers which may restrict areas or times of operation. May require an advance vehicle to remove large debris.

Street Flushers - Not affected by biggest interference to cleaning, parked cars. May remove finer sediments, moving them toward the gutter and stormwater inlets. For this reason, flushing fell out of favor and is now used primarily after sweeping. Flushing may be effective for combined sewer systems. Presently street flushing is not allowed under most NPDES permits.

Cross-Media Transfer of Pollutants

The California Air Resources Board (ARB) has established state ambient air quality standards including a standard for respirable particulate matter (less than or equal to 10 microns in diameter, symbolized as PM10). In the effort to sweep up finer sediments to remove attached heavy metals, municipalities should be aware that fine dust, that cannot be captured by the sweeping equipment and becomes airborne, could lead to issues of worker and public safety.

Bridges

Bridges that carry vehicular traffic generate some of the more direct discharges of runoff to surface waters. Bridge scupper drains cause a direct discharge of stormwater into receiving waters and have been shown to carry relatively high concentrations of pollutants. Bridge maintenance also generates wastes that may be either directly deposited to the water below or carried to the receiving water by stormwater. The following steps will help reduce the stormwater impacts of bridge maintenance:

- Site new bridges so that significant adverse impacts to wetlands, sensitive areas, critical habitat, and riparian vegetation are minimized.

- Design new bridges to avoid the use of scupper drains and route runoff to land for treatment control. Existing scupper drains should be cleaned on a regular basis to avoid sediment/debris accumulation.

- Reduce the discharge of pollutants to surface waters during maintenance by using suspended traps, vacuums, or booms in the water to capture paint, rust, and paint removing agents. Many of these wastes may be hazardous. Properly dispose of this waste by referring to CA21 (Hazardous Waste Management) in the Construction Handbook.

- Train employees and subcontractors to reduce the discharge of wastes during bridge maintenance.

De-icing

- Do not over-apply deicing salt and sand, and routinely calibrate spreaders.

- Near reservoirs, restrict the application of deicing salt and redirect any runoff away from reservoirs.

- Consider using alternative deicing agents (less toxic, biodegradable, etc.).

References and Resources

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July. 1998.

Orange County Stormwater Program
http://www.ocwatersheds.com/stormwater/swp_introduction.asp

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Santa Clara Valley Urban Runoff Pollution Prevention Program. 1997 Urban Runoff Management Plan. September 1997, updated October 2000.

Santa Clara Valley Urban Runoff Pollution Prevention Program. 2001. Fresh Concrete and Mortar Application Best Management Practices for the Construction Industry. June.

Santa Clara Valley Urban Runoff Pollution Prevention Program. 2001. Roadwork and Paving Best Management Practices for the Construction Industry. June.

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Roadway and Bridge Maintenance. On-line http://www.epa.gov/npdes/menuofbmps/poll_13.htm

Landscape Maintenance SC-73

Objectives

- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	
Bacteria	
Oil and Grease	
Organics	
Oxygen Demanding	☑

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Description

Landscape maintenance activities include vegetation removal; herbicide and insecticide application; fertilizer application; watering; and other gardening and lawn care practices. Vegetation control typically involves a combination of chemical (herbicide) application and mechanical methods. All of these maintenance practices have the potential to contribute pollutants to the storm drain system. The major objectives of this BMP are to minimize the discharge of pesticides, herbicides and fertilizers to the storm drain system and receiving waters; prevent the disposal of landscape waste into the storm drain system by collecting and properly disposing of clippings and cuttings, and educating employees and the public.

Approach

Pollution Prevention

- Implement an integrated pest management (IPM) program. IPM is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools.
- Choose low water using flowers, trees, shrubs, and groundcover.
- Consider alternative landscaping techniques such as naturescaping and xeriscaping.
- Conduct appropriate maintenance (i.e. properly timed fertilizing, weeding, pest control, and pruning) to help preserve the landscapes water efficiency.

- Consider grass cycling (grass cycling is the natural recycling of grass by leaving the clippings on the lawn when mowing. Grass clippings decompose quickly and release valuable nutrients back into the lawn).

Suggested Protocols

Mowing, Trimming, and Weeding

- Whenever possible use mechanical methods of vegetation removal (e.g mowing with tractor-type or push mowers, hand cutting with gas or electric powered weed trimmers) rather than applying herbicides. Use hand weeding where practical.

- Avoid loosening the soil when conducting mechanical or manual weed control, this could lead to erosion. Use mulch or other erosion control measures when soils are exposed.

- Performing mowing at optimal times. Mowing should not be performed if significant rain events are predicted.

- Mulching mowers may be recommended for certain flat areas. Other techniques may be employed to minimize mowing such as selective vegetative planting using low maintenance grasses and shrubs.

- Collect lawn and garden clippings, pruning waste, tree trimmings, and weeds. Chip if necessary, and compost or dispose of at a landfill (see waste management section of this fact sheet).

- Place temporarily stockpiled material away from watercourses, and berm or cover stockpiles to prevent material releases to storm drains.

Planting

- Determine existing native vegetation features (location, species, size, function, importance) and consider the feasibility of protecting them. Consider elements such as their effect on drainage and erosion, hardiness, maintenance requirements, and possible conflicts between preserving vegetation and the resulting maintenance needs.

- Retain and/or plant selected native vegetation whose features are determined to be beneficial, where feasible. Native vegetation usually requires less maintenance (e.g., irrigation, fertilizer) than planting new vegetation.

- Consider using low water use groundcovers when planting or replanting.

Waste Management

- Compost leaves, sticks, or other collected vegetation or dispose of at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.

- Place temporarily stockpiled material away from watercourses and storm drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.

- Reduce the use of high nitrogen fertilizers that produce excess growth requiring more frequent mowing or trimming.

- Avoid landscape wastes in and around storm drain inlets by either using bagging equipment or by manually picking up the material.

Irrigation

- Where practical, use automatic timers to minimize runoff.

- Use popup sprinkler heads in areas with a lot of activity or where there is a chance the pipes may be broken. Consider the use of mechanisms that reduce water flow to sprinkler heads if broken.

- Ensure that there is no runoff from the landscaped area(s) if re-claimed water is used for irrigation.

- If bailing of muddy water is required (e.g. when repairing a water line leak), do not put it in the storm drain; pour over landscaped areas.

- Irrigate slowly or pulse irrigate to prevent runoff and then only irrigate as much as is needed.

- Apply water at rates that do not exceed the infiltration rate of the soil.

Fertilizer and Pesticide Management

- Utilize a comprehensive management system that incorporates integrated pest management (IPM) techniques. There are many methods and types of IPM, including the following:

  - Mulching can be used to prevent weeds where turf is absent, fencing installed to keep rodents out, and netting used to keep birds and insects away from leaves and fruit.

  - Visible insects can be removed by hand (with gloves or tweezers) and placed in soapy water or vegetable oil. Alternatively, insects can be sprayed off the plant with water or in some cases vacuumed off of larger plants.

  - Store-bought traps, such as species-specific, pheromone-based traps or colored sticky cards, can be used.

  - Slugs can be trapped in small cups filled with beer that are set in the ground so the slugs can get in easily.

  - In cases where microscopic parasites, such as bacteria and fungi, are causing damage to plants, the affected plant material can be removed and disposed of (pruning equipment should be disinfected with bleach to prevent spreading the disease organism).

  - Small mammals and birds can be excluded using fences, netting, tree trunk guards.

  - Beneficial organisms, such as bats, birds, green lacewings, ladybugs, praying mantis, ground beetles, parasitic nematodes, trichogramma wasps, seed head weevils, and spiders that prey on detrimental pest species can be promoted.

- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.

- Use pesticides only if there is an actual pest problem (not on a regular preventative schedule).
- Do not use pesticides if rain is expected. Apply pesticides only when wind speeds are low (less than 5 mph).
- Do not mix or prepare pesticides for application near storm drains.
- Prepare the minimum amount of pesticide needed for the job and use the lowest rate that will effectively control the pest.
- Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Calibrate fertilizer and pesticide application equipment to avoid excessive application.
- Periodically test soils for determining proper fertilizer use.
- Sweep pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Purchase only the amount of pesticide that you can reasonably use in a given time period (month or year depending on the product).
- Triple rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Dispose of empty pesticide containers according to the instructions on the container label.

Inspection

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering, and repair leaks in the irrigation system as soon as they are observed.
- Inspect pesticide/fertilizer equipment and transportation vehicles daily.

Training

- Educate and train employees on use of pesticides and in pesticide application techniques to prevent pollution. Pesticide application must be under the supervision of a California qualified pesticide applicator.
- Train/encourage municipal maintenance crews to use IPM techniques for managing public green areas.
- Annually train employees within departments responsible for pesticide application on the appropriate portions of the agency's IPM Policy, SOPs, and BMPs, and the latest IPM techniques.

- Employees who are not authorized and trained to apply pesticides should be periodically (at least annually) informed that they cannot use over-the-counter pesticides in or around the workplace.

- Use a training log or similar method to document training.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup

- Have spill cleanup materials readily available and in a know in location

- Cleanup spills immediately and use dry methods if possible.

- Properly dispose of spill cleanup material.

Other Considerations

- The Federal Pesticide, Fungicide, and Rodenticide Act and California Title 3, Division 6, Pesticides and Pest Control Operations place strict controls over pesticide application and handling and specify training, annual refresher, and testing requirements. The regulations generally cover: a list of approved pesticides and selected uses, updated regularly; general application information; equipment use and maintenance procedures; and record keeping. The California Department of Pesticide Regulations and the County Agricultural Commission coordinate and maintain the licensing and certification programs. All public agency employees who apply pesticides and herbicides in "agricultural use" areas such as parks, golf courses, rights-of-way and recreation areas should be properly certified in accordance with state regulations. Contracts for landscape maintenance should include similar requirements.

- All employees who handle pesticides should be familiar with the most recent material safety data sheet (MSDS) files.

- Municipalities do not have the authority to regulate the use of pesticides by school districts, however the California Healthy Schools Act of 2000 (AB 2260) has imposed requirements on California school districts regarding pesticide use in schools. Posting of notification prior to the application of pesticides is now required, and IPM is stated as the preferred approach to pest management in schools.

Requirements

Costs

Additional training of municipal employees will be required to address IPM techniques and BMPs. IPM methods will likely increase labor cost for pest control which may be offset by lower chemical costs.

Maintenance

Not applicable

Supplemental Information

Further Detail of the BMP

Waste Management

Composting is one of the better disposal alternatives if locally available. Most municipalities either have or are planning yard waste composting facilities as a means of reducing the amount of waste going to the landfill. Lawn clippings from municipal maintenance programs as well as private sources would probably be compatible with most composting facilities

Contractors and Other Pesticide Users

Municipal agencies should develop and implement a process to ensure that any contractor employed to conduct pest control and pesticide application on municipal property engages in pest control methods consistent with the IPM Policy adopted by the agency. Specifically, municipalities should require contractors to follow the agency's IPM policy, SOPs, and BMPs; provide evidence to the agency of having received training on current IPM techniques when feasible; provide documentation of pesticide use on agency property to the agency in a timely manner.

References and Resources

King County Stormwater Pollution Control Manual. Best Management Practices for Businesses. 1995. King County Surface Water Management. July. On-line: http://dnr.metrokc.gov/wlr/dss/spcm.htm

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United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Landscaping and Lawn Care. Office of Water. Office of Wastewater Management. On-line: http://www.epa.gov/npdes/menuofbmps/poll_8.htm

Photo Credit: Geoff Brosseau

Objectives

- Contain
- Educate
- Reduce/Minimize

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	☑
Oil and Grease	☑
Organics	☑
Oxygen Demanding	☑

Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff that may contain certain pollutants. Maintaining catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis will remove pollutants, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

Approach

Suggested Protocols

Catch Basins/Inlet Structures

- Municipal staff should regularly inspect facilities to ensure the following:
  - Immediate repair of any deterioration threatening structural integrity.
  - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
  - Stenciling of catch basins and inlets (see SC-75 Waste Handling and Disposal).
- Clean catch basins, storm drain inlets, and other conveyance structures in high pollutant load areas just before the wet season to remove sediments and debris accumulated during the summer.

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- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.

- Keep accurate logs of the number of catch basins cleaned.

- Record the amount of waste collected.

- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.

- Dewater the wastes with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed of. Do not dewater near a storm drain or stream.

- Except for small communities with relatively few catch basins that may be cleaned manually, most municipalities will require mechanical cleaners such as eductors, vacuums, or bucket loaders.

Storm Drain Conveyance System

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.

- Collect flushed effluent and pump to the sanitary sewer for treatment.

Pump Stations

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.

- Do not allow discharge from cleaning a storm drain pump station or other facility to reach the storm drain system.

- Conduct quarterly routine maintenance at each pump station.

- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.

- Sample collected sediments to determine if landfill disposal is possible, or illegal discharges in the watershed are occurring.

Open Channel

- Consider modification of storm channel characteristics to improve channel hydraulics, to increase pollutant removals, and to enhance channel/creek aesthetic and habitat value.

- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a steam or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies

(SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS

Illicit Connections and Discharges

- During routine maintenance of conveyance system and drainage structures field staff should look for evidence of illegal discharges or illicit connections:
  - Is there evidence of spills such as paints, discoloring, etc.
  - Are there any odors associated with the drainage system
  - Record locations of apparent illegal discharges/illicit connections
  - Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of up gradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
  - Once the origin of flow is established, require illicit discharger to eliminate the discharge.
- Stencil storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as “Dump No Waste Drains to Stream” stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Illegal Dumping

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots
  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)
  - Mode of dumping (abandoned containers, “midnight dumping” from moving vehicles, direct dumping of materials, accidents/spills)
  - Responsible parties
- Post “No Dumping” signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

- The State Department of Fish and Game has a hotline for reporting violations called Cal TIP (1-800-952-5400). The phone number may be used to report any violation of a Fish and Game code (illegal dumping, poaching, etc.).

- The California Department of Toxic Substances Control's Waste Alert Hotline, 1-800-69TOXIC, can be used to report hazardous waste violations.

Training

- Train crews in proper maintenance activities, including record keeping and disposal.

- Only properly trained individuals are allowed to handle hazardous materials/wastes.

- Train municipal employees from all departments (public works, utilities, street cleaning, parks and recreation, industrial waste inspection, hazardous waste inspection, sewer maintenance) to recognize and report illegal dumping.

- Train municipal employees and educate businesses, contractors, and the general public in proper and consistent methods for disposal.

- Train municipal staff regarding non-stormwater discharges (See SC-10 Non-Stormwater Discharges).

Spill Response and Prevention

- Refer to SC-11, Prevention, Control & Cleanup

- Have spill cleanup materials readily available and in a known location.

- Cleanup spills immediately and use dry methods if possible.

- Properly dispose of spill cleanup material.

Other Considerations

- Cleanup activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.

- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and disposal of flushed effluent to sanitary sewer may be prohibited in some areas.

- Regulations may include adoption of substantial penalties for illegal dumping and disposal.

- Municipal codes should include sections prohibiting the discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.

- Private property access rights may be needed to track illegal discharges up gradient.

- Requirements of municipal ordinance authority for suspected source verification testing for illicit connections necessary for guaranteed rights of entry.

Requirements

Costs

- An aggressive catch basin cleaning program could require a significant capital and O&M budget. A careful study of cleaning effectiveness should be undertaken before increased cleaning is implemented. Catch basin cleaning costs are less expensive if vacuum street sweepers are available; cleaning catch basins manually can cost approximately twice as much as cleaning the basins with a vacuum attached to a sweeper.

- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary. Encouraging reporting of illicit discharges by employees can offset costs by saving expense on inspectors and directing resources more efficiently. Some programs have used funds available from “environmental fees” or special assessment districts to fund their illicit connection elimination programs.

Maintenance

- Two-person teams may be required to clean catch basins with vactor trucks.

- Identifying illicit discharges requires teams of at least two people (volunteers can be used), plus administrative personnel, depending on the complexity of the storm sewer system.

- Arrangements must be made for proper disposal of collected wastes.

- Requires technical staff to detect and investigate illegal dumping violations, and to coordinate public education.

Supplemental Information

Further Detail of the BMP

Storm Drain flushing

Sanitary sewer flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in sanitary sewer systems. The same principles that make sanitary sewer flushing effective can be used to flush storm drains. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as to an open channel, to another point where flushing will be initiated, or over to the sanitary sewer and on to the treatment facilities, thus preventing re-suspension and overflow of a portion of the solids during storm events. Flushing prevents “plug flow” discharges of concentrated pollutant loadings and sediments. The deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce the impacts of stormwater pollution, a second inflatable device, placed well downstream, may be used to re-collect the water after the force of the flushing wave has dissipated. A pump may then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure may be more practical or required to re-collect the flushed waters.

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75 percent for organics and 55-65 percent for dry weather grit/inorganic material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used or that fire hydrant line flushing coincide with storm drain flushing.

Flow Management

Flow management has been one of the principal motivations for designing urban stream corridors in the past. Such needs may or may not be compatible with the stormwater quality goals in the stream corridor.

Downstream flood peaks can be suppressed by reducing through flow velocity. This can be accomplished by reducing gradient with grade control structures or increasing roughness with boulders, dense vegetation, or complex banks forms. Reducing velocity correspondingly increases flood height, so all such measures have a natural association with floodplain open space. Flood elevations laterally adjacent to the stream can be lowered by increasing through flow velocity.

However, increasing velocity increases flooding downstream and inherently conflicts with channel stability and human safety. Where topography permits, another way to lower flood elevation is to lower the level of the floodway with drop structures into a large but subtly excavated bowl where flood flows we allowed to spread out.

Stream Corridor Planning

Urban streams receive and convey stormwater flows from developed or developing watersheds. Planning of stream corridors thus interacts with urban stormwater management programs. If local programs are intended to control or protect downstream environments by managing flows delivered to the channels, then it is logical that such programs should be supplemented by management of the materials, forms, and uses of the downstream riparian corridor. Any proposal for steam alteration or management should be investigated for its potential flow and stability effects on upstream, downstream, and laterally adjacent areas. The timing and rate of flow from various tributaries can combine in complex ways to alter flood hazards. Each section of channel is unique, influenced by its own distribution of roughness elements, management activities, and stream responses.

Flexibility to adapt to stream features and behaviors as they evolve must be included in stream reclamation planning. The amenity and ecology of streams may be enhanced through the landscape design options of 1) corridor reservation, 2) bank treatment, 3) geomorphic restoration, and 4) grade control.

Corridor reservation - Reserving stream corridors and valleys to accommodate natural stream meandering, aggradation, degradation, and over bank flows allows streams to find their own form and generate less ongoing erosion. In California, open stream corridors in recent urban developments have produced recreational open space, irrigation of streamside plantings, and the aesthetic amenity of flowing water.

Bank treatment - The use of armoring, vegetative cover, and flow deflection may be used to influence a channel's form, stability, and biotic habitat. To prevent bank erosion, armoring can be done with rigid construction materials, such as concrete, masonry, wood planks and logs, riprap, and gabions. Concrete linings have been criticized because of their lack of provision of biotic habitat. In contrast, riprap and gabions make relatively porous and flexible linings. Boulders, placed in the bed reduce velocity and erosive power.

Riparian vegetation can stabilize the banks of streams that are at or near a condition of equilibrium. Binding networks of roots increase bank shear strength. During flood flows, resilient vegetation is forced into erosion-inhibiting mats. The roughness of vegetation leads to lower velocity, further reducing erosive effects. Structural flow deflection can protect banks from erosion or alter fish habitat. By concentrating flow, a deflector causes a pool to be scoured in the bed.

Geomorphic restoration – Restoration refers to alteration of disturbed streams so their form and behavior emulate those of undisturbed streams. Natural meanders are retained, with grading to gentle slopes on the inside of curves to allow point bars and riffle-pool sequences to develop. Trees are retained to provide scenic quality, biotic productivity, and roots for bank stabilization, supplemented by plantings where necessary.

A restorative approach can be successful where the stream is already approaching equilibrium. However, if upstream urbanization continues new flow regimes will be generated that could disrupt the equilibrium of the treated system.

Grade Control - A grade control structure is a level shelf of a permanent material, such as stone, masonry, or concrete, over which stream water flows. A grade control structure is called a sill, weir, or drop structure, depending on the relation of its invert elevation to upstream and downstream channels.

A sill is installed at the preexisting channel bed elevation to prevent upstream migration of nick points. It establishes a firm base level below which the upstream channel can not erode.

A weir or check dam is installed with invert above the preexisting bed elevation. A weir raises the local base level of the stream and causes aggradation upstream. The gradient, velocity, and erosive potential of the stream channel are reduced. A drop structure lowers the downstream invert below its preexisting elevation, reducing downstream gradient and velocity. Weirs and drop structure control erosion by dissipating energy and reducing slope velocity.

When carefully applied, grade control structures can be highly versatile in establishing human and environmental benefits in stabilized channels. To be successful, application of grade control structures should be guided by analysis of the stream system both upstream and downstream from the area to he reclaimed.

Examples

The California Department of Water Resources began the Urban Stream Restoration Program in 1985. The program provides grant funds to municipalities and community groups to implement stream restoration projects. The projects reduce damages from streambank aid watershed instability arid floods while restoring streams' aesthetic, recreational, and fish and wildlife values.

In Buena Vista Park, upper floodway slopes are gentle and grassed to achieve continuity of usable park land across the channel of small boulders at the base of the slopes.

The San Diego River is a large, vegetative lined channel, which was planted in a variety of species to support riparian wildlife while stabilizing the steep banks of the floodway.

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Efficient Irrigation SD-12

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into stormwater drainage systems.

Approach

Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the stormwater conveyance system.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Designing New Installations

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where determined applicable and feasible by the Permittee:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.

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- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:
  - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff
  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect
  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible
  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth
- Employ other comparable, equally effective methods to reduce irrigation water runoff.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Storm Drain Signage SD-13

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- ☑ Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Waste materials dumped into storm drain inlets can have severe impacts on receiving and ground waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets.

Approach

The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Storm drain messages have become a popular method of alerting the public about the effects of and the prohibitions against waste disposal.

Suitable Applications

Stencils and signs alert the public to the destination of pollutants discharged to the storm drain. Signs are appropriate in residential, commercial, and industrial areas, as well as any other area where contributions or dumping to storm drains is likely.

Design Considerations

Storm drain message markers or placards are recommended at all storm drain inlets within the boundary of a development project. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side. All storm drain inlet locations should be identified on the development site map.

Designing New Installations

The following methods should be considered for inclusion in the project design and show on project plans:

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include "NO DUMPING

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– DRAINS TO OCEAN" and/or other graphical icons to discourage illegal dumping.

- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Note - Some local agencies have approved specific signage and/or storm drain message placards for use. Consult local agency stormwater staff to determine specific requirements for placard types and methods of application.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. If the project meets the definition of "redevelopment", then the requirements stated under " designing new installations" above should be included in all project design plans.

Additional Information

Maintenance Considerations

- Legibility of markers and signs should be maintained. If required by the agency with jurisdiction over the project, the owner/operator or homeowner's association should enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards or signs.

Placement

- Signage on top of curbs tends to weather and fade.

- Signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.

Supplemental Information

Examples

- Most MS4 programs have storm drain signage programs. Some MS4 programs will provide stencils, or arrange for volunteers to stencil storm drains as part of their outreach program.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

Description

Accidental releases of materials from above ground liquid storage tanks, drums, and dumpsters present the potential for contaminating stormwaters with many different pollutants. Tanks may store many potential stormwater runoff pollutants, such as gasoline, aviation gas, diesel fuel, kerosene, oils, greases, lubricants and other distilled, blended and refined products derived from crude petroleum. Materials spilled, leaked, or lost from storage tanks may accumulate in soils or on other surfaces and be carried away by rainfall runoff. These source controls apply to containers located outside of a building used to temporarily store liquid materials and include installing safeguards against accidental releases, installing secondary containment, conducting regular inspections, and training employees in standard operating procedures and spill cleanup techniques.

Targeted Constituents

Sediment	
Nutrients	✓
Trash	
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Approach

Pollution Prevention

- Educate employees about pollution prevention measures and goals.

- Keep an accurate, up-to-date inventory of the materials delivered and stored on-site.

- Try to keep chemicals in their original containers, and keep them well labeled.

Suggested Protocols

General

- Develop an operations plan that describes procedures for loading and/or unloading. Refer to SC-30 – Outdoor

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- Raise the containers off the ground by use of pallet or similar method, with provisions for spill control.

- Contain the material in such a manner that if the container leaks or spills, the contents will not discharge, flow, or be washed into the storm drainage system, surface waters or groundwater.

- Place drip pans or absorbent materials beneath all mounted container taps, and at all potential drip and spill locations during filling and unloading of containers. Any collected liquids or soiled absorbent materials must be reused/recycled or properly disposed.

- Ensure that any underground or aboveground storage tanks are designed and managed in accordance with applicable regulations, identified as a potential pollution source, and have secondary containment such as a berm or dike with an impervious surface.

Inspection

- Provide regular inspections:

  - Inspect storage areas regularly for leaks or spills.

  - Conduct routine inspections and check for external corrosion of material containers. Also check for structural failure, spills and overfills due to operator error, failure of piping system.

  - Check for leaks or spills during pumping of liquids or gases from truck or rail car to a storage facility or vice versa.

  - Visually inspect new tank or container installations for loose fittings, poor welding, and improper or poorly fitted gaskets.

  - Inspect tank foundations, connections, coatings, and tank walls and piping system. Look for corrosion, leaks, cracks, scratches, and other physical damage that may weaken the tank or container system.

  - Replace containers that are leaking, corroded, or otherwise deteriorating with ones in good condition. If the liquid chemicals are corrosive, containers made of compatible materials must be used instead of metal drums.

  - New or secondary containers must be labeled with the product name and hazards.

Training

- Train employee (e.g., fork lift operators) and contractors in proper spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.

- Train employees in proper storage measures.

- Use a training log or similar method to document training.

Loading/Unloading of Materials for more detailed BMP information pertaining to loading and unloading of liquids.

- Protect materials from rainfall, run-on, runoff, and wind dispersal:
  - Cover the storage area with a roof.
  - Minimize stormwater run-on by enclosing the area or building a berm around it.
  - Use a "doghouse" structure for storage of liquid containers.
  - Use covered dumpsters for waste product containers.
- Employ safeguards against accidental releases:
  - Provide overflow protection devices to warn operator or automatic shut down transfer pumps.
  - Provide protection guards (bollards) around tanks and piping to prevent damage from a vehicle or forklift.
  - Provide clear tagging or labeling, and restrict access to valves to reduce human error.
- Berm or surround tank or container with secondary containment system, including dikes, liners, vaults, or double walled tanks.
- Be aware and ready to address the fact that some municipalities require secondary containment areas to be connected to the sanitary sewer, prohibiting any hard connections to the storm drain.
- Contact the appropriate regulatory agency regarding environmental compliance for facilities with "spill ponds" designed to intercept, treat, and/or divert spills.
- Have registered and specifically trained professional engineers identify and correct potential problems such as loose fittings, poor welding, and improper or poorly fitted gaskets for newly installed tank systems.

Storage Areas

- Provide storage tank piping located below product level with a shut-off valve at the tank; ideally this valve should be an automatic shear valve with the shut-off located inside the tank.
- Provide barriers such as posts or guardrails, where tanks are exposed, to prevent collision damage with vehicles.
- Provide secure storage to prevent vandalism-caused contamination.
- Place tight-fitting lids on all containers.
- Enclose or cover the containers where they are stored.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Have an emergency plan, equipment, and trained personnel ready at all times to deal immediately with major spills.
- Collect all spilled liquids and properly dispose of them.
- Have employees trained in emergency spill cleanup procedures present when dangerous waste, liquid chemicals, or other wastes are delivered.
- Prevent operator errors by using engineering safeguards and thus reducing accidental releases of pollutants.
- Store and maintain appropriate spill cleanup materials in a location near the tank storage area and known to all.

Other Considerations

- Storage sheds often must meet building and fire code requirements.
- The local fire district must be consulted for limitations on clearance of roof covers over containers used to store flammable materials.
- All specific standards set by Federal and State laws concerning the storage of oil and hazardous materials must be met.
- Storage of reactive, ignitable, or flammable liquids should comply with the Uniform Fire Code and the National Electric Code.
- Storage of oil and hazardous materials must meet specific Federal and State standards including:
  - Spill Prevention Control and Countermeasure Plan (SPCC) Plan
  - Secondary containment
  - Integrity and leak detection monitoring
  - Emergency preparedness plans

Requirements

Costs

Costs will vary depending on the size of the facility and the necessary controls, such as berms or safeguards against accidental controls.

Maintenance

- Conduct weekly inspection.
- Sweep and clean the storage area regularly if it is paved, do not hose down the area to a storm drain.

Supplemental Information

The most common causes of unintentional releases are:

- Installation problems
- Failure of piping systems (pipes, pumps, flanges, couplings, hoses, and valves)
- External corrosion and structural failure
- Spills and overfills due to operator error
- Leaks during pumping of liquids or gases from truck or rail car to a storage tank or vice versa

Further Detail of the BMP

Aboveground Tank Leak and Spill Control

Storage of reactive, ignitable, or flammable liquids should comply with the Uniform Fire Code and the National Electric Code. Practices listed below should be employed to enhance the code requirements:

- Tanks should be placed in a designated area.
- Tanks located in areas where firearms are discharged should be encapsulated in concrete or the equivalent.
- Designated areas should be paved with Portland cement concrete, free of cracks and gaps, and impervious in order to contain leaks and spills,
- Liquid materials should be stored in UL approved double walled tanks or surrounded by a curb or dike to provide the volume to contain 10% of the volume of all of the containers or 110% of the volume of the largest container, whichever is greater. The area inside the curb should slope to a drain.
- For used oil or dangerous waste, a dead-end sump should be installed in the drain.
- All other liquids should be drained to the sanitary sewer if available. The drain must have a positive control such as a lock, valve, or plug to prevent release of contaminated liquids.
- Accumulated stormwater in petroleum storage areas should be passed through an oil/water separator

Maintenance is critical to preventing leaks and spills. Conduct routine weekly inspections and:

- Check for external corrosion and structural failure.
- Check for spills and overfills due to operator error.
- Check for failure of piping system (pipes, pumps, flanger, coupling, hoses, and valves).
- Check for leaks or spills during pumping of liquids or gases from truck or rail car to a storage facility or vice versa

- Inspect new tank or container installation visually for loose fittings, poor welding, and improper or poorly fitted gaskets.
- Inspect tank foundations, connections, coatings, and tank walls and piping system. Look for corrosion, leaks, cracks, scratches, and other physical damage that may weaken the tank or container system.
- Frequently release accumulated stormwater during the wet season.
- Have periodic integrity testing conducted by a qualified professional.

Container Management

- To limit the possibility of stormwater pollution, containers used to store dangerous waste or other liquids should be kept inside the building unless this is impractical due to site constraints. If the containers are placed outside, the following procedures should be employed:
  - Dumpsters used to store items awaiting transfer to a landfill should be placed in a lean-to structure or otherwise covered. Dumpsters shall be kept in good condition without corrosion or leaky seams.
  - Garbage dumpsters shall be replaced if they are deteriorating to the point where leakage is occurring. Dumpsters should be kept undercover to prevent the entry of stormwater. Employees should be made aware of the importance of keeping the dumpsters covered and free from leaks.
  - Waste container drums should be kept in an area such as a service bay. If drums are kept outside, they must be stored in a lean-to type structure, shed or walk-in container to keep rainfall from reaching the drums.

Dikes

One of the best protective measures against contamination of stormwater is diking. Containment dikes are berms or retaining walls that are designed to hold spills. Diking is an effective pollution prevention measure for above ground storage tanks and railcar or tank truck loading and unloading areas. The dike surrounds the area of concern and holds the spill, keeping spill materials separated from the stormwater side of the dike area. Diking can be used in any industrial or municipal facility, but it is most commonly used for controlling large spills or releases from liquid storage areas and liquid transfer areas.

- For single-wall tanks, containment dikes should be large enough to hold the contents of the storage tank for the facility plus rain water.
- For trucks, diked areas should be capable of holding an amount equal to the volume of the tank truck compartment. Diked construction material should be strong enough to safely hold spilled materials.
- Dike materials can consist of earth, concrete, synthetic materials, metal, or other impervious materials.
- Strong acids or bases may react with metal containers, concrete, and some plastics.

- Where strong acids or bases or stored, alternative dike materials should be considered. More active organic chemicals may need certain special liners for dikes.
- Dikes may also be designed with impermeable materials to increase containment capabilities.
- Dikes should be inspected during or after significant storms or spills to check for washouts or overflows.
- Regular checks of containment dikes to insure the dikes are capable of holding spills should be conducted.
- Inability of a structure to retain stormwater, dike erosion, soggy areas, or changes in vegetation indicate problems with dike structures. Damaged areas should be patched and stabilized immediately.
- Earthen dikes may require special maintenance of vegetation such as mulching and irrigation.

Curbing

Curbing is a barrier that surrounds an area of concern. Curbing is similar to containment diking in the way that it prevents spills and leaks from being released into the environment. Curbing is usually small scaled and does not contain large spills like diking. Curbing is common at many facilities in small areas where handling and transfer of liquid materials occur. Curbing can redirect contaminated stormwater away from the storage area. It is useful in areas where liquid materials are transferred from one container to another. Asphalt is a common material used for curbing; however, curbing materials can include earth, concrete, synthetic materials, metal, or other impenetrable materials.

- Spilled materials should be removed immediately from curbed areas to allow space for future spills.
- Curbs should have manually-controlled pump systems rather than common drainage systems for collection of spilled materials.
- The curbed area should be inspected regularly to clear clogging debris.
- Maintenance should also be conducted frequently to prevent overflow of any spilled materials as curbed areas are designed only for smaller spills.
- Curbing has the following advantages:
  - Excellent run-on control
  - Inexpensive
  - Ease of installment
  - Provides option to recycle materials spilled in curb areas
  - Common industry practice

Examples

The "doghouse" design has been used to store small liquid containers. The roof and flooring design prevent contact with direct rain or runoff. The doghouse has two solid structural walls and two canvas covered walls. The flooring is wire mesh about secondary containment. The unit has been used successfully at Lockheed Missile and Space Company in Sunnyvale.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- Collect and Convey

Description

Trash storage areas are areas where a trash receptacle (s) are located for use as a repository for solid wastes. Stormwater runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or creeks. Waste handling operations that may be sources of stormwater pollution include dumpsters, litter control, and waste piles.

Approach

This fact sheet contains details on the specific measures required to prevent or reduce pollutants in stormwater runoff associated with trash storage and handling. Preventative measures including enclosures, containment structures, and impervious pavements to mitigate spills, should be used to reduce the likelihood of contamination.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Design requirements for waste handling areas are governed by Building and Fire Codes, and by current local agency ordinances and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements. Hazardous waste should be handled in accordance with legal requirements established in Title 22, California Code of Regulation.

Wastes from commercial and industrial sites are typically hauled by either public or commercial carriers that may have design or access requirements for waste storage areas. The design criteria in this fact sheet are recommendations and are not intended to be in conflict with requirements established by the waste hauler. The waste hauler should be contacted prior to the design of your site trash collection areas. Conflicts or issues should be discussed with the local agency.

Designing New Installations

Trash storage areas should be designed to consider the following structural or treatment control BMPs:

- Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This might include berming or grading the waste handling area to prevent run-on of stormwater.

- Make sure trash container areas are screened or walled to prevent off-site transport of trash.

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CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Use lined bins or dumpsters to reduce leaking of liquid waste.
- Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
- Pave trash storage areas with an impervious surface to mitigate spills.
- Do not locate storm drains in immediate vicinity of the trash storage area.
- Post signs on all dumpsters informing users that hazardous materials are not to be disposed of therein.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Additional Information

Maintenance Considerations

The integrity of structural elements that are subject to damage (i.e., screens, covers, and signs) must be maintained by the owner/operator. Maintenance agreements between the local agency and the owner/operator may be required. Some agencies will require maintenance deed restrictions to be recorded of the property title. If required by the local agency, maintenance agreements or deed restrictions must be executed by the owner/operator before improvement plans are approved.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

The Ocean Begins at Your Front Door

PROJECT Pollution PREVENTION

Follow these simple steps to help reduce water pollution:

Household Activities

- Do not rinse spills with water. Use dry cleanup methods such as applying cat litter or another absorbent material, sweep and dispose of in the trash. Take items such as used or excess batteries, oven cleaners, automotive fluids, painting products and cathode ray tubes, like TVs and computer monitors, to a Household Hazardous Waste Collection Center (HHWCC).
- For a HHWCC near you call (714) 834-6752 or visit www.oclandfills.com.
- Do not hose down your driveway, sidewalk or patio to the street, gutter or storm drain. Sweep up debris and dispose of it in the trash.

Automotive

- Take your vehicle to a commercial car wash whenever possible. If you wash your vehicle at home, choose soaps, cleaners, or detergents labeled non-toxic, phosphate- free or biodegradable. Vegetable and citrus-based products are typically safest for the environment.
- Do not allow washwater from vehicle washing to drain into the street, gutter or storm drain. Excess washwater should be disposed of in the sanitary sewer (through a sink or toilet) or onto an absorbent surface like your lawn.
- Monitor your vehicles for leaks and place a pan under leaks. Keep your vehicles well maintained to stop and prevent leaks.
- Never pour oil or antifreeze in the street, gutter or storm drain. Recycle these substances at a service station, a waste oil collection center or used oil recycling center. For the nearest Used Oil Collection Center call 1-800-CLEANUP or visit www.1800cleanup.org.

Pool Maintenance

- Pool and spa water must be dechlorinated and free of excess acid, alkali or color to be allowed in the street, gutter or storm drain.
- When it is not raining, drain dechlorinated pool and spa water directly into the sanitary sewer.
- Some cities may have ordinances that do not allow pool water to be disposed of in the storm drain. Check with your city.

Landscape and Gardening

- Do not over-water. Water your lawn and garden by hand to control the amount of water you use or set irrigation systems to reflect seasonal water needs. If water flows off your yard onto your driveway or sidewalk, your system is over-watering. Periodically inspect and fix leaks and misdirected sprinklers.
- Do not rake or blow leaves, clippings or pruning waste into the street, gutter or storm drain. Instead, dispose of waste by composting, hauling it to a permitted landfill, or as green waste through your city's recycling program.
- Follow directions on pesticides and fertilizer, (measure, do not estimate amounts) and do not use if rain is predicted within 48 hours.
- Take unwanted pesticides to a HHWCC to be recycled. For locations and hours of HHWCC, call (714) 834-6752 or visit www.oclandfills.com.

Trash

- Place trash and litter that cannot be recycled in securely covered trash cans.
- Whenever possible, buy recycled products.
- Remember: Reduce, Reuse, Recycle.

Pet Care

- Always pick up after your pet. Flush waste down the toilet or dispose of it in the trash. Pet waste, if left outdoors, can wash into the street, gutter or storm drain.
- If possible, bathe your pets indoors. If you must bathe your pet outside, wash it on your lawn or another absorbent/permeable surface to keep the washwater from entering the street, gutter or storm drain.
- Follow directions for use of pet care products and dispose of any unused products at a HHWCC.

Common Pollutants

Home Maintenance

- Detergents, cleaners and solvents
- Oil and latex paint
- Swimming pool chemicals
- Outdoor trash and litter

Lawn and Garden

- Pet and animal waste
- Pesticides
- Clippings, leaves and soil
- Fertilizer

Automobile

- Oil and grease
- Radiator fluids and antifreeze
- Cleaning chemicals
- Brake pad dust

The Ocean Begins at Your Front Door

Never allow pollutants to enter the street, gutter or storm drain!

Did You Know?

- Most people believe that the largest source of water pollution in urban areas comes from specific sources such as factories and sewage treatment plants. In fact, the largest source of water pollution comes from city streets, neighborhoods, construction sites and parking lots. This type of pollution is sometimes called "non-point source" pollution.
- There are two types of non-point source pollution: stormwater and urban runoff pollution.
- Stormwater runoff results from rainfall. When rainstorms cause large volumes of water to rinse the urban landscape, picking up pollutants along the way.
- Urban runoff can happen any time of the year when excessive water use from irrigation, vehicle washing and other sources carries trash, lawn clippings and other urban pollutants into storm drains.

Where Does It Go?

- Anything we use outside homes, vehicles and businesses – like motor oil, paint, pesticides, fertilizers and cleaners – can be blown or washed into storm drains.
- A little water from a garden hose or rain can also send materials into storm drains.
- Storm drains are separate from our sanitary sewer systems; unlike water in sanitary sewers (from sinks or toilets), water in storm drains is not treated before entering our waterways.

Sources of Non-Point Source Pollution

- Automotive leaks and spills.
- Improper disposal of used oil and other engine fluids.
- Metals found in vehicle exhaust, weathered paint, rust, metal plating and tires.
- Pesticides and fertilizers from lawns, gardens and farms.
- Improper disposal of cleaners, paint and paint removers.
- Soil erosion and dust debris from landscape and construction activities.
- Litter, lawn clippings, animal waste, and other organic matter.
- Oil stains on parking lots and paved surfaces.

The Effect on the Ocean

Non-point source pollution can have a serious impact on water quality in Orange County. Pollutants from the storm drain system can harm marine life as well as coastal and wetland habitats. They can also degrade recreation areas such as beaches, harbors and bays.

Stormwater quality management programs have been developed throughout Orange County to educate and encourage the public to protect water quality, monitor runoff in the storm drain system, investigate illegal dumping and maintain storm drains.

Support from Orange County residents and businesses is needed to improve water quality and reduce urban runoff pollution. Proper use and disposal of materials will help stop pollution before it reaches the storm drain and the ocean.

For More Information

Orange County Stormwater Program

California Environmental Protection Agency
www.calepa.ca.gov

- **Air Resources Board**
  www.arb.ca.gov
- **Department of Pesticide Regulation**
  www.cdpr.ca.gov
- **Department of Toxic Substances Control**
  www.dtsc.ca.gov
- **Integrated Waste Management Board**
  www.ciwmb.ca.gov
- **Office of Environmental Health Hazard Assessment**
  www.oehha.ca.gov
- **State Water Resources Control Board**
  www.waterboards.ca.gov

Earth 911 - Community-Specific Environmental Information 1-800-cleanup or visit www.1800cleanup.org

Health Care Agency's Ocean and Bay Water Closure and Posting Hotline
(714) 433-6400 or visit www.ocbeachinfo.com

Integrated Waste Management Dept. of Orange County (714) 834-6752 or visit www.oclandfills.com for information on household hazardous waste collection centers, recycling centers and solid waste collection

O.C. Agriculture Commissioner
(714) 447-7100 or visit www.ocagcomm.com

Stormwater Best Management Practice Handbook
Visit www.cabmphandbooks.com

UC Master Gardener Hotline
(714) 708-1646 or visit www.uccemg.com

The Orange County Stormwater Program has created and moderates an electronic mailing list to facilitate communications, take questions and exchange ideas among its users about issues and topics related to stormwater and urban runoff and the implementation of program elements. To join the list, please send an email to ocstormwaterinfo-join@list.ocwatersheds.com

Aliso Viejo	(949)	425-2535
Anaheim Public Works Operations	(714)	765-6860
Brea Engineering	(714)	990-7666
Buena Park Public Works	(714)	562-3655
Costa Mesa Public Services	(714)	754-5323
Cypress Public Works	(714)	229-6740
Dana Point Public Works	(949)	248-3584
Fountain Valley Public Works	(714)	593-4441
Fullerton Engineering Dept.	(714)	738-6853
Garden Grove Public Works	(714)	741-5956
Huntington Beach Public Works	(714)	536-5431
Irvine Public Works	(949)	724-6315
La Habra Public Services	(562)	905-9792
La Palma Public Works	(714)	690-3310
Laguna Beach Water Quality	(949)	497-0378
Laguna Hills Public Services	(949)	707-2650
Laguna Niguel Public Works	(949)	362-4337
Laguna Woods Public Works	(949)	639-0500
Lake Forest Public Works	(949)	461-3480
Los Alamitos Community Dev.	(562)	431-3538
Mission Viejo Public Works	(949)	470-3056
Newport Beach, Code & Water Quality Enforcement	(949)	644-3215
Orange Public Works	(714)	532-6480
Placentia Public Works	(714)	993-8245
Rancho Santa Margarita	(949)	635-1800
San Clemente Environmental Programs	(949)	361-6143
San Juan Capistrano Engineering	(949)	234-4413
Santa Ana Public Works	(714)	647-3380
Seal Beach Engineering	(562)	431-2527 x317
Stanton Public Works	(714)	379-9222 x204
Tustin Public Works/Engineering	(714)	573-3150
Villa Park Engineering	(714)	998-1500
Westminster Public Works/Engineering	(714)	898-3311 x446
Yorba Linda Engineering	(714)	961-7138
Orange County Stormwater Program	(877)	897-7455

Orange County 24-Hour
Water Pollution Problem Reporting Hotline
1-877-89-SPILL (1-877-897-7455)

On-line Water Pollution Problem Reporting Form
www.ocwatersheds.com

Attachment 1 – Hydromodification

```
WinTR-20 Printed Page File      Beginning of Input Data List
TR20.inp

WinTR-20: Version 1.10                  0         0         0.05
Brea Mall
Pre-Development

SUB-AREA:
          Lower Lvl Outlet              .01745    97.       .1
          Upper Lvl Outlet              .00559    97.       .1

STREAM REACH:

STORM ANALYSIS:
          2-Yr                          2.05      Type I    2

STRUCTURE RATING:


GLOBAL OUTPUT:
          2         0.05                YYYYN     YYYYNN



WinTR-20 Printed Page File      End of Input Data List

                                            Brea Mall
                                         Pre-Development

                                 Name of printed page file:
                                           TR20.out

                                                  STORM 2-Yr

Area or    Drainage  Rain Gage     Runoff   ------------ Peak Flow ------------
 Reach      Area      ID or        Amount   Elevation   Time       Rate       Rate
Identifier  (sq mi)   Location      (in)       (ft)      (hr)      (cfs)      (csm)

Lower Lvl     0.017                1.719                 9.92      14.92     855.15

   Line
Start Time   ------------ Flow Values @ time increment of  0.006 hr ------------
     (hr)      (cfs)      (cfs)      (cfs)      (cfs)      (cfs)      (cfs)      (cfs)

     2.357      0.05       0.05       0.05       0.05       0.05       0.05       0.05
     2.402      0.05       0.06       0.06       0.06       0.06       0.06       0.06
     2.446      0.06       0.06       0.06       0.06       0.06       0.06       0.06
     2.490      0.06       0.06       0.06       0.06       0.07       0.07       0.07
     2.534      0.07       0.07       0.07       0.07       0.07       0.07       0.07
     2.578      0.07       0.07       0.07       0.07       0.07       0.07       0.08
     2.623      0.08       0.08       0.08       0.08       0.08       0.08       0.08
     2.667      0.08       0.08       0.08       0.08       0.08       0.08       0.08
     2.711      0.08       0.08       0.09       0.09       0.09       0.09       0.09
     2.755      0.09       0.09       0.09       0.09       0.09       0.09       0.09
     2.799      0.09       0.09       0.09       0.09       0.10       0.10       0.10
     2.844      0.10       0.10       0.10       0.10       0.10       0.10       0.10
     2.888      0.10       0.10       0.10       0.10       0.10       0.10       0.10
     2.932      0.11       0.11       0.11       0.11       0.11       0.11       0.11
     2.976      0.11       0.11       0.11       0.11       0.11       0.11       0.11
     3.021      0.11       0.12       0.12       0.12       0.12       0.12       0.12
     3.065      0.12       0.12       0.12       0.12       0.12       0.12       0.12
     3.109      0.12       0.12       0.12       0.13       0.13       0.13       0.13
     3.153      0.13       0.13       0.13       0.13       0.13       0.13       0.13
     3.197      0.13       0.13       0.13       0.13       0.14       0.14       0.14
     3.242      0.14       0.14       0.14       0.14       0.14       0.14       0.14
     3.286      0.14       0.14       0.14       0.14       0.14       0.14       0.14
     3.330      0.15       0.15       0.15       0.15       0.15       0.15       0.15
     3.374      0.15       0.15       0.15       0.15       0.15       0.15       0.15
     3.418      0.15       0.16       0.16       0.16       0.16       0.16       0.16
     3.463      0.16       0.16       0.16       0.16       0.16       0.16       0.16
     3.507      0.16       0.16       0.16       0.17       0.17       0.17       0.17
     3.551      0.17       0.17       0.17       0.17       0.17       0.17       0.17
     3.595      0.17       0.17       0.17       0.17       0.18       0.18       0.18
     3.639      0.18       0.18       0.18       0.18       0.18       0.18       0.18
     3.684      0.18       0.18       0.18       0.18       0.18       0.19       0.19
     3.728      0.19       0.19       0.19       0.19       0.19       0.19       0.19
     3.772      0.19       0.19       0.19       0.19       0.19       0.19       0.19
     3.816      0.20       0.20       0.20       0.20       0.20       0.20       0.20
```

3.861	0.20	0.20	0.20	0.20	0.20	0.20	0.20
3.905	0.20	0.20	0.21	0.21	0.21	0.21	0.21
3.949	0.21	0.21	0.21	0.21	0.21	0.21	0.21
3.993	0.21	0.21	0.22	0.22	0.22	0.22	0.22
4.037	0.22	0.22	0.22	0.22	0.22	0.22	0.22
4.082	0.22	0.22	0.22	0.22	0.23	0.23	0.23

Brea Mall
Pre-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.006 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
4.126	0.23	0.23	0.23	0.23	0.23	0.23	0.23
4.170	0.23	0.23	0.23	0.23	0.23	0.23	0.23
4.214	0.23	0.23	0.23	0.23	0.24	0.24	0.24
4.258	0.24	0.24	0.24	0.24	0.24	0.24	0.24
4.303	0.24	0.24	0.24	0.24	0.24	0.24	0.24
4.347	0.25	0.25	0.25	0.25	0.25	0.25	0.25
4.391	0.25	0.25	0.25	0.25	0.25	0.25	0.25
4.435	0.25	0.25	0.25	0.25	0.25	0.25	0.26
4.479	0.26	0.26	0.26	0.26	0.26	0.26	0.26
4.524	0.26	0.26	0.26	0.26	0.26	0.26	0.26
4.568	0.26	0.26	0.26	0.26	0.26	0.27	0.27
4.612	0.27	0.27	0.27	0.27	0.27	0.27	0.27
4.656	0.27	0.27	0.27	0.27	0.27	0.27	0.27
4.701	0.27	0.27	0.27	0.27	0.27	0.28	0.28
4.745	0.28	0.28	0.28	0.28	0.28	0.28	0.28
4.789	0.28	0.28	0.28	0.28	0.28	0.28	0.28
4.833	0.28	0.28	0.28	0.28	0.29	0.29	0.29
4.877	0.29	0.29	0.29	0.29	0.29	0.29	0.29
4.922	0.29	0.29	0.29	0.29	0.29	0.29	0.29
4.966	0.29	0.29	0.29	0.29	0.29	0.30	0.30
5.010	0.30	0.30	0.30	0.30	0.30	0.30	0.30
5.054	0.30	0.30	0.30	0.30	0.30	0.30	0.30
5.098	0.30	0.30	0.30	0.30	0.30	0.31	0.31
5.143	0.31	0.31	0.31	0.31	0.31	0.31	0.31
5.187	0.31	0.31	0.31	0.31	0.31	0.31	0.31
5.231	0.31	0.31	0.31	0.31	0.31	0.31	0.31
5.275	0.32	0.32	0.32	0.32	0.32	0.32	0.32
5.319	0.32	0.32	0.32	0.32	0.32	0.32	0.32
5.364	0.32	0.32	0.32	0.32	0.32	0.32	0.32
5.408	0.32	0.32	0.33	0.33	0.33	0.33	0.33
5.452	0.33	0.33	0.33	0.33	0.33	0.33	0.33
5.496	0.33	0.33	0.33	0.33	0.33	0.33	0.33
5.541	0.33	0.33	0.33	0.33	0.34	0.34	0.34
5.585	0.34	0.34	0.34	0.34	0.34	0.34	0.34
5.629	0.34	0.34	0.34	0.34	0.34	0.34	0.34
5.673	0.34	0.34	0.34	0.34	0.34	0.34	0.34
5.717	0.34	0.35	0.35	0.35	0.35	0.35	0.35
5.762	0.35	0.35	0.35	0.35	0.35	0.35	0.35
5.806	0.35	0.35	0.35	0.35	0.35	0.35	0.35
5.850	0.35	0.35	0.35	0.36	0.36	0.36	0.36
5.894	0.36	0.36	0.36	0.36	0.36	0.36	0.36
5.938	0.36	0.36	0.36	0.36	0.36	0.36	0.36
5.983	0.36	0.36	0.36	0.36	0.36	0.36	0.36
6.027	0.36	0.37	0.37	0.37	0.37	0.37	0.37
6.071	0.37	0.37	0.37	0.37	0.37	0.37	0.38
6.115	0.38	0.38	0.38	0.38	0.38	0.38	0.38
6.159	0.39	0.39	0.39	0.39	0.39	0.39	0.39
6.204	0.40	0.40	0.40	0.40	0.40	0.40	0.40
6.248	0.40	0.40	0.41	0.41	0.41	0.41	0.41
6.292	0.41	0.41	0.42	0.42	0.42	0.42	0.42
6.336	0.42	0.42	0.42	0.43	0.43	0.43	0.43

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:
Lower Lvl Outlet   .01745   97.   .1
Upper Lvl Outlet   .00559   97.   .1

Brea Mall
Pre-Development

Line Start Time (hr)	Flow Values @ time increment of 0.006 hr (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
6.381	0.43	0.43	0.43	0.43	0.44	0.44	0.44
6.425	0.44	0.44	0.44	0.44	0.45	0.45	0.45
6.469	0.45	0.45	0.45	0.46	0.46	0.46	0.46
6.513	0.46	0.46	0.46	0.46	0.46	0.47	0.47
6.557	0.47	0.47	0.47	0.47	0.48	0.48	0.48
6.602	0.48	0.48	0.48	0.48	0.48	0.49	0.49
6.646	0.49	0.49	0.49	0.49	0.50	0.50	0.50
6.690	0.50	0.50	0.50	0.50	0.51	0.51	0.51
6.734	0.51	0.51	0.51	0.51	0.52	0.52	0.52
6.778	0.52	0.52	0.52	0.53	0.53	0.53	0.53
6.823	0.53	0.53	0.53	0.53	0.54	0.54	0.54
6.867	0.54	0.54	0.54	0.54	0.55	0.55	0.55
6.911	0.55	0.55	0.55	0.55	0.55	0.56	0.56
6.955	0.56	0.56	0.56	0.57	0.57	0.57	0.57
6.999	0.57	0.57	0.57	0.58	0.58	0.58	0.58
7.044	0.58	0.58	0.58	0.59	0.59	0.59	0.59
7.088	0.59	0.59	0.59	0.59	0.59	0.59	0.60
7.132	0.60	0.60	0.60	0.60	0.60	0.60	0.60
7.176	0.60	0.60	0.60	0.60	0.60	0.60	0.61
7.221	0.61	0.61	0.61	0.61	0.61	0.61	0.61
7.265	0.61	0.61	0.61	0.61	0.62	0.62	0.62
7.309	0.62	0.62	0.62	0.62	0.62	0.62	0.62
7.353	0.62	0.62	0.62	0.63	0.63	0.63	0.63
7.397	0.63	0.63	0.63	0.63	0.63	0.63	0.63
7.442	0.63	0.63	0.63	0.64	0.64	0.64	0.64
7.486	0.64	0.64	0.64	0.64	0.64	0.64	0.64
7.530	0.64	0.64	0.64	0.64	0.65	0.65	0.65
7.574	0.65	0.65	0.65	0.65	0.65	0.65	0.65
7.618	0.65	0.65	0.65	0.65	0.66	0.66	0.66
7.663	0.66	0.66	0.66	0.66	0.66	0.66	0.66

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

7.707	0.66	0.66	0.66	0.66	0.66	0.66	0.67
7.751	0.67	0.67	0.67	0.67	0.67	0.67	0.67
7.795	0.67	0.67	0.67	0.67	0.68	0.68	0.68
7.839	0.68	0.68	0.68	0.68	0.68	0.68	0.68
7.884	0.68	0.68	0.69	0.69	0.69	0.69	0.69
7.928	0.69	0.69	0.69	0.69	0.69	0.69	0.69
7.972	0.69	0.69	0.69	0.69	0.70	0.70	0.70
8.016	0.70	0.70	0.70	0.70	0.71	0.71	0.71
8.061	0.71	0.72	0.72	0.72	0.73	0.73	0.73
8.105	0.73	0.74	0.74	0.74	0.75	0.75	0.75
8.149	0.76	0.77	0.77	0.78	0.79	0.79	0.80
8.193	0.80	0.80	0.81	0.81	0.81	0.82	0.82
8.237	0.83	0.83	0.84	0.85	0.85	0.86	0.87
8.282	0.87	0.88	0.88	0.89	0.89	0.89	0.90
8.326	0.90	0.91	0.91	0.92	0.92	0.93	0.94
8.370	0.94	0.95	0.96	0.96	0.97	0.97	0.97
8.414	0.98	0.98	0.99	0.99	1.00	1.00	1.01
8.458	1.02	1.02	1.03	1.04	1.04	1.05	1.05
8.503	1.06	1.06	1.06	1.07	1.07	1.08	1.08
8.547	1.09	1.10	1.10	1.11	1.12	1.12	1.13
8.591	1.13	1.14	1.14	1.14	1.15	1.15	1.16

WinTR-20 Version 1.10   Page   3   02/06/2022 11:07

Brea Mall
Pre-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.006 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
8.635	1.16	1.17	1.17	1.18	1.19	1.19	1.20
8.679	1.21	1.21	1.22	1.22	1.22	1.23	1.23
8.724	1.24	1.24	1.25	1.25	1.26	1.26	1.27
8.768	1.28	1.28	1.29	1.30	1.30	1.30	1.31
8.812	1.31	1.32	1.32	1.32	1.33	1.34	1.34
8.856	1.35	1.36	1.36	1.37	1.37	1.38	1.38
8.901	1.39	1.39	1.40	1.40	1.40	1.41	1.41

WinTR-20: Version 1.10 0 0 0.05
Mall (continued)
Pre-Development
STORM 2-Yr
SUB-AREA:
Lower Lvl Outlet .01745 97. .1
Upper Lvl Outlet .00559 97. .1

8.945	1.42	1.43	1.43	1.44	1.45	1.46	1.46
8.989	1.47	1.47	1.48	1.48	1.48	1.49	1.49
9.033	1.50	1.51	1.52	1.53	1.54	1.54	1.55
9.077	1.56	1.57	1.58	1.58	1.59	1.60	1.60
9.122	1.61	1.61	1.62	1.63	1.64	1.66	1.67
9.166	1.68	1.69	1.70	1.71	1.72	1.73	1.74
9.210	1.75	1.75	1.76	1.77	1.78	1.79	1.80
9.254	1.81	1.83	1.84	1.85	1.86	1.87	1.88
9.298	1.89	1.90	1.91	1.91	1.92	1.93	1.94
9.343	1.95	1.96	1.98	1.99	2.00	2.02	2.03
9.387	2.04	2.05	2.06	2.06	2.07	2.08	2.09
9.431	2.09	2.11	2.12	2.13	2.14	2.16	2.17
9.475	2.18	2.19	2.20	2.21	2.22	2.23	2.25
9.519	2.27	2.30	2.34	2.39	2.46	2.54	2.62
9.564	2.70	2.78	2.85	2.92	2.98	3.04	3.08
9.608	3.13	3.18	3.24	3.31	3.41	3.53	3.67
9.652	3.82	3.98	4.14	4.29	4.44	4.57	4.69
9.696	4.79	4.88	4.96	5.06	5.17	5.32	5.50
9.741	5.72	5.97	6.24	6.52	6.79	7.06	7.31
9.785	7.53	7.74	7.92	8.07	8.23	8.42	8.64
9.829	8.93	9.31	9.76	10.27	10.83	11.39	11.95
9.873	12.48	12.98	13.44	13.85	14.20	14.48	14.70
9.917	14.85	14.92	14.92	14.83	14.65	14.41	14.13
9.962	13.83	13.52	13.23	12.94	12.69	12.46	12.27
10.006	12.10	11.92	11.71	11.45	11.12	10.69	10.18
10.050	9.61	9.02	8.42	7.83	7.28	6.77	6.31
10.094	5.91	5.57	5.30	5.06	4.86	4.68	4.52
10.138	4.38	4.25	4.14	4.03	3.94	3.86	3.78
10.183	3.72	3.66	3.62	3.58	3.54	3.51	3.48
10.227	3.45	3.42	3.39	3.35	3.31	3.27	3.24
10.271	3.20	3.17	3.14	3.11	3.09	3.07	3.06
10.315	3.04	3.03	3.01	2.98	2.96	2.93	2.89
10.359	2.86	2.83	2.80	2.77	2.74	2.72	2.70
10.404	2.68	2.67	2.65	2.63	2.61	2.59	2.56
10.448	2.53	2.50	2.46	2.43	2.40	2.37	2.35
10.492	2.32	2.30	2.29	2.27	2.26	2.24	2.23
10.536	2.21	2.19	2.17	2.15	2.12	2.10	2.08
10.581	2.07	2.05	2.03	2.02	2.01	2.00	1.99

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

10.625	1.99	1.98	1.97	1.96	1.95	1.94	1.93
10.669	1.92	1.91	1.91	1.90	1.89	1.89	1.88
10.713	1.88	1.88	1.87	1.87	1.86	1.85	1.84
10.757	1.84	1.83	1.82	1.81	1.81	1.80	1.79
10.802	1.79	1.79	1.78	1.78	1.77	1.77	1.76
10.846	1.75	1.75	1.74	1.73	1.72	1.72	1.71

Brea Mall
Pre-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.006 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
10.890	1.70	1.70	1.69	1.69	1.69	1.68	1.68
10.934	1.67	1.66	1.66	1.65	1.64	1.63	1.63
10.978	1.62	1.61	1.61	1.60	1.60	1.59	1.59
11.023	1.59	1.58	1.58	1.57	1.57	1.56	1.56
11.067	1.55	1.54	1.54	1.54	1.53	1.53	1.53
11.111	1.52	1.52	1.52	1.52	1.51	1.51	1.51
11.155	1.50	1.50	1.50	1.49	1.49	1.49	1.49
11.199	1.49	1.48	1.48	1.48	1.48	1.48	1.48
11.244	1.47	1.47	1.47	1.46	1.46	1.46	1.46
11.288	1.45	1.45	1.45	1.45	1.45	1.45	1.44
11.332	1.44	1.44	1.44	1.43	1.43	1.43	1.43
11.376	1.42	1.42	1.42	1.42	1.42	1.41	1.41
11.421	1.41	1.41	1.41	1.41	1.40	1.40	1.40
11.465	1.39	1.39	1.39	1.39	1.38	1.38	1.38
11.509	1.38	1.38	1.38	1.37	1.37	1.37	1.37
11.553	1.36	1.36	1.36	1.36	1.35	1.35	1.35
11.597	1.35	1.35	1.34	1.34	1.34	1.34	1.34
11.642	1.33	1.33	1.33	1.33	1.32	1.32	1.32
11.686	1.32	1.31	1.31	1.31	1.31	1.31	1.31
11.730	1.30	1.30	1.30	1.30	1.29	1.29	1.29
11.774	1.29	1.28	1.28	1.28	1.28	1.28	1.27
11.818	1.27	1.27	1.27	1.27	1.26	1.26	1.26

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

11.863	1.26	1.25	1.25	1.25	1.25	1.24	1.24
11.907	1.24	1.24	1.24	1.24	1.23	1.23	1.23
11.951	1.23	1.22	1.22	1.22	1.21	1.21	1.21
11.995	1.21	1.21	1.21	1.20	1.20	1.20	1.20
12.039	1.20	1.19	1.19	1.19	1.19	1.19	1.18
12.084	1.18	1.18	1.18	1.18	1.18	1.17	1.17
12.128	1.17	1.17	1.17	1.17	1.17	1.16	1.16
12.172	1.16	1.16	1.16	1.16	1.15	1.15	1.15
12.216	1.15	1.15	1.15	1.15	1.15	1.14	1.14
12.261	1.14	1.14	1.14	1.14	1.13	1.13	1.13
12.305	1.13	1.13	1.13	1.13	1.13	1.13	1.12
12.349	1.12	1.12	1.12	1.12	1.12	1.11	1.11
12.393	1.11	1.11	1.11	1.11	1.11	1.11	1.11
12.437	1.10	1.10	1.10	1.10	1.10	1.09	1.09
12.482	1.09	1.09	1.09	1.09	1.09	1.09	1.09
12.526	1.08	1.08	1.08	1.08	1.08	1.08	1.07
12.570	1.07	1.07	1.07	1.07	1.07	1.07	1.06
12.614	1.06	1.06	1.06	1.06	1.06	1.06	1.06
12.658	1.05	1.05	1.05	1.05	1.05	1.05	1.04
12.703	1.04	1.04	1.04	1.04	1.04	1.04	1.04
12.747	1.04	1.03	1.03	1.03	1.03	1.03	1.02
12.791	1.02	1.02	1.02	1.02	1.02	1.02	1.02
12.835	1.02	1.01	1.01	1.01	1.01	1.01	1.01
12.879	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12.924	1.00	1.00	0.99	0.99	0.99	0.99	0.99
12.968	0.99	0.98	0.98	0.98	0.98	0.98	0.98
13.012	0.98	0.98	0.97	0.97	0.97	0.97	0.97
13.056	0.97	0.96	0.96	0.96	0.96	0.96	0.96
13.101	0.96	0.96	0.95	0.95	0.95	0.95	0.95

Line Start Time (hr)	------------ Flow Values @ time increment of 0.006 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

13.145	0.95	0.95	0.94	0.94	0.94	0.94	0.94
13.189	0.94	0.93	0.93	0.93	0.93	0.93	0.93
13.233	0.93	0.93	0.93	0.92	0.92	0.92	0.92
13.277	0.92	0.92	0.91	0.91	0.91	0.91	0.91
13.322	0.91	0.91	0.91	0.90	0.90	0.90	0.90
13.366	0.90	0.90	0.89	0.89	0.89	0.89	0.89
13.410	0.89	0.89	0.89	0.89	0.88	0.88	0.88
13.454	0.88	0.88	0.88	0.87	0.87	0.87	0.87
13.498	0.87	0.87	0.87	0.87	0.86	0.86	0.86
13.543	0.86	0.86	0.86	0.85	0.85	0.85	0.85
13.587	0.85	0.85	0.85	0.84	0.84	0.84	0.84
13.631	0.84	0.84	0.84	0.84	0.83	0.83	0.83
13.675	0.83	0.83	0.83	0.82	0.82	0.82	0.82
13.719	0.82	0.82	0.82	0.82	0.82	0.81	0.81
13.764	0.81	0.81	0.81	0.80	0.80	0.80	0.80
13.808	0.80	0.80	0.80	0.80	0.80	0.79	0.79
13.852	0.79	0.79	0.79	0.79	0.78	0.78	0.78
13.896	0.78	0.78	0.78	0.78	0.78	0.77	0.77
13.941	0.77	0.77	0.77	0.77	0.76	0.76	0.76
13.985	0.76	0.76	0.76	0.76	0.76	0.75	0.75
14.029	0.75	0.75	0.75	0.75	0.75	0.75	0.75
14.073	0.74	0.74	0.74	0.74	0.74	0.74	0.74
14.117	0.74	0.74	0.74	0.74	0.74	0.74	0.74
14.162	0.74	0.74	0.74	0.74	0.74	0.73	0.73
14.206	0.73	0.73	0.73	0.73	0.73	0.73	0.73
14.250	0.73	0.73	0.73	0.73	0.73	0.73	0.73
14.294	0.73	0.73	0.73	0.73	0.73	0.73	0.73
14.338	0.73	0.73	0.73	0.73	0.73	0.73	0.73
14.383	0.73	0.73	0.73	0.73	0.73	0.73	0.73
14.427	0.73	0.72	0.72	0.72	0.72	0.72	0.72
14.471	0.72	0.72	0.72	0.72	0.72	0.72	0.72
14.515	0.72	0.72	0.72	0.72	0.72	0.72	0.72
14.559	0.72	0.72	0.72	0.72	0.72	0.72	0.72
14.604	0.72	0.72	0.72	0.72	0.72	0.72	0.72
14.648	0.72	0.72	0.71	0.71	0.71	0.71	0.71
14.692	0.71	0.71	0.71	0.71	0.71	0.71	0.71
14.736	0.71	0.71	0.71	0.71	0.71	0.71	0.71

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

14.781	0.71	0.71	0.71	0.71	0.71	0.71	0.71
14.825	0.71	0.71	0.71	0.71	0.71	0.71	0.71
14.869	0.71	0.71	0.70	0.70	0.70	0.70	0.70
14.913	0.70	0.70	0.70	0.70	0.70	0.70	0.70
14.957	0.70	0.70	0.70	0.70	0.70	0.70	0.70
15.002	0.70	0.70	0.70	0.70	0.70	0.70	0.70
15.046	0.70	0.70	0.70	0.70	0.70	0.70	0.70
15.090	0.70	0.70	0.70	0.70	0.69	0.69	0.69
15.134	0.69	0.69	0.69	0.69	0.69	0.69	0.69
15.178	0.69	0.69	0.69	0.69	0.69	0.69	0.69
15.223	0.69	0.69	0.69	0.69	0.69	0.69	0.69
15.267	0.69	0.69	0.69	0.69	0.69	0.69	0.69
15.311	0.69	0.69	0.69	0.69	0.69	0.69	0.68
15.355	0.68	0.68	0.68	0.68	0.68	0.68	0.68

Brea Mall
Pre-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.006 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
15.399	0.68	0.68	0.68	0.68	0.68	0.68	0.68
15.444	0.68	0.68	0.68	0.68	0.68	0.68	0.68
15.488	0.68	0.68	0.68	0.68	0.68	0.68	0.68
15.532	0.68	0.68	0.68	0.68	0.68	0.68	0.67
15.576	0.67	0.67	0.67	0.67	0.67	0.67	0.67
15.621	0.67	0.67	0.67	0.67	0.67	0.67	0.67
15.665	0.67	0.67	0.67	0.67	0.67	0.67	0.67
15.709	0.67	0.67	0.67	0.67	0.67	0.67	0.67
15.753	0.67	0.67	0.67	0.67	0.67	0.67	0.67
15.797	0.66	0.66	0.66	0.66	0.66	0.66	0.66
15.842	0.66	0.66	0.66	0.66	0.66	0.66	0.66
15.886	0.66	0.66	0.66	0.66	0.66	0.66	0.66
15.930	0.66	0.66	0.66	0.66	0.66	0.66	0.66
15.974	0.66	0.66	0.66	0.66	0.66	0.66	0.66

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet   .01745   97.   .1
Upper Lvl Outlet   .00559   97.   .1

16.018	0.66	0.66	0.66	0.65	0.65	0.65	0.65
16.063	0.65	0.65	0.65	0.65	0.65	0.65	0.65
16.107	0.65	0.65	0.65	0.65	0.65	0.65	0.65
16.151	0.65	0.65	0.65	0.65	0.65	0.65	0.65
16.195	0.65	0.65	0.65	0.65	0.65	0.65	0.65
16.239	0.65	0.65	0.65	0.64	0.64	0.64	0.64
16.284	0.64	0.64	0.64	0.64	0.64	0.64	0.64
16.328	0.64	0.64	0.64	0.64	0.64	0.64	0.64
16.372	0.64	0.64	0.64	0.64	0.64	0.64	0.64
16.416	0.64	0.64	0.64	0.64	0.64	0.64	0.64
16.461	0.64	0.64	0.64	0.63	0.63	0.63	0.63
16.505	0.63	0.63	0.63	0.63	0.63	0.63	0.63
16.549	0.63	0.63	0.63	0.63	0.63	0.63	0.63
16.593	0.63	0.63	0.63	0.63	0.63	0.63	0.63
16.637	0.63	0.63	0.63	0.63	0.63	0.63	0.63
16.682	0.63	0.63	0.63	0.63	0.62	0.62	0.62
16.726	0.62	0.62	0.62	0.62	0.62	0.62	0.62
16.770	0.62	0.62	0.62	0.62	0.62	0.62	0.62
16.814	0.62	0.62	0.62	0.62	0.62	0.62	0.62
16.858	0.62	0.62	0.62	0.62	0.62	0.62	0.62
16.903	0.62	0.62	0.62	0.62	0.62	0.62	0.61
16.947	0.61	0.61	0.61	0.61	0.61	0.61	0.61
16.991	0.61	0.61	0.61	0.61	0.61	0.61	0.61
17.035	0.61	0.61	0.61	0.61	0.61	0.61	0.61
17.079	0.61	0.61	0.61	0.61	0.61	0.61	0.61
17.124	0.61	0.61	0.61	0.61	0.61	0.61	0.60
17.168	0.60	0.60	0.60	0.60	0.60	0.60	0.60
17.212	0.60	0.60	0.60	0.60	0.60	0.60	0.60
17.256	0.60	0.60	0.60	0.60	0.60	0.60	0.60
17.301	0.60	0.60	0.60	0.60	0.60	0.60	0.60
17.345	0.60	0.60	0.60	0.60	0.60	0.60	0.59
17.389	0.59	0.59	0.59	0.59	0.59	0.59	0.59
17.433	0.59	0.59	0.59	0.59	0.59	0.59	0.59
17.477	0.59	0.59	0.59	0.59	0.59	0.59	0.59
17.522	0.59	0.59	0.59	0.59	0.59	0.59	0.59
17.566	0.59	0.59	0.59	0.59	0.59	0.59	0.59
17.610	0.59	0.58	0.58	0.58	0.58	0.58	0.58

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development
STORM 2-Yr
SUB-AREA:
Lower Lvl Outlet   .01745   97.   .1
Upper Lvl Outlet   .00559   97.   .1

Brea Mall
Pre-Development

Line Start Time (hr)	Flow Values @ time increment of 0.006 hr (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
17.654	0.58	0.58	0.58	0.58	0.58	0.58	0.58
17.698	0.58	0.58	0.58	0.58	0.58	0.58	0.58
17.743	0.58	0.58	0.58	0.58	0.58	0.58	0.58
17.787	0.58	0.58	0.58	0.58	0.58	0.58	0.58
17.831	0.58	0.58	0.57	0.57	0.57	0.57	0.57
17.875	0.57	0.57	0.57	0.57	0.57	0.57	0.57
17.919	0.57	0.57	0.57	0.57	0.57	0.57	0.57
17.964	0.57	0.57	0.57	0.57	0.57	0.57	0.57
18.008	0.57	0.57	0.57	0.57	0.57	0.57	0.57
18.052	0.57	0.57	0.56	0.56	0.56	0.56	0.56
18.096	0.56	0.56	0.56	0.56	0.56	0.56	0.56
18.141	0.56	0.56	0.56	0.56	0.56	0.56	0.56
18.185	0.56	0.56	0.56	0.56	0.56	0.56	0.56
18.229	0.56	0.56	0.56	0.56	0.56	0.56	0.56
18.273	0.56	0.55	0.55	0.55	0.55	0.55	0.55
18.317	0.55	0.55	0.55	0.55	0.55	0.55	0.55
18.362	0.55	0.55	0.55	0.55	0.55	0.55	0.55
18.406	0.55	0.55	0.55	0.55	0.55	0.55	0.55
18.450	0.55	0.55	0.55	0.55	0.55	0.55	0.55
18.494	0.55	0.55	0.55	0.54	0.54	0.54	0.54
18.538	0.54	0.54	0.54	0.54	0.54	0.54	0.54
18.583	0.54	0.54	0.54	0.54	0.54	0.54	0.54
18.627	0.54	0.54	0.54	0.54	0.54	0.54	0.54
18.671	0.54	0.54	0.54	0.54	0.54	0.54	0.54
18.715	0.54	0.54	0.54	0.54	0.53	0.53	0.53
18.759	0.53	0.53	0.53	0.53	0.53	0.53	0.53
18.804	0.53	0.53	0.53	0.53	0.53	0.53	0.53
18.848	0.53	0.53	0.53	0.53	0.53	0.53	0.53
18.892	0.53	0.53	0.53	0.53	0.53	0.53	0.53

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:
Lower Lvl Outlet   .01745   97.   .1
Upper Lvl Outlet   .00559   97.   .1

18.936	0.53	0.53	0.53	0.53	0.52	0.52	0.52
18.981	0.52	0.52	0.52	0.52	0.52	0.52	0.52
19.025	0.52	0.52	0.52	0.52	0.52	0.52	0.52
19.069	0.52	0.52	0.52	0.52	0.52	0.52	0.52
19.113	0.52	0.52	0.52	0.52	0.52	0.52	0.52
19.157	0.52	0.52	0.52	0.51	0.51	0.51	0.51
19.202	0.51	0.51	0.51	0.51	0.51	0.51	0.51
19.246	0.51	0.51	0.51	0.51	0.51	0.51	0.51
19.290	0.51	0.51	0.51	0.51	0.51	0.51	0.51
19.334	0.51	0.51	0.51	0.51	0.51	0.51	0.51
19.378	0.51	0.51	0.51	0.51	0.50	0.50	0.50
19.423	0.50	0.50	0.50	0.50	0.50	0.50	0.50
19.467	0.50	0.50	0.50	0.50	0.50	0.50	0.50
19.511	0.50	0.50	0.50	0.50	0.50	0.50	0.50
19.555	0.50	0.50	0.50	0.50	0.50	0.50	0.50
19.599	0.50	0.50	0.50	0.50	0.50	0.50	0.49
19.644	0.49	0.49	0.49	0.49	0.49	0.49	0.49
19.688	0.49	0.49	0.49	0.49	0.49	0.49	0.49
19.732	0.49	0.49	0.49	0.49	0.49	0.49	0.49
19.776	0.49	0.49	0.49	0.49	0.49	0.49	0.49
19.821	0.49	0.49	0.49	0.49	0.49	0.49	0.48
19.865	0.48	0.48	0.48	0.48	0.48	0.48	0.48

Line Start Time (hr)	------------ Flow Values @ time increment of 0.006 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
19.909	0.48	0.48	0.48	0.48	0.48	0.48	0.48
19.953	0.48	0.48	0.48	0.48	0.48	0.48	0.48
19.997	0.48	0.48	0.48	0.48	0.48	0.48	0.48
20.042	0.48	0.48	0.48	0.48	0.48	0.47	0.47
20.086	0.47	0.47	0.47	0.47	0.47	0.47	0.47
20.130	0.47	0.47	0.47	0.47	0.47	0.47	0.47

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development
                                             STORM 2-Yr
SUB-AREA:
          Lower Lvl Outlet   .01745   97.   .1
          Upper Lvl Outlet   .00559   97.   .1

20.174	0.47	0.47	0.47	0.47	0.47	0.47	0.47
20.218	0.47	0.47	0.47	0.47	0.47	0.47	0.47
20.263	0.47	0.47	0.47	0.47	0.47	0.46	0.46
20.307	0.46	0.46	0.46	0.46	0.46	0.46	0.46
20.351	0.46	0.46	0.46	0.46	0.46	0.46	0.46
20.395	0.46	0.46	0.46	0.46	0.46	0.46	0.46
20.439	0.46	0.46	0.46	0.46	0.46	0.46	0.46
20.484	0.46	0.46	0.46	0.46	0.46	0.46	0.46
20.528	0.45	0.45	0.45	0.45	0.45	0.45	0.45
20.572	0.45	0.45	0.45	0.45	0.45	0.45	0.45
20.616	0.45	0.45	0.45	0.45	0.45	0.45	0.45
20.661	0.45	0.45	0.45	0.45	0.45	0.45	0.45
20.705	0.45	0.45	0.45	0.45	0.45	0.45	0.45
20.749	0.44	0.44	0.44	0.44	0.44	0.44	0.44
20.793	0.44	0.44	0.44	0.44	0.44	0.44	0.44
20.837	0.44	0.44	0.44	0.44	0.44	0.44	0.44
20.882	0.44	0.44	0.44	0.44	0.44	0.44	0.44
20.926	0.44	0.44	0.44	0.44	0.44	0.44	0.44
20.970	0.43	0.43	0.43	0.43	0.43	0.43	0.43
21.014	0.43	0.43	0.43	0.43	0.43	0.43	0.43
21.058	0.43	0.43	0.43	0.43	0.43	0.43	0.43
21.103	0.43	0.43	0.43	0.43	0.43	0.43	0.43
21.147	0.43	0.43	0.43	0.43	0.43	0.43	0.42
21.191	0.42	0.42	0.42	0.42	0.42	0.42	0.42
21.235	0.42	0.42	0.42	0.42	0.42	0.42	0.42
21.279	0.42	0.42	0.42	0.42	0.42	0.42	0.42
21.324	0.42	0.42	0.42	0.42	0.42	0.42	0.42
21.368	0.42	0.42	0.42	0.42	0.42	0.42	0.42
21.412	0.41	0.41	0.41	0.41	0.41	0.41	0.41
21.456	0.41	0.41	0.41	0.41	0.41	0.41	0.41
21.501	0.41	0.41	0.41	0.41	0.41	0.41	0.41
21.545	0.41	0.41	0.41	0.41	0.41	0.41	0.41
21.589	0.41	0.41	0.41	0.41	0.41	0.41	0.41
21.633	0.41	0.40	0.40	0.40	0.40	0.40	0.40
21.677	0.40	0.40	0.40	0.40	0.40	0.40	0.40
21.722	0.40	0.40	0.40	0.40	0.40	0.40	0.40
21.766	0.40	0.40	0.40	0.40	0.40	0.40	0.40
21.810	0.40	0.40	0.40	0.40	0.40	0.40	0.40

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

21.854	0.40	0.39	0.39	0.39	0.39	0.39	0.39
21.898	0.39	0.39	0.39	0.39	0.39	0.39	0.39
21.943	0.39	0.39	0.39	0.39	0.39	0.39	0.39
21.987	0.39	0.39	0.39	0.39	0.39	0.39	0.39
22.031	0.39	0.39	0.39	0.39	0.39	0.39	0.39
22.075	0.38	0.38	0.38	0.38	0.38	0.38	0.38
22.119	0.38	0.38	0.38	0.38	0.38	0.38	0.38

WinTR-20 Version 1.10   Page 9   02/06/2022 11:07

Brea Mall
Pre-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.006 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
22.164	0.38	0.38	0.38	0.38	0.38	0.38	0.38
22.208	0.38	0.38	0.38	0.38	0.38	0.38	0.38
22.252	0.38	0.38	0.38	0.38	0.38	0.38	0.38
22.296	0.37	0.37	0.37	0.37	0.37	0.37	0.37
22.341	0.37	0.37	0.37	0.37	0.37	0.37	0.37
22.385	0.37	0.37	0.37	0.37	0.37	0.37	0.37
22.429	0.37	0.37	0.37	0.37	0.37	0.37	0.37
22.473	0.37	0.37	0.37	0.37	0.37	0.37	0.37
22.517	0.37	0.37	0.36	0.36	0.36	0.36	0.36
22.562	0.36	0.36	0.36	0.36	0.36	0.36	0.36
22.606	0.36	0.36	0.36	0.36	0.36	0.36	0.36
22.650	0.36	0.36	0.36	0.36	0.36	0.36	0.36
22.694	0.36	0.36	0.36	0.36	0.36	0.36	0.36
22.738	0.36	0.36	0.35	0.35	0.35	0.35	0.35
22.783	0.35	0.35	0.35	0.35	0.35	0.35	0.35
22.827	0.35	0.35	0.35	0.35	0.35	0.35	0.35
22.871	0.35	0.35	0.35	0.35	0.35	0.35	0.35
22.915	0.35	0.35	0.35	0.35	0.35	0.35	0.35
22.959	0.35	0.34	0.34	0.34	0.34	0.34	0.34
23.004	0.34	0.34	0.34	0.34	0.34	0.34	0.34
23.048	0.34	0.34	0.34	0.34	0.34	0.34	0.34

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

23.092	0.34	0.34	0.34	0.34	0.34	0.34	0.34
23.136	0.34	0.34	0.34	0.34	0.34	0.34	0.34
23.181	0.33	0.33	0.33	0.33	0.33	0.33	0.33
23.225	0.33	0.33	0.33	0.33	0.33	0.33	0.33
23.269	0.33	0.33	0.33	0.33	0.33	0.33	0.33
23.313	0.33	0.33	0.33	0.33	0.33	0.33	0.33
23.357	0.33	0.33	0.33	0.33	0.33	0.33	0.33
23.402	0.33	0.32	0.32	0.32	0.32	0.32	0.32
23.446	0.32	0.32	0.32	0.32	0.32	0.32	0.32
23.490	0.32	0.32	0.32	0.32	0.32	0.32	0.32
23.534	0.32	0.32	0.32	0.32	0.32	0.32	0.32
23.578	0.32	0.32	0.32	0.32	0.32	0.32	0.32
23.623	0.32	0.32	0.31	0.31	0.31	0.31	0.31
23.667	0.31	0.31	0.31	0.31	0.31	0.31	0.31
23.711	0.31	0.31	0.31	0.31	0.31	0.31	0.31
23.755	0.31	0.31	0.31	0.31	0.31	0.31	0.31
23.799	0.31	0.31	0.31	0.31	0.31	0.31	0.31
23.844	0.31	0.31	0.30	0.30	0.30	0.30	0.30
23.888	0.30	0.30	0.30	0.30	0.30	0.30	0.30
23.932	0.30	0.30	0.30	0.30	0.30	0.30	0.30
23.976	0.30	0.30	0.30	0.30	0.30	0.30	0.29
24.021	0.29	0.28	0.27	0.25	0.23	0.21	0.19
24.065	0.17	0.15	0.13	0.11	0.09	0.08	0.07
24.109	0.06						

Brea Mall
Pre-Development

Area or Reach	Drainage Area	Rain Gage ID or	Runoff Amount	------------ Peak Flow ------------ Elevation	Time	Rate	Rate

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development
STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

Identifier	(sq mi)	Location	(in)	(ft)	(hr)	(cfs)	(csm)
Upper Lvl	0.006		1.709		9.92	4.78	855.15

Line Start Time (hr)	------------ Flow Values @ time increment of 0.006 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
3.437	0.05	0.05	0.05	0.05	0.05	0.05	0.05
3.482	0.05	0.05	0.05	0.05	0.05	0.05	0.05
3.526	0.05	0.05	0.05	0.05	0.05	0.05	0.05
3.570	0.05	0.05	0.05	0.06	0.06	0.06	0.06
3.614	0.06	0.06	0.06	0.06	0.06	0.06	0.06
3.658	0.06	0.06	0.06	0.06	0.06	0.06	0.06
3.703	0.06	0.06	0.06	0.06	0.06	0.06	0.06
3.747	0.06	0.06	0.06	0.06	0.06	0.06	0.06
3.791	0.06	0.06	0.06	0.06	0.06	0.06	0.06
3.835	0.06	0.06	0.06	0.06	0.06	0.06	0.06
3.879	0.06	0.06	0.07	0.07	0.07	0.07	0.07
3.924	0.07	0.07	0.07	0.07	0.07	0.07	0.07
3.968	0.07	0.07	0.07	0.07	0.07	0.07	0.07
4.012	0.07	0.07	0.07	0.07	0.07	0.07	0.07
4.056	0.07	0.07	0.07	0.07	0.07	0.07	0.07
4.101	0.07	0.07	0.07	0.07	0.07	0.07	0.07
4.145	0.07	0.07	0.07	0.07	0.07	0.07	0.07
4.189	0.07	0.07	0.07	0.07	0.07	0.07	0.08
4.233	0.08	0.08	0.08	0.08	0.08	0.08	0.08
4.277	0.08	0.08	0.08	0.08	0.08	0.08	0.08
4.322	0.08	0.08	0.08	0.08	0.08	0.08	0.08
4.366	0.08	0.08	0.08	0.08	0.08	0.08	0.08
4.410	0.08	0.08	0.08	0.08	0.08	0.08	0.08
4.454	0.08	0.08	0.08	0.08	0.08	0.08	0.08
4.498	0.08	0.08	0.08	0.08	0.08	0.08	0.08
4.543	0.08	0.08	0.08	0.08	0.08	0.08	0.08
4.587	0.08	0.08	0.08	0.09	0.09	0.09	0.09
4.631	0.09	0.09	0.09	0.09	0.09	0.09	0.09
4.675	0.09	0.09	0.09	0.09	0.09	0.09	0.09
4.719	0.09	0.09	0.09	0.09	0.09	0.09	0.09

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

4.764	0.09	0.09	0.09	0.09	0.09	0.09	0.09
4.808	0.09	0.09	0.09	0.09	0.09	0.09	0.09
4.852	0.09	0.09	0.09	0.09	0.09	0.09	0.09
4.896	0.09	0.09	0.09	0.09	0.09	0.09	0.09
4.941	0.09	0.09	0.09	0.09	0.09	0.09	0.09
4.985	0.09	0.09	0.09	0.09	0.09	0.09	0.10
5.029	0.10	0.10	0.10	0.10	0.10	0.10	0.10
5.073	0.10	0.10	0.10	0.10	0.10	0.10	0.10
5.117	0.10	0.10	0.10	0.10	0.10	0.10	0.10
5.162	0.10	0.10	0.10	0.10	0.10	0.10	0.10
5.206	0.10	0.10	0.10	0.10	0.10	0.10	0.10
5.250	0.10	0.10	0.10	0.10	0.10	0.10	0.10
5.294	0.10	0.10	0.10	0.10	0.10	0.10	0.10
5.338	0.10	0.10	0.10	0.10	0.10	0.10	0.10
5.383	0.10	0.10	0.10	0.10	0.10	0.10	0.10

Brea Mall
Pre-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.006 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
5.427	0.10	0.10	0.10	0.10	0.10	0.11	0.11
5.471	0.11	0.11	0.11	0.11	0.11	0.11	0.11
5.515	0.11	0.11	0.11	0.11	0.11	0.11	0.11
5.559	0.11	0.11	0.11	0.11	0.11	0.11	0.11
5.604	0.11	0.11	0.11	0.11	0.11	0.11	0.11
5.648	0.11	0.11	0.11	0.11	0.11	0.11	0.11
5.692	0.11	0.11	0.11	0.11	0.11	0.11	0.11
5.736	0.11	0.11	0.11	0.11	0.11	0.11	0.11
5.781	0.11	0.11	0.11	0.11	0.11	0.11	0.11
5.825	0.11	0.11	0.11	0.11	0.11	0.11	0.11
5.869	0.11	0.11	0.11	0.11	0.11	0.11	0.11
5.913	0.11	0.11	0.12	0.12	0.12	0.12	0.12
5.957	0.12	0.12	0.12	0.12	0.12	0.12	0.12

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

6.002	0.12	0.12	0.12	0.12	0.12	0.12	0.12
6.046	0.12	0.12	0.12	0.12	0.12	0.12	0.12
6.090	0.12	0.12	0.12	0.12	0.12	0.12	0.12
6.134	0.12	0.12	0.12	0.12	0.12	0.12	0.12
6.178	0.12	0.13	0.13	0.13	0.13	0.13	0.13
6.223	0.13	0.13	0.13	0.13	0.13	0.13	0.13
6.267	0.13	0.13	0.13	0.13	0.13	0.13	0.13
6.311	0.13	0.13	0.13	0.13	0.13	0.14	0.14
6.355	0.14	0.14	0.14	0.14	0.14	0.14	0.14
6.399	0.14	0.14	0.14	0.14	0.14	0.14	0.14
6.444	0.14	0.14	0.14	0.14	0.14	0.14	0.15
6.488	0.15	0.15	0.15	0.15	0.15	0.15	0.15
6.532	0.15	0.15	0.15	0.15	0.15	0.15	0.15
6.576	0.15	0.15	0.15	0.15	0.15	0.15	0.15
6.621	0.15	0.16	0.16	0.16	0.16	0.16	0.16
6.665	0.16	0.16	0.16	0.16	0.16	0.16	0.16
6.709	0.16	0.16	0.16	0.16	0.16	0.16	0.16
6.753	0.16	0.17	0.17	0.17	0.17	0.17	0.17
6.797	0.17	0.17	0.17	0.17	0.17	0.17	0.17
6.842	0.17	0.17	0.17	0.17	0.17	0.17	0.17
6.886	0.17	0.17	0.18	0.18	0.18	0.18	0.18
6.930	0.18	0.18	0.18	0.18	0.18	0.18	0.18
6.974	0.18	0.18	0.18	0.18	0.18	0.18	0.18
7.018	0.18	0.18	0.19	0.19	0.19	0.19	0.19
7.063	0.19	0.19	0.19	0.19	0.19	0.19	0.19
7.107	0.19	0.19	0.19	0.19	0.19	0.19	0.19
7.151	0.19	0.19	0.19	0.19	0.19	0.19	0.19
7.195	0.19	0.19	0.19	0.19	0.19	0.19	0.19
7.239	0.19	0.20	0.20	0.20	0.20	0.20	0.20
7.284	0.20	0.20	0.20	0.20	0.20	0.20	0.20
7.328	0.20	0.20	0.20	0.20	0.20	0.20	0.20
7.372	0.20	0.20	0.20	0.20	0.20	0.20	0.20
7.416	0.20	0.20	0.20	0.20	0.20	0.20	0.20
7.461	0.20	0.20	0.20	0.20	0.20	0.20	0.20
7.505	0.20	0.21	0.21	0.21	0.21	0.21	0.21
7.549	0.21	0.21	0.21	0.21	0.21	0.21	0.21
7.593	0.21	0.21	0.21	0.21	0.21	0.21	0.21
7.637	0.21	0.21	0.21	0.21	0.21	0.21	0.21

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

Brea Mall
Pre-Development

Line Start Time (hr)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
	------------ Flow Values @ time increment of 0.006 hr ------------						
7.682	0.21	0.21	0.21	0.21	0.21	0.21	0.21
7.726	0.21	0.21	0.21	0.21	0.21	0.21	0.21
7.770	0.21	0.21	0.21	0.22	0.22	0.22	0.22
7.814	0.22	0.22	0.22	0.22	0.22	0.22	0.22
7.858	0.22	0.22	0.22	0.22	0.22	0.22	0.22
7.903	0.22	0.22	0.22	0.22	0.22	0.22	0.22
7.947	0.22	0.22	0.22	0.22	0.22	0.22	0.22
7.991	0.22	0.22	0.22	0.22	0.22	0.22	0.22
8.035	0.23	0.23	0.23	0.23	0.23	0.23	0.23
8.079	0.23	0.23	0.23	0.23	0.24	0.24	0.24
8.124	0.24	0.24	0.24	0.24	0.24	0.25	0.25
8.168	0.25	0.25	0.25	0.25	0.26	0.26	0.26
8.212	0.26	0.26	0.26	0.26	0.27	0.27	0.27
8.256	0.27	0.27	0.28	0.28	0.28	0.28	0.28
8.301	0.28	0.28	0.29	0.29	0.29	0.29	0.29
8.345	0.29	0.30	0.30	0.30	0.30	0.30	0.31
8.389	0.31	0.31	0.31	0.31	0.31	0.31	0.32
8.433	0.32	0.32	0.32	0.32	0.33	0.33	0.33
8.477	0.33	0.33	0.34	0.34	0.34	0.34	0.34
8.522	0.34	0.34	0.34	0.35	0.35	0.35	0.35
8.566	0.36	0.36	0.36	0.36	0.36	0.36	0.37
8.610	0.37	0.37	0.37	0.37	0.37	0.37	0.38
8.654	0.38	0.38	0.38	0.38	0.39	0.39	0.39
8.698	0.39	0.39	0.39	0.39	0.40	0.40	0.40
8.743	0.40	0.40	0.41	0.41	0.41	0.41	0.41
8.787	0.41	0.42	0.42	0.42	0.42	0.42	0.42
8.831	0.42	0.43	0.43	0.43	0.43	0.43	0.44
8.875	0.44	0.44	0.44	0.44	0.44	0.45	0.45

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

8.919	0.45	0.45	0.45	0.45	0.46	0.46	0.46
8.964	0.46	0.46	0.47	0.47	0.47	0.47	0.47
9.008	0.47	0.48	0.48	0.48	0.48	0.48	0.49
9.052	0.49	0.49	0.49	0.50	0.50	0.50	0.51
9.096	0.51	0.51	0.51	0.51	0.51	0.52	0.52
9.141	0.52	0.53	0.53	0.53	0.54	0.54	0.55
9.185	0.55	0.55	0.55	0.56	0.56	0.56	0.56
9.229	0.57	0.57	0.57	0.58	0.58	0.59	0.59
9.273	0.59	0.60	0.60	0.60	0.61	0.61	0.61
9.317	0.61	0.62	0.62	0.62	0.63	0.63	0.63
9.362	0.64	0.64	0.65	0.65	0.65	0.66	0.66
9.406	0.66	0.66	0.67	0.67	0.67	0.67	0.68
9.450	0.68	0.69	0.69	0.70	0.70	0.70	0.71
9.494	0.71	0.71	0.71	0.72	0.73	0.74	0.75
9.538	0.77	0.79	0.81	0.84	0.86	0.89	0.91
9.583	0.94	0.96	0.97	0.99	1.00	1.02	1.04
9.627	1.06	1.09	1.13	1.18	1.22	1.28	1.33
9.671	1.38	1.42	1.46	1.50	1.53	1.56	1.59
9.715	1.62	1.66	1.70	1.76	1.83	1.91	2.00
9.759	2.09	2.18	2.26	2.34	2.41	2.48	2.54
9.804	2.59	2.64	2.70	2.77	2.86	2.98	3.13
9.848	3.29	3.47	3.65	3.83	4.00	4.16	4.31
9.892	4.44	4.55	4.64	4.71	4.76	4.78	4.78

Brea Mall
Pre-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.006 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
9.936	4.75	4.69	4.62	4.53	4.43	4.33	4.24
9.981	4.15	4.06	3.99	3.93	3.88	3.82	3.75
10.025	3.67	3.56	3.42	3.26	3.08	2.89	2.70
10.069	2.51	2.33	2.17	2.02	1.89	1.79	1.70
10.113	1.62	1.56	1.50	1.45	1.40	1.36	1.32

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet		.01745	97.	.1			
Upper Lvl Outlet		.00559	97.	.1			

10.157	1.29	1.26	1.24	1.21	1.19	1.17	1.16
10.202	1.15	1.13	1.12	1.12	1.11	1.10	1.08
10.246	1.07	1.06	1.05	1.04	1.03	1.02	1.01
10.290	1.00	0.99	0.98	0.98	0.97	0.97	0.96
10.334	0.96	0.95	0.94	0.93	0.92	0.91	0.90
10.378	0.89	0.88	0.87	0.86	0.86	0.85	0.85
10.423	0.84	0.84	0.83	0.82	0.81	0.80	0.79
10.467	0.78	0.77	0.76	0.75	0.74	0.74	0.73
10.511	0.73	0.72	0.72	0.71	0.71	0.70	0.69
10.555	0.69	0.68	0.67	0.67	0.66	0.66	0.65
10.599	0.65	0.64	0.64	0.64	0.64	0.63	0.63
10.644	0.63	0.62	0.62	0.62	0.62	0.61	0.61
10.688	0.61	0.61	0.60	0.60	0.60	0.60	0.60
10.732	0.60	0.60	0.59	0.59	0.59	0.59	0.58
10.776	0.58	0.58	0.58	0.57	0.57	0.57	0.57
10.821	0.57	0.57	0.57	0.56	0.56	0.56	0.56
10.865	0.55	0.55	0.55	0.55	0.55	0.54	0.54
10.909	0.54	0.54	0.54	0.54	0.54	0.53	0.53
10.953	0.53	0.53	0.52	0.52	0.52	0.52	0.51
10.997	0.51	0.51	0.51	0.51	0.51	0.51	0.51
11.042	0.50	0.50	0.50	0.50	0.50	0.49	0.49
11.086	0.49	0.49	0.49	0.49	0.49	0.49	0.49
11.130	0.49	0.48	0.48	0.48	0.48	0.48	0.48
11.174	0.48	0.48	0.48	0.48	0.48	0.48	0.47
11.218	0.47	0.47	0.47	0.47	0.47	0.47	0.47
11.263	0.47	0.47	0.47	0.47	0.47	0.47	0.46
11.307	0.46	0.46	0.46	0.46	0.46	0.46	0.46
11.351	0.46	0.46	0.46	0.46	0.46	0.46	0.45
11.395	0.45	0.45	0.45	0.45	0.45	0.45	0.45
11.439	0.45	0.45	0.45	0.45	0.45	0.45	0.44
11.484	0.44	0.44	0.44	0.44	0.44	0.44	0.44
11.528	0.44	0.44	0.44	0.44	0.44	0.44	0.44
11.572	0.43	0.43	0.43	0.43	0.43	0.43	0.43
11.616	0.43	0.43	0.43	0.43	0.43	0.43	0.43
11.661	0.42	0.42	0.42	0.42	0.42	0.42	0.42
11.705	0.42	0.42	0.42	0.42	0.42	0.42	0.42
11.749	0.42	0.41	0.41	0.41	0.41	0.41	0.41
11.793	0.41	0.41	0.41	0.41	0.41	0.41	0.41

WinTR-20: Version 1.10 0 0 0.05
Mall (continued)
Pre-Development
STORM 2-Yr
SUB-AREA:
Lower Lvl Outlet .01745 97. .1
Upper Lvl Outlet .00559 97. .1

11.837	0.41	0.40	0.40	0.40	0.40	0.40	0.40
11.882	0.40	0.40	0.40	0.40	0.40	0.40	0.40
11.926	0.40	0.40	0.39	0.39	0.39	0.39	0.39
11.970	0.39	0.39	0.39	0.39	0.39	0.39	0.39
12.014	0.39	0.39	0.38	0.38	0.38	0.38	0.38
12.058	0.38	0.38	0.38	0.38	0.38	0.38	0.38
12.103	0.38	0.38	0.38	0.38	0.38	0.37	0.37
12.147	0.37	0.37	0.37	0.37	0.37	0.37	0.37

Brea Mall
Pre-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.006 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
12.191	0.37	0.37	0.37	0.37	0.37	0.37	0.37
12.235	0.37	0.37	0.37	0.37	0.37	0.36	0.36
12.279	0.36	0.36	0.36	0.36	0.36	0.36	0.36
12.324	0.36	0.36	0.36	0.36	0.36	0.36	0.36
12.368	0.36	0.36	0.36	0.36	0.36	0.36	0.36
12.412	0.35	0.35	0.35	0.35	0.35	0.35	0.35
12.456	0.35	0.35	0.35	0.35	0.35	0.35	0.35
12.501	0.35	0.35	0.35	0.35	0.35	0.35	0.35
12.545	0.35	0.35	0.34	0.34	0.34	0.34	0.34
12.589	0.34	0.34	0.34	0.34	0.34	0.34	0.34
12.633	0.34	0.34	0.34	0.34	0.34	0.34	0.34
12.677	0.34	0.34	0.34	0.33	0.33	0.33	0.33
12.722	0.33	0.33	0.33	0.33	0.33	0.33	0.33
12.766	0.33	0.33	0.33	0.33	0.33	0.33	0.33
12.810	0.33	0.33	0.33	0.33	0.33	0.33	0.32
12.854	0.32	0.32	0.32	0.32	0.32	0.32	0.32
12.898	0.32	0.32	0.32	0.32	0.32	0.32	0.32
12.943	0.32	0.32	0.32	0.32	0.32	0.32	0.31
12.987	0.31	0.31	0.31	0.31	0.31	0.31	0.31
13.031	0.31	0.31	0.31	0.31	0.31	0.31	0.31

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

13.075	0.31	0.31	0.31	0.31	0.31	0.31	0.31
13.119	0.31	0.31	0.30	0.30	0.30	0.30	0.30
13.164	0.30	0.30	0.30	0.30	0.30	0.30	0.30
13.208	0.30	0.30	0.30	0.30	0.30	0.30	0.30
13.252	0.30	0.30	0.29	0.29	0.29	0.29	0.29
13.296	0.29	0.29	0.29	0.29	0.29	0.29	0.29
13.341	0.29	0.29	0.29	0.29	0.29	0.29	0.29
13.385	0.29	0.29	0.29	0.28	0.28	0.28	0.28
13.429	0.28	0.28	0.28	0.28	0.28	0.28	0.28
13.473	0.28	0.28	0.28	0.28	0.28	0.28	0.28
13.517	0.28	0.28	0.28	0.28	0.28	0.27	0.27
13.562	0.27	0.27	0.27	0.27	0.27	0.27	0.27
13.606	0.27	0.27	0.27	0.27	0.27	0.27	0.27
13.650	0.27	0.27	0.27	0.27	0.27	0.26	0.26
13.694	0.26	0.26	0.26	0.26	0.26	0.26	0.26
13.738	0.26	0.26	0.26	0.26	0.26	0.26	0.26
13.783	0.26	0.26	0.26	0.26	0.26	0.26	0.26
13.827	0.26	0.25	0.25	0.25	0.25	0.25	0.25
13.871	0.25	0.25	0.25	0.25	0.25	0.25	0.25
13.915	0.25	0.25	0.25	0.25	0.25	0.25	0.25
13.959	0.25	0.24	0.24	0.24	0.24	0.24	0.24
14.004	0.24	0.24	0.24	0.24	0.24	0.24	0.24
14.048	0.24	0.24	0.24	0.24	0.24	0.24	0.24
14.092	0.24	0.24	0.24	0.24	0.24	0.24	0.24
14.136	0.24	0.24	0.24	0.24	0.24	0.24	0.24
14.181	0.24	0.24	0.24	0.24	0.24	0.24	0.24
14.225	0.24	0.24	0.23	0.23	0.23	0.23	0.23
14.269	0.23	0.23	0.23	0.23	0.23	0.23	0.23
14.313	0.23	0.23	0.23	0.23	0.23	0.23	0.23
14.357	0.23	0.23	0.23	0.23	0.23	0.23	0.23
14.402	0.23	0.23	0.23	0.23	0.23	0.23	0.23

Brea Mall
Pre-Development

Line

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

Start Time	------------ Flow Values @ time increment of 0.006 hr ------------						
(hr)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
14.446	0.23	0.23	0.23	0.23	0.23	0.23	0.23
14.490	0.23	0.23	0.23	0.23	0.23	0.23	0.23
14.534	0.23	0.23	0.23	0.23	0.23	0.23	0.23
14.578	0.23	0.23	0.23	0.23	0.23	0.23	0.23
14.623	0.23	0.23	0.23	0.23	0.23	0.23	0.23
14.667	0.23	0.23	0.23	0.23	0.23	0.23	0.23
14.711	0.23	0.23	0.23	0.23	0.23	0.23	0.23
14.755	0.23	0.23	0.23	0.23	0.23	0.23	0.23
14.799	0.23	0.23	0.23	0.23	0.23	0.23	0.23
14.844	0.23	0.23	0.23	0.23	0.23	0.23	0.23
14.888	0.23	0.23	0.23	0.23	0.23	0.23	0.23
14.932	0.23	0.23	0.23	0.22	0.22	0.22	0.22
14.976	0.22	0.22	0.22	0.22	0.22	0.22	0.22
15.021	0.22	0.22	0.22	0.22	0.22	0.22	0.22
15.065	0.22	0.22	0.22	0.22	0.22	0.22	0.22
15.109	0.22	0.22	0.22	0.22	0.22	0.22	0.22
15.153	0.22	0.22	0.22	0.22	0.22	0.22	0.22
15.197	0.22	0.22	0.22	0.22	0.22	0.22	0.22
15.242	0.22	0.22	0.22	0.22	0.22	0.22	0.22
15.286	0.22	0.22	0.22	0.22	0.22	0.22	0.22
15.330	0.22	0.22	0.22	0.22	0.22	0.22	0.22
15.374	0.22	0.22	0.22	0.22	0.22	0.22	0.22
15.418	0.22	0.22	0.22	0.22	0.22	0.22	0.22
15.463	0.22	0.22	0.22	0.22	0.22	0.22	0.22
15.507	0.22	0.22	0.22	0.22	0.22	0.22	0.22
15.551	0.22	0.22	0.22	0.22	0.22	0.22	0.22
15.595	0.22	0.22	0.22	0.22	0.22	0.22	0.22
15.639	0.22	0.22	0.22	0.21	0.21	0.21	0.21
15.684	0.21	0.21	0.21	0.21	0.21	0.21	0.21
15.728	0.21	0.21	0.21	0.21	0.21	0.21	0.21
15.772	0.21	0.21	0.21	0.21	0.21	0.21	0.21
15.816	0.21	0.21	0.21	0.21	0.21	0.21	0.21
15.861	0.21	0.21	0.21	0.21	0.21	0.21	0.21
15.905	0.21	0.21	0.21	0.21	0.21	0.21	0.21
15.949	0.21	0.21	0.21	0.21	0.21	0.21	0.21

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

15.993	0.21	0.21	0.21	0.21	0.21	0.21	0.21
16.037	0.21	0.21	0.21	0.21	0.21	0.21	0.21
16.082	0.21	0.21	0.21	0.21	0.21	0.21	0.21
16.126	0.21	0.21	0.21	0.21	0.21	0.21	0.21
16.170	0.21	0.21	0.21	0.21	0.21	0.21	0.21
16.214	0.21	0.21	0.21	0.21	0.21	0.21	0.21
16.258	0.21	0.21	0.21	0.21	0.21	0.21	0.21
16.303	0.21	0.21	0.21	0.21	0.21	0.21	0.21
16.347	0.21	0.21	0.21	0.20	0.20	0.20	0.20
16.391	0.20	0.20	0.20	0.20	0.20	0.20	0.20
16.435	0.20	0.20	0.20	0.20	0.20	0.20	0.20
16.479	0.20	0.20	0.20	0.20	0.20	0.20	0.20
16.524	0.20	0.20	0.20	0.20	0.20	0.20	0.20
16.568	0.20	0.20	0.20	0.20	0.20	0.20	0.20
16.612	0.20	0.20	0.20	0.20	0.20	0.20	0.20
16.656	0.20	0.20	0.20	0.20	0.20	0.20	0.20

Brea Mall
Pre-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.006 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
16.701	0.20	0.20	0.20	0.20	0.20	0.20	0.20
16.745	0.20	0.20	0.20	0.20	0.20	0.20	0.20
16.789	0.20	0.20	0.20	0.20	0.20	0.20	0.20
16.833	0.20	0.20	0.20	0.20	0.20	0.20	0.20
16.877	0.20	0.20	0.20	0.20	0.20	0.20	0.20
16.922	0.20	0.20	0.20	0.20	0.20	0.20	0.20
16.966	0.20	0.20	0.20	0.20	0.20	0.20	0.20
17.010	0.20	0.20	0.20	0.20	0.20	0.20	0.20
17.054	0.20	0.20	0.20	0.19	0.19	0.19	0.19
17.098	0.19	0.19	0.19	0.19	0.19	0.19	0.19
17.143	0.19	0.19	0.19	0.19	0.19	0.19	0.19
17.187	0.19	0.19	0.19	0.19	0.19	0.19	0.19

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

17.231	0.19	0.19	0.19	0.19	0.19	0.19	0.19
17.275	0.19	0.19	0.19	0.19	0.19	0.19	0.19
17.319	0.19	0.19	0.19	0.19	0.19	0.19	0.19
17.364	0.19	0.19	0.19	0.19	0.19	0.19	0.19
17.408	0.19	0.19	0.19	0.19	0.19	0.19	0.19
17.452	0.19	0.19	0.19	0.19	0.19	0.19	0.19
17.496	0.19	0.19	0.19	0.19	0.19	0.19	0.19
17.541	0.19	0.19	0.19	0.19	0.19	0.19	0.19
17.585	0.19	0.19	0.19	0.19	0.19	0.19	0.19
17.629	0.19	0.19	0.19	0.19	0.19	0.19	0.19
17.673	0.19	0.19	0.19	0.19	0.19	0.19	0.19
17.717	0.19	0.19	0.19	0.19	0.19	0.19	0.19
17.762	0.19	0.19	0.18	0.18	0.18	0.18	0.18
17.806	0.18	0.18	0.18	0.18	0.18	0.18	0.18
17.850	0.18	0.18	0.18	0.18	0.18	0.18	0.18
17.894	0.18	0.18	0.18	0.18	0.18	0.18	0.18
17.938	0.18	0.18	0.18	0.18	0.18	0.18	0.18
17.983	0.18	0.18	0.18	0.18	0.18	0.18	0.18
18.027	0.18	0.18	0.18	0.18	0.18	0.18	0.18
18.071	0.18	0.18	0.18	0.18	0.18	0.18	0.18
18.115	0.18	0.18	0.18	0.18	0.18	0.18	0.18
18.159	0.18	0.18	0.18	0.18	0.18	0.18	0.18
18.204	0.18	0.18	0.18	0.18	0.18	0.18	0.18
18.248	0.18	0.18	0.18	0.18	0.18	0.18	0.18
18.292	0.18	0.18	0.18	0.18	0.18	0.18	0.18
18.336	0.18	0.18	0.18	0.18	0.18	0.18	0.18
18.381	0.18	0.18	0.18	0.18	0.18	0.18	0.18
18.425	0.18	0.18	0.18	0.18	0.18	0.18	0.18
18.469	0.18	0.17	0.17	0.17	0.17	0.17	0.17
18.513	0.17	0.17	0.17	0.17	0.17	0.17	0.17
18.557	0.17	0.17	0.17	0.17	0.17	0.17	0.17
18.602	0.17	0.17	0.17	0.17	0.17	0.17	0.17
18.646	0.17	0.17	0.17	0.17	0.17	0.17	0.17
18.690	0.17	0.17	0.17	0.17	0.17	0.17	0.17
18.734	0.17	0.17	0.17	0.17	0.17	0.17	0.17
18.778	0.17	0.17	0.17	0.17	0.17	0.17	0.17
18.823	0.17	0.17	0.17	0.17	0.17	0.17	0.17
18.867	0.17	0.17	0.17	0.17	0.17	0.17	0.17

WinTR-20 Printed Page File   Beginning of Input Data List
TR20.inp

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development
STORM 2-Yr
SUB-AREA:
Lower Lvl Outlet   .01745   97.   .1
Upper Lvl Outlet   .00559   97.   .1

18.911	0.17	0.17	0.17	0.17	0.17	0.17	0.17

Brea Mall
Pre-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.006 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
18.955	0.17	0.17	0.17	0.17	0.17	0.17	0.17
18.999	0.17	0.17	0.17	0.17	0.17	0.17	0.17
19.044	0.17	0.17	0.17	0.17	0.17	0.17	0.17
19.088	0.17	0.17	0.17	0.17	0.17	0.17	0.17
19.132	0.17	0.17	0.17	0.17	0.17	0.17	0.17
19.176	0.16	0.16	0.16	0.16	0.16	0.16	0.16
19.221	0.16	0.16	0.16	0.16	0.16	0.16	0.16
19.265	0.16	0.16	0.16	0.16	0.16	0.16	0.16
19.309	0.16	0.16	0.16	0.16	0.16	0.16	0.16
19.353	0.16	0.16	0.16	0.16	0.16	0.16	0.16
19.397	0.16	0.16	0.16	0.16	0.16	0.16	0.16
19.442	0.16	0.16	0.16	0.16	0.16	0.16	0.16
19.486	0.16	0.16	0.16	0.16	0.16	0.16	0.16
19.530	0.16	0.16	0.16	0.16	0.16	0.16	0.16
19.574	0.16	0.16	0.16	0.16	0.16	0.16	0.16
19.618	0.16	0.16	0.16	0.16	0.16	0.16	0.16
19.663	0.16	0.16	0.16	0.16	0.16	0.16	0.16
19.707	0.16	0.16	0.16	0.16	0.16	0.16	0.16
19.751	0.16	0.16	0.16	0.16	0.16	0.16	0.16
19.795	0.16	0.16	0.16	0.16	0.16	0.16	0.16
19.839	0.16	0.16	0.16	0.16	0.16	0.16	0.15
19.884	0.15	0.15	0.15	0.15	0.15	0.15	0.15
19.928	0.15	0.15	0.15	0.15	0.15	0.15	0.15
19.972	0.15	0.15	0.15	0.15	0.15	0.15	0.15
20.016	0.15	0.15	0.15	0.15	0.15	0.15	0.15
20.061	0.15	0.15	0.15	0.15	0.15	0.15	0.15
20.105	0.15	0.15	0.15	0.15	0.15	0.15	0.15

WinTR-20: Version 1.10 0 0 0.05
Mall (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

20.149	0.15	0.15	0.15	0.15	0.15	0.15	0.15
20.193	0.15	0.15	0.15	0.15	0.15	0.15	0.15
20.237	0.15	0.15	0.15	0.15	0.15	0.15	0.15
20.282	0.15	0.15	0.15	0.15	0.15	0.15	0.15
20.326	0.15	0.15	0.15	0.15	0.15	0.15	0.15
20.370	0.15	0.15	0.15	0.15	0.15	0.15	0.15
20.414	0.15	0.15	0.15	0.15	0.15	0.15	0.15
20.458	0.15	0.15	0.15	0.15	0.15	0.15	0.15
20.503	0.15	0.15	0.15	0.15	0.15	0.15	0.15
20.547	0.15	0.15	0.15	0.15	0.14	0.14	0.14
20.591	0.14	0.14	0.14	0.14	0.14	0.14	0.14
20.635	0.14	0.14	0.14	0.14	0.14	0.14	0.14
20.679	0.14	0.14	0.14	0.14	0.14	0.14	0.14
20.724	0.14	0.14	0.14	0.14	0.14	0.14	0.14
20.768	0.14	0.14	0.14	0.14	0.14	0.14	0.14
20.812	0.14	0.14	0.14	0.14	0.14	0.14	0.14
20.856	0.14	0.14	0.14	0.14	0.14	0.14	0.14
20.901	0.14	0.14	0.14	0.14	0.14	0.14	0.14
20.945	0.14	0.14	0.14	0.14	0.14	0.14	0.14
20.989	0.14	0.14	0.14	0.14	0.14	0.14	0.14
21.033	0.14	0.14	0.14	0.14	0.14	0.14	0.14
21.077	0.14	0.14	0.14	0.14	0.14	0.14	0.14
21.122	0.14	0.14	0.14	0.14	0.14	0.14	0.14
21.166	0.14	0.14	0.14	0.14	0.14	0.14	0.14

Line Start Time (hr)	------------ Flow Values @ time increment of 0.006 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
21.210	0.14	0.14	0.14	0.14	0.14	0.14	0.14
21.254	0.14	0.14	0.13	0.13	0.13	0.13	0.13
21.298	0.13	0.13	0.13	0.13	0.13	0.13	0.13
21.343	0.13	0.13	0.13	0.13	0.13	0.13	0.13

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

21.387	0.13	0.13	0.13	0.13	0.13	0.13	0.13
21.431	0.13	0.13	0.13	0.13	0.13	0.13	0.13
21.475	0.13	0.13	0.13	0.13	0.13	0.13	0.13
21.519	0.13	0.13	0.13	0.13	0.13	0.13	0.13
21.564	0.13	0.13	0.13	0.13	0.13	0.13	0.13
21.608	0.13	0.13	0.13	0.13	0.13	0.13	0.13
21.652	0.13	0.13	0.13	0.13	0.13	0.13	0.13
21.696	0.13	0.13	0.13	0.13	0.13	0.13	0.13
21.741	0.13	0.13	0.13	0.13	0.13	0.13	0.13
21.785	0.13	0.13	0.13	0.13	0.13	0.13	0.13
21.829	0.13	0.13	0.13	0.13	0.13	0.13	0.13
21.873	0.13	0.13	0.13	0.13	0.13	0.13	0.13
21.917	0.13	0.13	0.13	0.13	0.13	0.13	0.13
21.962	0.12	0.12	0.12	0.12	0.12	0.12	0.12
22.006	0.12	0.12	0.12	0.12	0.12	0.12	0.12
22.050	0.12	0.12	0.12	0.12	0.12	0.12	0.12
22.094	0.12	0.12	0.12	0.12	0.12	0.12	0.12
22.138	0.12	0.12	0.12	0.12	0.12	0.12	0.12
22.183	0.12	0.12	0.12	0.12	0.12	0.12	0.12
22.227	0.12	0.12	0.12	0.12	0.12	0.12	0.12
22.271	0.12	0.12	0.12	0.12	0.12	0.12	0.12
22.315	0.12	0.12	0.12	0.12	0.12	0.12	0.12
22.359	0.12	0.12	0.12	0.12	0.12	0.12	0.12
22.404	0.12	0.12	0.12	0.12	0.12	0.12	0.12
22.448	0.12	0.12	0.12	0.12	0.12	0.12	0.12
22.492	0.12	0.12	0.12	0.12	0.12	0.12	0.12
22.536	0.12	0.12	0.12	0.12	0.12	0.12	0.12
22.581	0.12	0.12	0.12	0.12	0.12	0.12	0.12
22.625	0.12	0.12	0.12	0.12	0.12	0.11	0.11
22.669	0.11	0.11	0.11	0.11	0.11	0.11	0.11
22.713	0.11	0.11	0.11	0.11	0.11	0.11	0.11
22.757	0.11	0.11	0.11	0.11	0.11	0.11	0.11
22.802	0.11	0.11	0.11	0.11	0.11	0.11	0.11
22.846	0.11	0.11	0.11	0.11	0.11	0.11	0.11
22.890	0.11	0.11	0.11	0.11	0.11	0.11	0.11
22.934	0.11	0.11	0.11	0.11	0.11	0.11	0.11
22.978	0.11	0.11	0.11	0.11	0.11	0.11	0.11
23.023	0.11	0.11	0.11	0.11	0.11	0.11	0.11

WinTR-20 Printed Page File   Beginning of Input Data List
TR20.inp

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development
STORM 2-Yr
SUB-AREA:
Lower Lvl Outlet   .01745   97.   .1
Upper Lvl Outlet   .00559   97.   .1

23.067	0.11	0.11	0.11	0.11	0.11	0.11	0.11
23.111	0.11	0.11	0.11	0.11	0.11	0.11	0.11
23.155	0.11	0.11	0.11	0.11	0.11	0.11	0.11
23.199	0.11	0.11	0.11	0.11	0.11	0.11	0.11
23.244	0.11	0.11	0.11	0.11	0.11	0.11	0.11
23.288	0.11	0.11	0.11	0.11	0.11	0.11	0.11
23.332	0.11	0.11	0.11	0.10	0.10	0.10	0.10
23.376	0.10	0.10	0.10	0.10	0.10	0.10	0.10
23.421	0.10	0.10	0.10	0.10	0.10	0.10	0.10

Brea Mall
Pre-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.006 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
23.465	0.10	0.10	0.10	0.10	0.10	0.10	0.10
23.509	0.10	0.10	0.10	0.10	0.10	0.10	0.10
23.553	0.10	0.10	0.10	0.10	0.10	0.10	0.10
23.597	0.10	0.10	0.10	0.10	0.10	0.10	0.10
23.642	0.10	0.10	0.10	0.10	0.10	0.10	0.10
23.686	0.10	0.10	0.10	0.10	0.10	0.10	0.10
23.730	0.10	0.10	0.10	0.10	0.10	0.10	0.10
23.774	0.10	0.10	0.10	0.10	0.10	0.10	0.10
23.818	0.10	0.10	0.10	0.10	0.10	0.10	0.10
23.863	0.10	0.10	0.10	0.10	0.10	0.10	0.10
23.907	0.10	0.10	0.10	0.10	0.10	0.10	0.10
23.951	0.10	0.10	0.10	0.10	0.10	0.10	0.10
23.995	0.10	0.10	0.10	0.09	0.09	0.09	0.09
24.039	0.08	0.08	0.07	0.06	0.05		

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	------------ Peak Flow ------------ Elevation (ft)	Time (hr)	Rate (cfs)	Rate (csm)

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:
Lower Lvl Outlet   .01745   97.   .1
Upper Lvl Outlet   .00559   97.   .1

OUTLET   0.023   1.717   9.92   19.70   855.15

Line Start Time (hr)	Flow Values @ time increment of 0.006 hr (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
2.357	0.05	0.05	0.05	0.05	0.05	0.05	0.05
2.402	0.05	0.06	0.06	0.06	0.06	0.06	0.06
2.446	0.06	0.06	0.06	0.06	0.06	0.06	0.06
2.490	0.06	0.06	0.06	0.06	0.07	0.07	0.07
2.534	0.07	0.07	0.07	0.07	0.07	0.07	0.07
2.578	0.07	0.07	0.07	0.07	0.07	0.07	0.08
2.623	0.08	0.08	0.08	0.08	0.08	0.08	0.08
2.667	0.08	0.08	0.08	0.08	0.08	0.08	0.08
2.711	0.08	0.08	0.09	0.09	0.09	0.09	0.09
2.755	0.09	0.09	0.09	0.09	0.09	0.09	0.09
2.799	0.09	0.09	0.09	0.09	0.10	0.10	0.10
2.844	0.10	0.10	0.10	0.10	0.10	0.10	0.10
2.888	0.10	0.10	0.10	0.10	0.10	0.10	0.10
2.932	0.11	0.11	0.11	0.11	0.11	0.11	0.11
2.976	0.11	0.11	0.11	0.11	0.11	0.11	0.11
3.021	0.11	0.12	0.12	0.12	0.12	0.12	0.12
3.065	0.12	0.12	0.12	0.12	0.12	0.12	0.12
3.109	0.12	0.12	0.12	0.13	0.13	0.13	0.13
3.153	0.13	0.13	0.13	0.13	0.13	0.13	0.13
3.197	0.13	0.13	0.13	0.13	0.14	0.14	0.14
3.242	0.14	0.14	0.14	0.14	0.14	0.14	0.14
3.286	0.14	0.14	0.14	0.14	0.14	0.14	0.14
3.330	0.15	0.15	0.15	0.15	0.15	0.15	0.15
3.374	0.15	0.15	0.15	0.15	0.15	0.15	0.15
3.418	0.15	0.16	0.16	0.21	0.21	0.21	0.21
3.463	0.21	0.21	0.21	0.21	0.21	0.21	0.22

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

Line Start Time (hr)	------------ Flow Values @ time increment of 0.006 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
3.507	0.22	0.22	0.22	0.22	0.22	0.22	0.22
3.551	0.22	0.22	0.22	0.22	0.23	0.23	0.23
3.595	0.23	0.23	0.23	0.23	0.23	0.23	0.23
3.639	0.23	0.23	0.24	0.24	0.24	0.24	0.24
3.684	0.24	0.24	0.24	0.24	0.24	0.24	0.25
3.728	0.25	0.25	0.25	0.25	0.25	0.25	0.25
3.772	0.25	0.25	0.25	0.25	0.26	0.26	0.26
3.816	0.26	0.26	0.26	0.26	0.26	0.26	0.26
3.861	0.26	0.26	0.27	0.27	0.27	0.27	0.27
3.905	0.27	0.27	0.27	0.27	0.27	0.27	0.27
3.949	0.28	0.28	0.28	0.28	0.28	0.28	0.28
3.993	0.28	0.28	0.28	0.28	0.29	0.29	0.29
4.037	0.29	0.29	0.29	0.29	0.29	0.29	0.29
4.082	0.29	0.29	0.30	0.30	0.30	0.30	0.30
4.126	0.30	0.30	0.30	0.30	0.30	0.30	0.30
4.170	0.30	0.30	0.31	0.31	0.31	0.31	0.31
4.214	0.31	0.31	0.31	0.31	0.31	0.31	0.31
4.258	0.31	0.31	0.31	0.32	0.32	0.32	0.32
4.303	0.32	0.32	0.32	0.32	0.32	0.32	0.32
4.347	0.32	0.32	0.32	0.33	0.33	0.33	0.33
4.391	0.33	0.33	0.33	0.33	0.33	0.33	0.33
4.435	0.33	0.33	0.33	0.34	0.34	0.34	0.34
4.479	0.34	0.34	0.34	0.34	0.34	0.34	0.34
4.524	0.34	0.34	0.34	0.34	0.34	0.35	0.35
4.568	0.35	0.35	0.35	0.35	0.35	0.35	0.35
4.612	0.35	0.35	0.35	0.35	0.35	0.35	0.36
4.656	0.36	0.36	0.36	0.36	0.36	0.36	0.36
4.701	0.36	0.36	0.36	0.36	0.36	0.36	0.36
4.745	0.36	0.37	0.37	0.37	0.37	0.37	0.37
4.789	0.37	0.37	0.37	0.37	0.37	0.37	0.37
4.833	0.37	0.37	0.37	0.38	0.38	0.38	0.38
4.877	0.38	0.38	0.38	0.38	0.38	0.38	0.38
4.922	0.38	0.38	0.38	0.38	0.39	0.39	0.39
4.966	0.39	0.39	0.39	0.39	0.39	0.39	0.39

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

5.010	0.39	0.39	0.39	0.39	0.39	0.39	0.39
5.054	0.40	0.40	0.40	0.40	0.40	0.40	0.40
5.098	0.40	0.40	0.40	0.40	0.40	0.40	0.40
5.143	0.40	0.40	0.40	0.41	0.41	0.41	0.41
5.187	0.41	0.41	0.41	0.41	0.41	0.41	0.41
5.231	0.41	0.41	0.41	0.41	0.41	0.41	0.42
5.275	0.42	0.42	0.42	0.42	0.42	0.42	0.42
5.319	0.42	0.42	0.42	0.42	0.42	0.42	0.42
5.364	0.42	0.43	0.43	0.43	0.43	0.43	0.43
5.408	0.43	0.43	0.43	0.43	0.43	0.43	0.43
5.452	0.43	0.43	0.43	0.43	0.43	0.44	0.44
5.496	0.44	0.44	0.44	0.44	0.44	0.44	0.44
5.541	0.44	0.44	0.44	0.44	0.44	0.44	0.44
5.585	0.44	0.44	0.45	0.45	0.45	0.45	0.45
5.629	0.45	0.45	0.45	0.45	0.45	0.45	0.45
5.673	0.45	0.45	0.45	0.45	0.45	0.45	0.45
5.717	0.46	0.46	0.46	0.46	0.46	0.46	0.46

Brea Mall
Pre-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.006 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
5.762	0.46	0.46	0.46	0.46	0.46	0.46	0.46
5.806	0.46	0.46	0.46	0.46	0.46	0.47	0.47
5.850	0.47	0.47	0.47	0.47	0.47	0.47	0.47
5.894	0.47	0.47	0.47	0.47	0.47	0.47	0.47
5.938	0.48	0.48	0.48	0.48	0.48	0.48	0.48
5.983	0.48	0.48	0.48	0.48	0.48	0.48	0.48
6.027	0.48	0.48	0.48	0.48	0.49	0.49	0.49
6.071	0.49	0.49	0.49	0.49	0.49	0.49	0.50
6.115	0.50	0.50	0.50	0.50	0.50	0.50	0.51
6.159	0.51	0.51	0.51	0.52	0.52	0.52	0.52
6.204	0.52	0.52	0.52	0.53	0.53	0.53	0.53

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

6.248	0.53	0.53	0.54	0.54	0.54	0.54	0.54
6.292	0.55	0.55	0.55	0.55	0.55	0.55	0.55
6.336	0.56	0.56	0.56	0.56	0.56	0.57	0.57
6.381	0.57	0.57	0.57	0.57	0.58	0.58	0.58
6.425	0.58	0.58	0.58	0.59	0.59	0.59	0.59
6.469	0.59	0.60	0.60	0.60	0.60	0.60	0.61
6.513	0.61	0.61	0.61	0.61	0.61	0.62	0.62
6.557	0.62	0.62	0.62	0.63	0.63	0.63	0.63
6.602	0.63	0.63	0.64	0.64	0.64	0.64	0.64
6.646	0.65	0.65	0.65	0.65	0.66	0.66	0.66
6.690	0.66	0.66	0.67	0.67	0.67	0.67	0.67
6.734	0.67	0.67	0.68	0.68	0.68	0.68	0.69
6.778	0.69	0.69	0.69	0.69	0.69	0.70	0.70
6.823	0.70	0.70	0.70	0.70	0.71	0.71	0.71
6.867	0.71	0.72	0.72	0.72	0.72	0.72	0.72
6.911	0.73	0.73	0.73	0.73	0.73	0.73	0.74
6.955	0.74	0.74	0.75	0.75	0.75	0.75	0.75
6.999	0.76	0.76	0.76	0.76	0.76	0.76	0.76
7.044	0.77	0.77	0.77	0.77	0.77	0.78	0.78
7.088	0.78	0.78	0.78	0.78	0.78	0.79	0.79
7.132	0.79	0.79	0.79	0.79	0.79	0.79	0.79
7.176	0.79	0.80	0.80	0.80	0.80	0.80	0.80
7.221	0.80	0.80	0.80	0.80	0.80	0.81	0.81
7.265	0.81	0.81	0.81	0.81	0.81	0.81	0.81
7.309	0.81	0.82	0.82	0.82	0.82	0.82	0.82
7.353	0.82	0.82	0.82	0.83	0.83	0.83	0.83
7.397	0.83	0.83	0.83	0.83	0.83	0.83	0.84
7.442	0.84	0.84	0.84	0.84	0.84	0.84	0.84
7.486	0.84	0.84	0.84	0.84	0.85	0.85	0.85
7.530	0.85	0.85	0.85	0.85	0.85	0.85	0.85
7.574	0.86	0.86	0.86	0.86	0.86	0.86	0.86
7.618	0.86	0.86	0.86	0.86	0.87	0.87	0.87
7.663	0.87	0.87	0.87	0.87	0.87	0.87	0.87
7.707	0.87	0.87	0.88	0.88	0.88	0.88	0.88
7.751	0.88	0.88	0.88	0.88	0.89	0.89	0.89
7.795	0.89	0.89	0.89	0.89	0.89	0.89	0.89
7.839	0.89	0.90	0.90	0.90	0.90	0.90	0.90
7.884	0.90	0.90	0.90	0.91	0.91	0.91	0.91

WinTR-20: Version 1.10 0 0 0.05
Mall (continued)
Pre-Development
STORM 2-Yr
SUB-AREA:
Lower Lvl Outlet .01745 97. .1
Upper Lvl Outlet .00559 97. .1

7.928	0.91	0.91	0.91	0.91	0.91	0.91	0.91
7.972	0.91	0.92	0.92	0.92	0.92	0.92	0.92

Brea Mall
Pre-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.006 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
8.016	0.92	0.92	0.92	0.93	0.93	0.94	0.94
8.061	0.94	0.95	0.95	0.96	0.96	0.96	0.97
8.105	0.97	0.97	0.98	0.98	0.98	0.99	1.00
8.149	1.00	1.01	1.02	1.03	1.04	1.04	1.05
8.193	1.06	1.06	1.07	1.07	1.07	1.08	1.09
8.237	1.09	1.10	1.11	1.12	1.13	1.14	1.14
8.282	1.15	1.16	1.16	1.17	1.17	1.18	1.18
8.326	1.19	1.20	1.20	1.21	1.22	1.23	1.24
8.370	1.25	1.26	1.26	1.27	1.28	1.28	1.29
8.414	1.29	1.30	1.30	1.31	1.32	1.32	1.33
8.458	1.34	1.35	1.36	1.37	1.38	1.38	1.39
8.503	1.39	1.40	1.40	1.41	1.41	1.42	1.43
8.547	1.44	1.45	1.46	1.46	1.47	1.48	1.49
8.591	1.49	1.50	1.51	1.51	1.52	1.52	1.53
8.635	1.53	1.54	1.55	1.56	1.57	1.58	1.58
8.679	1.59	1.60	1.61	1.61	1.62	1.62	1.63
8.724	1.63	1.64	1.64	1.65	1.66	1.67	1.68
8.768	1.69	1.70	1.70	1.71	1.72	1.72	1.73
8.812	1.73	1.74	1.74	1.75	1.76	1.76	1.77
8.856	1.78	1.79	1.80	1.81	1.81	1.82	1.83
8.901	1.83	1.84	1.84	1.85	1.85	1.86	1.87
8.945	1.88	1.89	1.89	1.90	1.91	1.92	1.93
8.989	1.94	1.94	1.95	1.95	1.96	1.96	1.97
9.033	1.98	1.99	2.00	2.01	2.03	2.04	2.05
9.077	2.06	2.07	2.08	2.09	2.10	2.11	2.11
9.122	2.12	2.13	2.14	2.16	2.17	2.19	2.20

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

9.166	2.22	2.24	2.25	2.26	2.28	2.29	2.30
9.210	2.30	2.31	2.32	2.33	2.35	2.36	2.38
9.254	2.40	2.41	2.43	2.45	2.46	2.48	2.49
9.298	2.50	2.51	2.52	2.53	2.54	2.55	2.56
9.343	2.58	2.59	2.61	2.63	2.65	2.66	2.68
9.387	2.69	2.70	2.72	2.72	2.73	2.74	2.75
9.431	2.77	2.78	2.80	2.81	2.83	2.85	2.87
9.475	2.88	2.90	2.91	2.92	2.93	2.95	2.96
9.519	2.99	3.03	3.09	3.16	3.25	3.35	3.46
9.564	3.56	3.67	3.77	3.86	3.94	4.01	4.07
9.608	4.13	4.20	4.28	4.38	4.50	4.66	4.85
9.652	5.05	5.26	5.47	5.67	5.86	6.03	6.19
9.696	6.32	6.44	6.55	6.68	6.83	7.02	7.26
9.741	7.55	7.88	8.24	8.60	8.97	9.32	9.65
9.785	9.95	10.22	10.45	10.66	10.87	11.11	11.41
9.829	11.80	12.29	12.89	13.57	14.29	15.04	15.78
9.873	16.48	17.14	17.75	18.29	18.75	19.12	19.40
9.917	19.60	19.70	19.70	19.57	19.34	19.03	18.66
9.962	18.26	17.86	17.46	17.09	16.75	16.45	16.20
10.006	15.98	15.74	15.46	15.12	14.68	14.11	13.44
10.050	12.69	11.90	11.12	10.34	9.61	8.94	8.33
10.094	7.80	7.36	6.99	6.68	6.41	6.18	5.97
10.138	5.78	5.61	5.46	5.32	5.20	5.09	4.99
10.183	4.91	4.84	4.78	4.72	4.68	4.64	4.60
10.227	4.56	4.52	4.47	4.42	4.37	4.32	4.27

WinTR-20 Version 1.10   Page 23   02/06/2022 11:07

Brea Mall
Pre-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.006 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
10.271	4.23	4.18	4.15	4.11	4.08	4.06	4.04
10.315	4.02	3.99	3.97	3.94	3.90	3.86	3.82
10.359	3.78	3.73	3.69	3.65	3.62	3.59	3.56

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

10.404	3.54	3.52	3.50	3.48	3.45	3.42	3.38
10.448	3.34	3.30	3.25	3.21	3.17	3.13	3.10
10.492	3.07	3.04	3.02	3.00	2.98	2.96	2.94
10.536	2.92	2.89	2.86	2.83	2.81	2.78	2.75
10.581	2.73	2.70	2.69	2.67	2.66	2.64	2.63
10.625	2.62	2.61	2.60	2.59	2.57	2.56	2.55
10.669	2.54	2.53	2.52	2.51	2.50	2.49	2.49
10.713	2.48	2.48	2.47	2.46	2.45	2.44	2.43
10.757	2.42	2.41	2.40	2.39	2.38	2.38	2.37
10.802	2.36	2.36	2.35	2.35	2.34	2.33	2.33
10.846	2.32	2.31	2.29	2.28	2.27	2.26	2.26
10.890	2.25	2.24	2.24	2.23	2.23	2.22	2.21
10.934	2.21	2.20	2.19	2.18	2.17	2.16	2.15
10.978	2.14	2.13	2.12	2.11	2.11	2.10	2.10
11.023	2.09	2.09	2.08	2.08	2.07	2.06	2.05
11.067	2.05	2.04	2.03	2.03	2.02	2.02	2.01
11.111	2.01	2.01	2.00	2.00	2.00	1.99	1.99
11.155	1.98	1.98	1.98	1.97	1.97	1.97	1.96
11.199	1.96	1.96	1.96	1.96	1.95	1.95	1.95
11.244	1.94	1.94	1.94	1.93	1.93	1.93	1.92
11.288	1.92	1.92	1.91	1.91	1.91	1.91	1.91
11.332	1.90	1.90	1.90	1.89	1.89	1.89	1.88
11.376	1.88	1.88	1.87	1.87	1.87	1.87	1.87
11.421	1.86	1.86	1.86	1.86	1.85	1.85	1.84
11.465	1.84	1.84	1.83	1.83	1.83	1.82	1.82
11.509	1.82	1.82	1.82	1.81	1.81	1.81	1.81
11.553	1.80	1.80	1.79	1.79	1.79	1.78	1.78
11.597	1.78	1.78	1.77	1.77	1.77	1.77	1.77
11.642	1.76	1.76	1.75	1.75	1.75	1.74	1.74
11.686	1.74	1.73	1.73	1.73	1.73	1.73	1.72
11.730	1.72	1.72	1.72	1.71	1.71	1.70	1.70
11.774	1.70	1.69	1.69	1.69	1.69	1.68	1.68
11.818	1.68	1.68	1.68	1.67	1.67	1.67	1.66
11.863	1.66	1.65	1.65	1.65	1.64	1.64	1.64
11.907	1.64	1.64	1.63	1.63	1.63	1.63	1.62
11.951	1.62	1.61	1.61	1.61	1.60	1.60	1.60
11.995	1.60	1.59	1.59	1.59	1.59	1.59	1.58
12.039	1.58	1.58	1.57	1.57	1.57	1.56	1.56

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:
Lower Lvl Outlet   .01745   97.   .1
Upper Lvl Outlet   .00559   97.   .1

12.084	1.56	1.56	1.55	1.55	1.55	1.55	1.55
12.128	1.55	1.55	1.54	1.54	1.54	1.54	1.53
12.172	1.53	1.53	1.53	1.53	1.52	1.52	1.52
12.216	1.52	1.52	1.52	1.52	1.51	1.51	1.51
12.261	1.51	1.50	1.50	1.50	1.50	1.50	1.49
12.305	1.49	1.49	1.49	1.49	1.49	1.49	1.48
12.349	1.48	1.48	1.48	1.47	1.47	1.47	1.47
12.393	1.47	1.47	1.46	1.46	1.46	1.46	1.46
12.437	1.46	1.45	1.45	1.45	1.45	1.45	1.44
12.482	1.44	1.44	1.44	1.44	1.44	1.43	1.43

Brea Mall
Pre-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.006 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
12.526	1.43	1.43	1.43	1.43	1.42	1.42	1.42
12.570	1.42	1.41	1.41	1.41	1.41	1.41	1.41
12.614	1.40	1.40	1.40	1.40	1.40	1.40	1.39
12.658	1.39	1.39	1.39	1.38	1.38	1.38	1.38
12.703	1.38	1.38	1.38	1.37	1.37	1.37	1.37
12.747	1.37	1.36	1.36	1.36	1.36	1.36	1.35
12.791	1.35	1.35	1.35	1.35	1.35	1.35	1.34
12.835	1.34	1.34	1.34	1.34	1.33	1.33	1.33
12.879	1.33	1.32	1.32	1.32	1.32	1.32	1.32
12.924	1.32	1.31	1.31	1.31	1.31	1.31	1.30
12.968	1.30	1.30	1.30	1.29	1.29	1.29	1.29
13.012	1.29	1.29	1.29	1.29	1.28	1.28	1.28
13.056	1.28	1.27	1.27	1.27	1.27	1.27	1.26
13.101	1.26	1.26	1.26	1.26	1.26	1.26	1.25
13.145	1.25	1.25	1.25	1.24	1.24	1.24	1.24
13.189	1.24	1.23	1.23	1.23	1.23	1.23	1.23
13.233	1.23	1.22	1.22	1.22	1.22	1.21	1.21
13.277	1.21	1.21	1.21	1.20	1.20	1.20	1.20

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

13.322	1.20	1.20	1.20	1.19	1.19	1.19	1.19
13.366	1.19	1.18	1.18	1.18	1.18	1.18	1.17
13.410	1.17	1.17	1.17	1.17	1.17	1.17	1.16
13.454	1.16	1.16	1.16	1.15	1.15	1.15	1.15
13.498	1.15	1.14	1.14	1.14	1.14	1.14	1.14
13.543	1.14	1.13	1.13	1.13	1.13	1.12	1.12
13.587	1.12	1.12	1.12	1.12	1.11	1.11	1.11
13.631	1.11	1.11	1.11	1.10	1.10	1.10	1.10
13.675	1.09	1.09	1.09	1.09	1.09	1.09	1.08
13.719	1.08	1.08	1.08	1.08	1.08	1.07	1.07
13.764	1.07	1.07	1.06	1.06	1.06	1.06	1.06
13.808	1.06	1.06	1.05	1.05	1.05	1.05	1.05
13.852	1.04	1.04	1.04	1.04	1.03	1.03	1.03
13.896	1.03	1.03	1.03	1.03	1.02	1.02	1.02
13.941	1.02	1.02	1.01	1.01	1.01	1.01	1.00
13.985	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14.029	0.99	0.99	0.99	0.99	0.99	0.99	0.98
14.073	0.98	0.98	0.98	0.98	0.98	0.98	0.98
14.117	0.98	0.98	0.98	0.98	0.97	0.97	0.97
14.162	0.97	0.97	0.97	0.97	0.97	0.97	0.97
14.206	0.97	0.97	0.97	0.97	0.97	0.97	0.97
14.250	0.97	0.97	0.97	0.97	0.97	0.97	0.96
14.294	0.96	0.96	0.96	0.96	0.96	0.96	0.96
14.338	0.96	0.96	0.96	0.96	0.96	0.96	0.96
14.383	0.96	0.96	0.96	0.96	0.96	0.96	0.96
14.427	0.96	0.96	0.96	0.96	0.96	0.96	0.95
14.471	0.95	0.95	0.95	0.95	0.95	0.95	0.95
14.515	0.95	0.95	0.95	0.95	0.95	0.95	0.95
14.559	0.95	0.95	0.95	0.95	0.95	0.95	0.95
14.604	0.95	0.95	0.95	0.95	0.95	0.95	0.95
14.648	0.94	0.94	0.94	0.94	0.94	0.94	0.94
14.692	0.94	0.94	0.94	0.94	0.94	0.94	0.94
14.736	0.94	0.94	0.94	0.94	0.94	0.94	0.94

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development
STORM 2-Yr

SUB-AREA:
Lower Lvl Outlet   .01745   97.   .1
Upper Lvl Outlet   .00559   97.   .1

Line Start Time (hr)	Flow Values @ time increment of 0.006 hr (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
14.781	0.94	0.94	0.94	0.94	0.94	0.94	0.93
14.825	0.93	0.93	0.93	0.93	0.93	0.93	0.93
14.869	0.93	0.93	0.93	0.93	0.93	0.93	0.93
14.913	0.93	0.93	0.93	0.93	0.93	0.93	0.93
14.957	0.93	0.93	0.93	0.93	0.92	0.92	0.92
15.002	0.92	0.92	0.92	0.92	0.92	0.92	0.92
15.046	0.92	0.92	0.92	0.92	0.92	0.92	0.92
15.090	0.92	0.92	0.92	0.92	0.92	0.92	0.92
15.134	0.92	0.92	0.92	0.92	0.91	0.91	0.91
15.178	0.91	0.91	0.91	0.91	0.91	0.91	0.91
15.223	0.91	0.91	0.91	0.91	0.91	0.91	0.91
15.267	0.91	0.91	0.91	0.91	0.91	0.91	0.91
15.311	0.91	0.91	0.91	0.91	0.91	0.90	0.90
15.355	0.90	0.90	0.90	0.90	0.90	0.90	0.90
15.399	0.90	0.90	0.90	0.90	0.90	0.90	0.90
15.444	0.90	0.90	0.90	0.90	0.90	0.90	0.90
15.488	0.90	0.90	0.90	0.89	0.89	0.89	0.89
15.532	0.89	0.89	0.89	0.89	0.89	0.89	0.89
15.576	0.89	0.89	0.89	0.89	0.89	0.89	0.89
15.621	0.89	0.89	0.89	0.89	0.89	0.89	0.89
15.665	0.89	0.89	0.88	0.88	0.88	0.88	0.88
15.709	0.88	0.88	0.88	0.88	0.88	0.88	0.88
15.753	0.88	0.88	0.88	0.88	0.88	0.88	0.88
15.797	0.88	0.88	0.88	0.88	0.88	0.88	0.88
15.842	0.88	0.88	0.87	0.87	0.87	0.87	0.87
15.886	0.87	0.87	0.87	0.87	0.87	0.87	0.87
15.930	0.87	0.87	0.87	0.87	0.87	0.87	0.87
15.974	0.87	0.87	0.87	0.87	0.87	0.87	0.87
16.018	0.87	0.87	0.86	0.86	0.86	0.86	0.86
16.063	0.86	0.86	0.86	0.86	0.86	0.86	0.86
16.107	0.86	0.86	0.86	0.86	0.86	0.86	0.86
16.151	0.86	0.86	0.86	0.86	0.86	0.86	0.86
16.195	0.85	0.85	0.85	0.85	0.85	0.85	0.85

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

16.239	0.85	0.85	0.85	0.85	0.85	0.85	0.85
16.284	0.85	0.85	0.85	0.85	0.85	0.85	0.85
16.328	0.85	0.85	0.85	0.85	0.85	0.85	0.84
16.372	0.84	0.84	0.84	0.84	0.84	0.84	0.84
16.416	0.84	0.84	0.84	0.84	0.84	0.84	0.84
16.461	0.84	0.84	0.84	0.84	0.84	0.84	0.84
16.505	0.84	0.84	0.84	0.84	0.84	0.84	0.84
16.549	0.83	0.83	0.83	0.83	0.83	0.83	0.83
16.593	0.83	0.83	0.83	0.83	0.83	0.83	0.83
16.637	0.83	0.83	0.83	0.83	0.83	0.83	0.83
16.682	0.83	0.83	0.83	0.83	0.83	0.82	0.82
16.726	0.82	0.82	0.82	0.82	0.82	0.82	0.82
16.770	0.82	0.82	0.82	0.82	0.82	0.82	0.82
16.814	0.82	0.82	0.82	0.82	0.82	0.82	0.82
16.858	0.82	0.82	0.82	0.81	0.81	0.81	0.81
16.903	0.81	0.81	0.81	0.81	0.81	0.81	0.81
16.947	0.81	0.81	0.81	0.81	0.81	0.81	0.81
16.991	0.81	0.81	0.81	0.81	0.81	0.81	0.81

Line Start Time (hr)	------------ Flow Values @ time increment of 0.006 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
17.035	0.81	0.81	0.81	0.80	0.80	0.80	0.80
17.079	0.80	0.80	0.80	0.80	0.80	0.80	0.80
17.124	0.80	0.80	0.80	0.80	0.80	0.80	0.80
17.168	0.80	0.80	0.80	0.80	0.80	0.80	0.80
17.212	0.80	0.80	0.80	0.79	0.79	0.79	0.79
17.256	0.79	0.79	0.79	0.79	0.79	0.79	0.79
17.301	0.79	0.79	0.79	0.79	0.79	0.79	0.79
17.345	0.79	0.79	0.79	0.79	0.79	0.79	0.79
17.389	0.79	0.78	0.78	0.78	0.78	0.78	0.78
17.433	0.78	0.78	0.78	0.78	0.78	0.78	0.78

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:
Lower Lvl Outlet   .01745   97.   .1
Upper Lvl Outlet   .00559   97.   .1

17.477	0.78	0.78	0.78	0.78	0.78	0.78	0.78
17.522	0.78	0.78	0.78	0.78	0.78	0.78	0.78
17.566	0.77	0.77	0.77	0.77	0.77	0.77	0.77
17.610	0.77	0.77	0.77	0.77	0.77	0.77	0.77
17.654	0.77	0.77	0.77	0.77	0.77	0.77	0.77
17.698	0.77	0.77	0.77	0.77	0.77	0.77	0.77
17.743	0.76	0.76	0.76	0.76	0.76	0.76	0.76
17.787	0.76	0.76	0.76	0.76	0.76	0.76	0.76
17.831	0.76	0.76	0.76	0.76	0.76	0.76	0.76
17.875	0.76	0.76	0.76	0.76	0.76	0.75	0.75
17.919	0.75	0.75	0.75	0.75	0.75	0.75	0.75
17.964	0.75	0.75	0.75	0.75	0.75	0.75	0.75
18.008	0.75	0.75	0.75	0.75	0.75	0.75	0.75
18.052	0.75	0.75	0.75	0.75	0.74	0.74	0.74
18.096	0.74	0.74	0.74	0.74	0.74	0.74	0.74
18.141	0.74	0.74	0.74	0.74	0.74	0.74	0.74
18.185	0.74	0.74	0.74	0.74	0.74	0.74	0.74
18.229	0.74	0.74	0.74	0.74	0.73	0.73	0.73
18.273	0.73	0.73	0.73	0.73	0.73	0.73	0.73
18.317	0.73	0.73	0.73	0.73	0.73	0.73	0.73
18.362	0.73	0.73	0.73	0.73	0.73	0.73	0.73
18.406	0.73	0.73	0.73	0.72	0.72	0.72	0.72
18.450	0.72	0.72	0.72	0.72	0.72	0.72	0.72
18.494	0.72	0.72	0.72	0.72	0.72	0.72	0.72
18.538	0.72	0.72	0.72	0.72	0.72	0.72	0.72
18.583	0.71	0.71	0.71	0.71	0.71	0.71	0.71
18.627	0.71	0.71	0.71	0.71	0.71	0.71	0.71
18.671	0.71	0.71	0.71	0.71	0.71	0.71	0.71
18.715	0.71	0.71	0.71	0.71	0.71	0.71	0.71
18.759	0.70	0.70	0.70	0.70	0.70	0.70	0.70
18.804	0.70	0.70	0.70	0.70	0.70	0.70	0.70
18.848	0.70	0.70	0.70	0.70	0.70	0.70	0.70
18.892	0.70	0.70	0.70	0.70	0.70	0.70	0.70
18.936	0.69	0.69	0.69	0.69	0.69	0.69	0.69
18.981	0.69	0.69	0.69	0.69	0.69	0.69	0.69
19.025	0.69	0.69	0.69	0.69	0.69	0.69	0.69
19.069	0.69	0.69	0.69	0.69	0.68	0.68	0.68
19.113	0.68	0.68	0.68	0.68	0.68	0.68	0.68

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

19.157	0.68	0.68	0.68	0.68	0.68	0.68	0.68
19.202	0.68	0.68	0.68	0.68	0.68	0.68	0.68
19.246	0.68	0.68	0.68	0.67	0.67	0.67	0.67

Brea Mall
Pre-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.006 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
19.290	0.67	0.67	0.67	0.67	0.67	0.67	0.67
19.334	0.67	0.67	0.67	0.67	0.67	0.67	0.67
19.378	0.67	0.67	0.67	0.67	0.67	0.67	0.67
19.423	0.67	0.67	0.67	0.66	0.66	0.66	0.66
19.467	0.66	0.66	0.66	0.66	0.66	0.66	0.66
19.511	0.66	0.66	0.66	0.66	0.66	0.66	0.66
19.555	0.66	0.66	0.66	0.66	0.66	0.66	0.66
19.599	0.66	0.65	0.65	0.65	0.65	0.65	0.65
19.644	0.65	0.65	0.65	0.65	0.65	0.65	0.65
19.688	0.65	0.65	0.65	0.65	0.65	0.65	0.65
19.732	0.65	0.65	0.65	0.65	0.65	0.65	0.64
19.776	0.64	0.64	0.64	0.64	0.64	0.64	0.64
19.821	0.64	0.64	0.64	0.64	0.64	0.64	0.64
19.865	0.64	0.64	0.64	0.64	0.64	0.64	0.64
19.909	0.64	0.64	0.64	0.64	0.64	0.64	0.63
19.953	0.63	0.63	0.63	0.63	0.63	0.63	0.63
19.997	0.63	0.63	0.63	0.63	0.63	0.63	0.63
20.042	0.63	0.63	0.63	0.63	0.63	0.63	0.63
20.086	0.63	0.63	0.63	0.63	0.63	0.62	0.62
20.130	0.62	0.62	0.62	0.62	0.62	0.62	0.62
20.174	0.62	0.62	0.62	0.62	0.62	0.62	0.62
20.218	0.62	0.62	0.62	0.62	0.62	0.62	0.62
20.263	0.62	0.62	0.61	0.61	0.61	0.61	0.61
20.307	0.61	0.61	0.61	0.61	0.61	0.61	0.61
20.351	0.61	0.61	0.61	0.61	0.61	0.61	0.61

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

20.395	0.61	0.61	0.61	0.61	0.61	0.61	0.61
20.439	0.61	0.61	0.60	0.60	0.60	0.60	0.60
20.484	0.60	0.60	0.60	0.60	0.60	0.60	0.60
20.528	0.60	0.60	0.60	0.60	0.60	0.60	0.60
20.572	0.60	0.60	0.60	0.60	0.60	0.60	0.60
20.616	0.60	0.59	0.59	0.59	0.59	0.59	0.59
20.661	0.59	0.59	0.59	0.59	0.59	0.59	0.59
20.705	0.59	0.59	0.59	0.59	0.59	0.59	0.59
20.749	0.59	0.59	0.59	0.59	0.59	0.59	0.58
20.793	0.58	0.58	0.58	0.58	0.58	0.58	0.58
20.837	0.58	0.58	0.58	0.58	0.58	0.58	0.58
20.882	0.58	0.58	0.58	0.58	0.58	0.58	0.58
20.926	0.58	0.58	0.58	0.58	0.58	0.57	0.57
20.970	0.57	0.57	0.57	0.57	0.57	0.57	0.57
21.014	0.57	0.57	0.57	0.57	0.57	0.57	0.57
21.058	0.57	0.57	0.57	0.57	0.57	0.57	0.57
21.103	0.57	0.57	0.57	0.57	0.57	0.56	0.56
21.147	0.56	0.56	0.56	0.56	0.56	0.56	0.56
21.191	0.56	0.56	0.56	0.56	0.56	0.56	0.56
21.235	0.56	0.56	0.56	0.56	0.56	0.56	0.56
21.279	0.56	0.56	0.55	0.55	0.55	0.55	0.55
21.324	0.55	0.55	0.55	0.55	0.55	0.55	0.55
21.368	0.55	0.55	0.55	0.55	0.55	0.55	0.55
21.412	0.55	0.55	0.55	0.55	0.55	0.55	0.55
21.456	0.55	0.54	0.54	0.54	0.54	0.54	0.54
21.501	0.54	0.54	0.54	0.54	0.54	0.54	0.54

Brea Mall
Pre-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.006 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
21.545	0.54	0.54	0.54	0.54	0.54	0.54	0.54
21.589	0.54	0.54	0.54	0.54	0.54	0.54	0.54

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

21.633	0.54	0.53	0.53	0.53	0.53	0.53	0.53
21.677	0.53	0.53	0.53	0.53	0.53	0.53	0.53
21.722	0.53	0.53	0.53	0.53	0.53	0.53	0.53
21.766	0.53	0.53	0.53	0.53	0.53	0.52	0.52
21.810	0.52	0.52	0.52	0.52	0.52	0.52	0.52
21.854	0.52	0.52	0.52	0.52	0.52	0.52	0.52
21.898	0.52	0.52	0.52	0.52	0.52	0.52	0.52
21.943	0.52	0.52	0.52	0.52	0.51	0.51	0.51
21.987	0.51	0.51	0.51	0.51	0.51	0.51	0.51
22.031	0.51	0.51	0.51	0.51	0.51	0.51	0.51
22.075	0.51	0.51	0.51	0.51	0.51	0.51	0.51
22.119	0.51	0.51	0.51	0.51	0.50	0.50	0.50
22.164	0.50	0.50	0.50	0.50	0.50	0.50	0.50
22.208	0.50	0.50	0.50	0.50	0.50	0.50	0.50
22.252	0.50	0.50	0.50	0.50	0.50	0.50	0.50
22.296	0.50	0.49	0.49	0.49	0.49	0.49	0.49
22.341	0.49	0.49	0.49	0.49	0.49	0.49	0.49
22.385	0.49	0.49	0.49	0.49	0.49	0.49	0.49
22.429	0.49	0.49	0.49	0.49	0.49	0.49	0.48
22.473	0.48	0.48	0.48	0.48	0.48	0.48	0.48
22.517	0.48	0.48	0.48	0.48	0.48	0.48	0.48
22.562	0.48	0.48	0.48	0.48	0.48	0.48	0.48
22.606	0.48	0.48	0.48	0.48	0.48	0.48	0.47
22.650	0.47	0.47	0.47	0.47	0.47	0.47	0.47
22.694	0.47	0.47	0.47	0.47	0.47	0.47	0.47
22.738	0.47	0.47	0.47	0.47	0.47	0.47	0.47
22.783	0.47	0.47	0.47	0.47	0.46	0.46	0.46
22.827	0.46	0.46	0.46	0.46	0.46	0.46	0.46
22.871	0.46	0.46	0.46	0.46	0.46	0.46	0.46
22.915	0.46	0.46	0.46	0.46	0.46	0.46	0.46
22.959	0.46	0.46	0.45	0.45	0.45	0.45	0.45
23.004	0.45	0.45	0.45	0.45	0.45	0.45	0.45
23.048	0.45	0.45	0.45	0.45	0.45	0.45	0.45
23.092	0.45	0.45	0.45	0.45	0.45	0.45	0.45
23.136	0.45	0.45	0.44	0.44	0.44	0.44	0.44
23.181	0.44	0.44	0.44	0.44	0.44	0.44	0.44
23.225	0.44	0.44	0.44	0.44	0.44	0.44	0.44
23.269	0.44	0.44	0.44	0.44	0.44	0.44	0.44

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

23.313	0.43	0.43	0.43	0.43	0.43	0.43	0.43
23.357	0.43	0.43	0.43	0.43	0.43	0.43	0.43
23.402	0.43	0.43	0.43	0.43	0.43	0.43	0.43
23.446	0.43	0.43	0.43	0.43	0.43	0.42	0.42
23.490	0.42	0.42	0.42	0.42	0.42	0.42	0.42
23.534	0.42	0.42	0.42	0.42	0.42	0.42	0.42
23.578	0.42	0.42	0.42	0.42	0.42	0.42	0.42
23.623	0.42	0.42	0.42	0.42	0.41	0.41	0.41
23.667	0.41	0.41	0.41	0.41	0.41	0.41	0.41
23.711	0.41	0.41	0.41	0.41	0.41	0.41	0.41
23.755	0.41	0.41	0.41	0.41	0.41	0.41	0.41

Brea Mall
Pre-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.006 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
23.799	0.41	0.41	0.41	0.40	0.40	0.40	0.40
23.844	0.40	0.40	0.40	0.40	0.40	0.40	0.40
23.888	0.40	0.40	0.40	0.40	0.40	0.40	0.40
23.932	0.40	0.40	0.40	0.40	0.40	0.40	0.40
23.976	0.39	0.39	0.39	0.39	0.39	0.39	0.39
24.021	0.38	0.37	0.36	0.33	0.31	0.28	0.25
24.065	0.22	0.15	0.13	0.11	0.09	0.08	0.07
24.109	0.06						

```
WinTR-20: Version 1.10                0         0         0.05
Mall                                                                     (continued)
Pre-Development
                                         STORM 2-Yr
SUB-AREA:
          Lower Lvl Outlet              .01745    97.       .1
          Upper Lvl Outlet              .00559    97.       .1
```

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development
STORM 2-Yr
SUB-AREA:
Lower Lvl Outlet   .01745   97.   .1
Upper Lvl Outlet   .00559   97.   .1

Pre-Development

Area or Reach Identifier	Drainage Area (sq mi)	Alternate	2-Yr (cfs)	(cfs)	(cfs)	(cfs)	(cfs)
			----------- Peak Flow by Storm -----------				
Lower Lvl	0.017		14.92				
Upper Lvl	0.006		4.78				
OUTLET	0.023		19.70				

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Pre-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01745	97.	.1
Upper Lvl Outlet	.00559	97.	.1

WinTR-55 Current Data Description

--- Identification Data ---

User:	CJN	Date:	2/6/2022
Project:	Brea Mall	Units:	English
SubTitle:	Pre-Development	Areal Units:	Acres
State:	California		
County:	Orange		

Filename: Q:\3180011\3180011.03\eng data\Hydrology\WinTR 55\220206 Brea Mall Pre-Development.w55

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
Lower Lvl		Outlet	11.17	97	0.1
Upper Lvl		Outlet	3.58	97	0.1

Total area: 14.75 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
2.05	.0	.0	.0	.0	6.58	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type I
Dimensionless Unit Hydrograph: <standard>

CJN

Brea Mall
Pre-Development
Orange County, California

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
2.05	.0	.0	.0	.0	6.58	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type I
Dimensionless Unit Hydrograph: <standard>

Brea Mall
Pre-Development
Orange County, California

Watershed Peak Table

Sub-Area or Reach Identifier	Peak Flow by Rainfall Return Period 2-Yr (cfs)
SUBAREAS	
Lower Lvl	14.92
Upper Lvl	4.78
REACHES	
OUTLET	19.70

CJN Brea Mall
Pre-Development
Orange County, California

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs) (hr)
SUBAREAS	
Lower Lvl	14.92 9.92
Upper Lvl	4.78 9.92
REACHES	
OUTLET	19.70

CJN

Brea Mall
Pre-Development
Orange County, California

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
Lower Lvl	11.17	0.100	97	Outlet	
Upper Lvl	3.58	0.100	97	Outlet	

Total Area: 14.75 (ac)

Brea Mall
Pre-Development
Orange County, California

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Lower Lvl							
SHALLOW	277	0.0100	0.025				0.038
CHANNEL	65	0.1271	0.012	0.79	3.14	18.056	0.001
CHANNEL	390	0.0025	0.012	7.07	9.42	5.159	0.021
					Time of Concentration		0.1
Upper Lvl							
SHALLOW	223	0.0400	0.025				0.015
					Time of Concentration		0.1

CJN

Brea Mall
Pre-Development
Orange County, California

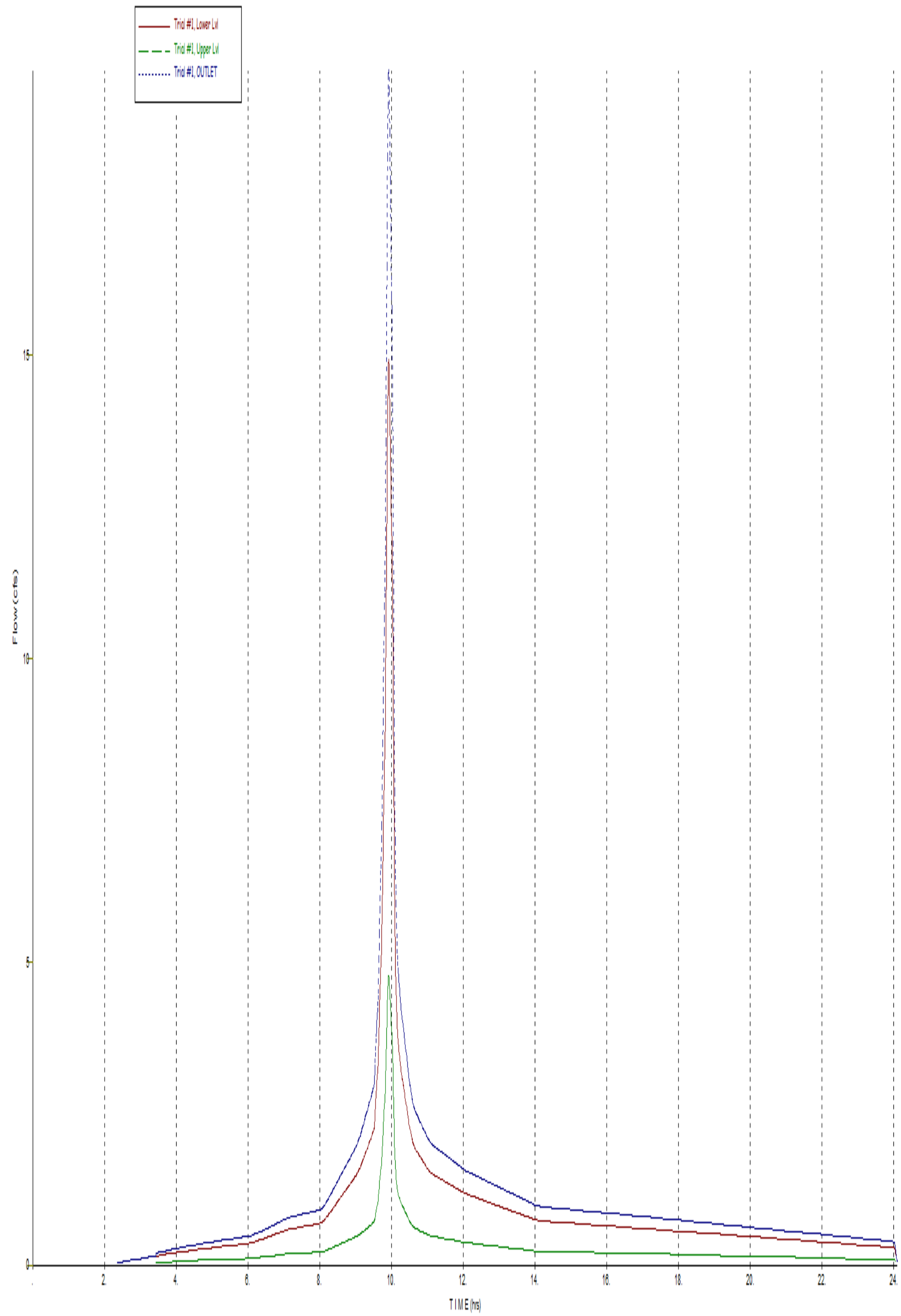
Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Lower Lvl	Open space; grass cover 50% to 75% (fair)	C	.61	79
	Paved parking lots, roofs, driveways	C	10.56	98
	Total Area / Weighted Curve Number		11.17	97
			=====	==
Upper Lvl	Open space; grass cover 50% to 75% (fair)	C	.13	79
	Paved parking lots, roofs, driveways	C	3.45	98
	Total Area / Weighted Curve Number		3.58	97
			====	==

Project: Brea Mall

Subareas: (Lower Lvl, Upper Lvl, Outlet) Storm: 2-Yr

Q:\3180011\3180011.03\eng data\Hydrology\WinTR 55\220206 Brea Mall Pre-Development.w55



WinTR-20 Printed Page File   Beginning of Input Data List
TR20.inp

WinTR-20: Version 1.10   0   0   0.05
Brea Mall
Post-Development

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

STREAM REACH:

STORM ANALYSIS:

2-Yr	2.05	Type I	2

STRUCTURE RATING:

GLOBAL OUTPUT:

2	0.05	YYYYN	YYYYNN

WinTR-20 Printed Page File   End of Input Data List

Brea Mall
Post-Development

Name of printed page file:
TR20.out

STORM 2-Yr

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
Lower Lvl	0.015		1.822		9.94	12.71	850.40

Line Start Time (hr)	Flow Values @ time increment of 0.008 hr (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
1.706	0.05	0.05	0.05	0.05	0.05	0.05	0.06
1.763	0.06	0.06	0.06	0.06	0.06	0.06	0.06
1.820	0.06	0.06	0.06	0.06	0.06	0.07	0.07
1.876	0.07	0.07	0.07	0.07	0.07	0.07	0.07
1.933	0.07	0.07	0.07	0.07	0.07	0.07	0.08
1.989	0.08	0.08	0.08	0.08	0.08	0.08	0.08
2.046	0.08	0.08	0.08	0.08	0.08	0.08	0.09
2.103	0.09	0.09	0.09	0.09	0.09	0.09	0.09
2.159	0.09	0.09	0.09	0.09	0.09	0.10	0.10
2.216	0.10	0.10	0.10	0.10	0.10	0.10	0.10
2.272	0.10	0.10	0.10	0.10	0.11	0.11	0.11
2.329	0.11	0.11	0.11	0.11	0.11	0.11	0.11
2.386	0.11	0.11	0.11	0.11	0.12	0.12	0.12
2.442	0.12	0.12	0.12	0.12	0.12	0.12	0.12
2.499	0.12	0.12	0.12	0.13	0.13	0.13	0.13
2.555	0.13	0.13	0.13	0.13	0.13	0.13	0.13
2.612	0.13	0.14	0.14	0.14	0.14	0.14	0.14
2.669	0.14	0.14	0.14	0.14	0.14	0.14	0.14
2.725	0.15	0.15	0.15	0.15	0.15	0.15	0.15
2.782	0.15	0.15	0.15	0.15	0.15	0.15	0.16
2.838	0.16	0.16	0.16	0.16	0.16	0.16	0.16
2.895	0.16	0.16	0.16	0.16	0.16	0.16	0.17
2.951	0.17	0.17	0.17	0.17	0.17	0.17	0.17
3.008	0.17	0.17	0.17	0.17	0.18	0.18	0.18
3.065	0.18	0.18	0.18	0.18	0.18	0.18	0.18
3.121	0.18	0.18	0.18	0.18	0.19	0.19	0.19
3.178	0.19	0.19	0.19	0.19	0.19	0.19	0.19
3.234	0.19	0.19	0.20	0.20	0.20	0.20	0.20
3.291	0.20	0.20	0.20	0.20	0.20	0.20	0.20
3.348	0.20	0.20	0.21	0.21	0.21	0.21	0.21
3.404	0.21	0.21	0.21	0.21	0.21	0.21	0.21
3.461	0.21	0.22	0.22	0.22	0.22	0.22	0.22
3.517	0.22	0.22	0.22	0.22	0.22	0.22	0.22
3.574	0.23	0.23	0.23	0.23	0.23	0.23	0.23

3.631	0.23	0.23	0.23	0.23	0.23	0.23	0.23
3.687	0.24	0.24	0.24	0.24	0.24	0.24	0.24
3.744	0.24	0.24	0.24	0.24	0.24	0.24	0.25
3.800	0.25	0.25	0.25	0.25	0.25	0.25	0.25
3.857	0.25	0.25	0.25	0.25	0.25	0.25	0.26
3.913	0.26	0.26	0.26	0.26	0.26	0.26	0.26

Brea Mall
Post-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.008 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
3.970	0.26	0.26	0.26	0.26	0.26	0.27	0.27
4.027	0.27	0.27	0.27	0.27	0.27	0.27	0.27
4.083	0.27	0.27	0.27	0.27	0.27	0.28	0.28
4.140	0.28	0.28	0.28	0.28	0.28	0.28	0.28
4.196	0.28	0.28	0.28	0.28	0.28	0.28	0.28
4.253	0.28	0.28	0.28	0.29	0.29	0.29	0.29
4.310	0.29	0.29	0.29	0.29	0.29	0.29	0.29
4.366	0.29	0.29	0.29	0.29	0.29	0.29	0.29
4.423	0.30	0.30	0.30	0.30	0.30	0.30	0.30
4.479	0.30	0.30	0.30	0.30	0.30	0.30	0.30
4.536	0.30	0.30	0.30	0.30	0.30	0.30	0.31
4.593	0.31	0.31	0.31	0.31	0.31	0.31	0.31
4.649	0.31	0.31	0.31	0.31	0.31	0.31	0.31
4.706	0.31	0.31	0.31	0.31	0.31	0.31	0.32
4.762	0.32	0.32	0.32	0.32	0.32	0.32	0.32
4.819	0.32	0.32	0.32	0.32	0.32	0.32	0.32
4.876	0.32	0.32	0.32	0.32	0.33	0.33	0.33
4.932	0.33	0.33	0.33	0.33	0.33	0.33	0.33
4.989	0.33	0.33	0.33	0.33	0.33	0.33	0.33
5.045	0.33	0.33	0.33	0.33	0.33	0.33	0.34
5.102	0.34	0.34	0.34	0.34	0.34	0.34	0.34
5.158	0.34	0.34	0.34	0.34	0.34	0.34	0.34
5.215	0.34	0.34	0.34	0.34	0.34	0.34	0.34
5.272	0.34	0.35	0.35	0.35	0.35	0.35	0.35
5.328	0.35	0.35	0.35	0.35	0.35	0.35	0.35
5.385	0.35	0.35	0.35	0.35	0.35	0.35	0.35
5.441	0.35	0.35	0.36	0.36	0.36	0.36	0.36
5.498	0.36	0.36	0.36	0.36	0.36	0.36	0.36
5.555	0.36	0.36	0.36	0.36	0.36	0.36	0.36
5.611	0.36	0.36	0.36	0.36	0.36	0.36	0.37
5.668	0.37	0.37	0.37	0.37	0.37	0.37	0.37
5.724	0.37	0.37	0.37	0.37	0.37	0.37	0.37
5.781	0.37	0.37	0.37	0.37	0.37	0.37	0.37
5.838	0.37	0.37	0.37	0.38	0.38	0.38	0.38
5.894	0.38	0.38	0.38	0.38	0.38	0.38	0.38
5.951	0.38	0.38	0.38	0.38	0.38	0.38	0.38
6.007	0.38	0.38	0.38	0.38	0.38	0.38	0.39
6.064	0.39	0.39	0.39	0.39	0.39	0.39	0.39
6.120	0.39	0.39	0.39	0.40	0.40	0.40	0.40
6.177	0.40	0.40	0.41	0.41	0.41	0.41	0.41
6.234	0.41	0.41	0.42	0.42	0.42	0.42	0.42
6.290	0.42	0.43	0.43	0.43	0.43	0.43	0.43
6.347	0.43	0.44	0.44	0.44	0.44	0.44	0.44
6.403	0.45	0.45	0.45	0.45	0.45	0.45	0.45
6.460	0.46	0.46	0.46	0.46	0.46	0.47	0.47
6.517	0.47	0.47	0.47	0.47	0.48	0.48	0.48
6.573	0.48	0.48	0.48	0.49	0.49	0.49	0.49
6.630	0.49	0.49	0.49	0.50	0.50	0.50	0.50
6.686	0.50	0.51	0.51	0.51	0.51	0.51	0.51
6.743	0.52	0.52	0.52	0.52	0.52	0.53	0.53
6.800	0.53	0.53	0.53	0.53	0.53	0.54	0.54

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development
STORM 2-Yr
SUB-AREA:
Lower Lvl Outlet   .01495   98.   .128
Upper Lvl Outlet   .00809   98.   .133

Brea Mall
Post-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.008 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
6.856	0.54	0.54	0.54	0.54	0.55	0.55	0.55
6.913	0.55	0.55	0.55	0.56	0.56	0.56	0.56
6.969	0.56	0.56	0.57	0.57	0.57	0.57	0.57
7.026	0.58	0.58	0.58	0.58	0.58	0.58	0.58
7.082	0.59	0.59	0.59	0.59	0.59	0.59	0.59
7.139	0.59	0.59	0.60	0.60	0.60	0.60	0.60
7.196	0.60	0.60	0.60	0.60	0.60	0.60	0.60
7.252	0.60	0.61	0.61	0.61	0.61	0.61	0.61
7.309	0.61	0.61	0.61	0.61	0.61	0.61	0.61
7.365	0.62	0.62	0.62	0.62	0.62	0.62	0.62
7.422	0.62	0.62	0.62	0.62	0.62	0.62	0.63
7.479	0.63	0.63	0.63	0.63	0.63	0.63	0.63
7.535	0.63	0.63	0.63	0.63	0.63	0.63	0.64
7.592	0.64	0.64	0.64	0.64	0.64	0.64	0.64
7.648	0.64	0.64	0.64	0.64	0.64	0.64	0.64
7.705	0.64	0.65	0.65	0.65	0.65	0.65	0.65
7.762	0.65	0.65	0.65	0.65	0.65	0.65	0.65
7.818	0.66	0.66	0.66	0.66	0.66	0.66	0.66
7.875	0.66	0.66	0.66	0.66	0.66	0.66	0.67
7.931	0.67	0.67	0.67	0.67	0.67	0.67	0.67
7.988	0.67	0.67	0.67	0.67	0.67	0.67	0.68
8.045	0.68	0.68	0.68	0.69	0.69	0.69	0.70
8.101	0.70	0.70	0.71	0.71	0.71	0.72	0.72
8.158	0.73	0.73	0.74	0.74	0.75	0.76	0.76
8.214	0.77	0.77	0.78	0.78	0.79	0.79	0.80
8.271	0.81	0.81	0.82	0.83	0.83	0.84	0.84
8.327	0.85	0.86	0.86	0.87	0.87	0.88	0.89
8.384	0.90	0.90	0.91	0.91	0.92	0.93	0.93
8.441	0.94	0.94	0.95	0.96	0.96	0.97	0.98
8.497	0.98	0.99	0.99	1.00	1.01	1.01	1.02

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

8.554	1.02	1.03	1.04	1.04	1.05	1.06	1.06
8.610	1.07	1.07	1.08	1.08	1.09	1.10	1.10
8.667	1.11	1.12	1.12	1.13	1.14	1.14	1.15
8.724	1.15	1.16	1.16	1.17	1.18	1.18	1.19
8.780	1.20	1.20	1.21	1.21	1.22	1.22	1.23
8.837	1.23	1.24	1.25	1.25	1.26	1.27	1.27
8.893	1.28	1.29	1.29	1.30	1.30	1.31	1.31
8.950	1.32	1.33	1.33	1.34	1.35	1.35	1.36
9.007	1.36	1.37	1.38	1.38	1.39	1.40	1.40
9.063	1.41	1.42	1.43	1.44	1.45	1.46	1.47
9.120	1.47	1.48	1.49	1.50	1.51	1.52	1.53
9.176	1.55	1.56	1.57	1.58	1.59	1.60	1.61
9.233	1.62	1.63	1.64	1.65	1.67	1.68	1.69
9.289	1.70	1.71	1.73	1.74	1.75	1.76	1.77
9.346	1.78	1.79	1.80	1.82	1.83	1.84	1.85
9.403	1.86	1.88	1.89	1.90	1.91	1.92	1.93
9.459	1.94	1.95	1.97	1.98	1.99	2.00	2.02
9.516	2.03	2.05	2.08	2.12	2.17	2.24	2.31
9.572	2.38	2.45	2.53	2.60	2.66	2.73	2.80
9.629	2.88	2.97	3.07	3.20	3.34	3.49	3.64
9.686	3.79	3.93	4.06	4.19	4.32	4.46	4.61

Brea Mall
Post-Development

Line Start Time (hr)	Flow Values @ time increment of 0.008 hr (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
9.742	4.79	5.01	5.25	5.50	5.77	6.03	6.28
9.799	6.51	6.74	6.98	7.23	7.50	7.83	8.22
9.855	8.68	9.18	9.70	10.23	10.74	11.22	11.66
9.912	12.05	12.36	12.57	12.69	12.71	12.65	12.51
9.969	12.32	12.10	11.86	11.62	11.39	11.16	10.91
10.025	10.65	10.35	10.00	9.57	9.07	8.54	7.99
10.082	7.44	6.91	6.42	5.96	5.55	5.19	4.90

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

10.138	4.64	4.42	4.23	4.06	3.91	3.78	3.66
10.195	3.56	3.47	3.39	3.32	3.26	3.20	3.15
10.252	3.09	3.04	2.99	2.95	2.90	2.86	2.83
10.308	2.80	2.76	2.74	2.71	2.68	2.65	2.62
10.365	2.58	2.55	2.51	2.48	2.45	2.43	2.40
10.421	2.38	2.36	2.33	2.30	2.27	2.24	2.21
10.478	2.18	2.15	2.12	2.09	2.07	2.04	2.02
10.534	2.00	1.98	1.96	1.94	1.91	1.89	1.87
10.591	1.85	1.83	1.81	1.80	1.78	1.77	1.76
10.648	1.75	1.74	1.73	1.71	1.70	1.69	1.69
10.704	1.68	1.67	1.66	1.66	1.65	1.64	1.64
10.761	1.63	1.62	1.61	1.60	1.60	1.59	1.58
10.817	1.58	1.57	1.56	1.56	1.55	1.54	1.54
10.874	1.53	1.52	1.51	1.51	1.50	1.49	1.49
10.931	1.48	1.48	1.47	1.46	1.45	1.45	1.44
10.987	1.43	1.42	1.42	1.41	1.41	1.40	1.40
11.044	1.39	1.38	1.38	1.37	1.37	1.36	1.36
11.100	1.35	1.35	1.34	1.34	1.34	1.33	1.33
11.157	1.33	1.32	1.32	1.31	1.31	1.31	1.31
11.214	1.30	1.30	1.30	1.30	1.29	1.29	1.29
11.270	1.29	1.28	1.28	1.28	1.28	1.27	1.27
11.327	1.27	1.27	1.26	1.26	1.26	1.26	1.25
11.383	1.25	1.25	1.25	1.24	1.24	1.24	1.24
11.440	1.23	1.23	1.23	1.23	1.22	1.22	1.22
11.496	1.22	1.21	1.21	1.21	1.21	1.20	1.20
11.553	1.20	1.20	1.19	1.19	1.19	1.19	1.18
11.610	1.18	1.18	1.18	1.17	1.17	1.17	1.17
11.666	1.16	1.16	1.16	1.16	1.15	1.15	1.15
11.723	1.15	1.14	1.14	1.14	1.14	1.13	1.13
11.779	1.13	1.13	1.12	1.12	1.12	1.12	1.11
11.836	1.11	1.11	1.11	1.10	1.10	1.10	1.10
11.893	1.09	1.09	1.09	1.09	1.08	1.08	1.08
11.949	1.08	1.08	1.07	1.07	1.07	1.06	1.06
12.006	1.06	1.06	1.05	1.05	1.05	1.05	1.05
12.062	1.04	1.04	1.04	1.04	1.03	1.03	1.03
12.119	1.03	1.03	1.03	1.02	1.02	1.02	1.02
12.176	1.02	1.01	1.01	1.01	1.01	1.01	1.01
12.232	1.01	1.00	1.00	1.00	1.00	1.00	1.00

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

12.289	0.99	0.99	0.99	0.99	0.99	0.99	0.99
12.345	0.98	0.98	0.98	0.98	0.98	0.98	0.97
12.402	0.97	0.97	0.97	0.97	0.97	0.97	0.96
12.458	0.96	0.96	0.96	0.96	0.95	0.95	0.95
12.515	0.95	0.95	0.95	0.95	0.94	0.94	0.94
12.572	0.94	0.94	0.94	0.93	0.93	0.93	0.93

Brea Mall
Post-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.008 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
12.628	0.93	0.93	0.93	0.92	0.92	0.92	0.92
12.685	0.92	0.92	0.91	0.91	0.91	0.91	0.91
12.741	0.91	0.91	0.90	0.90	0.90	0.90	0.90
12.798	0.90	0.89	0.89	0.89	0.89	0.89	0.89
12.855	0.89	0.88	0.88	0.88	0.88	0.88	0.88
12.911	0.87	0.87	0.87	0.87	0.87	0.87	0.87
12.968	0.86	0.86	0.86	0.86	0.86	0.86	0.85
13.024	0.85	0.85	0.85	0.85	0.85	0.84	0.84
13.081	0.84	0.84	0.84	0.84	0.83	0.83	0.83
13.138	0.83	0.83	0.83	0.83	0.82	0.82	0.82
13.194	0.82	0.82	0.82	0.81	0.81	0.81	0.81
13.251	0.81	0.81	0.81	0.80	0.80	0.80	0.80
13.307	0.80	0.80	0.79	0.79	0.79	0.79	0.79
13.364	0.79	0.78	0.78	0.78	0.78	0.78	0.78
13.421	0.78	0.77	0.77	0.77	0.77	0.77	0.77
13.477	0.76	0.76	0.76	0.76	0.76	0.76	0.76
13.534	0.75	0.75	0.75	0.75	0.75	0.75	0.74
13.590	0.74	0.74	0.74	0.74	0.74	0.74	0.73
13.647	0.73	0.73	0.73	0.73	0.73	0.72	0.72
13.703	0.72	0.72	0.72	0.72	0.71	0.71	0.71
13.760	0.71	0.71	0.71	0.70	0.70	0.70	0.70
13.817	0.70	0.70	0.70	0.69	0.69	0.69	0.69

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

13.873	0.69	0.69	0.68	0.68	0.68	0.68	0.68
13.930	0.68	0.68	0.67	0.67	0.67	0.67	0.67
13.986	0.67	0.66	0.66	0.66	0.66	0.66	0.66
14.043	0.66	0.65	0.65	0.65	0.65	0.65	0.65
14.100	0.65	0.65	0.65	0.65	0.64	0.64	0.64
14.156	0.64	0.64	0.64	0.64	0.64	0.64	0.64
14.213	0.64	0.64	0.64	0.64	0.64	0.64	0.64
14.269	0.64	0.64	0.64	0.64	0.64	0.64	0.64
14.326	0.64	0.63	0.63	0.63	0.63	0.63	0.63
14.383	0.63	0.63	0.63	0.63	0.63	0.63	0.63
14.439	0.63	0.63	0.63	0.63	0.63	0.63	0.63
14.496	0.63	0.63	0.63	0.63	0.63	0.63	0.63
14.552	0.63	0.63	0.63	0.63	0.63	0.62	0.62
14.609	0.62	0.62	0.62	0.62	0.62	0.62	0.62
14.665	0.62	0.62	0.62	0.62	0.62	0.62	0.62
14.722	0.62	0.62	0.62	0.62	0.62	0.62	0.62
14.779	0.62	0.62	0.62	0.62	0.62	0.62	0.62
14.835	0.62	0.62	0.61	0.61	0.61	0.61	0.61
14.892	0.61	0.61	0.61	0.61	0.61	0.61	0.61
14.948	0.61	0.61	0.61	0.61	0.61	0.61	0.61
15.005	0.61	0.61	0.61	0.61	0.61	0.61	0.61
15.062	0.61	0.61	0.61	0.61	0.61	0.61	0.60
15.118	0.60	0.60	0.60	0.60	0.60	0.60	0.60
15.175	0.60	0.60	0.60	0.60	0.60	0.60	0.60
15.231	0.60	0.60	0.60	0.60	0.60	0.60	0.60
15.288	0.60	0.60	0.60	0.60	0.60	0.60	0.60
15.345	0.60	0.60	0.60	0.59	0.59	0.59	0.59
15.401	0.59	0.59	0.59	0.59	0.59	0.59	0.59
15.458	0.59	0.59	0.59	0.59	0.59	0.59	0.59

Line Start Time	------------ Flow Values @ time increment of 0.008 hr ------------						
(hr)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

15.514	0.59	0.59	0.59	0.59	0.59	0.59	0.59
15.571	0.59	0.59	0.59	0.59	0.59	0.59	0.59
15.628	0.59	0.58	0.58	0.58	0.58	0.58	0.58
15.684	0.58	0.58	0.58	0.58	0.58	0.58	0.58
15.741	0.58	0.58	0.58	0.58	0.58	0.58	0.58
15.797	0.58	0.58	0.58	0.58	0.58	0.58	0.58
15.854	0.58	0.58	0.58	0.58	0.57	0.57	0.57
15.910	0.57	0.57	0.57	0.57	0.57	0.57	0.57
15.967	0.57	0.57	0.57	0.57	0.57	0.57	0.57
16.024	0.57	0.57	0.57	0.57	0.57	0.57	0.57
16.080	0.57	0.57	0.57	0.57	0.57	0.57	0.57
16.137	0.57	0.57	0.56	0.56	0.56	0.56	0.56
16.193	0.56	0.56	0.56	0.56	0.56	0.56	0.56
16.250	0.56	0.56	0.56	0.56	0.56	0.56	0.56
16.307	0.56	0.56	0.56	0.56	0.56	0.56	0.56
16.363	0.56	0.56	0.56	0.56	0.56	0.55	0.55
16.420	0.55	0.55	0.55	0.55	0.55	0.55	0.55
16.476	0.55	0.55	0.55	0.55	0.55	0.55	0.55
16.533	0.55	0.55	0.55	0.55	0.55	0.55	0.55
16.590	0.55	0.55	0.55	0.55	0.55	0.55	0.55
16.646	0.55	0.55	0.55	0.54	0.54	0.54	0.54
16.703	0.54	0.54	0.54	0.54	0.54	0.54	0.54
16.759	0.54	0.54	0.54	0.54	0.54	0.54	0.54
16.816	0.54	0.54	0.54	0.54	0.54	0.54	0.54
16.872	0.54	0.54	0.54	0.54	0.54	0.54	0.53
16.929	0.53	0.53	0.53	0.53	0.53	0.53	0.53
16.986	0.53	0.53	0.53	0.53	0.53	0.53	0.53
17.042	0.53	0.53	0.53	0.53	0.53	0.53	0.53
17.099	0.53	0.53	0.53	0.53	0.53	0.53	0.53
17.155	0.53	0.53	0.53	0.52	0.52	0.52	0.52
17.212	0.52	0.52	0.52	0.52	0.52	0.52	0.52
17.269	0.52	0.52	0.52	0.52	0.52	0.52	0.52
17.325	0.52	0.52	0.52	0.52	0.52	0.52	0.52
17.382	0.52	0.52	0.52	0.52	0.52	0.52	0.52
17.438	0.51	0.51	0.51	0.51	0.51	0.51	0.51
17.495	0.51	0.51	0.51	0.51	0.51	0.51	0.51
17.552	0.51	0.51	0.51	0.51	0.51	0.51	0.51

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

17.608	0.51	0.51	0.51	0.51	0.51	0.51	0.51
17.665	0.51	0.51	0.51	0.51	0.50	0.50	0.50
17.721	0.50	0.50	0.50	0.50	0.50	0.50	0.50
17.778	0.50	0.50	0.50	0.50	0.50	0.50	0.50
17.834	0.50	0.50	0.50	0.50	0.50	0.50	0.50
17.891	0.50	0.50	0.50	0.50	0.50	0.50	0.50
17.948	0.50	0.49	0.49	0.49	0.49	0.49	0.49
18.004	0.49	0.49	0.49	0.49	0.49	0.49	0.49
18.061	0.49	0.49	0.49	0.49	0.49	0.49	0.49
18.117	0.49	0.49	0.49	0.49	0.49	0.49	0.49
18.174	0.49	0.49	0.49	0.49	0.48	0.48	0.48
18.231	0.48	0.48	0.48	0.48	0.48	0.48	0.48
18.287	0.48	0.48	0.48	0.48	0.48	0.48	0.48
18.344	0.48	0.48	0.48	0.48	0.48	0.48	0.48

Brea Mall
Post-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.008 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
18.400	0.48	0.48	0.48	0.48	0.48	0.48	0.48
18.457	0.48	0.48	0.47	0.47	0.47	0.47	0.47
18.514	0.47	0.47	0.47	0.47	0.47	0.47	0.47
18.570	0.47	0.47	0.47	0.47	0.47	0.47	0.47
18.627	0.47	0.47	0.47	0.47	0.47	0.47	0.47
18.683	0.47	0.47	0.47	0.47	0.47	0.46	0.46
18.740	0.46	0.46	0.46	0.46	0.46	0.46	0.46
18.797	0.46	0.46	0.46	0.46	0.46	0.46	0.46
18.853	0.46	0.46	0.46	0.46	0.46	0.46	0.46
18.910	0.46	0.46	0.46	0.46	0.46	0.46	0.46
18.966	0.46	0.46	0.45	0.45	0.45	0.45	0.45
19.023	0.45	0.45	0.45	0.45	0.45	0.45	0.45
19.079	0.45	0.45	0.45	0.45	0.45	0.45	0.45
19.136	0.45	0.45	0.45	0.45	0.45	0.45	0.45

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

19.193	0.45	0.45	0.45	0.45	0.45	0.45	0.44
19.249	0.44	0.44	0.44	0.44	0.44	0.44	0.44
19.306	0.44	0.44	0.44	0.44	0.44	0.44	0.44
19.362	0.44	0.44	0.44	0.44	0.44	0.44	0.44
19.419	0.44	0.44	0.44	0.44	0.44	0.44	0.44
19.476	0.44	0.44	0.43	0.43	0.43	0.43	0.43
19.532	0.43	0.43	0.43	0.43	0.43	0.43	0.43
19.589	0.43	0.43	0.43	0.43	0.43	0.43	0.43
19.645	0.43	0.43	0.43	0.43	0.43	0.43	0.43
19.702	0.43	0.43	0.43	0.43	0.43	0.43	0.43
19.759	0.42	0.42	0.42	0.42	0.42	0.42	0.42
19.815	0.42	0.42	0.42	0.42	0.42	0.42	0.42
19.872	0.42	0.42	0.42	0.42	0.42	0.42	0.42
19.928	0.42	0.42	0.42	0.42	0.42	0.42	0.42
19.985	0.42	0.42	0.42	0.41	0.41	0.41	0.41
20.041	0.41	0.41	0.41	0.41	0.41	0.41	0.41
20.098	0.41	0.41	0.41	0.41	0.41	0.41	0.41
20.155	0.41	0.41	0.41	0.41	0.41	0.41	0.41
20.211	0.41	0.41	0.41	0.41	0.41	0.41	0.41
20.268	0.40	0.40	0.40	0.40	0.40	0.40	0.40
20.324	0.40	0.40	0.40	0.40	0.40	0.40	0.40
20.381	0.40	0.40	0.40	0.40	0.40	0.40	0.40
20.438	0.40	0.40	0.40	0.40	0.40	0.40	0.40
20.494	0.40	0.40	0.40	0.39	0.39	0.39	0.39
20.551	0.39	0.39	0.39	0.39	0.39	0.39	0.39
20.607	0.39	0.39	0.39	0.39	0.39	0.39	0.39
20.664	0.39	0.39	0.39	0.39	0.39	0.39	0.39
20.721	0.39	0.39	0.39	0.39	0.39	0.39	0.39
20.777	0.38	0.38	0.38	0.38	0.38	0.38	0.38
20.834	0.38	0.38	0.38	0.38	0.38	0.38	0.38
20.890	0.38	0.38	0.38	0.38	0.38	0.38	0.38
20.947	0.38	0.38	0.38	0.38	0.38	0.38	0.38
21.004	0.38	0.38	0.38	0.38	0.37	0.37	0.37
21.060	0.37	0.37	0.37	0.37	0.37	0.37	0.37
21.117	0.37	0.37	0.37	0.37	0.37	0.37	0.37
21.173	0.37	0.37	0.37	0.37	0.37	0.37	0.37
21.230	0.37	0.37	0.37	0.37	0.37	0.37	0.37

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development
STORM 2-Yr
SUB-AREA:
Lower Lvl Outlet   .01495   98.   .128
Upper Lvl Outlet   .00809   98.   .133

Brea Mall
Post-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.008 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
21.286	0.36	0.36	0.36	0.36	0.36	0.36	0.36
21.343	0.36	0.36	0.36	0.36	0.36	0.36	0.36
21.400	0.36	0.36	0.36	0.36	0.36	0.36	0.36
21.456	0.36	0.36	0.36	0.36	0.36	0.36	0.36
21.513	0.36	0.36	0.36	0.36	0.35	0.35	0.35
21.569	0.35	0.35	0.35	0.35	0.35	0.35	0.35
21.626	0.35	0.35	0.35	0.35	0.35	0.35	0.35
21.683	0.35	0.35	0.35	0.35	0.35	0.35	0.35
21.739	0.35	0.35	0.35	0.35	0.35	0.35	0.35
21.796	0.35	0.34	0.34	0.34	0.34	0.34	0.34
21.852	0.34	0.34	0.34	0.34	0.34	0.34	0.34
21.909	0.34	0.34	0.34	0.34	0.34	0.34	0.34
21.966	0.34	0.34	0.34	0.34	0.34	0.34	0.34
22.022	0.34	0.34	0.34	0.34	0.34	0.33	0.33
22.079	0.33	0.33	0.33	0.33	0.33	0.33	0.33
22.135	0.33	0.33	0.33	0.33	0.33	0.33	0.33
22.192	0.33	0.33	0.33	0.33	0.33	0.33	0.33
22.248	0.33	0.33	0.33	0.33	0.33	0.33	0.33
22.305	0.33	0.32	0.32	0.32	0.32	0.32	0.32
22.362	0.32	0.32	0.32	0.32	0.32	0.32	0.32
22.418	0.32	0.32	0.32	0.32	0.32	0.32	0.32
22.475	0.32	0.32	0.32	0.32	0.32	0.32	0.32
22.531	0.32	0.32	0.32	0.32	0.32	0.31	0.31
22.588	0.31	0.31	0.31	0.31	0.31	0.31	0.31
22.645	0.31	0.31	0.31	0.31	0.31	0.31	0.31
22.701	0.31	0.31	0.31	0.31	0.31	0.31	0.31
22.758	0.31	0.31	0.31	0.31	0.31	0.31	0.31
22.814	0.31	0.30	0.30	0.30	0.30	0.30	0.30
22.871	0.30	0.30	0.30	0.30	0.30	0.30	0.30

WinTR-20: Version 1.10 0 0 0.05
Mall (continued)
Post-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

22.928	0.30	0.30	0.30	0.30	0.30	0.30	0.30
22.984	0.30	0.30	0.30	0.30	0.30	0.30	0.30
23.041	0.30	0.30	0.30	0.30	0.30	0.29	0.29
23.097	0.29	0.29	0.29	0.29	0.29	0.29	0.29
23.154	0.29	0.29	0.29	0.29	0.29	0.29	0.29
23.210	0.29	0.29	0.29	0.29	0.29	0.29	0.29
23.267	0.29	0.29	0.29	0.29	0.29	0.29	0.29
23.324	0.29	0.29	0.28	0.28	0.28	0.28	0.28
23.380	0.28	0.28	0.28	0.28	0.28	0.28	0.28
23.437	0.28	0.28	0.28	0.28	0.28	0.28	0.28
23.493	0.28	0.28	0.28	0.28	0.28	0.28	0.28
23.550	0.28	0.28	0.28	0.28	0.28	0.27	0.27
23.607	0.27	0.27	0.27	0.27	0.27	0.27	0.27
23.663	0.27	0.27	0.27	0.27	0.27	0.27	0.27
23.720	0.27	0.27	0.27	0.27	0.27	0.27	0.27
23.776	0.27	0.27	0.27	0.27	0.27	0.27	0.27
23.833	0.27	0.27	0.26	0.26	0.26	0.26	0.26
23.890	0.26	0.26	0.26	0.26	0.26	0.26	0.26
23.946	0.26	0.26	0.26	0.26	0.26	0.26	0.26
24.003	0.26	0.26	0.25	0.25	0.24	0.23	0.22
24.059	0.20	0.18	0.16	0.14	0.13	0.11	0.09
24.116	0.08	0.07	0.06				

Brea Mall
Post-Development

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	------------ Peak Flow ------------ Elevation (ft)	Time (hr)	Rate (cfs)	Rate (csm)
Upper Lvl	0.008		1.819		9.94	6.83	843.97

Line Start Time (hr)	------------ Flow Values @ time increment of 0.008 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

2.182	0.05	0.05	0.05	0.05	0.05	0.05	0.05
2.241	0.05	0.05	0.05	0.05	0.06	0.06	0.06
2.300	0.06	0.06	0.06	0.06	0.06	0.06	0.06
2.359	0.06	0.06	0.06	0.06	0.06	0.06	0.06
2.417	0.06	0.06	0.06	0.06	0.06	0.06	0.06
2.476	0.07	0.07	0.07	0.07	0.07	0.07	0.07
2.535	0.07	0.07	0.07	0.07	0.07	0.07	0.07
2.594	0.07	0.07	0.07	0.07	0.07	0.07	0.07
2.653	0.07	0.07	0.08	0.08	0.08	0.08	0.08
2.711	0.08	0.08	0.08	0.08	0.08	0.08	0.08
2.770	0.08	0.08	0.08	0.08	0.08	0.08	0.08
2.829	0.08	0.08	0.08	0.08	0.09	0.09	0.09
2.888	0.09	0.09	0.09	0.09	0.09	0.09	0.09
2.947	0.09	0.09	0.09	0.09	0.09	0.09	0.09
3.005	0.09	0.09	0.09	0.09	0.09	0.09	0.10
3.064	0.10	0.10	0.10	0.10	0.10	0.10	0.10
3.123	0.10	0.10	0.10	0.10	0.10	0.10	0.10
3.182	0.10	0.10	0.10	0.10	0.10	0.10	0.10
3.241	0.10	0.11	0.11	0.11	0.11	0.11	0.11
3.299	0.11	0.11	0.11	0.11	0.11	0.11	0.11
3.358	0.11	0.11	0.11	0.11	0.11	0.11	0.11
3.417	0.11	0.11	0.11	0.11	0.12	0.12	0.12
3.476	0.12	0.12	0.12	0.12	0.12	0.12	0.12
3.535	0.12	0.12	0.12	0.12	0.12	0.12	0.12
3.593	0.12	0.12	0.12	0.12	0.12	0.12	0.13
3.652	0.13	0.13	0.13	0.13	0.13	0.13	0.13
3.711	0.13	0.13	0.13	0.13	0.13	0.13	0.13
3.770	0.13	0.13	0.13	0.13	0.13	0.13	0.13
3.829	0.13	0.13	0.14	0.14	0.14	0.14	0.14
3.887	0.14	0.14	0.14	0.14	0.14	0.14	0.14
3.946	0.14	0.14	0.14	0.14	0.14	0.14	0.14
4.005	0.14	0.14	0.14	0.14	0.14	0.15	0.15
4.064	0.15	0.15	0.15	0.15	0.15	0.15	0.15
4.123	0.15	0.15	0.15	0.15	0.15	0.15	0.15
4.181	0.15	0.15	0.15	0.15	0.15	0.15	0.15
4.240	0.15	0.15	0.15	0.15	0.15	0.15	0.15
4.299	0.16	0.16	0.16	0.16	0.16	0.16	0.16
4.358	0.16	0.16	0.16	0.16	0.16	0.16	0.16

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

4.417	0.16	0.16	0.16	0.16	0.16	0.16	0.16
4.475	0.16	0.16	0.16	0.16	0.16	0.16	0.16
4.534	0.16	0.16	0.16	0.16	0.16	0.16	0.17
4.593	0.17	0.17	0.17	0.17	0.17	0.17	0.17
4.652	0.17	0.17	0.17	0.17	0.17	0.17	0.17
4.711	0.17	0.17	0.17	0.17	0.17	0.17	0.17
4.769	0.17	0.17	0.17	0.17	0.17	0.17	0.17

Brea Mall
Post-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.008 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
4.828	0.17	0.17	0.17	0.17	0.17	0.17	0.17
4.887	0.18	0.18	0.18	0.18	0.18	0.18	0.18
4.946	0.18	0.18	0.18	0.18	0.18	0.18	0.18
5.005	0.18	0.18	0.18	0.18	0.18	0.18	0.18
5.063	0.18	0.18	0.18	0.18	0.18	0.18	0.18
5.122	0.18	0.18	0.18	0.18	0.18	0.18	0.18
5.181	0.18	0.18	0.18	0.18	0.18	0.18	0.19
5.240	0.19	0.19	0.19	0.19	0.19	0.19	0.19
5.299	0.19	0.19	0.19	0.19	0.19	0.19	0.19
5.357	0.19	0.19	0.19	0.19	0.19	0.19	0.19
5.416	0.19	0.19	0.19	0.19	0.19	0.19	0.19
5.475	0.19	0.19	0.19	0.19	0.19	0.19	0.19
5.534	0.19	0.19	0.19	0.19	0.20	0.20	0.20
5.593	0.20	0.20	0.20	0.20	0.20	0.20	0.20
5.651	0.20	0.20	0.20	0.20	0.20	0.20	0.20
5.710	0.20	0.20	0.20	0.20	0.20	0.20	0.20
5.769	0.20	0.20	0.20	0.20	0.20	0.20	0.20
5.828	0.20	0.20	0.20	0.20	0.20	0.20	0.20
5.887	0.20	0.20	0.20	0.20	0.20	0.20	0.21
5.945	0.21	0.21	0.21	0.21	0.21	0.21	0.21
6.004	0.21	0.21	0.21	0.21	0.21	0.21	0.21

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development
STORM 2-Yr
SUB-AREA:
Lower Lvl Outlet   .01495   98.   .128
Upper Lvl Outlet   .00809   98.   .133

6.063	0.21	0.21	0.21	0.21	0.21	0.21	0.21
6.122	0.21	0.21	0.21	0.21	0.21	0.22	0.22
6.181	0.22	0.22	0.22	0.22	0.22	0.22	0.22
6.239	0.22	0.22	0.23	0.23	0.23	0.23	0.23
6.298	0.23	0.23	0.23	0.23	0.23	0.23	0.23
6.357	0.24	0.24	0.24	0.24	0.24	0.24	0.24
6.416	0.24	0.24	0.24	0.24	0.25	0.25	0.25
6.475	0.25	0.25	0.25	0.25	0.25	0.25	0.25
6.533	0.26	0.26	0.26	0.26	0.26	0.26	0.26
6.592	0.26	0.26	0.26	0.26	0.27	0.27	0.27
6.651	0.27	0.27	0.27	0.27	0.27	0.27	0.27
6.710	0.28	0.28	0.28	0.28	0.28	0.28	0.28
6.769	0.28	0.28	0.28	0.28	0.29	0.29	0.29
6.827	0.29	0.29	0.29	0.29	0.29	0.29	0.29
6.886	0.29	0.30	0.30	0.30	0.30	0.30	0.30
6.945	0.30	0.30	0.30	0.30	0.31	0.31	0.31
7.004	0.31	0.31	0.31	0.31	0.31	0.31	0.31
7.063	0.31	0.32	0.32	0.32	0.32	0.32	0.32
7.121	0.32	0.32	0.32	0.32	0.32	0.32	0.32
7.180	0.32	0.32	0.32	0.32	0.32	0.33	0.33
7.239	0.33	0.33	0.33	0.33	0.33	0.33	0.33
7.298	0.33	0.33	0.33	0.33	0.33	0.33	0.33
7.357	0.33	0.33	0.33	0.33	0.33	0.33	0.34
7.415	0.34	0.34	0.34	0.34	0.34	0.34	0.34
7.474	0.34	0.34	0.34	0.34	0.34	0.34	0.34
7.533	0.34	0.34	0.34	0.34	0.34	0.34	0.34
7.592	0.34	0.34	0.34	0.35	0.35	0.35	0.35
7.651	0.35	0.35	0.35	0.35	0.35	0.35	0.35
7.709	0.35	0.35	0.35	0.35	0.35	0.35	0.35
7.768	0.35	0.35	0.35	0.35	0.35	0.35	0.35

WinTR-20 Version 1.10   Page 10   02/06/2022 11:17

Brea Mall
Post-Development

Line
Start Time   ------------ Flow Values @ time increment of 0.008 hr ------------

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

(hr)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
7.827	0.35	0.36	0.36	0.36	0.36	0.36	0.36
7.886	0.36	0.36	0.36	0.36	0.36	0.36	0.36
7.945	0.36	0.36	0.36	0.36	0.36	0.36	0.36
8.003	0.36	0.36	0.36	0.36	0.37	0.37	0.37
8.062	0.37	0.37	0.37	0.37	0.38	0.38	0.38
8.121	0.38	0.38	0.39	0.39	0.39	0.39	0.40
8.180	0.40	0.40	0.41	0.41	0.41	0.42	0.42
8.239	0.42	0.43	0.43	0.43	0.44	0.44	0.44
8.297	0.45	0.45	0.45	0.46	0.46	0.46	0.47
8.356	0.47	0.47	0.48	0.48	0.49	0.49	0.49
8.415	0.50	0.50	0.50	0.51	0.51	0.51	0.52
8.474	0.52	0.52	0.53	0.53	0.53	0.54	0.54
8.533	0.54	0.55	0.55	0.55	0.56	0.56	0.57
8.591	0.57	0.57	0.58	0.58	0.58	0.59	0.59
8.650	0.59	0.60	0.60	0.60	0.61	0.61	0.61
8.709	0.62	0.62	0.62	0.63	0.63	0.63	0.64
8.768	0.64	0.64	0.65	0.65	0.65	0.66	0.66
8.827	0.66	0.67	0.67	0.67	0.68	0.68	0.68
8.885	0.69	0.69	0.69	0.70	0.70	0.70	0.71
8.944	0.71	0.71	0.72	0.72	0.72	0.73	0.73
9.003	0.74	0.74	0.74	0.75	0.75	0.75	0.76
9.062	0.76	0.77	0.77	0.78	0.78	0.79	0.79
9.121	0.80	0.80	0.80	0.81	0.82	0.82	0.83
9.179	0.84	0.84	0.85	0.85	0.86	0.87	0.87
9.238	0.88	0.88	0.89	0.90	0.90	0.91	0.92
9.297	0.92	0.93	0.94	0.94	0.95	0.95	0.96
9.356	0.97	0.97	0.98	0.99	1.00	1.00	1.01
9.415	1.01	1.02	1.03	1.03	1.04	1.05	1.05
9.473	1.06	1.07	1.07	1.08	1.09	1.10	1.11
9.532	1.12	1.14	1.17	1.20	1.24	1.28	1.32
9.591	1.36	1.40	1.44	1.48	1.52	1.56	1.61
9.650	1.68	1.75	1.83	1.91	1.99	2.07	2.15
9.709	2.22	2.29	2.37	2.46	2.55	2.67	2.80
9.767	2.94	3.08	3.23	3.37	3.50	3.63	3.76
9.826	3.91	4.07	4.26	4.49	4.75	5.02	5.31
9.885	5.60	5.87	6.13	6.36	6.55	6.70	6.79

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

9.944	6.83	6.81	6.75	6.66	6.55	6.43	6.30
10.003	6.18	6.05	5.91	5.76	5.58	5.38	5.14
10.061	4.87	4.57	4.27	3.98	3.69	3.43	3.19
10.120	2.97	2.78	2.62	2.49	2.37	2.27	2.18
10.179	2.10	2.03	1.96	1.91	1.86	1.82	1.78
10.238	1.75	1.72	1.69	1.66	1.63	1.60	1.58
10.297	1.55	1.53	1.51	1.50	1.48	1.46	1.45
10.355	1.43	1.41	1.39	1.37	1.35	1.34	1.32
10.414	1.31	1.29	1.28	1.26	1.25	1.23	1.22
10.473	1.20	1.18	1.16	1.15	1.13	1.12	1.11
10.532	1.09	1.08	1.07	1.06	1.04	1.03	1.02
10.591	1.01	1.00	0.99	0.98	0.97	0.96	0.95
10.649	0.95	0.94	0.94	0.93	0.92	0.92	0.91
10.708	0.91	0.90	0.90	0.90	0.89	0.89	0.88
10.767	0.88	0.87	0.87	0.87	0.86	0.86	0.85

Brea Mall
Post-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.008 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
10.826	0.85	0.85	0.84	0.84	0.84	0.83	0.83
10.885	0.82	0.82	0.82	0.81	0.81	0.81	0.80
10.943	0.80	0.79	0.79	0.79	0.78	0.78	0.77
11.002	0.77	0.77	0.76	0.76	0.76	0.75	0.75
11.061	0.75	0.74	0.74	0.74	0.73	0.73	0.73
11.120	0.73	0.72	0.72	0.72	0.72	0.72	0.71
11.179	0.71	0.71	0.71	0.71	0.71	0.71	0.70
11.237	0.70	0.70	0.70	0.70	0.70	0.69	0.69
11.296	0.69	0.69	0.69	0.69	0.69	0.69	0.68
11.355	0.68	0.68	0.68	0.68	0.68	0.67	0.67
11.414	0.67	0.67	0.67	0.67	0.67	0.67	0.66
11.473	0.66	0.66	0.66	0.66	0.66	0.66	0.65
11.531	0.65	0.65	0.65	0.65	0.65	0.65	0.64

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

11.590	0.64	0.64	0.64	0.64	0.64	0.64	0.64
11.649	0.63	0.63	0.63	0.63	0.63	0.63	0.62
11.708	0.62	0.62	0.62	0.62	0.62	0.62	0.62
11.767	0.61	0.61	0.61	0.61	0.61	0.61	0.61
11.825	0.60	0.60	0.60	0.60	0.60	0.60	0.60
11.884	0.59	0.59	0.59	0.59	0.59	0.59	0.59
11.943	0.58	0.58	0.58	0.58	0.58	0.58	0.58
12.002	0.57	0.57	0.57	0.57	0.57	0.57	0.57
12.061	0.57	0.56	0.56	0.56	0.56	0.56	0.56
12.119	0.56	0.56	0.56	0.55	0.55	0.55	0.55
12.178	0.55	0.55	0.55	0.55	0.55	0.55	0.54
12.237	0.54	0.54	0.54	0.54	0.54	0.54	0.54
12.296	0.54	0.54	0.54	0.54	0.53	0.53	0.53
12.355	0.53	0.53	0.53	0.53	0.53	0.53	0.53
12.413	0.53	0.52	0.52	0.52	0.52	0.52	0.52
12.472	0.52	0.52	0.52	0.52	0.52	0.51	0.51
12.531	0.51	0.51	0.51	0.51	0.51	0.51	0.51
12.590	0.51	0.51	0.51	0.50	0.50	0.50	0.50
12.649	0.50	0.50	0.50	0.50	0.50	0.50	0.50
12.707	0.49	0.49	0.49	0.49	0.49	0.49	0.49
12.766	0.49	0.49	0.49	0.49	0.48	0.48	0.48
12.825	0.48	0.48	0.48	0.48	0.48	0.48	0.48
12.884	0.48	0.48	0.47	0.47	0.47	0.47	0.47
12.943	0.47	0.47	0.47	0.47	0.47	0.47	0.46
13.001	0.46	0.46	0.46	0.46	0.46	0.46	0.46
13.060	0.46	0.46	0.46	0.46	0.45	0.45	0.45
13.119	0.45	0.45	0.45	0.45	0.45	0.45	0.45
13.178	0.45	0.44	0.44	0.44	0.44	0.44	0.44
13.237	0.44	0.44	0.44	0.44	0.44	0.43	0.43
13.295	0.43	0.43	0.43	0.43	0.43	0.43	0.43
13.354	0.43	0.43	0.43	0.42	0.42	0.42	0.42
13.413	0.42	0.42	0.42	0.42	0.42	0.42	0.42
13.472	0.41	0.41	0.41	0.41	0.41	0.41	0.41
13.531	0.41	0.41	0.41	0.41	0.41	0.40	0.40
13.589	0.40	0.40	0.40	0.40	0.40	0.40	0.40
13.648	0.40	0.40	0.39	0.39	0.39	0.39	0.39
13.707	0.39	0.39	0.39	0.39	0.39	0.39	0.38
13.766	0.38	0.38	0.38	0.38	0.38	0.38	0.38

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development
                                          STORM 2-Yr
SUB-AREA:
          Lower Lvl Outlet   .01495   98.   .128
          Upper Lvl Outlet   .00809   98.   .133

Brea Mall
Post-Development

Line Start Time (hr)	Flow Values @ time increment of 0.008 hr (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
13.825	0.38	0.38	0.38	0.38	0.37	0.37	0.37
13.883	0.37	0.37	0.37	0.37	0.37	0.37	0.37
13.942	0.37	0.36	0.36	0.36	0.36	0.36	0.36
14.001	0.36	0.36	0.36	0.36	0.36	0.36	0.35
14.060	0.35	0.35	0.35	0.35	0.35	0.35	0.35
14.119	0.35	0.35	0.35	0.35	0.35	0.35	0.35
14.177	0.35	0.35	0.35	0.35	0.35	0.35	0.35
14.236	0.35	0.35	0.35	0.35	0.34	0.34	0.34
14.295	0.34	0.34	0.34	0.34	0.34	0.34	0.34
14.354	0.34	0.34	0.34	0.34	0.34	0.34	0.34
14.413	0.34	0.34	0.34	0.34	0.34	0.34	0.34
14.471	0.34	0.34	0.34	0.34	0.34	0.34	0.34
14.530	0.34	0.34	0.34	0.34	0.34	0.34	0.34
14.589	0.34	0.34	0.34	0.34	0.34	0.34	0.34
14.648	0.34	0.34	0.34	0.34	0.34	0.34	0.34
14.707	0.34	0.34	0.34	0.34	0.34	0.33	0.33
14.765	0.33	0.33	0.33	0.33	0.33	0.33	0.33
14.824	0.33	0.33	0.33	0.33	0.33	0.33	0.33
14.883	0.33	0.33	0.33	0.33	0.33	0.33	0.33
14.942	0.33	0.33	0.33	0.33	0.33	0.33	0.33
15.001	0.33	0.33	0.33	0.33	0.33	0.33	0.33
15.059	0.33	0.33	0.33	0.33	0.33	0.33	0.33
15.118	0.33	0.33	0.33	0.33	0.33	0.33	0.33
15.177	0.33	0.33	0.33	0.33	0.33	0.33	0.32
15.236	0.32	0.32	0.32	0.32	0.32	0.32	0.32
15.295	0.32	0.32	0.32	0.32	0.32	0.32	0.32
15.353	0.32	0.32	0.32	0.32	0.32	0.32	0.32
15.412	0.32	0.32	0.32	0.32	0.32	0.32	0.32

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development
STORM 2-Yr
SUB-AREA:
Lower Lvl Outlet   .01495   98.   .128
Upper Lvl Outlet   .00809   98.   .133

15.471	0.32	0.32	0.32	0.32	0.32	0.32	0.32
15.530	0.32	0.32	0.32	0.32	0.32	0.32	0.32
15.589	0.32	0.32	0.32	0.32	0.32	0.32	0.32
15.647	0.32	0.32	0.32	0.32	0.32	0.32	0.32
15.706	0.31	0.31	0.31	0.31	0.31	0.31	0.31
15.765	0.31	0.31	0.31	0.31	0.31	0.31	0.31
15.824	0.31	0.31	0.31	0.31	0.31	0.31	0.31
15.883	0.31	0.31	0.31	0.31	0.31	0.31	0.31
15.941	0.31	0.31	0.31	0.31	0.31	0.31	0.31
16.000	0.31	0.31	0.31	0.31	0.31	0.31	0.31
16.059	0.31	0.31	0.31	0.31	0.31	0.31	0.31
16.118	0.31	0.31	0.31	0.31	0.31	0.31	0.31
16.177	0.31	0.30	0.30	0.30	0.30	0.30	0.30
16.235	0.30	0.30	0.30	0.30	0.30	0.30	0.30
16.294	0.30	0.30	0.30	0.30	0.30	0.30	0.30
16.353	0.30	0.30	0.30	0.30	0.30	0.30	0.30
16.412	0.30	0.30	0.30	0.30	0.30	0.30	0.30
16.471	0.30	0.30	0.30	0.30	0.30	0.30	0.30
16.529	0.30	0.30	0.30	0.30	0.30	0.30	0.30
16.588	0.30	0.30	0.30	0.30	0.30	0.30	0.30
16.647	0.30	0.30	0.29	0.29	0.29	0.29	0.29
16.706	0.29	0.29	0.29	0.29	0.29	0.29	0.29
16.765	0.29	0.29	0.29	0.29	0.29	0.29	0.29

Brea Mall
Post-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.008 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
16.823	0.29	0.29	0.29	0.29	0.29	0.29	0.29
16.882	0.29	0.29	0.29	0.29	0.29	0.29	0.29
16.941	0.29	0.29	0.29	0.29	0.29	0.29	0.29
17.000	0.29	0.29	0.29	0.29	0.29	0.29	0.29
17.059	0.29	0.29	0.29	0.29	0.29	0.29	0.29

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

17.117	0.29	0.29	0.29	0.28	0.28	0.28	0.28
17.176	0.28	0.28	0.28	0.28	0.28	0.28	0.28
17.235	0.28	0.28	0.28	0.28	0.28	0.28	0.28
17.294	0.28	0.28	0.28	0.28	0.28	0.28	0.28
17.353	0.28	0.28	0.28	0.28	0.28	0.28	0.28
17.411	0.28	0.28	0.28	0.28	0.28	0.28	0.28
17.470	0.28	0.28	0.28	0.28	0.28	0.28	0.28
17.529	0.28	0.28	0.28	0.28	0.28	0.28	0.28
17.588	0.28	0.28	0.28	0.28	0.27	0.27	0.27
17.647	0.27	0.27	0.27	0.27	0.27	0.27	0.27
17.705	0.27	0.27	0.27	0.27	0.27	0.27	0.27
17.764	0.27	0.27	0.27	0.27	0.27	0.27	0.27
17.823	0.27	0.27	0.27	0.27	0.27	0.27	0.27
17.882	0.27	0.27	0.27	0.27	0.27	0.27	0.27
17.941	0.27	0.27	0.27	0.27	0.27	0.27	0.27
17.999	0.27	0.27	0.27	0.27	0.27	0.27	0.27
18.058	0.27	0.27	0.27	0.27	0.26	0.26	0.26
18.117	0.26	0.26	0.26	0.26	0.26	0.26	0.26
18.176	0.26	0.26	0.26	0.26	0.26	0.26	0.26
18.235	0.26	0.26	0.26	0.26	0.26	0.26	0.26
18.293	0.26	0.26	0.26	0.26	0.26	0.26	0.26
18.352	0.26	0.26	0.26	0.26	0.26	0.26	0.26
18.411	0.26	0.26	0.26	0.26	0.26	0.26	0.26
18.470	0.26	0.26	0.26	0.26	0.26	0.26	0.26
18.529	0.26	0.26	0.26	0.26	0.26	0.25	0.25
18.587	0.25	0.25	0.25	0.25	0.25	0.25	0.25
18.646	0.25	0.25	0.25	0.25	0.25	0.25	0.25
18.705	0.25	0.25	0.25	0.25	0.25	0.25	0.25
18.764	0.25	0.25	0.25	0.25	0.25	0.25	0.25
18.823	0.25	0.25	0.25	0.25	0.25	0.25	0.25
18.881	0.25	0.25	0.25	0.25	0.25	0.25	0.25
18.940	0.25	0.25	0.25	0.25	0.25	0.25	0.25
18.999	0.25	0.25	0.25	0.25	0.25	0.25	0.24
19.058	0.24	0.24	0.24	0.24	0.24	0.24	0.24
19.117	0.24	0.24	0.24	0.24	0.24	0.24	0.24
19.175	0.24	0.24	0.24	0.24	0.24	0.24	0.24
19.234	0.24	0.24	0.24	0.24	0.24	0.24	0.24
19.293	0.24	0.24	0.24	0.24	0.24	0.24	0.24

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

19.352	0.24	0.24	0.24	0.24	0.24	0.24	0.24
19.411	0.24	0.24	0.24	0.24	0.24	0.24	0.24
19.469	0.24	0.24	0.24	0.24	0.24	0.24	0.23
19.528	0.23	0.23	0.23	0.23	0.23	0.23	0.23
19.587	0.23	0.23	0.23	0.23	0.23	0.23	0.23
19.646	0.23	0.23	0.23	0.23	0.23	0.23	0.23
19.705	0.23	0.23	0.23	0.23	0.23	0.23	0.23
19.763	0.23	0.23	0.23	0.23	0.23	0.23	0.23

Brea Mall
Post-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.008 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
19.822	0.23	0.23	0.23	0.23	0.23	0.23	0.23
19.881	0.23	0.23	0.23	0.23	0.23	0.23	0.23
19.940	0.23	0.23	0.23	0.23	0.23	0.23	0.22
19.999	0.22	0.22	0.22	0.22	0.22	0.22	0.22
20.057	0.22	0.22	0.22	0.22	0.22	0.22	0.22
20.116	0.22	0.22	0.22	0.22	0.22	0.22	0.22
20.175	0.22	0.22	0.22	0.22	0.22	0.22	0.22
20.234	0.22	0.22	0.22	0.22	0.22	0.22	0.22
20.293	0.22	0.22	0.22	0.22	0.22	0.22	0.22
20.351	0.22	0.22	0.22	0.22	0.22	0.22	0.22
20.410	0.22	0.22	0.22	0.22	0.22	0.22	0.22
20.469	0.21	0.21	0.21	0.21	0.21	0.21	0.21
20.528	0.21	0.21	0.21	0.21	0.21	0.21	0.21
20.587	0.21	0.21	0.21	0.21	0.21	0.21	0.21
20.645	0.21	0.21	0.21	0.21	0.21	0.21	0.21
20.704	0.21	0.21	0.21	0.21	0.21	0.21	0.21
20.763	0.21	0.21	0.21	0.21	0.21	0.21	0.21
20.822	0.21	0.21	0.21	0.21	0.21	0.21	0.21
20.881	0.21	0.21	0.21	0.21	0.21	0.21	0.21
20.939	0.20	0.20	0.20	0.20	0.20	0.20	0.20

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

20.998	0.20	0.20	0.20	0.20	0.20	0.20	0.20
21.057	0.20	0.20	0.20	0.20	0.20	0.20	0.20
21.116	0.20	0.20	0.20	0.20	0.20	0.20	0.20
21.175	0.20	0.20	0.20	0.20	0.20	0.20	0.20
21.233	0.20	0.20	0.20	0.20	0.20	0.20	0.20
21.292	0.20	0.20	0.20	0.20	0.20	0.20	0.20
21.351	0.20	0.20	0.20	0.20	0.20	0.20	0.20
21.410	0.19	0.19	0.19	0.19	0.19	0.19	0.19
21.469	0.19	0.19	0.19	0.19	0.19	0.19	0.19
21.527	0.19	0.19	0.19	0.19	0.19	0.19	0.19
21.586	0.19	0.19	0.19	0.19	0.19	0.19	0.19
21.645	0.19	0.19	0.19	0.19	0.19	0.19	0.19
21.704	0.19	0.19	0.19	0.19	0.19	0.19	0.19
21.763	0.19	0.19	0.19	0.19	0.19	0.19	0.19
21.821	0.19	0.19	0.19	0.19	0.19	0.19	0.19
21.880	0.19	0.18	0.18	0.18	0.18	0.18	0.18
21.939	0.18	0.18	0.18	0.18	0.18	0.18	0.18
21.998	0.18	0.18	0.18	0.18	0.18	0.18	0.18
22.057	0.18	0.18	0.18	0.18	0.18	0.18	0.18
22.115	0.18	0.18	0.18	0.18	0.18	0.18	0.18
22.174	0.18	0.18	0.18	0.18	0.18	0.18	0.18
22.233	0.18	0.18	0.18	0.18	0.18	0.18	0.18
22.292	0.18	0.18	0.18	0.18	0.18	0.18	0.18
22.351	0.18	0.17	0.17	0.17	0.17	0.17	0.17
22.409	0.17	0.17	0.17	0.17	0.17	0.17	0.17
22.468	0.17	0.17	0.17	0.17	0.17	0.17	0.17
22.527	0.17	0.17	0.17	0.17	0.17	0.17	0.17
22.586	0.17	0.17	0.17	0.17	0.17	0.17	0.17
22.645	0.17	0.17	0.17	0.17	0.17	0.17	0.17
22.703	0.17	0.17	0.17	0.17	0.17	0.17	0.17
22.762	0.17	0.17	0.17	0.17	0.17	0.17	0.17

Brea Mall
Post-Development

Line

WinTR-20: Version 1.10 0 0 0.05
Mall (continued)
Post-Development
STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

Start Time (hr)	Flow Values @ time increment of 0.008 hr (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
22.821	0.17	0.16	0.16	0.16	0.16	0.16	0.16
22.880	0.16	0.16	0.16	0.16	0.16	0.16	0.16
22.939	0.16	0.16	0.16	0.16	0.16	0.16	0.16
22.997	0.16	0.16	0.16	0.16	0.16	0.16	0.16
23.056	0.16	0.16	0.16	0.16	0.16	0.16	0.16
23.115	0.16	0.16	0.16	0.16	0.16	0.16	0.16
23.174	0.16	0.16	0.16	0.16	0.16	0.16	0.16
23.233	0.16	0.16	0.16	0.16	0.16	0.16	0.16
23.291	0.16	0.15	0.15	0.15	0.15	0.15	0.15
23.350	0.15	0.15	0.15	0.15	0.15	0.15	0.15
23.409	0.15	0.15	0.15	0.15	0.15	0.15	0.15
23.468	0.15	0.15	0.15	0.15	0.15	0.15	0.15
23.527	0.15	0.15	0.15	0.15	0.15	0.15	0.15
23.585	0.15	0.15	0.15	0.15	0.15	0.15	0.15
23.644	0.15	0.15	0.15	0.15	0.15	0.15	0.15
23.703	0.15	0.15	0.15	0.15	0.15	0.15	0.15
23.762	0.15	0.15	0.14	0.14	0.14	0.14	0.14
23.821	0.14	0.14	0.14	0.14	0.14	0.14	0.14
23.879	0.14	0.14	0.14	0.14	0.14	0.14	0.14
23.938	0.14	0.14	0.14	0.14	0.14	0.14	0.14
23.997	0.14	0.14	0.14	0.14	0.13	0.13	0.12
24.056	0.12	0.11	0.10	0.09	0.08	0.07	0.06

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Time (hr)	Rate (cfs)	Rate (csm)
OUTLET	0.023		1.821		9.94	19.54	848.10

Line Start Time (hr)	Flow Values @ time increment of 0.008 hr (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
1.706	0.05	0.05	0.05	0.05	0.05	0.05	0.06
1.763	0.06	0.06	0.06	0.06	0.06	0.06	0.06

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

1.820	0.06	0.06	0.06	0.06	0.06	0.07	0.07
1.876	0.07	0.07	0.07	0.07	0.07	0.07	0.07
1.933	0.07	0.07	0.07	0.07	0.07	0.07	0.08
1.989	0.08	0.08	0.08	0.08	0.08	0.08	0.08
2.046	0.08	0.08	0.08	0.08	0.08	0.08	0.09
2.103	0.09	0.09	0.09	0.09	0.09	0.09	0.09
2.159	0.09	0.09	0.10	0.14	0.15	0.15	0.15
2.216	0.15	0.15	0.15	0.15	0.15	0.15	0.16
2.272	0.16	0.16	0.16	0.16	0.16	0.16	0.16
2.329	0.17	0.17	0.17	0.17	0.17	0.17	0.17
2.386	0.17	0.17	0.18	0.18	0.18	0.18	0.18
2.442	0.18	0.18	0.18	0.19	0.19	0.19	0.19
2.499	0.19	0.19	0.19	0.19	0.19	0.20	0.20
2.555	0.20	0.20	0.20	0.20	0.20	0.20	0.21
2.612	0.21	0.21	0.21	0.21	0.21	0.21	0.21
2.669	0.22	0.22	0.22	0.22	0.22	0.22	0.22

Brea Mall
Post-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.008 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
2.725	0.22	0.22	0.23	0.23	0.23	0.23	0.23
2.782	0.23	0.23	0.23	0.24	0.24	0.24	0.24
2.838	0.24	0.24	0.24	0.24	0.24	0.25	0.25
2.895	0.25	0.25	0.25	0.25	0.25	0.25	0.25
2.951	0.26	0.26	0.26	0.26	0.26	0.26	0.26
3.008	0.26	0.27	0.27	0.27	0.27	0.27	0.27
3.065	0.27	0.27	0.28	0.28	0.28	0.28	0.28
3.121	0.28	0.28	0.28	0.28	0.29	0.29	0.29
3.178	0.29	0.29	0.29	0.29	0.29	0.30	0.30
3.234	0.30	0.30	0.30	0.30	0.30	0.30	0.31
3.291	0.31	0.31	0.31	0.31	0.31	0.31	0.31
3.348	0.31	0.31	0.32	0.32	0.32	0.32	0.32

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

3.404	0.32	0.32	0.32	0.33	0.33	0.33	0.33
3.461	0.33	0.33	0.33	0.33	0.33	0.34	0.34
3.517	0.34	0.34	0.34	0.34	0.34	0.34	0.35
3.574	0.35	0.35	0.35	0.35	0.35	0.35	0.35
3.631	0.35	0.36	0.36	0.36	0.36	0.36	0.36
3.687	0.36	0.36	0.37	0.37	0.37	0.37	0.37
3.744	0.37	0.37	0.37	0.37	0.38	0.38	0.38
3.800	0.38	0.38	0.38	0.38	0.38	0.38	0.39
3.857	0.39	0.39	0.39	0.39	0.39	0.39	0.39
3.913	0.39	0.40	0.40	0.40	0.40	0.40	0.40
3.970	0.40	0.40	0.41	0.41	0.41	0.41	0.41
4.027	0.41	0.41	0.41	0.41	0.42	0.42	0.42
4.083	0.42	0.42	0.42	0.42	0.42	0.42	0.42
4.140	0.43	0.43	0.43	0.43	0.43	0.43	0.43
4.196	0.43	0.43	0.43	0.43	0.43	0.43	0.44
4.253	0.44	0.44	0.44	0.44	0.44	0.44	0.44
4.310	0.44	0.44	0.44	0.45	0.45	0.45	0.45
4.366	0.45	0.45	0.45	0.45	0.45	0.45	0.45
4.423	0.45	0.46	0.46	0.46	0.46	0.46	0.46
4.479	0.46	0.46	0.46	0.46	0.46	0.46	0.47
4.536	0.47	0.47	0.47	0.47	0.47	0.47	0.47
4.593	0.47	0.47	0.47	0.47	0.47	0.47	0.48
4.649	0.48	0.48	0.48	0.48	0.48	0.48	0.48
4.706	0.48	0.48	0.48	0.48	0.48	0.49	0.49
4.762	0.49	0.49	0.49	0.49	0.49	0.49	0.49
4.819	0.49	0.49	0.49	0.49	0.49	0.50	0.50
4.876	0.50	0.50	0.50	0.50	0.50	0.50	0.50
4.932	0.50	0.50	0.50	0.51	0.51	0.51	0.51
4.989	0.51	0.51	0.51	0.51	0.51	0.51	0.51
5.045	0.51	0.51	0.51	0.51	0.52	0.52	0.52
5.102	0.52	0.52	0.52	0.52	0.52	0.52	0.52
5.158	0.52	0.52	0.52	0.52	0.52	0.53	0.53
5.215	0.53	0.53	0.53	0.53	0.53	0.53	0.53
5.272	0.53	0.53	0.53	0.53	0.53	0.53	0.54
5.328	0.54	0.54	0.54	0.54	0.54	0.54	0.54
5.385	0.54	0.54	0.54	0.54	0.54	0.54	0.55
5.441	0.55	0.55	0.55	0.55	0.55	0.55	0.55
5.498	0.55	0.55	0.55	0.55	0.55	0.55	0.55

WinTR-20: Version 1.10 0 0 0.05
Mall (continued)
Post-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

5.555	0.55	0.56	0.56	0.56	0.56	0.56	0.56

Brea Mall
Post-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.008 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
5.611	0.56	0.56	0.56	0.56	0.56	0.56	0.56
5.668	0.56	0.56	0.56	0.57	0.57	0.57	0.57
5.724	0.57	0.57	0.57	0.57	0.57	0.57	0.57
5.781	0.57	0.57	0.57	0.57	0.57	0.57	0.58
5.838	0.58	0.58	0.58	0.58	0.58	0.58	0.58
5.894	0.58	0.58	0.58	0.58	0.58	0.58	0.58
5.951	0.59	0.59	0.59	0.59	0.59	0.59	0.59
6.007	0.59	0.59	0.59	0.59	0.59	0.59	0.59
6.064	0.59	0.60	0.60	0.60	0.60	0.60	0.60
6.120	0.60	0.61	0.61	0.61	0.61	0.61	0.62
6.177	0.62	0.62	0.63	0.63	0.63	0.63	0.63
6.234	0.64	0.64	0.64	0.64	0.65	0.65	0.65
6.290	0.65	0.66	0.66	0.66	0.66	0.66	0.67
6.347	0.67	0.67	0.67	0.68	0.68	0.68	0.68
6.403	0.69	0.69	0.69	0.69	0.70	0.70	0.70
6.460	0.70	0.71	0.71	0.71	0.72	0.72	0.72
6.517	0.72	0.73	0.73	0.73	0.73	0.73	0.74
6.573	0.74	0.74	0.75	0.75	0.75	0.75	0.76
6.630	0.76	0.76	0.76	0.77	0.77	0.77	0.77
6.686	0.78	0.78	0.78	0.79	0.79	0.79	0.79
6.743	0.79	0.80	0.80	0.80	0.81	0.81	0.81
6.800	0.81	0.82	0.82	0.82	0.82	0.83	0.83
6.856	0.83	0.83	0.84	0.84	0.84	0.84	0.85
6.913	0.85	0.85	0.85	0.86	0.86	0.86	0.86
6.969	0.87	0.87	0.87	0.88	0.88	0.88	0.88
7.026	0.89	0.89	0.89	0.89	0.90	0.90	0.90
7.082	0.90	0.90	0.91	0.91	0.91	0.91	0.91

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

7.139	0.91	0.92	0.92	0.92	0.92	0.92	0.92
7.196	0.92	0.92	0.93	0.93	0.93	0.93	0.93
7.252	0.93	0.93	0.93	0.93	0.94	0.94	0.94
7.309	0.94	0.94	0.94	0.94	0.94	0.95	0.95
7.365	0.95	0.95	0.95	0.95	0.95	0.96	0.96
7.422	0.96	0.96	0.96	0.96	0.96	0.96	0.96
7.479	0.96	0.97	0.97	0.97	0.97	0.97	0.97
7.535	0.97	0.97	0.97	0.97	0.98	0.98	0.98
7.592	0.98	0.98	0.98	0.98	0.98	0.99	0.99
7.648	0.99	0.99	0.99	0.99	0.99	0.99	0.99
7.705	0.99	0.99	1.00	1.00	1.00	1.00	1.00
7.762	1.00	1.00	1.00	1.00	1.01	1.01	1.01
7.818	1.01	1.01	1.01	1.01	1.01	1.02	1.02
7.875	1.02	1.02	1.02	1.02	1.02	1.02	1.03
7.931	1.03	1.03	1.03	1.03	1.03	1.03	1.03
7.988	1.03	1.03	1.03	1.04	1.04	1.04	1.04
8.045	1.04	1.05	1.05	1.06	1.06	1.07	1.07
8.101	1.08	1.08	1.09	1.09	1.10	1.10	1.11
8.158	1.12	1.13	1.14	1.15	1.16	1.16	1.17
8.214	1.18	1.19	1.20	1.20	1.21	1.22	1.23
8.271	1.24	1.25	1.26	1.27	1.28	1.29	1.30
8.327	1.31	1.32	1.33	1.34	1.35	1.36	1.37
8.384	1.38	1.39	1.40	1.41	1.42	1.42	1.43
8.441	1.44	1.45	1.46	1.47	1.48	1.49	1.50

Line Start Time (hr)	------------ Flow Values @ time increment of 0.008 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
8.497	1.51	1.52	1.53	1.54	1.55	1.56	1.57
8.554	1.58	1.59	1.60	1.61	1.62	1.63	1.64
8.610	1.65	1.65	1.66	1.67	1.68	1.69	1.70
8.667	1.71	1.72	1.73	1.74	1.75	1.76	1.77

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development
STORM 2-Yr

SUB-AREA:
Lower Lvl Outlet   .01495   98.   .128
Upper Lvl Outlet   .00809   98.   .133

8.724	1.77	1.78	1.79	1.80	1.81	1.82	1.83
8.780	1.84	1.85	1.86	1.87	1.88	1.89	1.89
8.837	1.90	1.91	1.92	1.93	1.94	1.95	1.96
8.893	1.97	1.98	1.99	2.00	2.00	2.01	2.02
8.950	2.03	2.04	2.05	2.06	2.07	2.08	2.09
9.007	2.10	2.11	2.12	2.13	2.14	2.15	2.16
9.063	2.18	2.19	2.21	2.22	2.23	2.24	2.26
9.120	2.27	2.28	2.29	2.31	2.32	2.34	2.36
9.176	2.38	2.40	2.41	2.43	2.45	2.46	2.48
9.233	2.49	2.51	2.52	2.54	2.56	2.58	2.60
9.289	2.62	2.64	2.66	2.67	2.69	2.70	2.72
9.346	2.74	2.75	2.77	2.80	2.82	2.83	2.85
9.403	2.87	2.89	2.90	2.92	2.93	2.95	2.97
9.459	2.99	3.01	3.03	3.05	3.07	3.09	3.10
9.516	3.13	3.16	3.21	3.26	3.34	3.43	3.54
9.572	3.65	3.77	3.88	3.98	4.09	4.19	4.30
9.629	4.42	4.55	4.72	4.91	5.12	5.35	5.57
9.686	5.80	6.01	6.22	6.42	6.62	6.84	7.07
9.742	7.35	7.67	8.04	8.43	8.83	9.23	9.61
9.799	9.98	10.33	10.69	11.08	11.50	12.00	12.60
9.855	13.29	14.05	14.84	15.64	16.42	17.17	17.85
9.912	18.45	18.93	19.28	19.49	19.54	19.46	19.26
9.969	18.98	18.66	18.31	17.95	17.60	17.24	16.86
10.025	16.45	16.00	15.46	14.81	14.07	13.26	12.43
10.082	11.59	10.78	10.02	9.32	8.68	8.12	7.65
10.138	7.24	6.90	6.59	6.32	6.09	5.87	5.69
10.195	5.53	5.38	5.26	5.15	5.05	4.96	4.87
10.252	4.79	4.71	4.63	4.56	4.49	4.43	4.37
10.308	4.32	4.27	4.23	4.18	4.14	4.09	4.04
10.365	3.99	3.93	3.88	3.84	3.79	3.75	3.71
10.421	3.67	3.64	3.60	3.56	3.51	3.46	3.41
10.478	3.37	3.32	3.27	3.23	3.19	3.16	3.12
10.534	3.09	3.06	3.03	2.99	2.96	2.92	2.89
10.591	2.86	2.83	2.80	2.78	2.75	2.73	2.72
10.648	2.70	2.68	2.66	2.65	2.63	2.62	2.60
10.704	2.59	2.58	2.57	2.56	2.55	2.53	2.52
10.761	2.51	2.50	2.49	2.47	2.46	2.45	2.44
10.817	2.43	2.42	2.41	2.40	2.39	2.38	2.37

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

10.874	2.36	2.35	2.33	2.32	2.31	2.30	2.29
10.931	2.29	2.28	2.27	2.26	2.24	2.23	2.22
10.987	2.21	2.20	2.19	2.18	2.17	2.16	2.15
11.044	2.14	2.14	2.13	2.12	2.11	2.10	2.09
11.100	2.08	2.08	2.07	2.06	2.06	2.05	2.05
11.157	2.04	2.04	2.03	2.03	2.02	2.02	2.01
11.214	2.01	2.01	2.00	2.00	2.00	1.99	1.99
11.270	1.98	1.98	1.97	1.97	1.97	1.96	1.96
11.327	1.96	1.95	1.95	1.94	1.94	1.94	1.93

Brea Mall
Post-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.008 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
11.383	1.93	1.92	1.92	1.92	1.91	1.91	1.91
11.440	1.90	1.90	1.89	1.89	1.89	1.88	1.88
11.496	1.87	1.87	1.87	1.86	1.86	1.86	1.85
11.553	1.85	1.84	1.84	1.84	1.83	1.83	1.82
11.610	1.82	1.82	1.81	1.81	1.81	1.80	1.80
11.666	1.79	1.79	1.79	1.78	1.78	1.77	1.77
11.723	1.77	1.76	1.76	1.76	1.75	1.75	1.74
11.779	1.74	1.74	1.73	1.73	1.73	1.72	1.72
11.836	1.72	1.71	1.71	1.70	1.70	1.69	1.69
11.893	1.69	1.68	1.68	1.68	1.67	1.67	1.67
11.949	1.66	1.66	1.65	1.65	1.64	1.64	1.64
12.006	1.63	1.63	1.63	1.62	1.62	1.62	1.61
12.062	1.61	1.61	1.60	1.60	1.59	1.59	1.59
12.119	1.59	1.58	1.58	1.58	1.58	1.57	1.57
12.176	1.57	1.56	1.56	1.56	1.56	1.55	1.55
12.232	1.55	1.55	1.55	1.54	1.54	1.54	1.53
12.289	1.53	1.53	1.53	1.53	1.52	1.52	1.52
12.345	1.52	1.51	1.51	1.51	1.51	1.50	1.50
12.402	1.50	1.50	1.49	1.49	1.49	1.49	1.49

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development
STORM 2-Yr

SUB-AREA:
Lower Lvl Outlet   .01495   98.   .128
Upper Lvl Outlet   .00809   98.   .133

12.458	1.48	1.48	1.48	1.47	1.47	1.47	1.47
12.515	1.47	1.46	1.46	1.46	1.46	1.45	1.45
12.572	1.45	1.45	1.44	1.44	1.44	1.44	1.43
12.628	1.43	1.43	1.43	1.43	1.42	1.42	1.42
12.685	1.41	1.41	1.41	1.41	1.41	1.40	1.40
12.741	1.40	1.40	1.39	1.39	1.39	1.39	1.38
12.798	1.38	1.38	1.38	1.37	1.37	1.37	1.37
12.855	1.37	1.36	1.36	1.36	1.35	1.35	1.35
12.911	1.35	1.35	1.34	1.34	1.34	1.34	1.33
12.968	1.33	1.33	1.33	1.32	1.32	1.32	1.32
13.024	1.31	1.31	1.31	1.31	1.30	1.30	1.30
13.081	1.30	1.29	1.29	1.29	1.29	1.29	1.28
13.138	1.28	1.28	1.28	1.27	1.27	1.27	1.27
13.194	1.26	1.26	1.26	1.26	1.25	1.25	1.25
13.251	1.25	1.24	1.24	1.24	1.24	1.23	1.23
13.307	1.23	1.23	1.22	1.22	1.22	1.22	1.22
13.364	1.21	1.21	1.21	1.20	1.20	1.20	1.20
13.421	1.20	1.19	1.19	1.19	1.19	1.18	1.18
13.477	1.18	1.18	1.17	1.17	1.17	1.17	1.16
13.534	1.16	1.16	1.16	1.16	1.15	1.15	1.15
13.590	1.14	1.14	1.14	1.14	1.14	1.13	1.13
13.647	1.13	1.13	1.12	1.12	1.12	1.12	1.11
13.703	1.11	1.11	1.11	1.10	1.10	1.10	1.10
13.760	1.09	1.09	1.09	1.09	1.08	1.08	1.08
13.817	1.08	1.08	1.07	1.07	1.07	1.07	1.06
13.873	1.06	1.06	1.05	1.05	1.05	1.05	1.05
13.930	1.04	1.04	1.04	1.04	1.03	1.03	1.03
13.986	1.03	1.02	1.02	1.02	1.02	1.02	1.01
14.043	1.01	1.01	1.01	1.01	1.00	1.00	1.00
14.100	1.00	1.00	1.00	0.99	0.99	0.99	0.99
14.156	0.99	0.99	0.99	0.99	0.99	0.99	0.99
14.213	0.99	0.99	0.99	0.98	0.98	0.98	0.98

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development
STORM 2-Yr

SUB-AREA:
Lower Lvl Outlet   .01495   98.   .128
Upper Lvl Outlet   .00809   98.   .133

Line Start Time (hr)	Flow Values @ time increment of 0.008 hr (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
14.269	0.98	0.98	0.98	0.98	0.98	0.98	0.98
14.326	0.98	0.98	0.98	0.98	0.98	0.98	0.98
14.383	0.98	0.97	0.97	0.97	0.97	0.97	0.97
14.439	0.97	0.97	0.97	0.97	0.97	0.97	0.97
14.496	0.97	0.97	0.97	0.97	0.97	0.97	0.97
14.552	0.97	0.96	0.96	0.96	0.96	0.96	0.96
14.609	0.96	0.96	0.96	0.96	0.96	0.96	0.96
14.665	0.96	0.96	0.96	0.96	0.96	0.96	0.96
14.722	0.96	0.95	0.95	0.95	0.95	0.95	0.95
14.779	0.95	0.95	0.95	0.95	0.95	0.95	0.95
14.835	0.95	0.95	0.95	0.95	0.95	0.95	0.95
14.892	0.95	0.94	0.94	0.94	0.94	0.94	0.94
14.948	0.94	0.94	0.94	0.94	0.94	0.94	0.94
15.005	0.94	0.94	0.94	0.94	0.94	0.94	0.94
15.062	0.94	0.93	0.93	0.93	0.93	0.93	0.93
15.118	0.93	0.93	0.93	0.93	0.93	0.93	0.93
15.175	0.93	0.93	0.93	0.93	0.93	0.93	0.93
15.231	0.93	0.92	0.92	0.92	0.92	0.92	0.92
15.288	0.92	0.92	0.92	0.92	0.92	0.92	0.92
15.345	0.92	0.92	0.92	0.92	0.92	0.92	0.92
15.401	0.91	0.91	0.91	0.91	0.91	0.91	0.91
15.458	0.91	0.91	0.91	0.91	0.91	0.91	0.91
15.514	0.91	0.91	0.91	0.91	0.91	0.91	0.91
15.571	0.90	0.90	0.90	0.90	0.90	0.90	0.90
15.628	0.90	0.90	0.90	0.90	0.90	0.90	0.90
15.684	0.90	0.90	0.90	0.90	0.90	0.90	0.90
15.741	0.90	0.89	0.89	0.89	0.89	0.89	0.89
15.797	0.89	0.89	0.89	0.89	0.89	0.89	0.89
15.854	0.89	0.89	0.89	0.89	0.89	0.89	0.89
15.910	0.88	0.88	0.88	0.88	0.88	0.88	0.88
15.967	0.88	0.88	0.88	0.88	0.88	0.88	0.88
16.024	0.88	0.88	0.88	0.88	0.88	0.88	0.88
16.080	0.87	0.87	0.87	0.87	0.87	0.87	0.87
16.137	0.87	0.87	0.87	0.87	0.87	0.87	0.87

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

16.193	0.87	0.87	0.87	0.87	0.87	0.87	0.87
16.250	0.86	0.86	0.86	0.86	0.86	0.86	0.86
16.307	0.86	0.86	0.86	0.86	0.86	0.86	0.86
16.363	0.86	0.86	0.86	0.86	0.86	0.86	0.85
16.420	0.85	0.85	0.85	0.85	0.85	0.85	0.85
16.476	0.85	0.85	0.85	0.85	0.85	0.85	0.85
16.533	0.85	0.85	0.85	0.85	0.85	0.85	0.84
16.590	0.84	0.84	0.84	0.84	0.84	0.84	0.84
16.646	0.84	0.84	0.84	0.84	0.84	0.84	0.84
16.703	0.84	0.84	0.84	0.84	0.84	0.84	0.83
16.759	0.83	0.83	0.83	0.83	0.83	0.83	0.83
16.816	0.83	0.83	0.83	0.83	0.83	0.83	0.83
16.872	0.83	0.83	0.83	0.83	0.83	0.82	0.82
16.929	0.82	0.82	0.82	0.82	0.82	0.82	0.82
16.986	0.82	0.82	0.82	0.82	0.82	0.82	0.82
17.042	0.82	0.82	0.82	0.82	0.82	0.81	0.81
17.099	0.81	0.81	0.81	0.81	0.81	0.81	0.81

WinTR-20 Version 1.10   Page 21   02/06/2022 11:17

Brea Mall
Post-Development

Line Start Time (hr)	------------ Flow Values @ time increment of 0.008 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
17.155	0.81	0.81	0.81	0.81	0.81	0.81	0.81
17.212	0.81	0.81	0.81	0.81	0.81	0.80	0.80
17.269	0.80	0.80	0.80	0.80	0.80	0.80	0.80
17.325	0.80	0.80	0.80	0.80	0.80	0.80	0.80
17.382	0.80	0.80	0.80	0.80	0.80	0.79	0.79
17.438	0.79	0.79	0.79	0.79	0.79	0.79	0.79
17.495	0.79	0.79	0.79	0.79	0.79	0.79	0.79
17.552	0.79	0.79	0.79	0.79	0.78	0.78	0.78
17.608	0.78	0.78	0.78	0.78	0.78	0.78	0.78
17.665	0.78	0.78	0.78	0.78	0.78	0.78	0.78
17.721	0.78	0.78	0.78	0.78	0.77	0.77	0.77

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

17.778	0.77	0.77	0.77	0.77	0.77	0.77	0.77
17.834	0.77	0.77	0.77	0.77	0.77	0.77	0.77
17.891	0.77	0.77	0.77	0.77	0.76	0.76	0.76
17.948	0.76	0.76	0.76	0.76	0.76	0.76	0.76
18.004	0.76	0.76	0.76	0.76	0.76	0.76	0.76
18.061	0.76	0.76	0.76	0.75	0.75	0.75	0.75
18.117	0.75	0.75	0.75	0.75	0.75	0.75	0.75
18.174	0.75	0.75	0.75	0.75	0.75	0.75	0.75
18.231	0.75	0.75	0.75	0.74	0.74	0.74	0.74
18.287	0.74	0.74	0.74	0.74	0.74	0.74	0.74
18.344	0.74	0.74	0.74	0.74	0.74	0.74	0.74
18.400	0.74	0.74	0.74	0.73	0.73	0.73	0.73
18.457	0.73	0.73	0.73	0.73	0.73	0.73	0.73
18.514	0.73	0.73	0.73	0.73	0.73	0.73	0.73
18.570	0.73	0.73	0.72	0.72	0.72	0.72	0.72
18.627	0.72	0.72	0.72	0.72	0.72	0.72	0.72
18.683	0.72	0.72	0.72	0.72	0.72	0.72	0.72
18.740	0.72	0.72	0.71	0.71	0.71	0.71	0.71
18.797	0.71	0.71	0.71	0.71	0.71	0.71	0.71
18.853	0.71	0.71	0.71	0.71	0.71	0.71	0.71
18.910	0.71	0.70	0.70	0.70	0.70	0.70	0.70
18.966	0.70	0.70	0.70	0.70	0.70	0.70	0.70
19.023	0.70	0.70	0.70	0.70	0.70	0.70	0.70
19.079	0.70	0.69	0.69	0.69	0.69	0.69	0.69
19.136	0.69	0.69	0.69	0.69	0.69	0.69	0.69
19.193	0.69	0.69	0.69	0.69	0.69	0.69	0.69
19.249	0.69	0.68	0.68	0.68	0.68	0.68	0.68
19.306	0.68	0.68	0.68	0.68	0.68	0.68	0.68
19.362	0.68	0.68	0.68	0.68	0.68	0.68	0.68
19.419	0.67	0.67	0.67	0.67	0.67	0.67	0.67
19.476	0.67	0.67	0.67	0.67	0.67	0.67	0.67
19.532	0.67	0.67	0.67	0.67	0.67	0.67	0.67
19.589	0.66	0.66	0.66	0.66	0.66	0.66	0.66
19.645	0.66	0.66	0.66	0.66	0.66	0.66	0.66
19.702	0.66	0.66	0.66	0.66	0.66	0.66	0.66
19.759	0.65	0.65	0.65	0.65	0.65	0.65	0.65
19.815	0.65	0.65	0.65	0.65	0.65	0.65	0.65
19.872	0.65	0.65	0.65	0.65	0.65	0.65	0.64

WinTR-20: Version 1.10 0 0 0.05
Mall (continued)
Post-Development

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

19.928	0.64	0.64	0.64	0.64	0.64	0.64	0.64
19.985	0.64	0.64	0.64	0.64	0.64	0.64	0.64

Line Start Time (hr)	------------ Flow Values @ time increment of 0.008 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
20.041	0.64	0.64	0.64	0.64	0.64	0.63	0.63
20.098	0.63	0.63	0.63	0.63	0.63	0.63	0.63
20.155	0.63	0.63	0.63	0.63	0.63	0.63	0.63
20.211	0.63	0.63	0.63	0.63	0.63	0.63	0.62
20.268	0.62	0.62	0.62	0.62	0.62	0.62	0.62
20.324	0.62	0.62	0.62	0.62	0.62	0.62	0.62
20.381	0.62	0.62	0.62	0.62	0.62	0.61	0.61
20.438	0.61	0.61	0.61	0.61	0.61	0.61	0.61
20.494	0.61	0.61	0.61	0.61	0.61	0.61	0.61
20.551	0.61	0.61	0.61	0.61	0.60	0.60	0.60
20.607	0.60	0.60	0.60	0.60	0.60	0.60	0.60
20.664	0.60	0.60	0.60	0.60	0.60	0.60	0.60
20.721	0.60	0.60	0.60	0.60	0.59	0.59	0.59
20.777	0.59	0.59	0.59	0.59	0.59	0.59	0.59
20.834	0.59	0.59	0.59	0.59	0.59	0.59	0.59
20.890	0.59	0.59	0.59	0.58	0.58	0.58	0.58
20.947	0.58	0.58	0.58	0.58	0.58	0.58	0.58
21.004	0.58	0.58	0.58	0.58	0.58	0.58	0.58
21.060	0.58	0.58	0.58	0.57	0.57	0.57	0.57
21.117	0.57	0.57	0.57	0.57	0.57	0.57	0.57
21.173	0.57	0.57	0.57	0.57	0.57	0.57	0.57
21.230	0.57	0.57	0.57	0.56	0.56	0.56	0.56
21.286	0.56	0.56	0.56	0.56	0.56	0.56	0.56
21.343	0.56	0.56	0.56	0.56	0.56	0.56	0.56
21.400	0.56	0.56	0.55	0.55	0.55	0.55	0.55
21.456	0.55	0.55	0.55	0.55	0.55	0.55	0.55

WinTR-20: Version 1.10 0 0 0.05
Mall (continued)
Post-Development
STORM 2-Yr
SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

21.513	0.55	0.55	0.55	0.55	0.55	0.55	0.55
21.569	0.55	0.55	0.54	0.54	0.54	0.54	0.54
21.626	0.54	0.54	0.54	0.54	0.54	0.54	0.54
21.683	0.54	0.54	0.54	0.54	0.54	0.54	0.54
21.739	0.54	0.54	0.53	0.53	0.53	0.53	0.53
21.796	0.53	0.53	0.53	0.53	0.53	0.53	0.53
21.852	0.53	0.53	0.53	0.53	0.53	0.53	0.53
21.909	0.53	0.52	0.52	0.52	0.52	0.52	0.52
21.966	0.52	0.52	0.52	0.52	0.52	0.52	0.52
22.022	0.52	0.52	0.52	0.52	0.52	0.52	0.52
22.079	0.51	0.51	0.51	0.51	0.51	0.51	0.51
22.135	0.51	0.51	0.51	0.51	0.51	0.51	0.51
22.192	0.51	0.51	0.51	0.51	0.51	0.51	0.51
22.248	0.50	0.50	0.50	0.50	0.50	0.50	0.50
22.305	0.50	0.50	0.50	0.50	0.50	0.50	0.50
22.362	0.50	0.50	0.50	0.50	0.50	0.50	0.49
22.418	0.49	0.49	0.49	0.49	0.49	0.49	0.49
22.475	0.49	0.49	0.49	0.49	0.49	0.49	0.49
22.531	0.49	0.49	0.49	0.49	0.49	0.49	0.48
22.588	0.48	0.48	0.48	0.48	0.48	0.48	0.48
22.645	0.48	0.48	0.48	0.48	0.48	0.48	0.48
22.701	0.48	0.48	0.48	0.48	0.48	0.48	0.47
22.758	0.47	0.47	0.47	0.47	0.47	0.47	0.47
22.814	0.47	0.47	0.47	0.47	0.47	0.47	0.47
22.871	0.47	0.47	0.47	0.47	0.47	0.46	0.46

Line Start Time (hr)	------------ Flow Values @ time increment of 0.008 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
22.928	0.46	0.46	0.46	0.46	0.46	0.46	0.46
22.984	0.46	0.46	0.46	0.46	0.46	0.46	0.46
23.041	0.46	0.46	0.46	0.46	0.45	0.45	0.45

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

23.097	0.45	0.45	0.45	0.45	0.45	0.45	0.45
23.154	0.45	0.45	0.45	0.45	0.45	0.45	0.45
23.210	0.45	0.45	0.45	0.45	0.44	0.44	0.44
23.267	0.44	0.44	0.44	0.44	0.44	0.44	0.44
23.324	0.44	0.44	0.44	0.44	0.44	0.44	0.44
23.380	0.44	0.44	0.44	0.43	0.43	0.43	0.43
23.437	0.43	0.43	0.43	0.43	0.43	0.43	0.43
23.493	0.43	0.43	0.43	0.43	0.43	0.43	0.43
23.550	0.43	0.43	0.43	0.42	0.42	0.42	0.42
23.607	0.42	0.42	0.42	0.42	0.42	0.42	0.42
23.663	0.42	0.42	0.42	0.42	0.42	0.42	0.42
23.720	0.42	0.42	0.42	0.41	0.41	0.41	0.41
23.776	0.41	0.41	0.41	0.41	0.41	0.41	0.41
23.833	0.41	0.41	0.41	0.41	0.41	0.41	0.41
23.890	0.41	0.41	0.40	0.40	0.40	0.40	0.40
23.946	0.40	0.40	0.40	0.40	0.40	0.40	0.40
24.003	0.40	0.40	0.39	0.39	0.37	0.36	0.34
24.059	0.31	0.29	0.26	0.23	0.20	0.17	0.15
24.116	0.08	0.07	0.06				

WinTR-20: Version 1.10   0   0   0.05
Mall   (continued)
Post-Development
STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

Brea Mall
Post-Development

Area or Reach Identifier	Drainage Area (sq mi)	Alternate	----------- Peak Flow by Storm ----------- 2-Yr (cfs)	(cfs)	(cfs)	(cfs)	(cfs)
Lower Lvl	0.015		12.71				
Upper Lvl	0.008		6.83				
OUTLET	0.023		19.54				

STORM 2-Yr

SUB-AREA:

Lower Lvl Outlet	.01495	98.	.128
Upper Lvl Outlet	.00809	98.	.133

WinTR-55 Current Data Description

--- Identification Data ---

User: CJN
Project: Brea Mall
SubTitle: Post-Development
State: California
County: Orange
Filename: Q:\3180011\3180011.03\eng data\Hydrology\WinTR 55\220206 Brea Mall Post-Development.w55

Date: 2/6/2022
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
Lower Lvl		Outlet	9.57	98	.128
Upper Lvl		Outlet	5.18	98	.133

Total area: 14.75 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
2.05	.0	.0	.0	.0	6.58	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type I
Dimensionless Unit Hydrograph: <standard>

CJN

Brea Mall
Post-Development
Orange County, California

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
2.05	.0	.0	.0	.0	6.58	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type I
Dimensionless Unit Hydrograph: <standard>

Brea Mall
Post-Development
Orange County, California

Watershed Peak Table

Sub-Area or Reach Identifier	Peak Flow by Rainfall Return Period 2-Yr (cfs)
SUBAREAS	
Lower Lvl	12.71
Upper Lvl	6.83
REACHES	
OUTLET	19.54

CJN Brea Mall

Post-Development

Orange County, California

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs) (hr)
SUBAREAS	
Lower Lvl	12.71 9.94
Upper Lvl	6.83 9.94
REACHES	
OUTLET	19.54

Brea Mall
Post-Development
Orange County, California

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
Lower Lvl	9.57	0.128	98	Outlet	
Upper Lvl	5.18	0.133	98	Outlet	

Total Area: 14.75 (ac)

CJN

Brea Mall
Post-Development
Orange County, California

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Lower Lvl							
SHALLOW	458	0.0100	0.025				0.063
CHANNEL	745	0.0050	0.012	1.76	4.71	4.599	0.045
CHANNEL	405	0.0050	0.012	3.14	6.28	5.625	0.020
					Time of Concentration		.128
							========
Upper Lvl							
SHEET	100	0.0200	0.011				0.025
SHALLOW	210	0.0200	0.025				0.020
CHANNEL	462	0.0050	0.012	0.35	2.09	2.674	0.048
CHANNEL	505	0.0050	0.012	0.79	3.14	3.507	0.040
					Time of Concentration		.133
							========

CJN

Brea Mall
Post-Development
Orange County, California

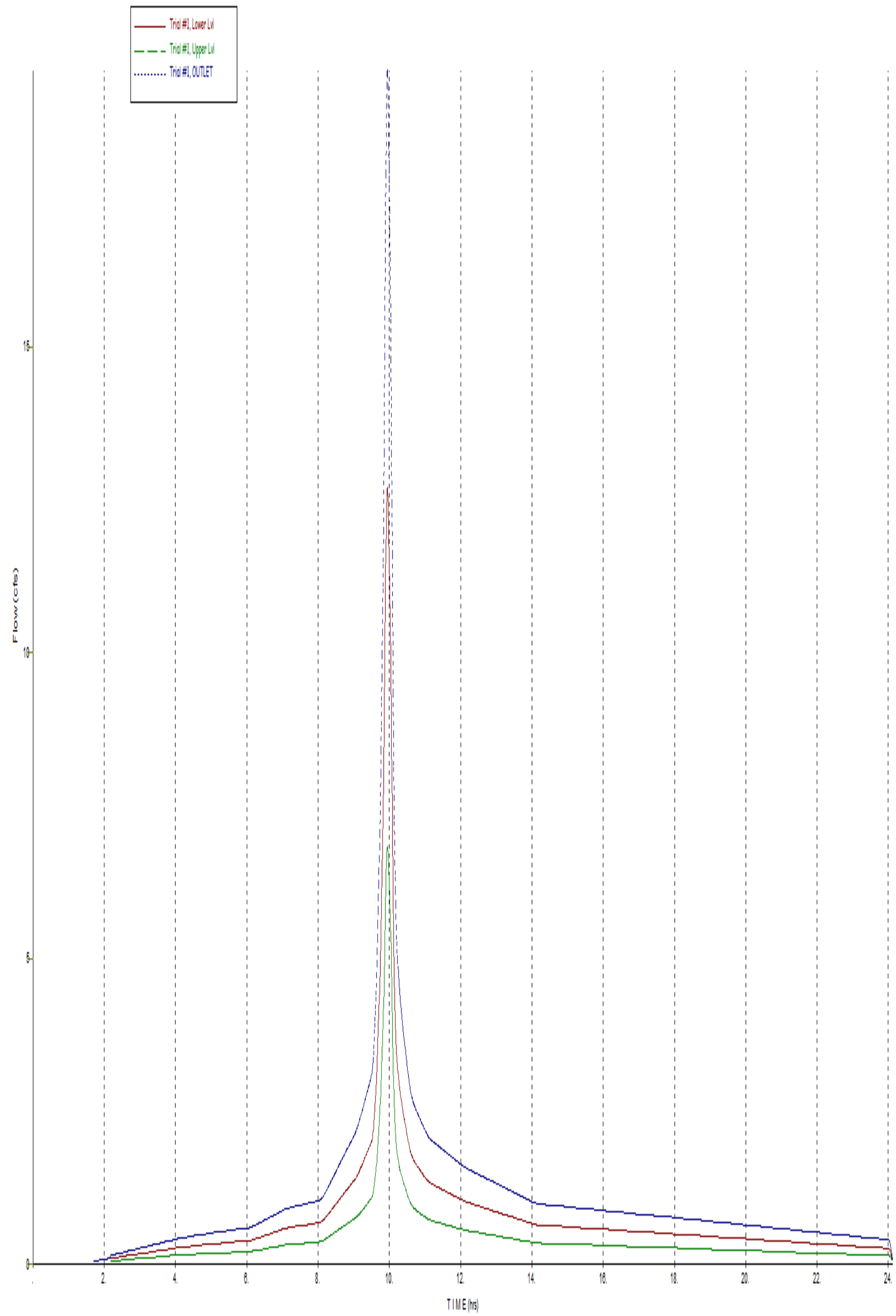
Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Lower Lvl	Paved parking lots, roofs, driveways	C	9.57	98
	Total Area / Weighted Curve Number		9.57 ====	98 ==
Upper Lvl	Paved parking lots, roofs, driveways	C	5.18	98
	Total Area / Weighted Curve Number		5.18 ====	98 ==

Project: Brea Mall

Subareas: (Lower Lvl, Upper Lvl, Outlet) Storm: 2-Yr

Q:\3180011\3180011.03\eng data\Hydrology\WinTR 55\220206 Brea Mall Post-Development.w55



Attachment 2 – Geotechnical Report & Percolation Testing Report

October 7, 2021

SIMON
225 West Washington street
Indianapolis, Indiana 46204

Attn: Mr. Mark Lingelbach
Senior Civil Engineer
P: (317) 263-7992
E: mlingelbach@simon.com

Re: Percolation Testing Report
Brea Mall Development
1066 Brea mall
Brea, California 92821
Terracon Project No. 60215197

Dear Mr. Lingelbach:

Terracon Consultants, Inc. (Terracon) has completed the percolation testing services for the above referenced project. These services were performed in general accordance with Terracon's proposal number P60215197 dated August 2, 2021. This percolation test report presents the results of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of infiltration systems for the proposed project.

Terracon's scope of work consisted of advancing three percolation borings to approximate depths of 8 feet below existing site grades (bgs). Locations of the percolation test and the soil borings are shown on the attached Test Location Plan.

Typical Subsurface Profile

We have developed a general characterization of the subsurface soil and groundwater conditions based upon our review of the data and our understanding of the geologic setting and planned construction.

Surface conditions at the site consisted of a 3 to 6-inch thick layer of asphalt concrete overlying a 4 to 10-inch thick layer of aggregate base course. The subsurface soils generally consisted of medium dense to very dense sand with varying amounts of silt and clay to a maximum drilled depth of 8 feet bgs.

Conditions encountered at each boring location are indicated on the individual boring logs which are attached to this report. Stratification boundaries on the boring logs represent the approximate location of changes in native soil types; in situ, the transition between materials may be gradual.

Laboratory tests were conducted on selected soil samples and the test results are presented on the attached boring logs. Atterberg limit test results indicate that on-site clay soils generally have low to medium plasticity.

Groundwater

Groundwater was not observed in the percolation borings while drilling, or for the short duration the borings could remain open. These observations represent groundwater conditions at the time of the field exploration and may not be indicative of other times, or at other locations.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

A preliminary geotechnical investigation report prepared by PSI for the project site, dated August 2, 2019, was provided to us by the client (PSI Project No. 00661644). According to the report, groundwater was encountered in all of the borings advanced for the investigation during or upon completion of drilling at depths ranging from about 22 to 53 feet below ground surface.

Infiltration Tests

Three in-situ percolation tests were performed in Borings P-1 through P-3 to an approximate depth of 8 feet bgs. A 2-inch thick layer of gravel was placed in the bottom of each boring after the boring was drilled to investigate the soil profile. A 3-inch diameter perforated pipe was installed on top of the gravel layer in each boring. Gravel was used to backfill between the perforated pipes and the boring sidewall. The borings were then filled with water for a pre-soak period. Testing began after a pre-soak period. At the beginning of the test, the pipe was refilled with water and readings were taken at standardized time intervals. Percolation rates are provided in the following table:

TEST RESULTS				
Test Location (depth, feet bgs)	**Soil Classification**	**Slowest Measured Percolation Rate (in/hr.)**	**Correlated Infiltration Rate[1] (in/hr.)**	**Water Head (in)**
P-1 (0 to 8 ft)	Silty Sand and Clayey Sand	65	2.3	55
P-2 (0 to 8 ft)	Poorly Graded Sand with Silt	288	22.1	24

TEST RESULTS				
Test Location (depth, feet bgs)	**Soil Classification**	**Slowest Measured Percolation Rate (in/hr.)**	**Correlated Infiltration Rate[1] (in/hr.)**	**Water Head (in)**
P-3 (0 to 8 ft)	Silty Clayey Sand	65	2.3	55

[1]If proposed infiltration system will mainly rely on vertical downward seepage, the correlated infiltration rates should be used. The infiltration rates were correlated using the Porchet method.

The field test results are not intended to be design rates. They represent the result of our tests, at the depths and locations indicated, as described above. The design rate should be determined by the designer by applying an appropriate factor of safety. In general, a minimum safety factor of 2.0 is recommended.

With time, the bottoms of infiltration systems tend to plug with organics, sediments, and other debris. Long term maintenance will likely be required to remove these deleterious materials to help reduce decreases in actual percolation rates.

The percolation tests were performed with clear water, whereas the storm water will likely not be clear, but may contain organics, fines, and grease/oil. The presence of these deleterious materials will tend to decrease the rate that water percolates from the infiltration systems. Design of the storm water infiltration systems should account for the presence of these materials and should incorporate structures/devices to remove these deleterious materials.

Based on the soils encountered in our borings, we expect the percolation rates of the soils could be different than measured in the field due to variations in fines and gravel content. The design elevation and size of the proposed infiltration system should account for this expected variability in infiltration rates.

Infiltration testing should be performed after construction of the infiltration system to verify the design infiltration rates. It should be noted that siltation and vegetation growth along with other factors may affect the infiltration rates of the infiltration areas. The actual infiltration rate may vary from the values reported here.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Ellie H. Nezhad, P.E.(Texas)
Senior Staff Engineer

Scott G. Lawson, P.E., G.E.
Senior Geotechnical Engineer

Attachments: Site Location Plan
Exploration Plan
Boring Logs
Laboratory Data
General Notes
Unified Soil Classification System

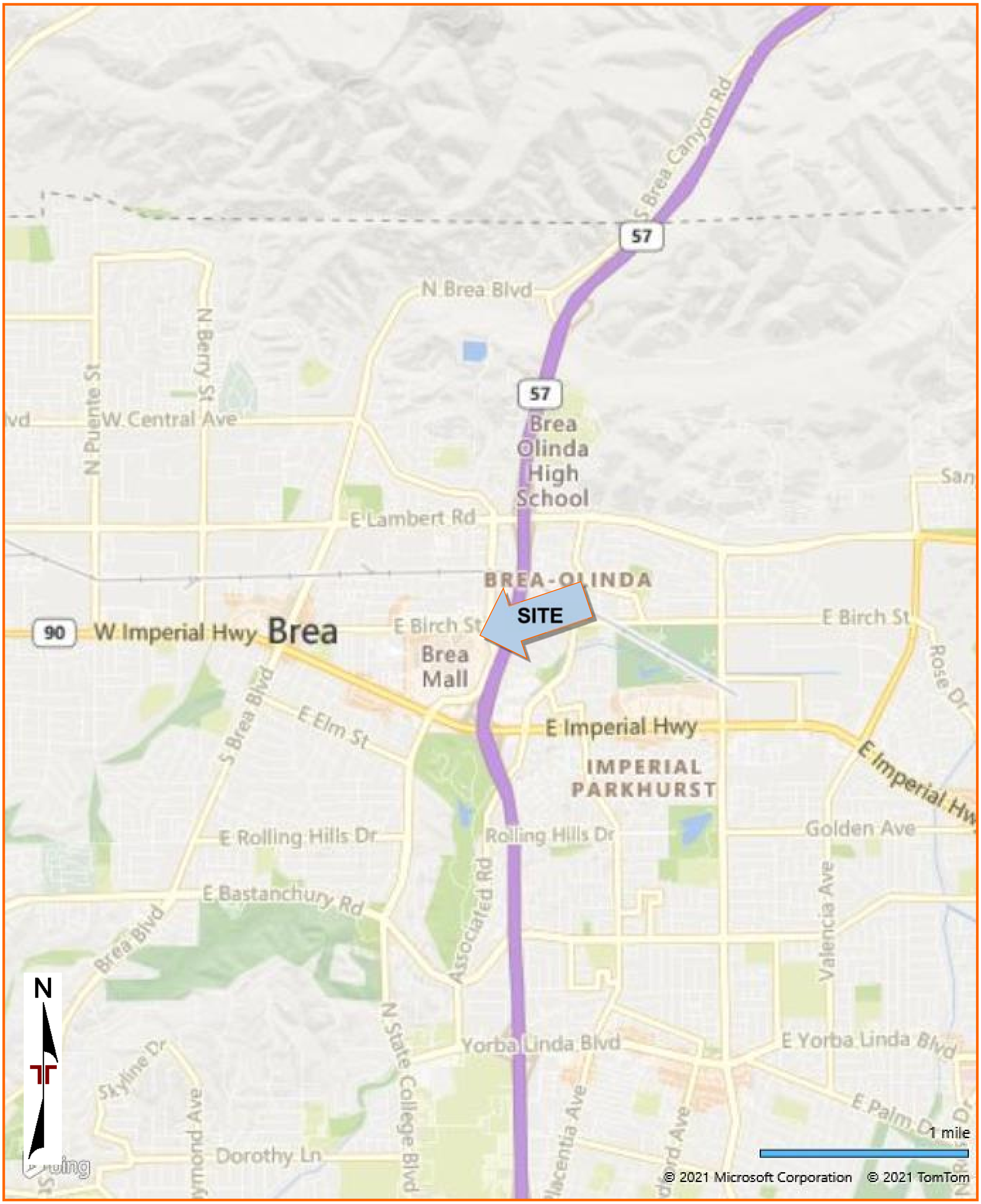


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

Brea Mall Development ■ Brea, CA

October 6, 2021 ■ Terracon Project No. 60215197

Terracon GeoReport

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

BORING LOG NO. P-1

PROJECT: Brea Mall Development

CLIENT: Simon Property Group Inc
Indianapolis, IN

SITE: 1650 Brea Mall
Brea, CA

LOCATION See Exploration Plan

Latitude: 33.9132° Longitude: -117.8872°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3	**ASPHALT**, 3 inches thickness											
0.6	**AGGREGATE BASE COURSE**, 4 inches thickness											
2.5	**CLAYEY SAND (SC)**, brown											
5.0	**SILTY CLAYEY SAND (SC-SM)**, brown, medium dense				8-16-24				14	116	25-18-7	41
6.5	**SILTY SAND (SM)**, brown, medium dense	5			4-6-9 N=15							
8.0	**POORLY GRADED SAND WITH SILT (SP-SM)**, brown											

Boring terminated at 8 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

Boring Started: 09-21-2021	Boring Completed: 09-21-2021
Excavator: CME 75 track	Operator: 2R
Project No.: 60215197	

BORING LOG NO. P-2

PROJECT: Brea Mall Development

CLIENT: Simon Property Group Inc
Indianapolis, IN

SITE: 1650 Brea Mall
Brea, CA

LOCATION See Exploration Plan

Latitude: 33.9128° Longitude: -117.8889°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3	**ASPHALT**, 4 inches thickness											
1.2	**AGGREGATE BASE COURSE**, 10 inches thickness											
2.5	**POORLY GRADED SAND (SP-SM)**, yellow brown, dense											
	POORLY GRADED SAND WITH SILT (SP-SM), brown, medium dense				20-22-45							
		5			7-12-14 N=26				7		NP	7
8.0												

Boring terminated at 8 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

Boring Started: 09-21-2021	Boring Completed: 09-21-2021
Excavator: CME 75 track	Operator: 2R
Project No.: 60215197	

BORING LOG NO. P-3

PROJECT: Brea Mall Development

CLIENT: Simon Property Group Inc
Indianapolis, IN

SITE: 1650 Brea Mall
Brea, CA

LOCATION See Exploration Plan

Latitude: 33.9148° Longitude: -117.8881°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.5	**ASPHALT**, 6 inches thickness											
1.1	**AGGREGATE BASE COURSE**, 7 inches thickness											
6.5	**CLAYEY SAND (SC)**, dark brown	5							9		31-14-17	42
8.0	**SILTY CLAYEY SAND (SC-SM)**, brown, very dense				32-50/6"							
	Boring terminated at 8 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

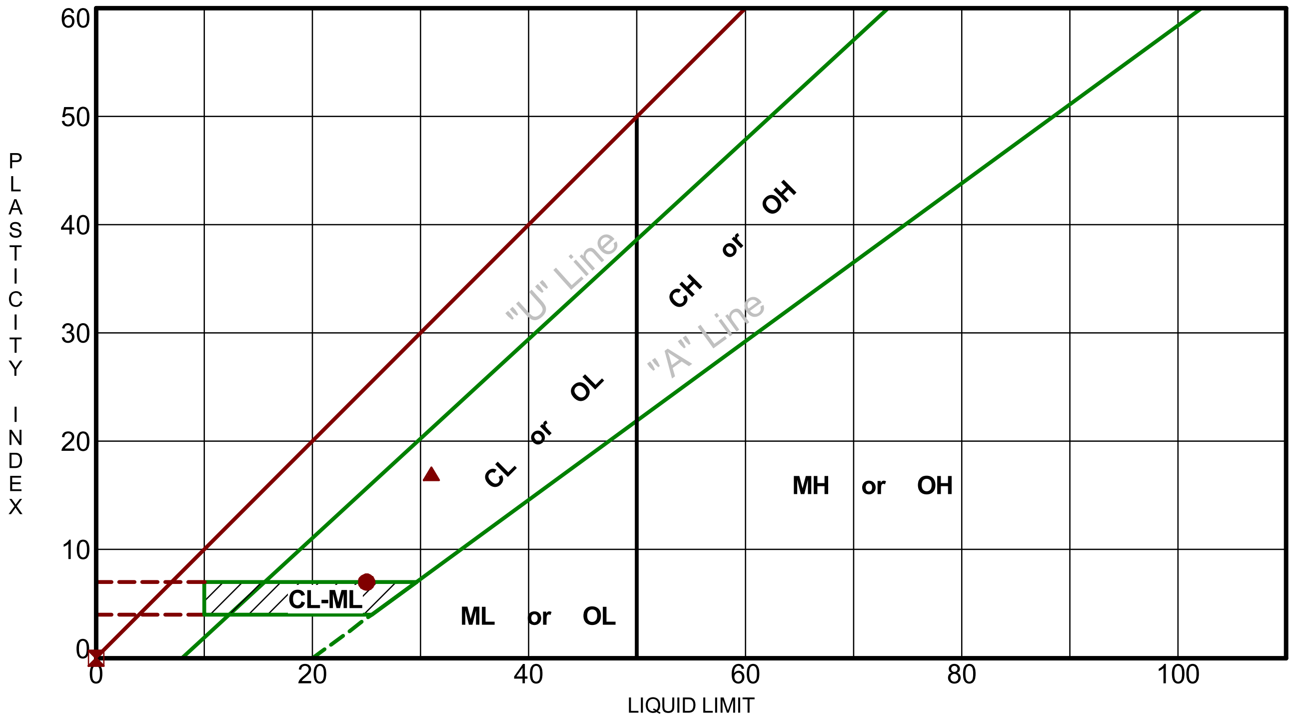
Groundwater not encountered

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

Boring Started: 09-21-2021	Boring Completed: 09-21-2021
Excavator: CME 75 track	Operator: 2R
Project No.: 60215197	

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID		Depth	LL	PL	PI	Fines	USCS	Description
●	P-1	2.5 - 4	25	18	7	41.2	SC-SM	SILTY, CLAYEY SAND
⊠	P-2	5 - 6.5	NP	NP	NP	7.5		
▲	P-3	1.1 - 2.5	31	14	17	42.0	SC	CLAYEY SAND

PROJECT: Brea Mall Development	Terracon 1421 Edinger Ave, Ste C Tustin, CA	PROJECT NUMBER: 60215197
SITE: 1650 Brea Mall Brea, CA		CLIENT: Simon Property Group Inc Indianapolis, IN

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Brea Mall Development ■ Brea, CA

Terracon Project No. 60215197

Terracon GeoReport

SAMPLING

- Modified Dames & Moore Ring Sampler
- Grab Sample
- Standard Penetration Test

WATER LEVEL

- **Water Initially Encountered**
- **Water Level After a Specified Period of Time**
- **Water Level After a Specified Period of Time**
- **Cave In Encountered**

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

N	**Standard Penetration Test Resistance (Blows/Ft.)**
(HP)	**Hand Penetrometer**
(T)	**Torvane**
(DCP)	**Dynamic Cone Penetrometer**
UC	**Unconfined Compressive Strength**
(PID)	**Photo-Ionization Detector**
(OVA)	**Organic Vapor Analyzer**

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

LOCATION AND ELEVATION NOTES

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		**CONSISTENCY OF FINE-GRAINED SOILS** (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (tsf)**	**Standard Penetration or N-Value Blows/Ft.**
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELEVANCE OF SOIL BORING LOG

The soil boring logs contained within this document are intended for application to the project as described in this document. Use of these soil boring logs for any other purpose may not be appropriate.

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification: Group Symbol	Soil Classification: Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]	GW	Well-graded gravel [F]
			$Cu < 4$ and/or [Cc<1 or Cc>3.0] [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]	SW	Well-graded sand [I]
			$Cu < 6$ and/or [Cc<1 or Cc>3.0] [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]	CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K, L, M]
		Organic:	(Liquid limit - oven dried) / (Liquid limit - not dried) < 0.75	OL	Organic clay [K, L, M, N]
					Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line	CH	Fat clay [K, L, M]
			PI plots below "A" line	MH	Elastic Silt [K, L, M]
		Organic:	(Liquid limit - oven dried) / (Liquid limit - not dried) < 0.75	OH	Organic clay [K, L, M, P]
					Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

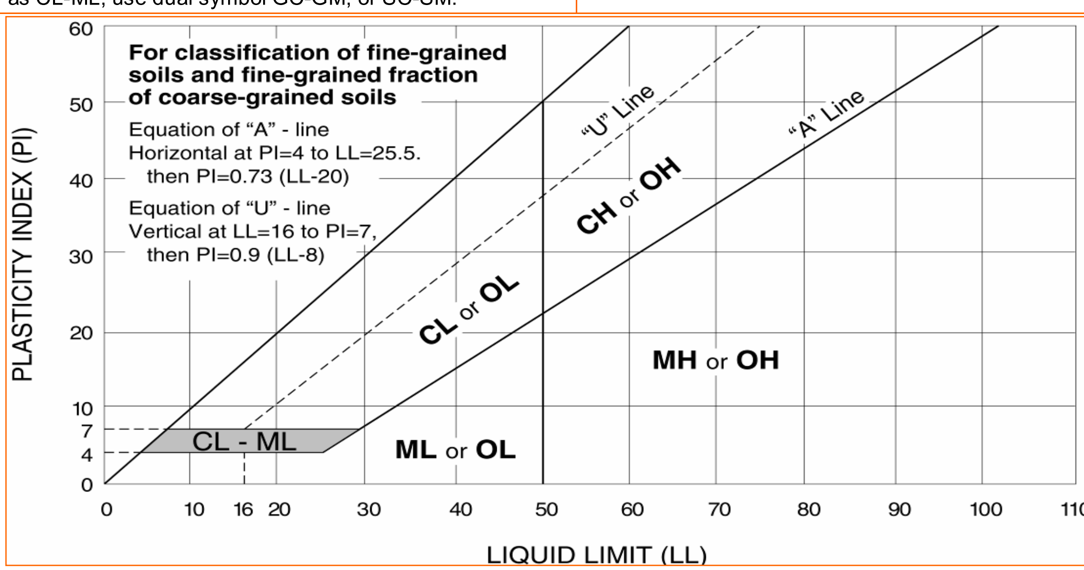
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



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Laguna Hills, CA 92653
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Terracon.com

July 7, 2022

SIMON
225 West Washington Street
Indianapolis, Indiana 46204

Attn: Mr. Mark Lingelbach
Senior Civil Engineer
P: (317) 263-7992
E: MLingelbach@simon.com

Re: Geotechnical Engineering Report Addendum No. 1
Brea Mall Developments
1066 Brea Mall
Brea, Orange County, California
Terracon Project No. 60215197

Dear Mr. Lingelbach

We have completed the additional geotechnical engineering services for the proposed Brea Mall Developments at 1066 Brea Mall in Brea, Orange County, California. We previously prepared a geotechnical engineering report for the project titled "Brea Mall Developments, Brea, Orange County, California", dated March 15, 2022 (Terracon Project No. 60215197). That report detailed our subsurface exploration, laboratory testing, and geotechnical engineering recommendations concerning earthwork and the design and construction of foundations, floor slabs, retaining walls, infiltration systems, and pavements for the project. The additional recommendations provided herein are considered an addendum to the previously issued geotechnical report.

Based on correspondence with the design team, additional subsurface characterization within the vacant Sears building was requested to supplement the geotechnical recommendations provided in our March 15, 2022 report.

Additionally, based on City review comments, additional infiltration testing at the proposed stormwater infiltration invert depth of 10 feet below existing site grades (bgs) and groundwater mounding analysis was requested to assist in determination of the feasibility of an on-site stormwater infiltration system.

As such, Terracon has conducted supplemental exploration and infiltration testing to support the design. This addendum report presents additional subsurface characterization within the footprint of the proposed retail buildings and provides further geotechnical recommendations pertaining to the design and construction of proposed infiltration systems at the site.

The recommendations presented in this addendum are based on the referenced geotechnical report, the results of additional subsurface exploration and laboratory testing, and our analyses. Recommendations provided in the referenced geotechnical report remain applicable except where specified herein.

SCOPE OF WORK

Terracon's additional scope of work included advancing six exploratory borings, laboratory testing, and preparation of this addendum. Four borings were advanced within the interior of the vacant Sears building and two were advanced within the footprint of the proposed infiltration system. The borings were advanced to approximate depths of from 10 to 31½ feet bgs with a track mounted "Mole" rig. One boring was used for percolation testing targeting approximate depths of 5 to 10 feet bgs. Locations of the soil borings are shown on the attached **Exploration Plan**.

GEOTECHNICAL CHARACTERIZATION

We have developed a general characterization of the subsurface soil and groundwater conditions based upon our review of the data and our understanding of the geologic setting and planned construction.

The geotechnical characterization forms the basis of our geotechnical calculations and evaluation of site preparation, foundation options and pavement options. As noted in **Closure** section of this addendum, the characterization is based upon widely spaced exploration points across the site, and variations are likely.

Subsurface Soil Conditions

Surface conditions within the vacant Sears building consisted of an approximately 4½ to 6-inch thick layer of concrete. Subsurface materials encountered in the borings within the building (B-11 to B-14) generally consisted dense to very dense silty clayey sand, silty sand, clayey sand, and poorly graded sand with silt with minor interbedded layers of hard lean clay.

Surface conditions within the footprint of the proposed infiltration system consisted of a 3-inch thick layer of asphalt concrete overlying a 10-inch thick layer of aggregate base course. Subsurface conditions encountered in the borings (P-4 and PB-1) consisted of medium dense to very dense clayey sand, silty clayey sand, silty sand, and poorly graded sand.

Conditions encountered at each boring location are indicated on the individual boring logs shown in the **Attachments** of this report. The logs were numbered to be in consecutive order with those previously reported in our March 15, 2022 report. Stratification boundaries on the boring logs represent the approximate location of changes in native soil types; in situ, the transition between materials may be gradual.

Laboratory Testing

Laboratory tests were conducted on selected soil samples and the test results are presented in the **Attachments** of this report and on the boring logs. Results of laboratory testing are summarized in this section.

- Atterberg limit test results indicate that the on-site soils varied from low to medium plasticity.
- Expansion index testing on near surface soils resulted in expansion indices of 4 and 28 corresponding to "very low" to "low" expansion potential as determined by ASTM D4829.

Groundwater Conditions

Groundwater was not encountered in the soil borings to a maximum depth of 31½ feet bgs. Historic groundwater was reported in our referenced geotechnical report.

In clayey soils with low permeability, the accurate determination of groundwater level may not be possible without long term observation. Long term observation after drilling could not be performed as borings were backfilled immediately upon completion due to safety concerns. Groundwater levels can best be determined by implementation of a groundwater monitoring plan.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the level indicated below. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

SHALLOW FOUNDATIONS RECOMMENDATIONS

Based on results of the additional exploration and laboratory testing, recommendations provided in the **Shallow Foundations** section of our March 15, 2022 report remain applicable for the proposed structures. Recommendations for shallow foundations assume that the site has been prepared in accordance with the earthwork requirements of the report.

FLOOR SLABS

Based on results of the additional exploration and laboratory testing, recommendations provided in the **Floor Slabs** section of our March 15, 2022 report remain applicable for the proposed slabs. Recommendations for floor slabs assume that the site has been prepared in accordance with the earthwork requirements of the report.

STORMWATER MANAGEMENT

Infiltration System

We understand that the anticipated infiltration system will consist of an infiltration chamber with an approximate footprint of 74.5 by 132.8 feet and invert depth at approximately 10 feet bgs.

Infiltration Design and Considerations

One in-situ percolation test was performed in Boring P-4 targeting an approximate depth of 5 to 10 feet bgs. A 2-inch thick layer of gravel was placed in the bottom of the boring after the boring was drilled to investigate the soil profile. A 3-inch diameter perforated pipe was installed on top of the gravel layer in the boring. Gravel was used to backfill between the perforated pipes and the boring sidewall. The boring was then filled with water for a pre-soak period. Testing began after a pre-soak period. At the beginning of the test, the pipe was refilled with water and readings were taken at standardized time intervals. Percolation rates are provided in the following table:

TEST RESULTS				
Test Location (depth, feet bgs)	Soil Classification	Slowest Measured Percolation Rate (in/hr.)	Correlated Infiltration Rate[1] (in/hr.)	Water Head (in)
P-4 (5 to 10 ft)	Clayey sand over poorly graded sand	87	2.4	53

[1]If proposed infiltration system will mainly rely on vertical downward seepage, the correlated infiltration rates should be used. The infiltration rates were correlated using the Porchet method.

The field test results are not intended to be design rates. They represent the result of our tests, at the depths and locations indicated, as described above. <u>A clayey layer was encountered at an approximate depth of 15 to 30 feet bgs. This layer may have lower infiltration characteristics which may generate perched water conditions and should be considered in design.</u> The design rate should be determined by the designer by applying an appropriate factor of safety. Based on discussion with the project Civil Engineer, we understand that a factor of safety of 3 will be considered.

With time, the bottoms of infiltration systems tend to plug with organics, sediments, and other debris. Long term maintenance will likely be required to remove these deleterious materials to help reduce decreases in actual percolation rates.

The percolation tests were performed with clear water, whereas the storm water will likely not be clear, but may contain organics, fines, and grease/oil. The presence of these deleterious materials will tend to decrease the rate that water percolates from the infiltration systems. Design of the storm water infiltration systems should account for the presence of these materials and should incorporate structures/devices to remove these deleterious materials.

Based on the soils encountered in our borings, we expect the percolation rates of the soils could be different than measured in the field due to variations in fines and gravel content. The design elevation and size of the proposed infiltration system should account for this expected variability in infiltration rates.

Infiltration testing should be performed after construction of the infiltration system to verify the design infiltration rates. It should be noted that siltation and vegetation growth along with other factors may affect the infiltration rates of the infiltration areas. The actual infiltration rate may vary from the values reported here.

Groundwater Mounding

At the request of the City, groundwater mounding analysis was conducted in accordance with the Orange County Technical Guidance Document (OC TGD). The simplified groundwater equations (Hantush equations) were utilized for analysis. The recharge rate was taken to be the design infiltration rate. A factor of safety of 3 and dimensions of the infiltration system were provided by the project Civil Engineer. Horizontal hydraulic conductivity, specific yield, duration of infiltration, and thickness of the saturated zone were estimated in accordance with the recommended values of Section VIII2.2 of the OC TGD.

Based on the analysis, the maximum groundwater mounding (measured from beneath the center of the infiltration system at the end of the duration of infiltration) was estimated to be approximately 6 feet above the groundwater table. Previous exploration conducted by Terracon reported groundwater depths ranging from approximately 28 to 45 feet bgs. Based on the groundwater mounding analysis, we estimate that the seasonal high groundwater mounded depth is at an approximate depth of 22 feet bgs. As such, it's our opinion that the separation between the proposed invert of the infiltration system (10 feet below the ground surface) and the seasonal high mounded groundwater depth is greater than 10 feet. An output of the analysis is provided in the **Attachments** of this addendum.

CLOSURE

Our review, analysis, and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data reviewed or provided in the referenced geotechnical report. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear during the construction phases, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our services and any correspondence or collaboration on this project are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

All recommendations and limitations provided in the referenced geotechnical report remain valid and applicable for the proposed project except where superseded or identified herein.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this addendum, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Victor V. Nguyen, E.I.T.
Senior Staff Engineer

Scott G. Lawson, P.E., G.E.
Senior Engineer

REGISTERED PROFESSIONAL ENGINEER
SCOTT G. LAWSON
No. GE 2829
Exp. 9/30/23
GEOTECHNICAL
STATE OF CALIFORNIA

APR review by Keith P. Askew, P.E., G.E.

Attachments: Site Location Plan
Exploration Plan
Boring Logs
Laboratory Test Data
Groundwater Mounding Analysis Output

SITE LOCATION

Brea Mall Developments ■ Brea, CA

July 7, 2022 ■ Terracon Project No. 60215197

Terracon GeoReport

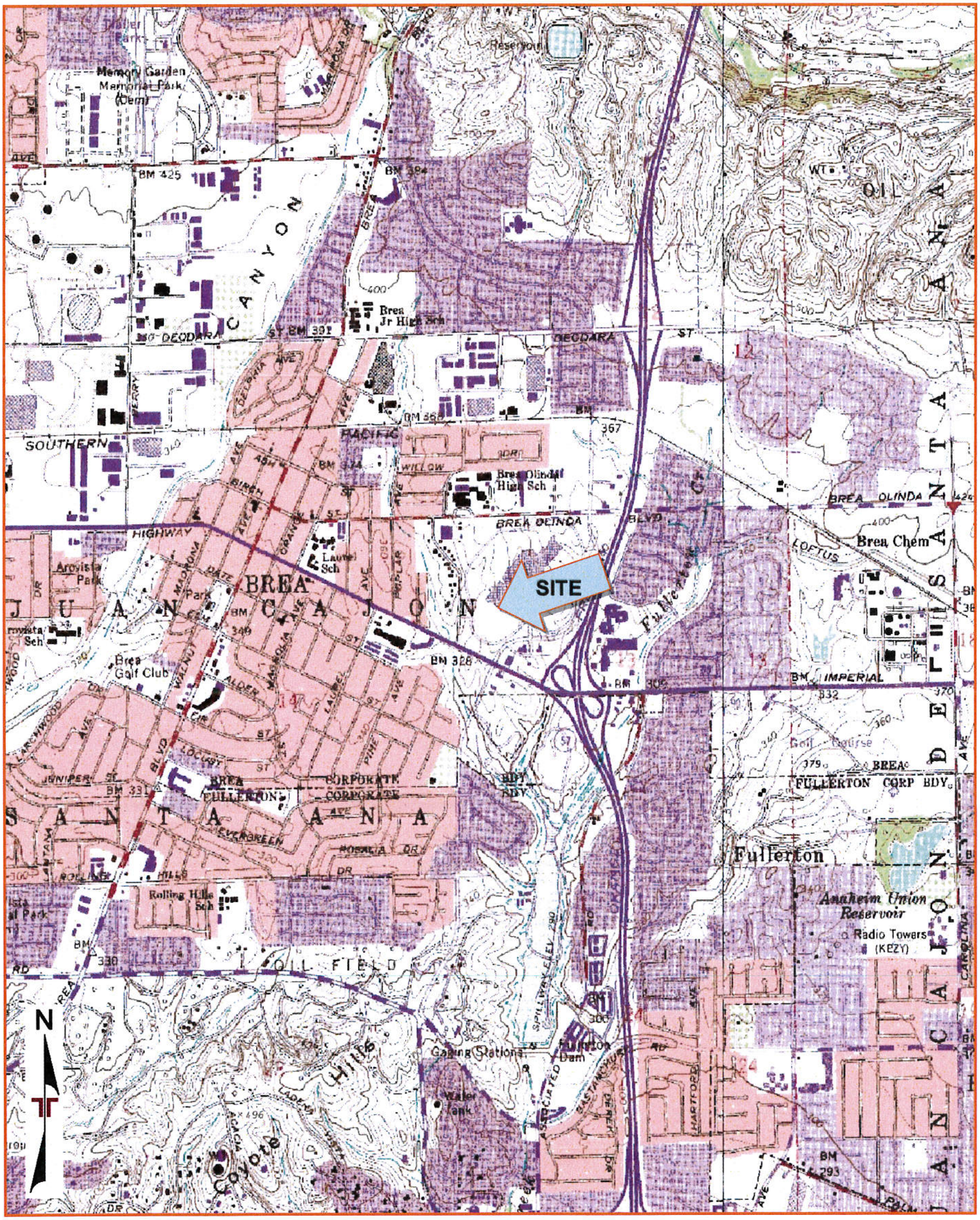


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY QUADRANGLES INCLUDE: LA HABRA, CA (1/1/1981) and YORBA LINDA, CA (1/1/1981).

EXPLORATION PLAN

Brea Mall Developments ■ Brea, CA

July 7, 2022 ■ Terracon Project No. 60215197

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

BORING LOG NO. B-11

PROJECT: Brea Mall Development

CLIENT: Simon Property Group Inc Indianapolis, IN

SITE: 1650 Brea Mall Brea, CA

LOCATION See Exploration Plan

Latitude: 33.9146° Longitude: -117.8870°

DEPTH	Description	Depth (Ft.)	Sample Type	Field Test Results	Expansion Index	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
0.4	**CONCRETE**, 5" thickness								
	SILTY CLAYEY SAND (SC-SM), trace gravel, brown								
	very dense			31-50/5"	4	1.9	100	27-21-6	44
5.0	**SILTY SAND (SM)**, brown to tan, very dense	5		37-50/4"		2.0	103		
7.5	**POORLY GRADED SAND WITH SILT (SP-SM)**, brown to tan, very dense			34-50/4"		3.6	111		
	dense	10							
				33-31-50/5"		4.9	99		
	very dense	15							
				14-40-35 N=75					10
20.0	**LEAN CLAY WITH SAND (CL)**, brown, hard	20		17-32-50/5"		13.3	122		
24.0	**CLAYEY SAND (SC)**, brown, very dense			50/6"					
		25							
28.9				28-50/5"		10.0	118		
	Boring Terminated at 28.9 Feet								

Other column headings: GRAPHIC LOG, WATER LEVEL OBSERVATIONS, STRENGTH TEST (TEST TYPE, COMPRESSIVE STRENGTH (tsf), STRAIN (%))

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
6" Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with concrete

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

Boring Started: 06-13-2022	Boring Completed: 06-13-2022
Drill Rig: Mole Rig	Driller: Pacific Drilling
Project No.: 60215197	

BORING LOG NO. B-12

PROJECT: Brea Mall Development

CLIENT: Simon Property Group Inc Indianapolis, IN

SITE: 1650 Brea Mall Brea, CA

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 33.9144° Longitude: -117.8876° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	EXPANSION INDEX	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	0.4 **CONCRETE**, 4.5" thickness												
	SILTY CLAYEY SAND (SC-SM), trace gravel, brown											28-18-10	
	very dense				2-15-50/3"								
		5			32-50/6"								
	7.5												
	Auger Refusal at 7.5 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
6" Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with concrete

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

Boring Started: 06-14-2022	Boring Completed: 06-14-2022
Drill Rig: Mole Rig	Driller: Pacific Drilling
Project No.: 60215197	

BORING LOG NO. B-12A

PROJECT: Brea Mall Development

CLIENT: Simon Property Group Inc Indianapolis, IN

SITE: 1650 Brea Mall Brea, CA

LOCATION See Exploration Plan

Latitude: 33.9144° Longitude: -117.8876°

GRAPHIC LOG	DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	EXPANSION INDEX	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	0.4	**CONCRETE**, 4.5" thickness												
		SILTY CLAYEY SAND (SC-SM), brown												
		very dense				25-50/5"								29
	5.8		5			31-50/4"								
		SANDY LEAN CLAY (CL), brown, hard												
	10.0													
		POORLY GRADED SAND WITH SILT (SP-SM), light brown, very dense	10			30-50/6"								
		light brown to brown, very dense	15			50/6"								
	21.3	trace gravel	20			25-43-50/4"								
		Boring Terminated at 21.3 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
6" Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with concrete

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

Boring Started: 06-13-2022	Boring Completed: 06-13-2022
Drill Rig: Mole Rig	Driller: Pacific Drilling
Project No.: 60215197	

BORING LOG NO. B-13

PROJECT: Brea Mall Development

CLIENT: Simon Property Group Inc
Indianapolis, IN

SITE: 1650 Brea Mall
Brea, CA

LOCATION See Exploration Plan

Latitude: 33.9148° Longitude: -117.8874°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	EXPANSION INDEX	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.5	**CONCRETE**, 6" thickness												
	CLAYEY SAND (SC), trace gravel, brown												
	very dense				25-50/6"								
		5			20-44-50/5"								35
					20-32-50/3"								
		10											
					22-43-50/1"					12.2	108		
		15											
					17-17-50/5"								
17.4	**LEAN CLAY WITH SAND (CL)**, brown, hard												
20.0		20											
20.8	**SILTY SAND (SM)**, trace clay, brown, very dense				40-50/3"					7.7	100		
	Boring Terminated at 20.8 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
6" Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with concrete

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

Boring Started: 06-14-2022

Boring Completed: 06-14-2022

Drill Rig: Mole Rig

Driller: Pacific Drilling

Project No.: 60215197

BORING LOG NO. B-14

PROJECT: Brea Mall Development

CLIENT: Simon Property Group Inc Indianapolis, IN

SITE: 1650 Brea Mall Brea, CA

LOCATION See Exploration Plan

Latitude: 33.9150° Longitude: -117.8875°

GRAPHIC LOG / DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	EXPANSION INDEX	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.4	**CONCRETE**, 4.5" thickness												
	CLAYEY SAND (SC), trace gravel, brown					28						28-18-10	44
	very dense				17-30-50/4"					11.8	107		
	trace gravel, brown to light brown	5			40-50/4"					9.1	117		
7.5	**SILTY CLAYEY SAND (SC-SM)**, brown to light brown, dense				16-45-50/6"					5.1	101		
		10											
	trace gravel, very dense				40-50/4"					19.4	92		27
		15											
16.0	**CLAYEY SAND (SC)**, brown, very dense				30-37-38 N=75								
20.0	**SILTY CLAY (CL-ML)**, trace sand, brown, hard	20			50/6"					13.3	105		
24.0	**CLAYEY SAND (SC)**, brown, very dense	25			9-35-50/4"								49
28.8					35-50/4"					14.5	118		
	Boring Terminated at 28.8 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
6" Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with concrete

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

Boring Started: 06-13-2022 | Boring Completed: 06-13-2022

Drill Rig: Mole Rig | Driller: Pacific Drilling

Project No.: 60215197

BORING LOG NO. P-4

PROJECT: Brea Mall Development

CLIENT: Simon Property Group Inc Indianapolis, IN

SITE: 1650 Brea Mall Brea, CA

LOCATION See Exploration Plan

Latitude: 33.9127° Longitude: -117.8891°

DEPTH	Material Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	EXPANSION INDEX	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3	**ASPHALT**, 3" thickness												
1.1	**AGGREGATE BASE COURSE**, 10" thickness												
	CLAYEY SAND (SC), trace gravel, brown												48
	dense	5			18-26-42					11.0	110		
8.5													
10.0	**POORLY GRADED SAND (SP)**, trace gravel, light brown, dense	10			18-21-47					6.5	115		
	Boring Terminated at 10 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
6" Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

Boring Started: 06-14-2022	Boring Completed: 06-14-2022
Drill Rig: Mole Rig	Driller: Pacific Drilling
Project No.: 60215197	

BORING LOG NO. PB-1

PROJECT: Brea Mall Development

CLIENT: Simon Property Group Inc Indianapolis, IN

SITE: 1650 Brea Mall Brea, CA

LOCATION See Exploration Plan

Latitude: 33.9128° Longitude: -117.8890°

DEPTH	Material Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	EXPANSION INDEX	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3	**ASPHALT**, 3" thickness												
1.1	**AGGREGATE BASE COURSE**, 10" thickness												
	CLAYEY SAND (SC), brown to dark brown			Grab									
5.0	**SILTY CLAYEY SAND (SC-SM)**, brown to light brown, medium dense	5			12-20-30					8.7	95		
10.0	**POORLY GRADED SAND (SP)**, trace silt, light brown, very dense	10			22-50/5"					4.0	103		
15.0	**CLAYEY SAND (SC)**, reddish brown, very dense	15			33-50/5"					12.8	119	29-17-12	49
	dense	20			21-37-50/6"					15.7	116		
	dark brown	25			21-40-50/6"					14.3	119		48
30.0		30											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
6" Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

Boring Started: 06-14-2022	Boring Completed: 06-14-2022
Drill Rig: Mole Rig	Driller: Pacific Drilling
Project No.: 60215197	

BORING LOG NO. PB-1

PROJECT: Brea Mall Development

CLIENT: Simon Property Group Inc Indianapolis, IN

SITE: 1650 Brea Mall Brea, CA

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 33.9128° Longitude: -117.8890° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	EXPANSION INDEX	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILTY SAND (SM), reddish brown, medium dense, no recovery 31.5				17-28-30								
	Boring Terminated at 31.5 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
6" Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

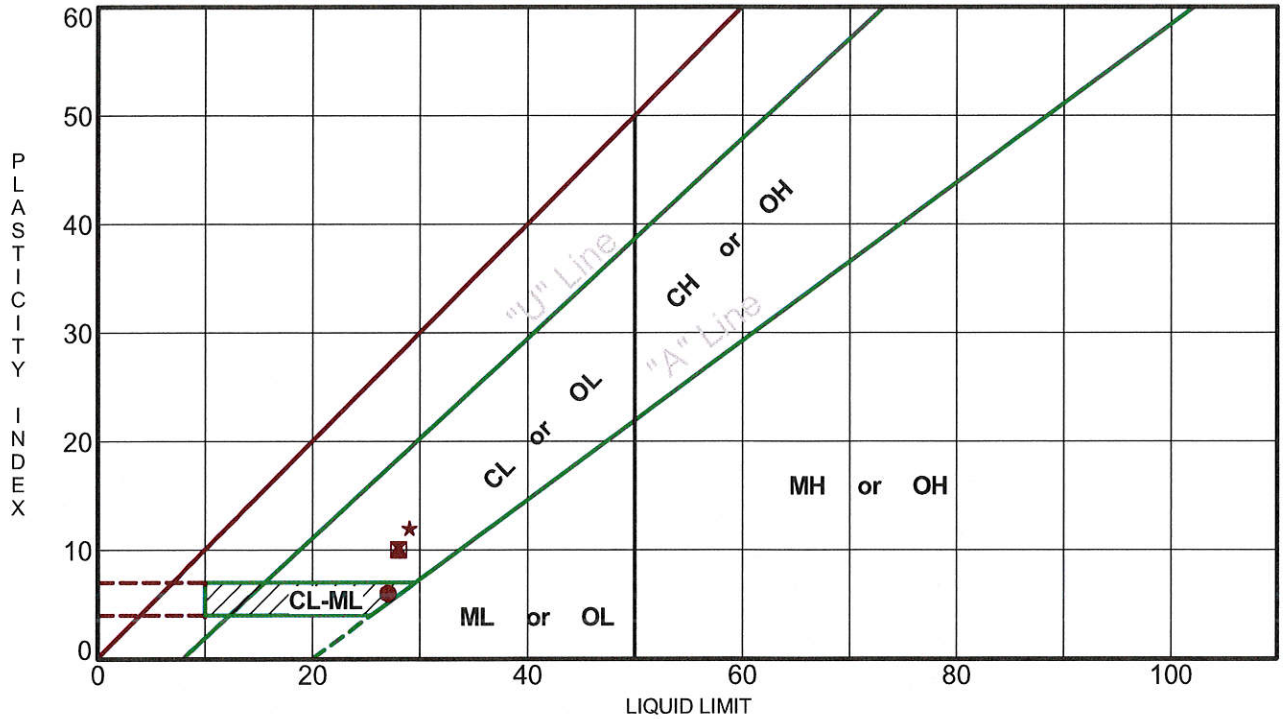
Groundwater not encountered

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

Boring Started: 06-14-2022	Boring Completed: 06-14-2022
Drill Rig: Mole Rig	Driller: Pacific Drilling
Project No.: 60215197	

ATTERBERG LIMITS RESULTS

ASTM D4318



	Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
●	B-11	0.9 - 5	27	21	6	44.3	SC-SM	SILTY, CLAYEY SAND
⊠	B-12	0.4 - 5	28	18	10		SC-SM	SILTY, CLAYEY SAND
▲	B-14	0.4 - 4.5	28	18	10	43.9	SC	CLAYEY SAND
★	PB-1	15 - 15.9	29	17	12	48.7	SC	CLAYEY SAND

PROJECT: Brea Mall Development

SITE: 1650 Brea Mall
Brea, CA

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

PROJECT NUMBER: 60215197

CLIENT: Simon Property Group Inc
Indianapolis, IN

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

use consistent units (e.g. feet & days **or** inches & hours)

Input Values				
1.6000	*R*	**Recharge (infiltration) rate (feet/day)**		
0.200	Sy	**Specific yield, Sy (dimensionless, between 0 and 1)**		
48.00	K	**Horizontal hydraulic conductivity, Kh (feet/day)***		
37.260	x	**1/2 length of basin (x direction, in feet)**		
66.410	y	**1/2 width of basin (y direction, in feet)**		
10.000	t	**duration of infiltration period (days)**		
20.000	hi(0)	**initial thickness of saturated zone (feet)**		

Conversion Table

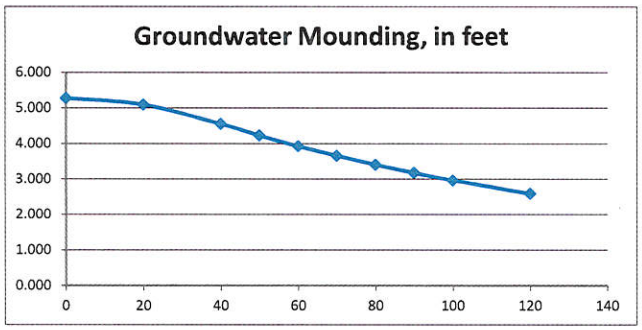
inch/hour	**feet/day**
0.67	1.33
2.00	4.00
hours	**days**
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

25.276	h(max)	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
5.276	Δh(max)	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Ground-water Mounding, in feet	**Distance from center of basin in x direction, in feet**
5.276	0
5.095	20
4.557	40
4.233	50
3.932	60
3.658	70
3.408	80
3.179	90
2.969	100
2.597	120

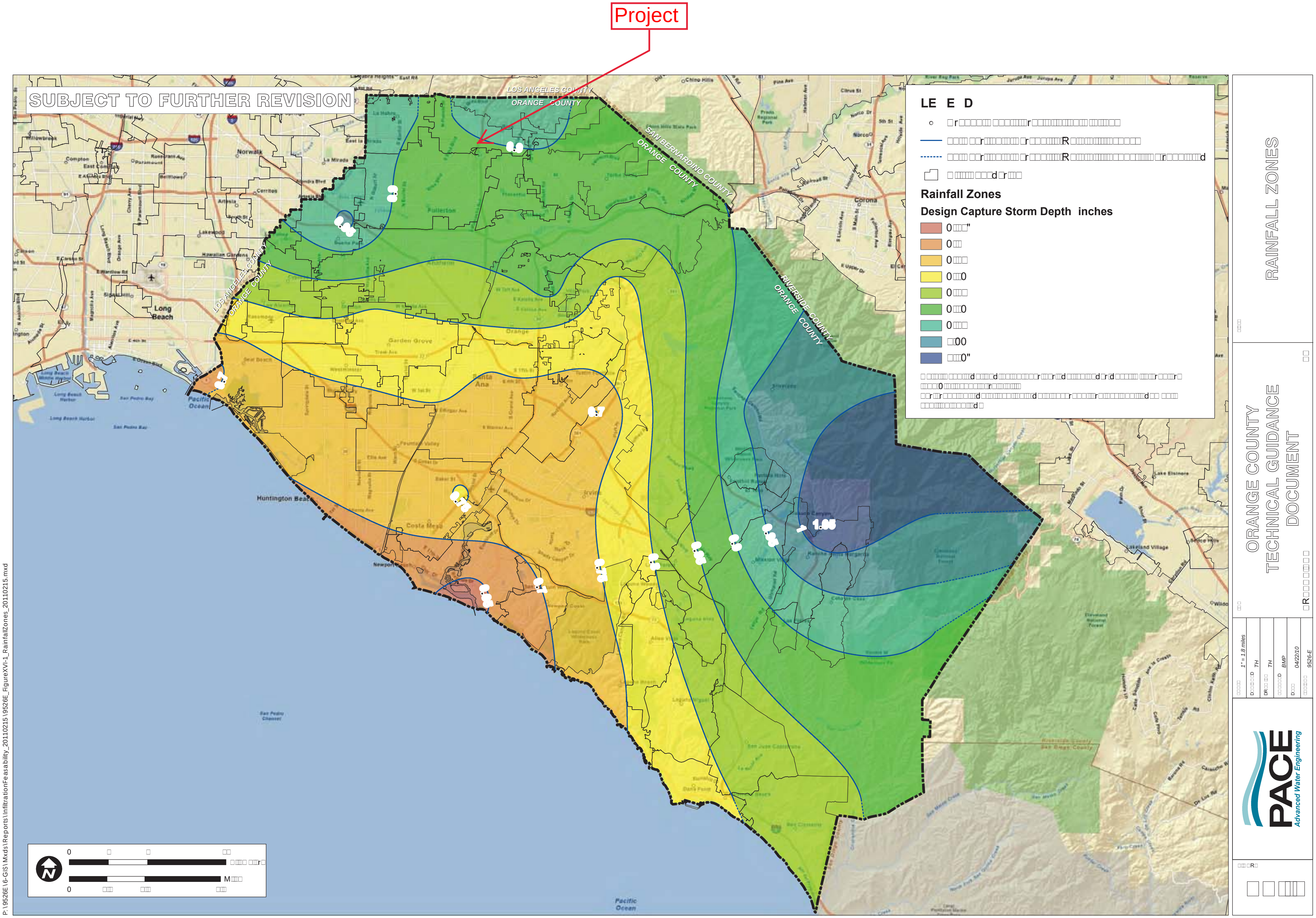
Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

Attachment 3 – Applicable Maps from TGD


Project
SUBJECT TO FURTHER REVISION
LOS ANGELES COUNTY
ORANGE COUNTY
SAN BERNARDINO COUNTY
RIVERSIDE COUNTY
Rainfall Zones
Design Capture Storm Depth inches
Fullerton
Anaheim
Garden Grove
Santa Ana
Orange
Irvine
Costa Mesa
Huntington Beach
Newport
Long Beach
Pacific Ocean
1.05
RAINFALL ZONES
ORANGE COUNTY TECHNICAL GUIDANCE DOCUMENT
PACE
Advanced Water Engineering
1" = 1.8 miles
TH
TH
BMP
04/22/10
9526-E
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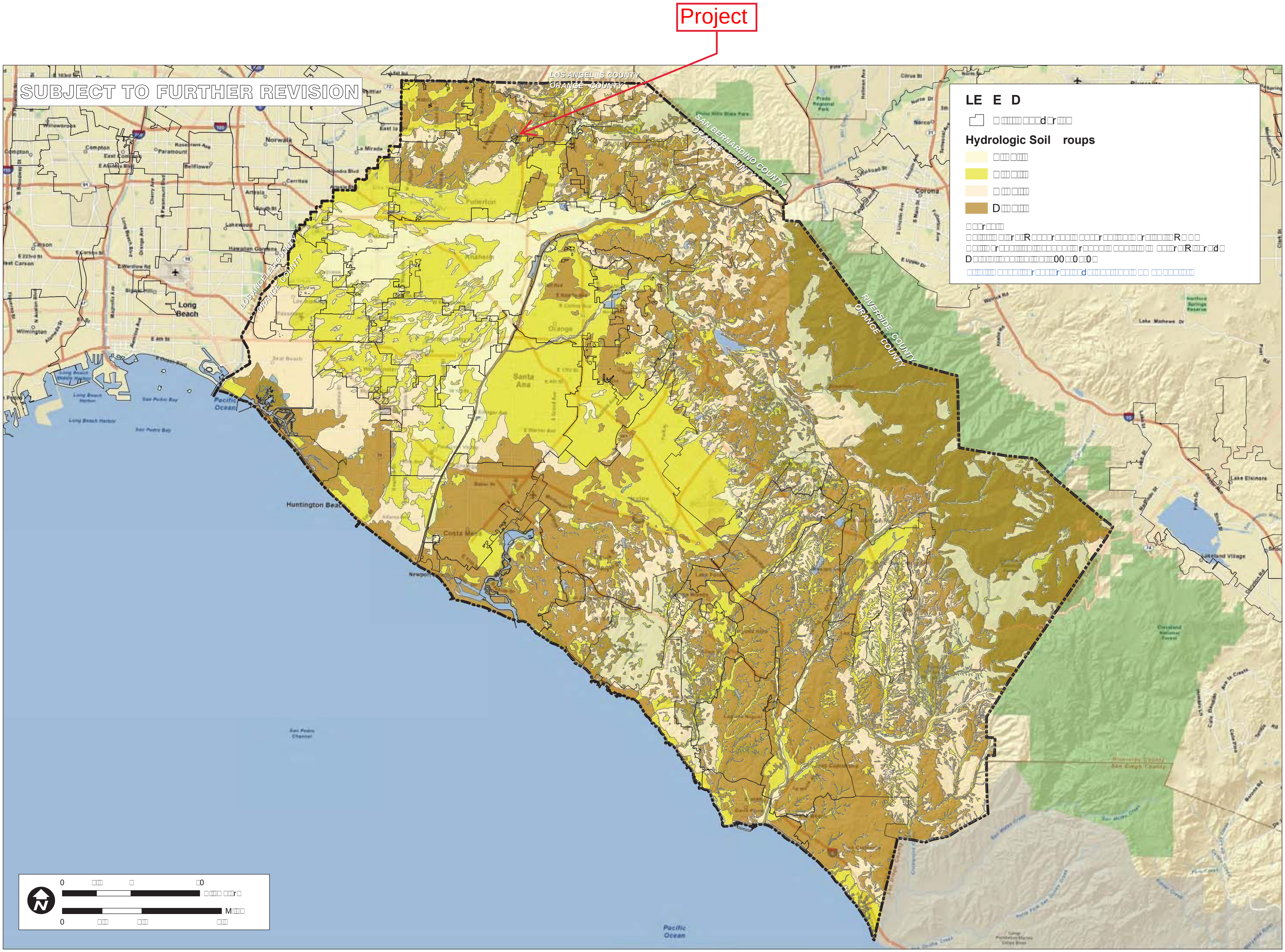

NRCS HYDROLOGIC SOILS GROUPS

ORANGE COUNTY INFILTRATION STUDY

1" = 1.8 miles

TH

TH

BMP

02/09/11

9526-E

PACE Advanced Water Engineering

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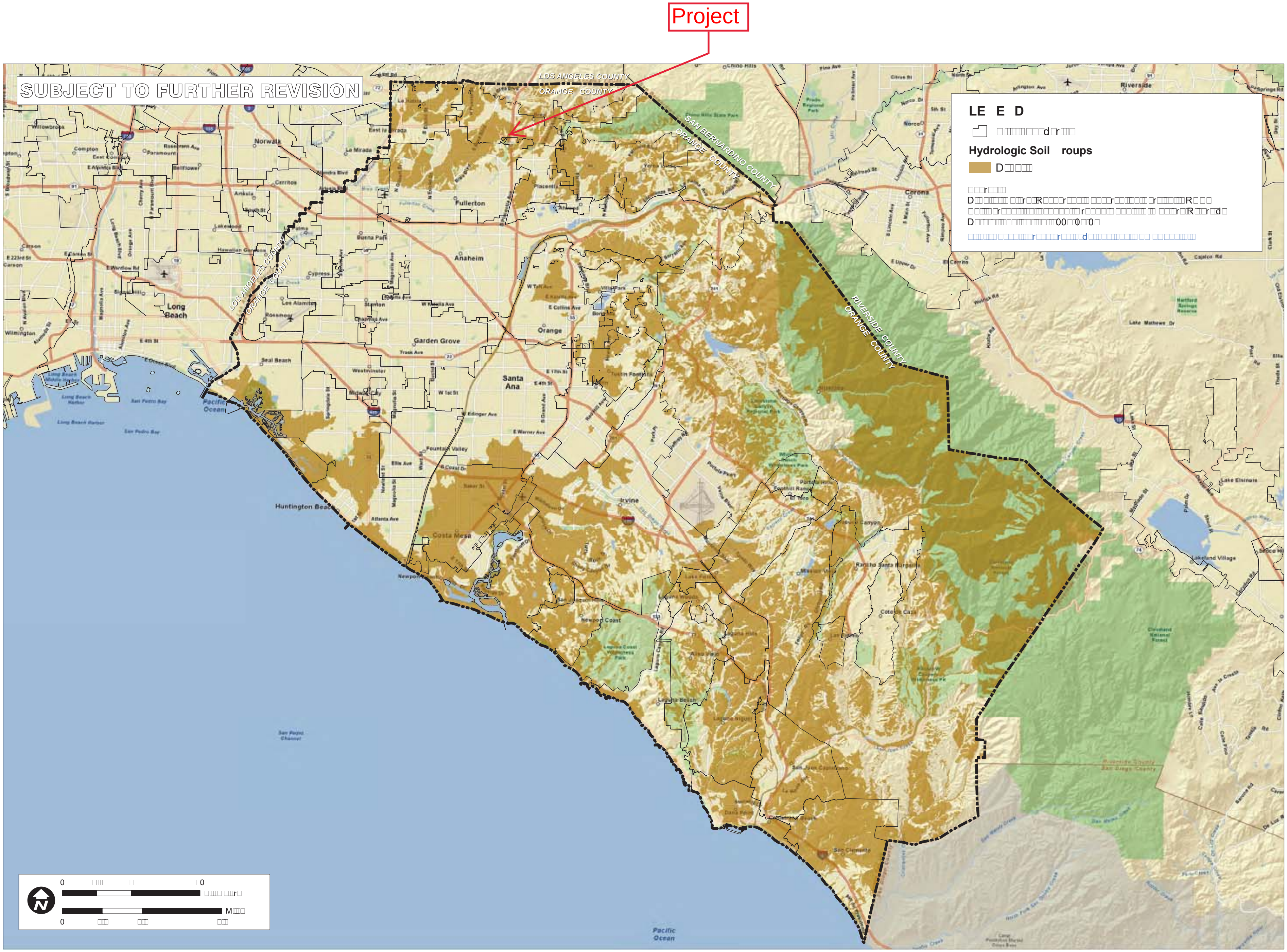

HYDROLOGIC SOIL GROUP
TYPE D NRCS SOIL SURVEY

ORANGE COUNTY
INFILTRATION STUDY

1" = 1.8 miles
TH
TH
BMP
02/09/11
9526-E

PACE
Advanced Water Engineering

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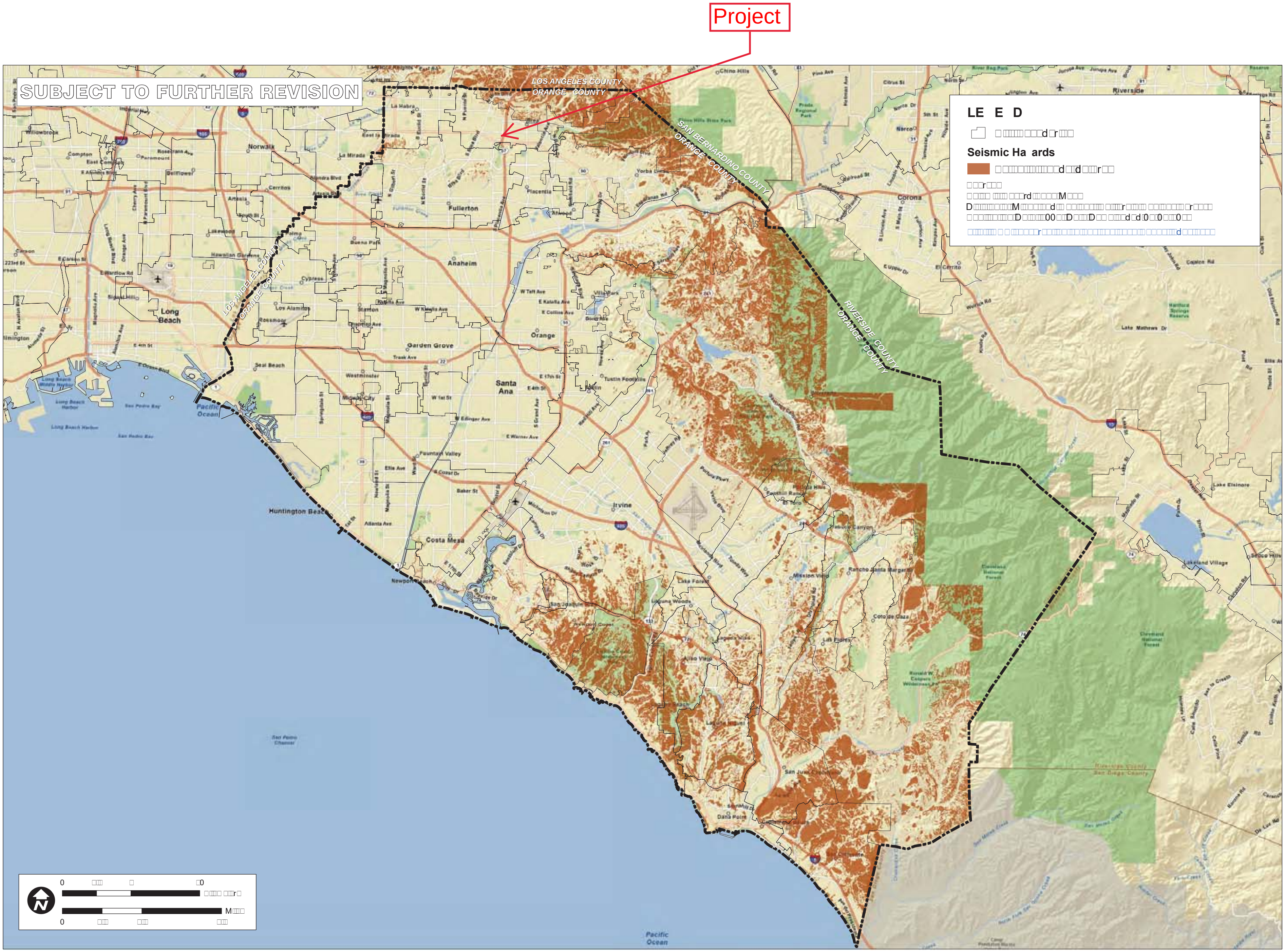

HYDROLOGIC SOIL GROUP
TYPE D NRCS SOIL SURVEY

ORANGE COUNTY
INFILTRATION STUDY

1" = 1.25 miles

TH

TH

BMP

02/09/11

9526-E

PACE
Advanced Water Engineering

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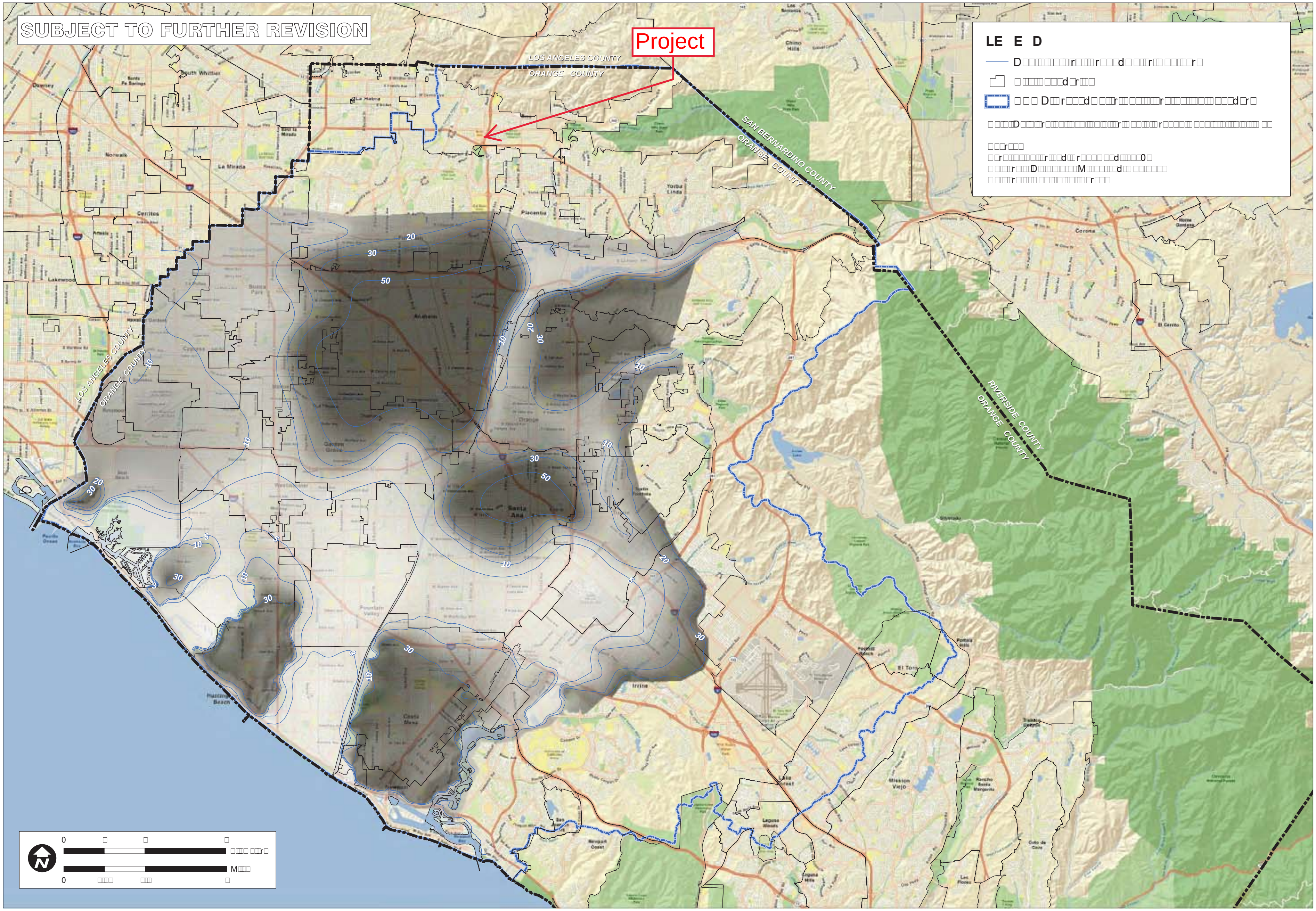

NORTH ORANGE COUNTY MAPPED DEPTH TO FIRST GROUNDWATER

ORANGE COUNTY INFILTRATION STUDY

PACE
Advanced Water Engineering

	1" = 1.25 miles
	TH
	TH
	BMP
	02/09/11
	9526-E

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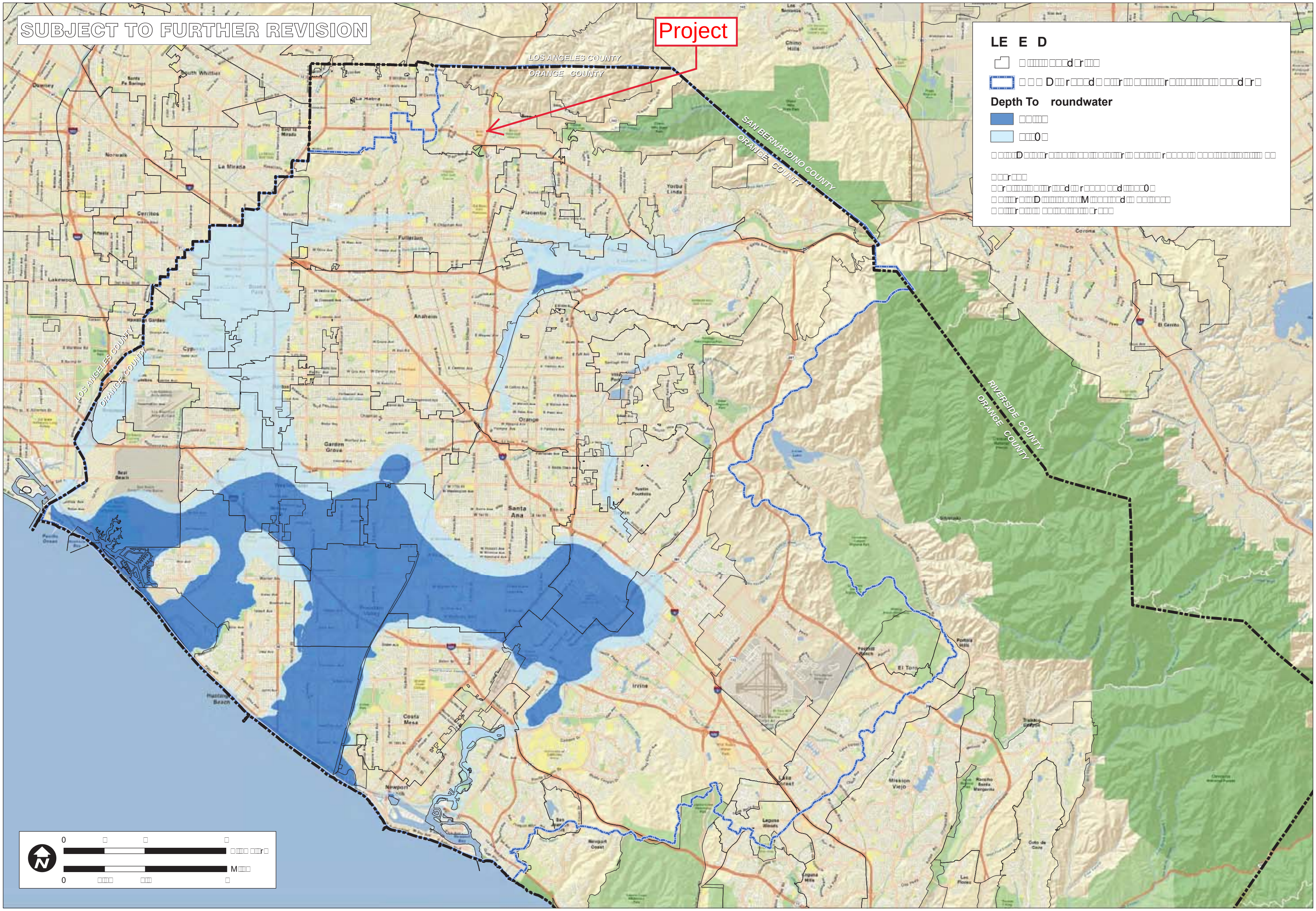

NORTH ORANGE COUNTY
MAPPED SHALLOW GROUNDWATER

ORANGE COUNTY
INFILTRATION STUDY

1" = 1.25 miles
TH
TH
BMP
02/09/11
9526-E

PACE
Advanced Water Engineering

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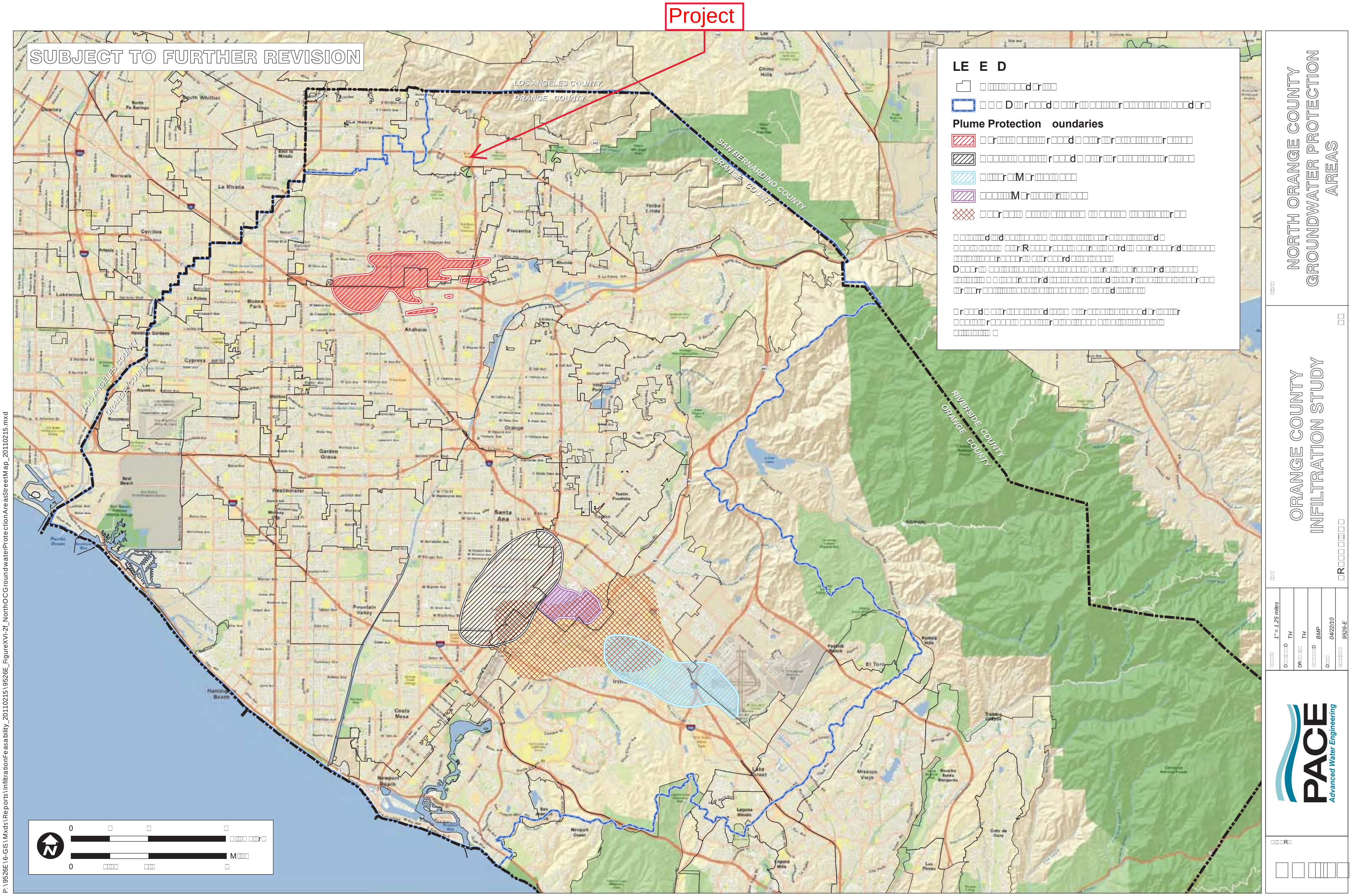
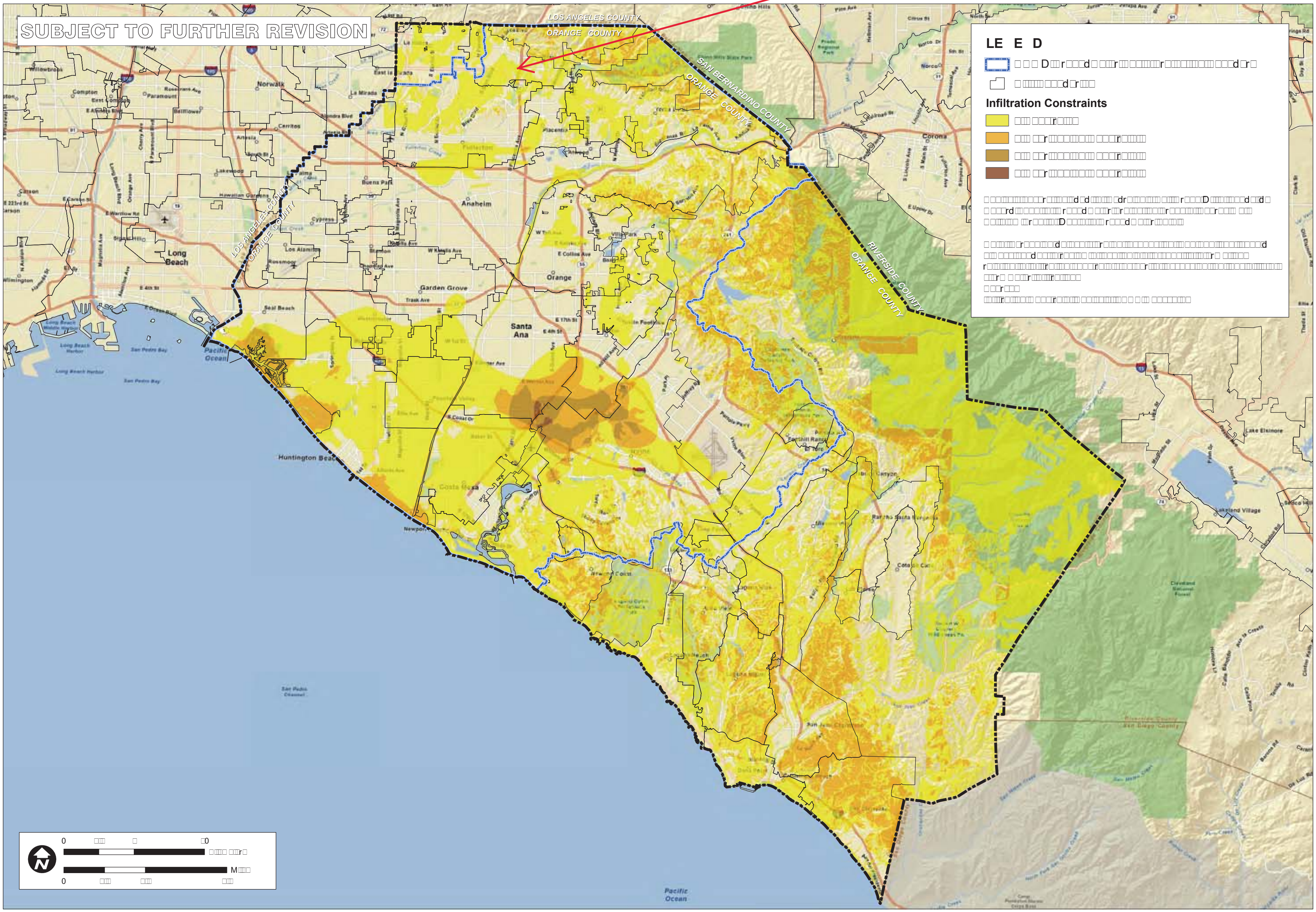

Project
SUBJECT TO FURTHER REVISION
LOS ANGELES COUNTY
ORANGE COUNTY
SAN BERNARDINO COUNTY
ORANGE COUNTY
RIVERSIDE COUNTY
ORANGE COUNTY
Plume Protection oundaries
Anaheim
Orange
Santa Ana
Garden Grove
Westminster
Fountain Valley
Huntington Beach
Costa Mesa
Newport Beach
Irvine
Tustin
Yorba Linda
Placentia
Buena Park
Cypress
La Palma
Norwalk
La Mirada
Cerritos
Lakewood
Seal Beach
Los Alamitos
Laguna Woods
Mission Viejo
Lake Forest
El Toro
Pacific Ocean
1" = 1.25 miles
TH
TH
BMP
04/22/10
9526-E
NORTH ORANGE COUNTY GROUNDWATER PROTECTION AREAS
ORANGE COUNTY INFILTRATION STUDY
PACE
Advanced Water Engineering
P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-2f_NorthOCGroundwaterProtectionAreasStreetMap_20110215.mxd

Project



INFILTRATION ANALYSIS
OVERLAPPING CONSTRAINT
LOCATIONS

ORANGE COUNTY
INFILTRATION STUDY

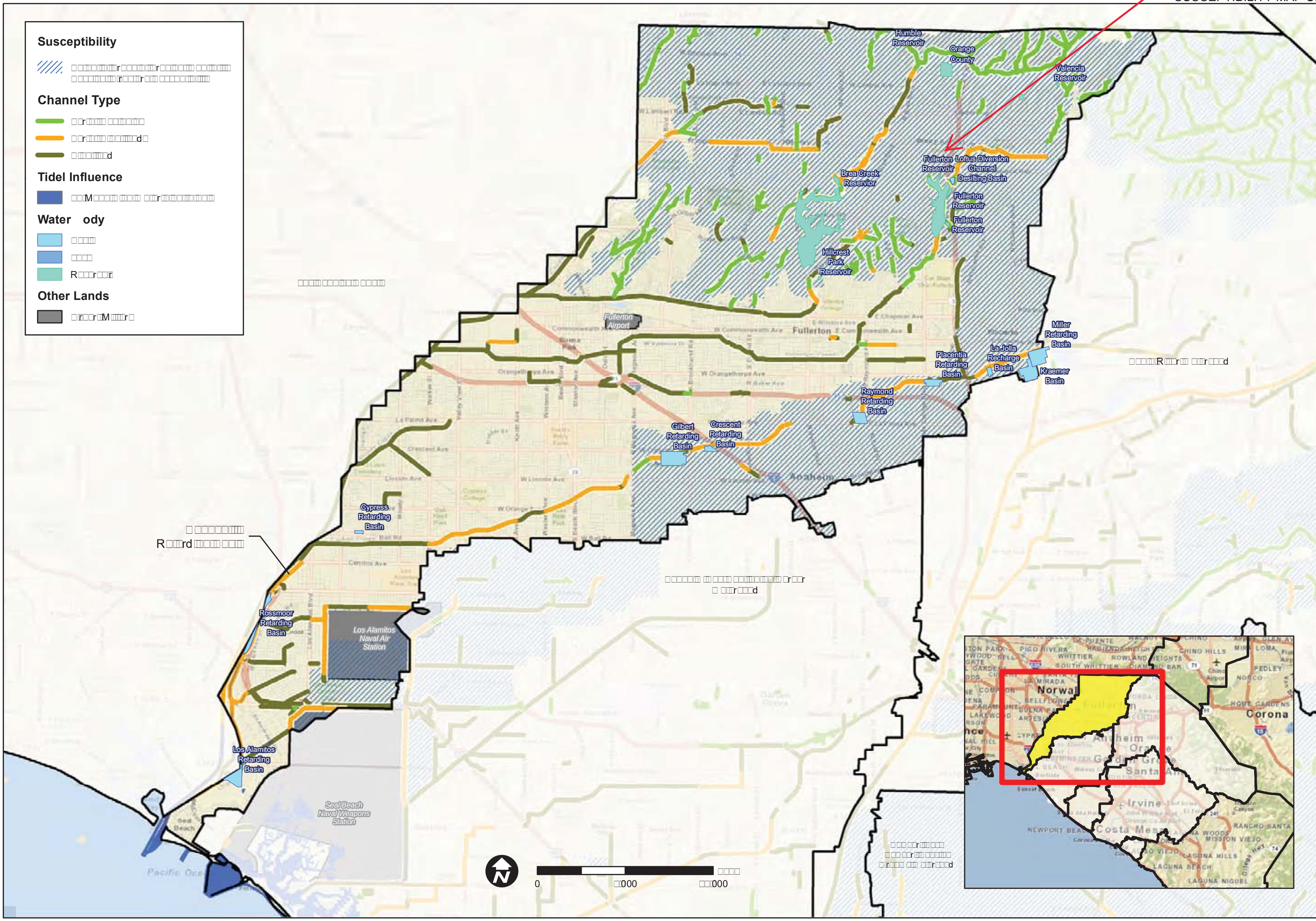
1" = 1.8 miles
TH
TH
BMP
04/22/10
9526-E

PACE
Advanced Water Engineering

P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-2g_InfiltrationFinal_20110215.mxd

Project

SUSCEPTIBILITY MAP UPATE (FEB 2013)



SUSCEPTIBILITY ANALYSIS SAN GABRIEL-COYOTE CREEK

ORANGE COUNTY WATERSHED MASTER PLANNING

1" = 8000'

TH

TH

BMP

04/30/10

9526-E

PACE Advanced Water Engineering

1

P:\9526E\6-GIS\Mxds\SusceptabilityMaps_20100505\9526E_SanGabrielCoyoteCreekSusceptibility_20100430.mxd

Attachment 4 – Infiltration Feasibility Screening

Table 2.7: Infiltration BMP Feasibility Worksheet

	Infeasibility Criteria	*Yes*	*No*
[illegible]	**Would Infiltration MPs pose significant ris for groundwater related concerns** R [illegible] r [illegible] **Appendix III** [illegible]		XX
[illegible] Per Geotechnical Report Groundwater was encountered at at depth of 25-30 feet deep. Additionally, the project is not located within any groundwater basin protection area per TGD Maps provided in Attachment 3. [illegible]			
[illegible]	[illegible] M [illegible] **pose significant ris of increasing ris of geotechnical ha ards that cannot be mitigated to an acceptable level** [illegible] • [illegible] M [illegible] • [illegible] M [illegible] • [illegible]		XX
[illegible] Per Geotechnical Report and Addendum, there are no studies/findings that would prohibit infiltration. [illegible]			
[illegible]	[illegible] D [illegible] **violate downstream water rights** [illegible]		XX
[illegible] There are no downstream water rights restricting infiltration [illegible]			

Table 2.7: Infiltration BMP Feasibility Worksheet (continued)

	Partial Infeasibility Criteria	*Yes*	*No*
	located on HS D soils ... D		XX
There are areas onsite that are HSG D Soils. However, the Infiltration Chamber is not located within those areas.			
	measured infiltration rate below proposed facility less than .3 inches per hour ... **Appendix II**		XX
Measured infiltration rate is 2.4 in/hr in Chamber Area per Geotechnical Report.			
	reduction of over predeveloped conditions cause impairments to downstream beneficial uses such as change of seasonality of ephemeral washes or increased discharge of contaminated groundwater to surface waters		XX
There are no identified ephemeral washes or contaminated groundwater at the project site or discharge location.			
	an increase in infiltration over predeveloped conditions cause impairments to downstream beneficial uses such as change of seasonality of ephemeral washes or increased discharge of contaminated groundwater to surface waters		XX
There are no identified ephemeral washes or contaminated groundwater at the project site or discharge location.			

Table 2.7: Infiltration BMP Feasibility Worksheet (continued)

Infiltration Screening Results (check box corresponding to result):		
[illegible]	[illegible] **Appendix II** [illegible] [illegible] No. There is no recorded I&I of the sanitary sewer system in the area. The Sanitary Sewer is not located near the proposed chamber systems. [illegible]	NO
[illegible]	[illegible] **not feasible** [illegible] [illegible] Answers 1-3 are all marked "NO". [illegible]	
[illegible]0[illegible]	[illegible] **permissible but is not presumed to be feasible for the entire DC** . [illegible] [illegible] Answers 4-7 are all marked "NO". [illegible]	
[illegible]	[illegible]	Infiltration of Full DCV is Feasible

Harvest and Use Infeasibility

Harvest and use infeasibility criteria include:

- If inadequate demand exists for the use of the harvested rainwater. See **Appendix X** for guidance on determining harvested water demand and applicable feasibility thresholds.
- If the use of harvested water for the type of demand on the project violates codes or ordinances most applicable to stormwater harvesting in effect at the time of project application and a waiver of these codes and/or ordinances cannot be obtained. It is noted that codes and ordinances most applicable to stormwater harvesting may change

Worksheet H: Factor of Safety and Design Infiltration Rate and Worksheet

[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	1.0	0.25
		[illegible]	[illegible]	2.0	0.5
		[illegible]	[illegible]	2.0	0.5
		[illegible]	[illegible]	1.0	0.25
		[illegible]			1.50
[illegible]	D[illegible]	[illegible]	[illegible]	3.0	0.75
		[illegible]	[illegible]	1.0	0.25
		[illegible]	[illegible]	2.0	0.50
		[illegible]	[illegible]	2.0	0.50
		[illegible]			2.00
[illegible]					3
[illegible]					2.4in/hr
[illegible]					0.80in/hr

Supporting Data

[illegible]

In-situ percolation testing was performed in accordance with the Technical Guidance Document for the preparation of this WQMP. See Attachment 2 of this WQMP for more information.

ote: [illegible]

Worksheet I: Summary of Groundwater-related Feasibility Criteria

[illegible]	[illegible] Table VIII.2 [illegible]	[illegible]	
[illegible]	[illegible]	14.75	[illegible]
[illegible]	[illegible]	Infiltration Chambers	
[illegible]	[illegible]	11,908	[illegible]
[illegible]	[illegible] Building Roofs, AC Pavement ring road / Parking Lot and Open Space		
[illegible]	[illegible]	[illegible]	M
[illegible]	[illegible] Trash full capture devices are proposed on the proposed storm drain inlets. A Barracuda Hydrodynamic Separator is proposed upstream of the Chamber.		
[illegible]	[illegible] VIII.2 [illegible]	[illegible] 0 [illegible]	
[illegible]	[illegible] Geotechnical Addendum shows a Mounding Analysis with seasonal high groundwater located at 22 feet below ground surface. Proposed Infiltration chamber system is a maximum of 12' deep.		
[illegible]	[illegible]	[illegible]	16-20
[illegible]	[illegible]	[illegible]	10-14
[illegible]	[illegible] The maximum depth of the chamber system is 12', which will be a minimum of 10' from the top of the seasonally high mounded groundwater per the analysis provided by Terracon.		
[illegible]	[illegible] Figure	[illegible]	

Worksheet I: Summary of Groundwater-related Feasibility Criteria

	VIII.2 [illegible]	
[illegible]	[illegible] Figure VIII.2 [illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible] No site-specific study has been prepared. Answers 13-15 based on available data	
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible] Per the Geotechnical Report Groundwater is expected at 28-45 bgs. Site does not have any groundwater infiltration constraints based on the available maps in the TGD.		

Note: if a single criterion or group of criteria would render infiltration infeasible, it is not necessary to evaluate every question in this worksheet.

Attachment 5 – WQMP Summary Report

City of Brea
Project Specific WQMP Summary Report

INSTRUCTIONS: Project applicant, please fill out and check all that apply.

Project Name: Brea Mall Expansion	Project Address: 1065 Brea Mall, Brea, CA 92821
WQMP Application Number (BLD #): TBD	APN(s): 319-101-37
Watershed: Coyote Creek-San Gabriel River	Project Size (Acres): 14.75ac
New Development or Redevelopment: Redevelopment	Design Capture Volume (ft^3): 35,264cf
Land Use Type (check one): ☐ Industrial (SIC Code):______ ☐ Commercial (SIC Code):______ ☒ Mixed Use ☐ Residential ☐ Municipal (i.e. CIP) ☐ Other (specify): ______	Total BMP Treatment Capacity (ft^3): 35,331cf (chamber) 2.43cfs (hydrodynamic separator) Hydromodification (Yes/No): Yes Owner/Company Name: Simon Property Group Owner Address: 225 West Washington Street, Indianapolis, IN 46204 Contact Name: Mark Lingelbach Contact Phone: 317.263.7992 HOA/POA (Yes/No): No

STRUCTURAL BMP SUMMARY TABLE

Provide an itemized list of each LID and FCS BMP for each proposed project DMA. Expand this table as needed.

LID BMP Description (i.e. HSC-1, BIO-2, include manufacturer and model number if possible)	DMA ID (as noted on BMP Plot Plan)	DMA Acres	DCV (indicate units)	BMP Treatment Capacity (indicate units)	BMP GPS Coordinates
1. INF-7 (ADS DC-780)	DMA 1	14.75	35,264	35,331	33° 54' 46"N; 117° 53' 20" W
2.					
	TOTAL	14.75	35,264	35,331	
Does BMP Capacity Exceed DCV (Y/N)?			Yes		

FCS Description	DMA ID	Location Description	FCS GPS Coordinates
1. Barracuda Hydrodynamic Separator	DMA 1	Upstream of Chamber System	33° 54' 47" N; 117° 53' 20" W
2. Bio Clean Trash Full Capture Filter	INL 115	East of Residential Building	33° 54 '47" N; 117° 53 '15" W
3. Bio Clean Trash Full Capture Filter	INL 115A	East of Residential Building	33° 54' 47" N; 117° 53' 15" W
4. Bio Clean Trash Full Capture Filter	INL 125	South of Sporting Goods	33° 54' 51" N; 117° 53' 14" W
5. Bio Clean Trash Full Capture Filter	INL 130	South of Sporting Goods	33° 54' 51" N; 117° 53' 14" W
6. Bio Clean Trash Full Capture Filter	INL 135	Southwest of Residential	33° 54' 47" N; 117° 53' 20" W
7. Bio Clean Trash Full Capture Filter	INL 150	North of Residential	33° 54' 50" N; 117° 53' 20" W
8. Bio Clean Trash Full Capture Filter	INL 155	North of Residential	33° 54' 50" N; 117° 53' 20" W
9. Bio Clean Trash Full Capture Filter	INL 165	East of Fitness	33° 54' 52" N; 117° 53' 19" W
10. Bio Clean Trash Full Capture Filter	INL 165A	North of Fitness	33° 54' 54" N; 117° 53' 20" W
11. Bio Clean Trash Full Capture Filter	INL 165B	North of Fitness	33° 54' 54" N; 117° 53' 21" W
12. Bio Clean Trash Full Capture Filter	INL 170	South of Retail A	33° 54' 52" N; 117° 53' 19" W
13. Bio Clean Trash Full Capture Filter	INL 175	East of Retail A	33° 54' 52" N; 117° 53' 19" W
14. Bio Clean Trash Full Capture Filter	INL 180	East of Retail A	33° 54' 54" N; 117° 53' 18" W
15. Bio Clean Trash Full Capture Filter	INL 185	North of Retail A	33° 54' 54" N; 117° 53' 18" W

Non-Structural Source Control BMP's (check all that apply):

- [x] N1 Owner, Tenant, Occupant Education
- [x] N2 Activity Restrictions
- [x] N3 Common Area Landscape Mgmt
- [x] N4 BMP Maintenance
- [ ] N5 Title 22 CCR Compliance
- [ ] N6 Local Water Quality Permit
- [ ] N7 Spill Contingency Plan
- [ ] N8 Underground Storage Tank
- [ ] N9 Hazardous Materials Disclosure
- [x] N10 Uniform Fire Code
- [x] N11 Common Area Litter Control
- [x] N12 Employee Training
- [x] N13 Loading Dock Good Housekeeping
- [x] N14 Common Area Catch Basin Inspection
- [x] N15 Street Sweeping Private Streets & Parking Lots
- [ ] N16 Retail Gasoline Outlets

Structural Source Control BMP's (check all that apply):

- [x] S1 Storm Drain System Stenciling/Signage
- [ ] S2 Outdoor Material Storage Areas
- [x] S3 Trash Storage Areas
- [x] S4 Efficient Irrigation Systems & Landscape Design
- [x] S5 Protect Slopes & Channels
- [x] S6 Loading Dock Areas
- [ ] S7 Maintenance Bays
- [ ] S8 Vehicle Wash Areas
- [ ] S9 Outdoor Process Areas
- [ ] S10 Equipment Wash Areas
- [ ] S11 Fueling Areas
- [ ] S12 Hillside Landscaping
- [x] S13 Wash Water Controls for Food Prep Areas
- [ ] S14 Community Car Wash Racks

Project WQMP Summary Exhibit

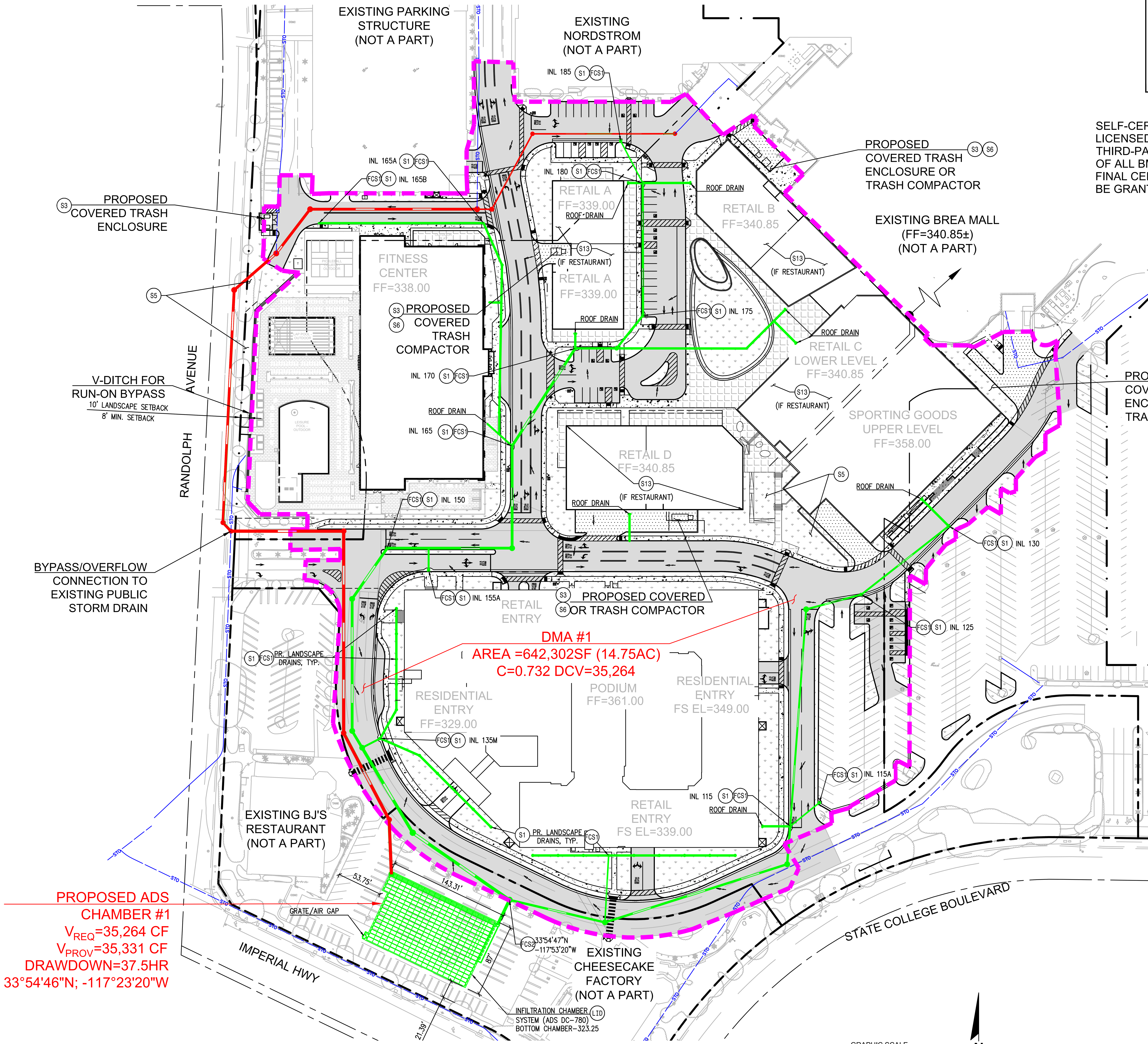
This WQMP Summary Exhibit (“Summary Exhibit”) is to ensure there is a consistent and clarified exhibit included as part of the WQMP submittal process. The purpose of this Summary Exhibit is for it to be used by City inspectors to verify that post-construction structural BMPs are implemented correctly at the project site and as described in the approved WQMP. Though similar, the required elements of this Summary Exhibit are separate from the WQMP Plot Plan that is otherwise found in the WQMP report, as it should only include information relevant to the understanding of stormwater BMP operations and maintenance (i.e. no construction notes) and minimize use of topo lines, elevation callouts, etc. The Summary Exhibit shall include the following elements:

- Drainage Management Areas (DMAs) and flow information (i.e. surface flow arrows and pipe flow arrows),
- BMPs (LID and Structural Source Control – i.e. trash enclosures, catch basin stenciling),
- FCS – Full Capture Systems for trash TMDLs,
- Other structural water quality devices (i.e. roof downspout filters),
- All connections between on-site stormwater structures and off-site storm drains,
- And list of structural BMP ID (CASQA-appropriate).

Where applicable, the applicant shall input concise BMP sizing information in tabular form in the Summary Exhibit. This BMP sizing information should be grouped by drainage area and include:

- DMA ID,
- BMP ID (i.e. MWS #1, CDS #1, INF #1) and TGD BMP ID (i.e. BIO-1, BIO-7, INF-1, HSC-2),
- BMP description (i.e. dimensions, model number),
- And BMP location coordinates.

BMPs should be grouped by drainage area in BMP summary table. Color can be used to highlight the information above but should not be used for other plan details. Details unrelated to stormwater should be turned off/screened back/de-emphasized where possible. If using a hatch for pavement or landscaping, ensure it is also screened back and not distracting from BMPs.



PAVING LEGEND:

- HEAVY DUTY A.C. PAVEMENT IN RING ROAD / LIGHT DUTY A.C. PAVEMENT IN PARKING AREAS
- CONCRETE PAVEMENT
- PASEO AREA (SOFTSCAPE/HARDSCAPE)
- LANDSCAPING
- CONCRETE WALKWAY

LEGEND:

- EXISTING STORM DRAIN
- PROPOSED STORM DRAIN (TO CHAMBER SYSTEM)
- PROPOSED STORM DRAIN (RUN-OFF DRAINS OFF-SITE)
- DRAINAGE MANAGEMENT AREA (14.75AC)

LID BMPS:

- LID — INSTALL ADS (MODEL DC-780) CHAMBER SYSTEM FOR FULL INFILTRATION OF DESIGN STORM (INF-7)

FULL CAPTURE BMPS:

- FCS1 — INSTALL BIOCLEAN (MODEL: BC-GRATE) INLET FILTER AT EXISTING AND PROPOSED INLETS
- FCS2 — INSTALL (MODEL: BAYSAVER BARRACUDA S6) HYDRODYNAMIC SEPARATOR FOR PRETREATMENT

STRUCTURAL SOURCE CONTROL BMPS:

- S1 — STORM DRAIN SYSTEM STENCILING AND SIGNAGE (CASQA SD-13)
- S3 — TRASH STORAGE AREAS (CASQA SD-32)
- S4 — EFFICIENT IRRIGATION SYSTEMS AND LANDSCAPE DESIGN (NOT SHOWN AS FINAL LANDSCAPE AREAS ARE NOT YET DETERMINED - THIS WILL BE APPLIED TO ALL PROPOSED LANDSCAPE AREAS ON THE PROJECT SITE - CASQA SD-12)
- S5 — PROTECT SLOPES & CHANNELS (SECTION 3.4 OF TGD)
- S6 — LOADING DOCK AREAS (CASQA SD-31)
- S13 — WASH WATER CONTROLS FOR FOOD PREP AREAS (HEALTH & SAFETY CODE 27520)

SELF-CERTIFICATIONS FROM A STATE LICENSED PROFESSIONAL ENGINEER OR THIRD-PARTY CERTIFICATIONS ARE REQUIRED OF ALL BMPs CONSTRUCTED ON THIS PLAN OR FINAL CERTIFICATE OF OCCUPANCY WILL NOT BE GRANTED FROM THE CITY.

STRUCTURAL BMP SUMMARY TABLE

Provide an itemized list of each LID and FCS BMP for each proposed project DMA. Expand this table as needed.

LID BMP Description (i.e. HSC-1, BIO-2, include manufacturer and model number if possible)	DMA ID (as noted on BMP Plot Plan)	DMA Acres	DCV (indicate units)	BMP Treatment Capacity (indicate units)	BMP GPS Coordinates
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	TOTAL	14.75	35,264	35,331	
	Does BMP Capacity Exceed DCV (Y/N)?		Yes		

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4. Bio Clean Trash Full Capture Filter	INL 125	South of Sporting Goods	33° 54' 51" N; 117° 53' 14" W
5. Bio Clean Trash Full Capture Filter	INL 130	South of Sporting Goods	33° 54' 51" N; 117° 53' 14" W
6. Bio Clean Trash Full Capture Filter	INL 135	Southwest of Residential	33° 54' 47" N; 117° 53' 20" W
7. Bio Clean Trash Full Capture Filter	INL 150	North of Residential	33° 54' 50" N; 117° 53' 20" W
8. Bio Clean Trash Full Capture Filter	INL 155	North of Residential	33° 54' 50" N; 117° 53' 20" W
9. Bio Clean Trash Full Capture Filter	INL 165	East of Fitness	33° 54' 52" N; 117° 53' 19" W
10. Bio Clean Trash Full Capture Filter	INL 165A	North of Fitness	33° 54' 54" N; 117° 53' 20" W
11. Bio Clean Trash Full Capture Filter	INL 165B	North of Fitness	33° 54' 54" N; 117° 53' 21" W
12. Bio Clean Trash Full Capture Filter	INL 170	South of Retail A	33° 54' 52" N; 117° 53' 19" W
13. Bio Clean Trash Full Capture Filter	INL 175	East of Retail A	33° 54' 52" N; 117° 53' 19" W
14. Bio Clean Trash Full Capture Filter	INL 180	East of Retail A	33° 54' 54" N; 117° 53' 18" W
15. Bio Clean Trash Full Capture Filter	INL 185	North of Retail A	33° 54' 54" N; 117° 53' 18" W

City of Brea Project Specific WQMP Summary Report 2

NOT FOR CONSTRUCTION

RAS JOB NO. 3180011.03

PROJECT MANAGER: CHRIS T. BRATTY

DESIGNED BY: CJN

CHECKED BY: RMK

GRAPHIC SCALE 30 0 30 60 120 (IN FEET)

N

BREA MALL AND RESIDENCES AT BREA

1065 Brea Mall, Brea, CA 92821

WQMP SUMMARY EXHIBIT

raSmith CREATIVITY BEYOND ENGINEERING
8911 Research Drive
Irvine, CA 92618-4237
(949) 872-2378
rasmith.com

WQS-01

Scale 1" = 60'
Job No. 2018-170
Date 10/26/22

Attachment 6 – Operation & Maintenance Plan

OPERATIO S A D MAI TE A CE O&M PLA

PRELIMI AR WATER ALIT MA A EME T PLA

FOR

REA MALL

REA CA

AP M ER: □□□□□0□□□□□

OW ER:

SIMO PROPERT RO P

OCEL LER

ICE PRESIDE T DE ELOPME T

WEST WASHI TO STREET

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PHO E: 3 . . 3

EMAIL: LER SIMO .COM

LE AL DESCRIPTIO :

[illegible]

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Non-Structural Source Control BMPs			
Yes	**N1. Education for Property Owners, Tenants and Occupants** Simon Property Group shall conduct orientation during the first four weeks of startup and as on-going. An awareness program will be established to inform all the employees of the impacts of dumping oil, antifreeze, paints, solvents or other potentially harmful chemicals into storm drain; the proper use (e.g., application methods, frequencies and precautions) and management of fertilizers, pesticides and herbicides in landscaping maintenance practices; the impacts of littering and improper water disposal.	• Ensure employees responsible for the maintenance of BMPs are familiar with the requirements of the WQMP. • All new employees trained within 1 month of hire. Annual retraining required.	Simon Property Group
Yes	**N2. Activity Restrictions** Simon Property Group shall conduct daily management of business activities. Simon Property Group will conduct orientation during the first four weeks of startup and as on-going. Each business activity is restricted under the City of Brea guidance, Conditions, Covenants and Restrictions (CC&Rs), and Conditions of Approval. • No vehicle maintenance activities including vehicle washing • Kitchen mats may not be hosed off outside. • Prohibition of discharge of hazardous waste to the storm drain system. • Prohibition of storage and handling of hazardous materials. • No outdoor storage.	<u>Inspection</u> • Check to ensure that all employees/tenants are adhering to activity restrictions and other restrictions outlined in this WQMP. Retrain/ reeducate as necessary. • Ongoing <u>Maintenance</u> • Provide refresher water quality training. • Annually and as necessary when employee(s) observed to be not adhering to activity restrictions and other restrictions outlined in the WQMP.	Simon Property Group

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Yes	**N3. Common Area Landscape Management** Simon Property Group will ensure that landscape areas shall be maintained on a weekly basis through Grounds and Maintenance personnel and when new personnel are hired. Maintenance shall include: Plant vegetation that reduces water, fertilizer, herbicide, and pesticide use. Waste shall be disposed of by composting or at a permitted landfill and shall not be raked or blown into the street, gutter, or storm drains. Irrigation systems shall be inspected monthly for leaks. Leaks shall be repaired as soon as they are observed. Avoid over-watering of vegetation. If excessive runoff is observed, automatic timers shall be adjusted. Fertilizers, herbicides, and pesticides shall be used as directed on the label. If fertilizer is spilled on a paved surface it should be swept up immediately and placed in its container. Water shall not be used to clean fertilizer spills unless necessary and only after the area has been thoroughly cleaned using dry cleaning methods. Pesticides, herbicides, and fertilizers shall not be applied within 48 hours prior to rain or if wind speeds exceed 5 mph. For additional information, see Help Prevent Ocean Pollution - Proper Maintenance Practices for Your Business included in Section VII of this report. Also refer to the BMP Maintenance Responsibility /Frequency Matrix in Section V for details.	• Landscape maintenance will consist of trimming and replanting of vegetation (See SC-73 in Section VII), repair and maintenance of irrigation systems (See S4), and appropriate use of fertilizers and pesticides. • Landscape maintenance shall be performed on a weekly basis.	Simon Property Group

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Yes	**N4. BMP Maintenance** Simon Property Group through its site and landscape maintenance contractors will be responsible for inspection and maintenance activities in landscape areas. Debris and other water pollutants will be controlled, contained and disposed of in a proper manner by the maintenance contractors hired by Simon Property Group. The site maintenance manager will maintain and inspect non-structural and structural BMPs on the site at least once a month. Each BMPs shall be inspected per required frequency of BMP suggested in the Maintenance Responsibility / Frequency Matrix included in Section VI.	Inspect the systems for signs of erosion. • Semi-annually, at minimum, or after each major (1/2") rain event. Maintenance • Remove sediment, and restore to design specifications. Add Riprap and slope protection as needed. • Provide training to employees within 1 month.	Simon Property Group
Yes	**N10. Uniform Fire Code Implementation** Compliance with Article 80 of the Uniform Fire Code enforced by fire protection agency.	See building plans for fire code implementation.	Simon Property Group
Yes	**N11. Common Area Litter Control** Simon Property Group through site maintenance contractor shall implement litter control procedures and management in the landscape and parking lot areas in order to prevent and reduce pollution of storm water runoff on a weekly basis. Waste containers located outside shall be provided with spill prevention features and emptied on a regular basis, but as a minimum on a weekly basis. SC-11 Spill Prevention, Control & Cleanup	<u>Inspection</u> • Inspect common areas daily for loose trash/litter. <u>Maintenance</u> • Pick up loose trash/litter and place in trash receptacles. • Mop trash enclosure weekly minimum, or more frequently if needed.	Simon Property Group

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Yes	**N12. Employee Training** Simon Property Group shall conduct an employee training program and shall inform and train employees engaged in maintenance activities regarding the impacts of dumping oil, antifreeze, paints, solvents or other potentially harmful chemicals into storm sewer; the proper use (e.g., application methods, frequencies and precautions) and management of fertilizers, pesticides and herbicides in landscaping maintenance practice; the impacts of littering an improper water disposal. Employee training program shall be conducted on an ongoing basis and during the first month of startup period. This WQMP shall be a reference to be used for the program and an annual review of the provisions of the WQMP shall be done by each employee. If there are any changes of ownership on the site, a new owner shall be responsible once the ownership is transferred.	Water Quality Management Plan serves as the education for property owners, tenants, and occupants. • Provide water quality orientation to new employees, tenants, etc. • Within two weeks of hire.	Simon Property Group

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Yes	**N13. Housekeeping of Loading Docks** There will not be pollutants entering the storm drain system from any loading areas. Simon Property Group shall maintain good housekeeping practices in the loading dock environment and keep the dock areas clean and free of debris. Loading areas shall be checked periodically to ensure containment of accumulated water and prevention of storm water run-on. See SD-31 in Section VII for more information.	<u>Inspection</u> • Inspect the loading dock area daily for loose trash/litter and sweep biweekly. • Any spills or broken containers shall be cleaned up immediately. <u>Maintenance</u> • Pick up loose trash/litter and place in trash receptacles. • Daily No wash water is to be discharged to the storm drain system.	Simon Property Group

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Yes	**N14. Common Area Catch Basin Inspection** Simon Property Group shall be responsible for ensuring that the onsite catch basins, and overflow pipes shall be inspected and maintained once per year, at minimum. See SC-74 in Section VII for more information.	Inspection • Inspect the catch basin for obstructions/debris buildup and to ensure that it continues to function properly. • Four times per year, at minimum. Maintenance • Remove obstructions and clean debris and contaminants out of catch basin to ensure it continues to function properly. • As determined necessary during inspection. Cleaning shall take place prior to the onset of the rainy season (generally accepted as October 1st through April 30th).	Simon Property Group
Yes	**N15. Street Sweeping Private Streets and Parking Lots** Simon Property Group through its site maintenance contractor shall provide vacuum sweeping of parking lots on a weekly basis. In addition, the sweeping program will be intensified prior to the start of the rainy season around October 15 of every year to minimize water pollution during the “first flush” storm. Further BMPs and information are listed below: SC43-Parking/Storage Area Maintenance SC70-Landscape Maintenance	Inspection • Inspect the parking area daily for loose trash/litter and sweep weekly using sweeping contractor. Maintenance • Pick up loose trash/litter and place in trash receptacles. • Daily	Simon Property Group
Structural Source Control BMPs			

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Yes	**S1. Provide Storm Drain System Stenciling and Signage** It is widely recognized that the use of storm drains and catch basins for illegal disposal of waste materials can introduce a significant quantity of pollutants into receiving waters. Contributing to this problem is the common misconception that storm drains and sanitary sewers are part of the same system and that materials dumped into storm drains will ultimately arrive at a waste water treatment facility. Stenciling catch basins by the owner will inform the public about non-point source pollution, highlighting the direct link between such basins and sensitive Orange County receiving waters and draws public attention to the fate of materials that are dumped into the storm drain system. The stencil will carry the message "NO DUMPING-DRAINS TO OCEAN". Repair of storm drain system stenciling and signage shall be performed regularly and at least three times a year or as many times a necessary during the storm seasons. SD13-Storm Drain Signage SC44-Drainage System Maintenance	Inspection • Inspect the legibility of storm drain signage. • Once per year, at a minimum. Maintenance • Replace storm drain signage as necessary to maintain legibility. • Catch basins/inlets must be restenciled, at minimum, every 5 years.	Simon Property Group

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Yes	**S3. Design Trash Enclosures to Reduce Pollutant Introduction** Simon Property Group shall provide trash and waste storage areas through its contractors. Simon Property Group through its site maintenance contractor shall maintain daily. Trash dumpster shall be picked up at least once a week. Loose trash shall be picked up daily and shall be placed in containers periodically. The trash storage areas shall be inspected and maintained daily by the maintenance contractor in order to prevent overflowing dumpster and open lids. The trash container area shall contain trash bins with covers and trash area shall be roofed over in order to prevent rain from entering the bin to reduce water pollution. The bins will be provided with self-closing features and will be inspected on a regular basis as needed for the amount of trash generated. The design of the trash container area will include features such that drainage from adjoining roofs and pavements shall be diverted around the trash container areas. All trash container areas will be surrounded by walls and gates to prevent offsite transport of trash. All employees will be instructed to make sure that covers are kept closed and only opened at the time the trash is deposited. Trash and waste storage areas will be constructed to reduce pollution. It will be located outside the building and trash enclosure will be installed. SD32-Trash Storage Areas	See N11.	Simon Property Group

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Yes	**S4. Use Efficient Irrigation Systems and Landscape Design** Projects shall design the timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the municipal storm drain system. (Limited exclusion: detached residential homes.) The following methods to reduce excessive irrigation runoff shall be considered, and incorporated on common areas of development and other areas where determined applicable and feasible by the Permittee: 1. Employing rain shutoff devices to prevent irrigation after precipitation. 2. Designing irrigation systems to each landscape area's specific water requirements. 3. Using flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines. 4. Implementing landscape plan consistent with County Water Conservation Resolution or city equivalent, which may include provision of water sensors, programmable irrigation times (for short cycles), etc. 5. The timing and application methods of irrigation water shall be designed to minimize the runoff of excess irrigation water into the municipal storm drain system. 6. Employing other comparable, equally effective, methods to reduce irrigation water runoff. 7. Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider other design features, such as: •Use mulches (such as wood chips or shredded wood products) in planter areas without ground cover to minimize sediment in runoff. •Install appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant material where possible and/or as recommended by the landscape architect. •Leave a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible. •Choose plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth. Irrigation practices shall comply with local and statewide ordinances related to irrigation efficiency. See SD-12 in Section VIIfor more information.	<u>Inspection</u> • Inspect irrigation equipment for leaks and check timers. • Inspect landscaped areas to ensure vegetation is not being over or under watered. • Monthly. <u>Maintenance</u> • Repair leaks and adjust timers and irrigation heads. • As necessary to maintain proper operation of equipment and to avoid over and under watering of vegetation and excessive runoff from vegetated areas.	Simon Property Group

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Yes	**S5. Protect Slopes and Channels and provide energy dissipation** Project plans shall include site design BMPs to decrease the potential for erosion of slopes and/or channels. The following design principles should be considered, incorporated and implemented where determined applicable and feasible by the Permittee: 1. Convey runoff safely from the tops of slopes 2. Avoid disturbing steep or unstable slopes 3. Avoid disturbing natural channels 4. Install permanent stabilization BMPs on disturbed slopes as quickly as possible. 5. Vegetate slopes with native or drought tolerant vegetation 6. Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems, unless infiltration would cause geotechnical hazards. 7. If hydromodification control is not provided before discharging to ta channel, install permanent stabilization BMPs in channel crossings as quickly as possible, and ensure that increases in runoff velocity and frequency caused by the project do not erode the channel. 8. Install energy dissipators, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipators should be installed in such a way as to minimize impacts to receiving waters. 9. Instead of discharging to steep reaches, consider collecting and conveying runoff to downgradient discharge points. 10. On-site conveyance channels should be lined, where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. 11. Other design principles which are comparable and equally effective.	Inspection • Check slopes for signs of erosion bi-annually and after rain events. • Check that slope protection and energy dissipating devices are working Maintenance • Install and/or repair slope protection devices at sign of failure.	Simon Property Group

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Yes	**S6. Loading Dock Areas** See SD-31 in Section VII for more information.	Loading /unloading dock areas shall include the following: 1. Cover loading dock areas, or design drainage to preclude run-on and runoff, unless the material loaded and unloaded at the docks does not have potential to contribute to stormwater pollution, and this use is ensured for the life of the facility. 2. Direct connections to the municipal storm drain system from below grade loading docks (truck wells) or similar structures are prohibited. Stormwater can be discharged through a permitted connection to the storm drain system with a treatment control BMP applicable to the use. 3. Other comparable and equally effective features that prevent unpermitted discharges to the municipal storm drain system. 4. Housekeeping of loading docks shall be consistent with N13. See CASQA Stormwater Handbook Section 3.2.8 for additional information.	Simon Property Group

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Yes	**S13. Wash Water for food preparation areas** Food establishments (per State Health & Safety Code 27520) shall have either contained areas or sinks, each with sanitary sewer connections for disposal of wash waters containing kitchen and food wastes. If located outside, the contained areas shall be provided and appropriately placed stating the prohibition of discharging washwater to the storm drain system.	Wash water from kitchens and food preparation areas are designed to drain to the sanitary sewer system. Grease interceptors will be provided downstream.	Simon Property Group

BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Low Impact Development BMPs		
Hydrologic Source Control BMP # 1 Not applicable		
Hydrologic Source Control BMP # 2 Not applicable		
Miscellaneous BMP # 1 Drop Inlet	Inspect for standing water. If standing water stands within the inlet between storms and does not drain within 48 hours after rainfall, maintenance of inlet is required. Remove any possible trash or blockage from the inlet, or perform storm drain jetting for maintenance. Inspect inlet for trash and debris accumulation in the drop inlet. If trash and debris have accumulated, it must be removed from the drop inlet and disposed of properly.	Simon Property Group
Miscellaneous BMP # 2 Inlet Stenciling	Review condition of stencil yearly, repaint as needed	Simon Property Group

BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
LID BMP # 1 ADS Infiltration Chamber	**Step 1 - Inspect Isolator Row for Sediment** A. Inspection Ports i. Remove lid from floor box frame ii. Remove cap from Inspection Riser iii. Using a flashlight and a stadia rod, measure depth of sediment and record results on maintenance log. iv. If sediment is at, or above, 3 inch depth, proceed to Step 2. If not, proceed to Step 3. B. All Isolator Rows i. Remove cover from manhole at upstream end of isolator row ii. Using a flashlight, inspect down isolator row through outlet pipe (mirrors on poles or cameras may be used to avoid a confined space entry; follow OSHA regulations for confined space entry if entering manhole) iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches) proceed to Step 2. If not proceed to Step 3. **Step 2 - Clean out Isolator Row using the JetVac Process** A. A fixed culvert cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable B. Apply multiple passes of JerVac until backflush water is clean C. Vacuum manhole sump as required **Step 3 – Replace all Caps, lids and covers, record observations and actions** **Step 4 – Inspect and clean basins and manholes upstream of the ADS System**	Simon Property Group (Inspections shall take place every 6 months during the first year of operation. Adjust the inspection interval based on previous observations of sediment accumulation and high water elevations; conduct jetting and vactoring only when inspections show that maintenance is necessary)

Treatment Control BMPs		
Treatment Control BMP # 1 Not Applicable		
Pre-Treatment/Gross Solids Removal BMPs		
BMP Name and BMP Implementation, Maintenance and Inspection Procedures	**Implementation, Maintenance, and Inspection Frequency and Schedule**	**Person or Entity with Operation & Maintenance Responsibility**
Pre-Treatment BMP # 1 Bio Clean Trash Full Capture Filter	Inspections should occur following any rain event greater than ½" or at four times per year minimum. 1. Empty the sediment bag if more than half filled with sediment and debris, or as directed. 2. Remove the grate and lift from drainage structure. 3. Dispose of sediment or debris as directed by the Engineer or Maintenance contract. 4. An industrial vacuum can be used to collect sediment. 5. Remove caked on silt from sediment bag and flush with Medium spray with optimal filtration. 6. Replace bag if torn or punctured to >½" diameter on lower half of bag.	Simon Property Group

Pre-Treatment BMP #2 Barracuda Hydrodynamic Separator	Inspections should occur following any rain event greater than ½”. At an minimum Barracuda System should be cleaned annually. 1. Remove manhole lid (may require traffic control) 2. To determine sediment depth, the maintenance contractor should lower a stadia rod into he manhole until it contacts the top of the captured sediment and mark that spot on the road. 3. Push the probe through to the bottom of the sump and mark that spot to determine sediment depth. Maintenance should occur when the sediment has reached the levels indicated in the Storage Capacity Chart. Maintenance 1. Remove the manhole cover to provide access to the pollutant storage. Pollutants are stored in the sump, below the bowl assembly visible from the surface. You’ll access this area throught he 10” diameter access cylinder. 2. Use a vacuum truck or similar equipment to remove all water, debris, oils and sediment. 3. Use a high pressure water hose to clean the manhole of all the remaining sediment and debris. Then, use the vacuum truck to remove the water. 4. Fill the cleaned manhole with water until the level reaches the invert of the outlet pipe. 5. Replace the manhole cover. 6. Dispose of the polluted water, oils, sediment and trash at an approved facility.	Simon Property Group

Required Permits

Forms to Record MP Implementation Maintenance and Inspection

Record eeping

Attachments

RECORD OF MP IMPLEME TATIO MAI TE A CE A D I SPECTIO

Today s Date: ____________________

ame of Person Performing Activity Printed : ____________________

Signature: ____________________

BMP Name (As Shown in O&M Plan)	Brief Description of Implementation, Maintenance, and Inspection Activity Performed

9.0 Inspection and Maintenance

9.1 ISOLATOR ROW INSPECTION

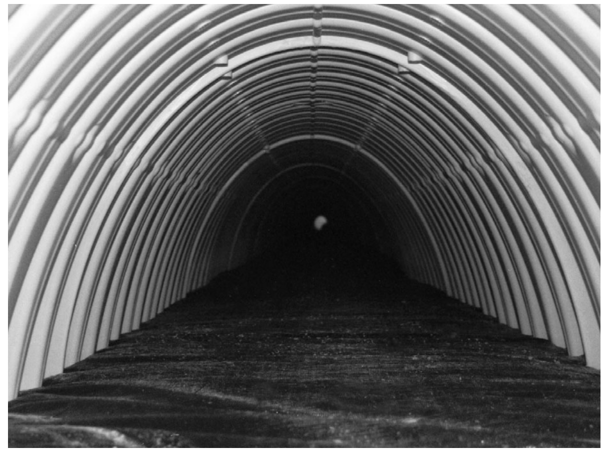
Regular inspection and maintenance are essential to assure a properly functioning stormwater system. Inspection is easily accomplished through the manhole or optional inspection ports of an Isolator Row. Please follow local and OSHA rules for a confined space entry.

Inspection ports can allow inspection to be accomplished completely from the surface without the need for a confined space entry. Inspection ports provide visual access to the system with the use of a flashlight. A stadia rod may be inserted to determine the depth of sediment. If upon visual inspection it is found that sediment has accumulated to an average depth exceeding 3” (76 mm), cleanout is required.

A StormTech Isolator Row should initially be inspected immediately after completion of the site’s construction. While every effort should be made to prevent sediment from entering the system during construction, it is during this time that excess amounts of sediments are most likely to enter any stormwater system. Inspection and maintenance, if necessary, should be performed prior to passing responsibility over to the site’s owner. Once in normal service, a StormTech Isolator Row should be inspected bi-annually until an understanding of the sites characteristics is developed. The site’s maintenance manager can then revise the inspection schedule based on experience or local requirements.

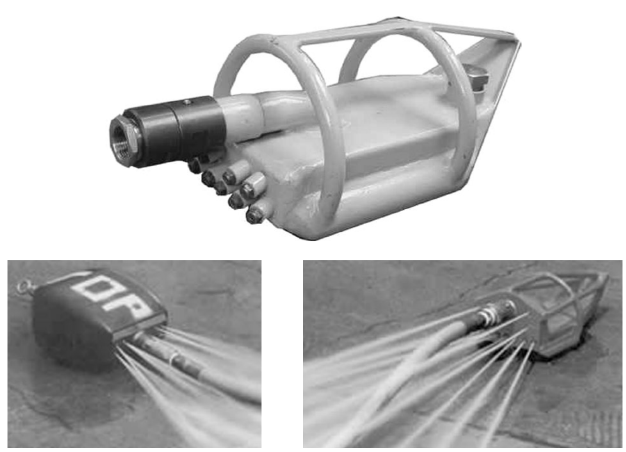
9.2 ISOLATOR ROW MAINTENANCE

JetVac maintenance is recommended if sediment has been collected to an average depth of 3” (76 mm) inside the Isolator Row. More frequent maintenance may be required to maintain minimum flow rates through the Isolator Row. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, a wave of suspended sediments is flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/ JetVac combination vehicles. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45” (1143 mm) are best. The JetVac process shall only be performed on StormTech Rows that have AASHTO class 1 woven geotextile over their foundation stone (ADS 315WTM or equal).



Looking down the Isolator Row

A typical JetVac truck (This is not a StormTech product.)

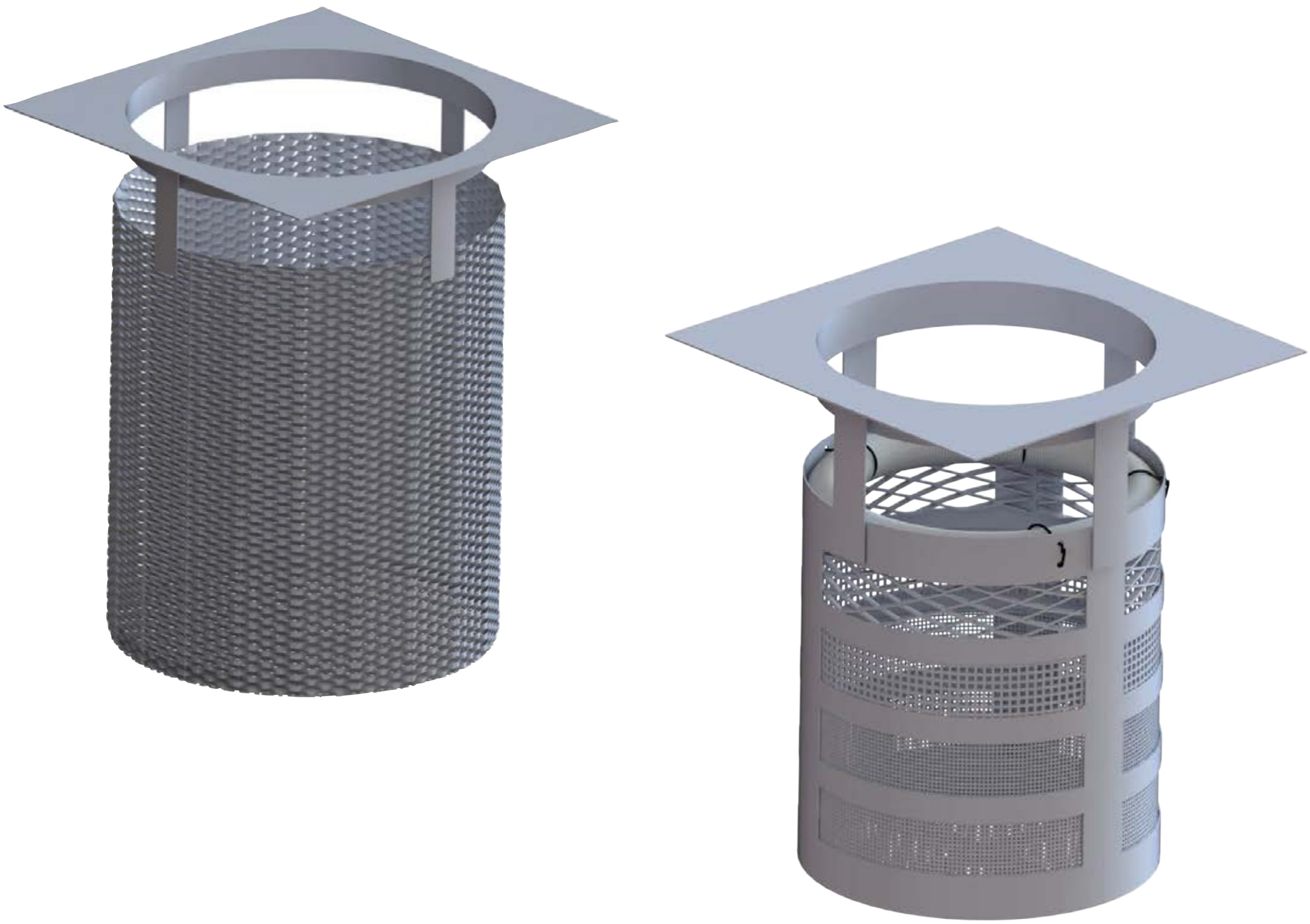


Examples of culvert cleaning nozzles appropriate for Isolator Row maintenance. (These are not StormTech products).

Grate Inlet Filter

Bio Clean
A Forterra Company

OPERATION & MAINTENANCE



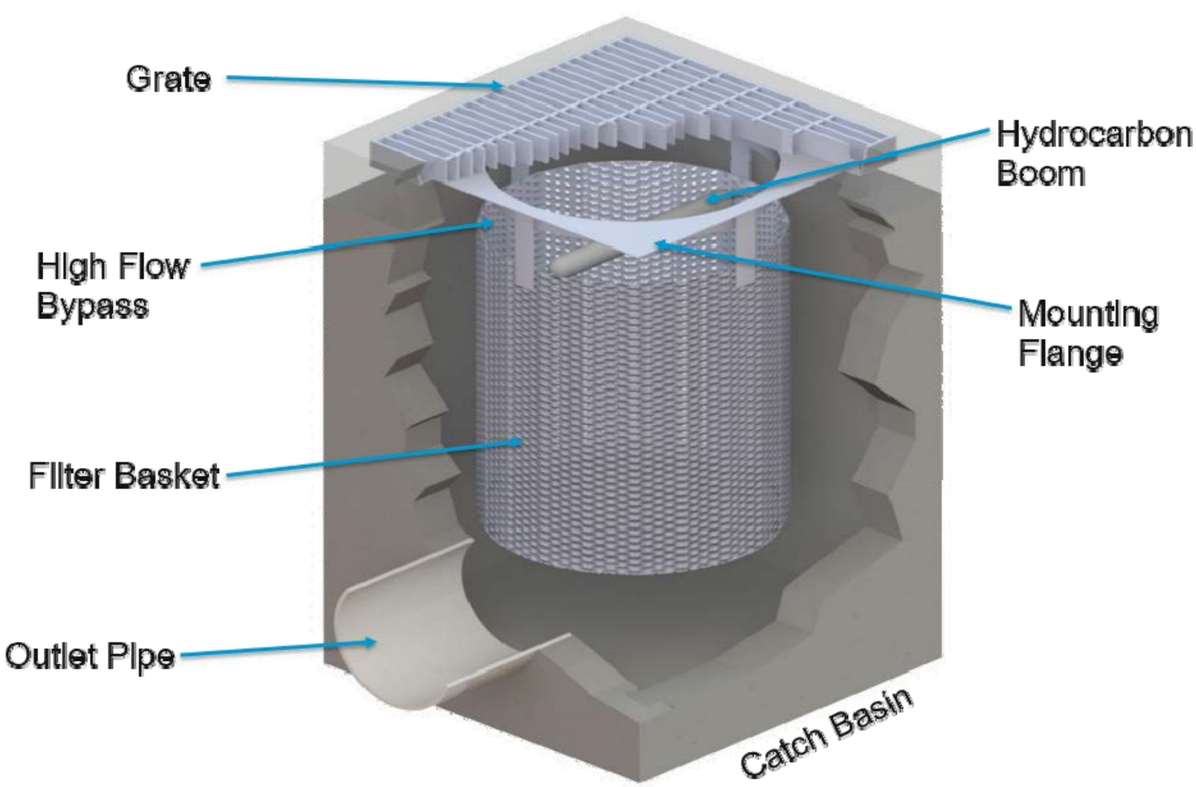
Bio Clean Environmental Services, Inc.
398 Via El Centro
Oceanside, CA 92058

www.BioCleanEnvironmental.com
p: 760.433.7640
f: 760.433.3176

OPERATION & MAINTENANCE

The Bio Clean Grate Inlet Filter is a stormwater device designed to remove high levels of trash, debris, sediments and hydrocarbons. The filter is available in several configurations including trash full capture, multi-level screening, Kraken membrane filter and media filter variations. This manual covers maintenance procedures of the trash full capture and multi-level screening configurations. A supplemental manual is available for the Kraken and media filter variations. This filter is made of 100% stainless steel and is available and various sizes and depths allowing it to fit in any grated catch basin inlet. The filters heavy duty construction allows for cleaning with any vacuum truck. The filet can also easily be cleaned by hand.

As with all stormwater BMPs, inspection and maintenance on the Grate Inlet Filter is necessary. Stormwater regulations require BMPs be inspected and maintained to ensure they are operating as designed to allow for effective pollutant removal and provide protection to receiving water bodies. It is recommended that inspections be performed multiple times during the first year to assess site-specific loading conditions. This is recommended because pollutant loading can vary greatly from site to site. Variables such as nearby soil erosion or construction sites, winter sanding of roads, amount of daily traffic and land use can increase pollutant loading on the system. The first year of inspections can be used to set inspection and maintenance intervals for subsequent years. Without appropriate maintenance a BMP can exceed its storage capacity which can negatively affect its continued performance in removing and retaining captured pollutants.

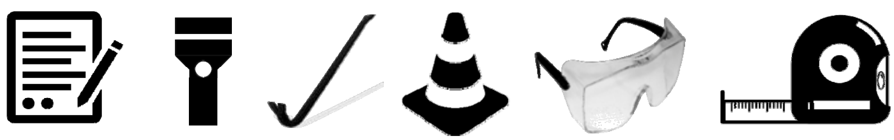


System Diagram:

Inspection Equipment

Following is a list of equipment to allow for simple and effective inspection of the Grate Inlet Filter:

- Bio Clean Environmental Inspection Form (contained within this manual).
- Manhole hook or appropriate tools to remove access hatches and covers.
- Appropriate traffic control signage and procedures.
- Protective clothing and eye protection.
- Note: entering a confined space requires appropriate safety and certification. It is generally not required for routine inspections or maintenance of the system.



Inspection Steps

The core to any successful stormwater BMP maintenance program is routine inspections. The inspection steps required on the Grate Inlet Filter are quick and easy. As mentioned above the first year should be seen as the maintenance interval establishment phase. During the first year more frequent inspections should occur in order to gather loading data and maintenance requirements for that specific site. This information can be used to establish a base for long-term inspection and maintenance interval requirements.

The Grate Inlet Filter can be inspected though visual observation. All necessary pre-inspection steps must be carried out before inspection occurs, such as safety measures to protect the inspector and nearby pedestrians from any dangers associated with an open grated inlet. Once the grate has been safely removed the inspection process can proceed:

- Prepare the inspection form by writing in the necessary information including project name, location, date & time, unit number and other info (see inspection form).
- Observe the filter with the grate removed.
- Look for any out of the ordinary obstructions on the grate or in the filter and its bypass. Write down any observations on the inspection form.
- Through observation and/or digital photographs estimate the amount of trash, foliage and sediment accumulated inside the filter basket. Record this information on the inspection form.
- Observe the condition and color of the hydrocarbon boom. Record this information on the inspection form.
- Finalize inspection report for analysis by the maintenance manager to determine if maintenance is required.

Maintenance Indicators

Based upon observations made during inspection, maintenance of the system may be required based on the following indicators:

- Missing or damaged internal components.
- Obstructions in the filter basket and its bypass.
- Excessive accumulation of trash, foliage and sediment in the filter basket. Maintenance is required when the basket is greater than half-full.
- The following chart shows the 50% and 100% storage capacity of each filter height:

Model	Filter Basket Diameter (in)	Filter Basket Height (in)	50% Storage Capacity (cu ft)	100% Storage Capacity (cu ft)
BC-GRATE-12-12-12	10.00	12.00	0.27	0.55
BC-GRATE-18-18-18	16.00	18.00	1.05	2.09
BC-GRATE-24-24-24	21.00	24.00	2.41	4.81
BC-GRATE-30-30-24	27.00	24.00	3.98	7.95
BC-GRATE-36-36-24	33.00	24.00	5.94	11.88
BC-GRATE-48-48-18	44.00	18.00	7.92	15.84

Maintenance Equipment

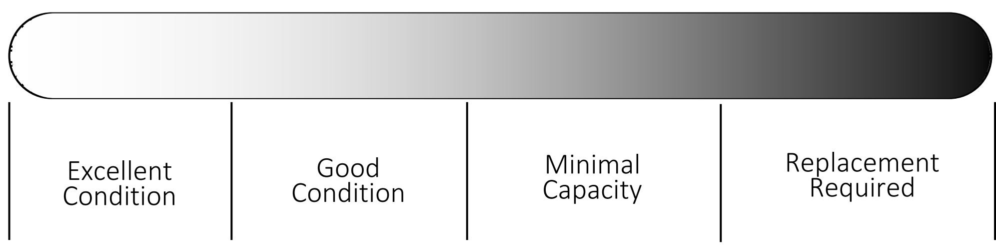
It is recommended that a vacuum truck be utilized to minimize the time required to maintain the Curb Inlet Filter, though it can easily cleaned by hand:

- Bio Clean Environmental Maintenance Form (contained in O&M Manual).
- Manhole hook or appropriate tools to remove the grate.
- Appropriate safety signage and procedures.
- Protective clothing and eye protection.
- Note: entering a confined space requires appropriate safety and certification. It is generally not required for routine maintenance of the system. Small or large vacuum truck (with pressure washer attachment preferred).

Maintenance Procedures

It is recommended that maintenance occurs at least two days after the most recent rain event to allow debris and sediments to dry out. Maintaining the system while flows are still entering it will increase the time and complexity required for maintenance. Cleaning of the Grate Inlet Filter can be performed utilizing a vacuum truck. Once all safety measures have been set up cleaning of the Grate Inlet Filter can proceed as followed:

- Remove grate (traffic control and safety measures to be completed prior).
- Using an extension on a vacuum truck position the hose over the opened catch basin. Insert the vacuum hose down into the filter basket and suck out trash, foliage and sediment. A pressure wash is recommended and will assist in spraying of any debris stuck on the side or bottom of the filter basket. Power wash off the filter basket sides and bottom.
- Next remove the hydrocarbon boom that is attached to the inside of the filter basket. The hydrocarbon boom is fastened to rails on two opposite sides of the basket (vertical rails). Assess the color and condition of the boom using the following information in the next bullet point. If replacement is required install and fasten on a new hydrocarbon boom. Booms can be ordered directly from the manufacturer.
- Follow is a replacement indication color chart for the hydrocarbon booms:



- The last step is to replace the grate and remove all traffic control.
- All removed debris and pollutants shall be disposed of following local and state requirements.
- Disposal requirements for recovered pollutants may vary depending on local guidelines. In most areas the sediment, once dewatered, can be disposed of in a sanitary landfill. It is not anticipated that the sediment would be classified as hazardous waste.
- In the case of damaged components, replacement parts can be ordered from the manufacturer. Hydrocarbon booms can also be ordered directly from the manufacturer as previously noted.

Maintenance Sequence

Remove grate and set up vacuum truck to clean the filter basket.

Insert the vacuum hose down into the filter basket and suck out debris. Use a pressure washer to assist in vacuum removal. Pressure wash off screens.

Remove the hydrocarbon boom that is attached to the inside of the filter basket. The hydrocarbon boom is fastened to rails on two opposite sides of the basket (vertical rails). Assess the color and condition of the boom using the following information in the next bullet point. If replacement is required install and fasten on a new hydrocarbon boom.

Close up and replace the grate and remove all traffic control. All removed debris and pollutants shall be disposed of following local and state requirements.

For Maintenance Services or Information Please Contact Us At:
760-433-7640
Or Email:
info@biocleanenvironmental.com

Bio Clean
A Forterra Company

Inspection and Maintenance Report
Catch Basin Only

Project Name ______________________

Project Address ______________________
(city) (Zip Code)

Owner / Management Company ______________________

Contact ______________________ Phone ( ) –

Inspector Name ______________________ Date / / Time ______ AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition ______________________ Additional Notes ______________________

For Office Use Only
(Reviewed By)
(Date) Office personnel to complete section to the left.

Site Map #	GPS Coordinates of Insert	Catch Basin Size	Evidence of Illicit Discharge?	Trash Accumulation	Foliage Accumulation	Sediment Accumulation	Signs of Structural Damage?	Functioning Properly or Maintenance Needed?
1	Lat: Long:							
2	Lat: Long:							
3	Lat: Long:							
4	Lat: Long:							
5	Lat: Long:							
6	Lat: Long:							
7	Lat: Long:							
8	Lat: Long:							
10	Lat: Long:							
11	Lat: Long:							
12	Lat: Long:							

Comments:

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Maintenance Guide

BaySaver Barracuda™

July 2017

One of the advantages of the BaySaver Barracuda is the ease of maintenance. Like any system that collects pollutants, the BaySaver Barracuda must be maintained for continued effectiveness. Maintenance is a simple procedure performed using a vacuum truck or similar equipment. The systems were designed to minimize the volume of water removed during routine maintenance, reducing disposal costs.

Contractors can access the pollutants stored in the manhole through the manhole cover. This allows them to gain vacuum hose access to the bottom of the manhole to remove sediment and trash. There is no confined space entry necessary for inspection or maintenance.

The entire maintenance procedure typically takes from 2 to 4 hours, depending on the size of the system, the captured material, and the capacity of the vacuum truck.

Local regulations may apply to the maintenance procedure. Safe and legal disposal of pollutants is the responsibility of the maintenance contractor. Maintenance should be performed only by a qualified contractor.

Inspection and Cleaning Cycle

Periodic inspection is needed to determine the need for and frequency of maintenance. You should begin inspecting as soon as construction is complete and thereafter on an annual basis. Typically, the system needs to be cleaned every 1-3 years.

Excessive oils, fuels or sediments may reduce the maintenance cycle. Periodic inspection is important.

Determining When to Clean

To determine the sediment depth, the maintenance contractor should lower a stadia rod into the manhole until it contacts the top of the captured sediment and mark that spot on the rod. Then push the probe through to the bottom of the sump and mark that spot to determine sediment depth.

Maintenance should occur when the sediment has reached the levels indicated in the Storage Capacity Chart.

BaySaver Barracuda Storage Capacities

Model	Manhole Diameter	Treatment Chamber Capacity	Standard Sediment Capacity (20” depth)	NJDEP Sediment Capacity (50% of standard depth)
S3	36”	212 gallons	0.44 cubic yards	0.22 cubic yards
S4	48”	564 gallons	0.78 cubic yards	0.39 cubic yards
S5	60”	881 gallons	1.21 cubic yards	0.61 cubic yards
S6	72”	1269 gallons	1.75 cubic yards	0.88 cubic yards
S8	96”	3835 gallons	3.10 cubic yards	1.55 cubic yards
S10	120”	7496 gallons	4.85 cubic yards	2.43 cubic yards

Maintenance Instructions

1. Remove the manhole cover to provide access to the pollutant storage. Pollutants are stored in the sump, below the bowl assembly visible from the surface. You’ll access this area through the 10” diameter access cylinder.

2. Use a vacuum truck or other similar equipment to remove all water, debris, oils and sediment. See figure 1.
3. Use a high pressure hose to clean the manhole of all the remaining sediment and debris. Then, use the vacuum truck to remove the water.
4. Fill the cleaned manhole with water until the level reaches the invert of the outlet pipe.
5. Replace the manhole cover.
6. Dispose of the polluted water, oils, sediment and trash at an approved facility.
   - Local regulations prohibit the discharge of solid material into the sanitary system. Check with the local sewer authority for authority to discharge the liquid.
   - Some localities treat the pollutants as leachate. Check with local regulators about disposal requirements.
   - Additional local regulations may apply to the maintenance procedure.

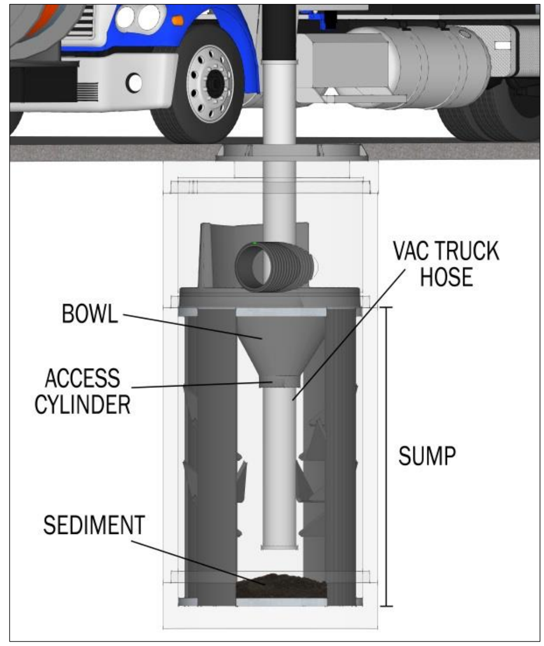
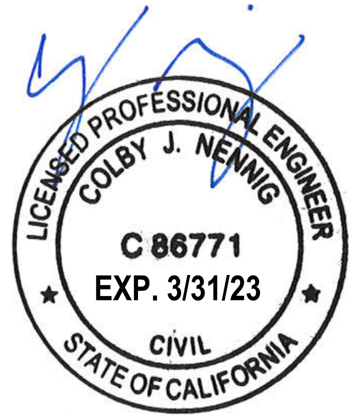


Figure 1

Preliminary Hydrology Study



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TO: [illegible]

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Existing Summary	Hydrologic Area (sf)	Hydrologic Area (ac)	Impervious (sf)	Impervious (ac)	Pervious (sf)	Pervious (ac)
Existing	642,302	14.75	606,975	13.93	35,327	0.81
Area 1 (West)	486,917	11.18	460,137	10.56	26,780	0.61
Area 2 (East)	104,200	2.39	98,469	2.26	5,731	0.13
Area 3 (Central)	51,185	1.18	51,185	1.18	-	0.00

Proposed	Hydrologic Area (sf)	Hydrologic Area (ac)	Impervious (sf)	Impervious (ac)	Pervious (sf)	Pervious (ac)
DA #1A	10,550	0.24	10,550	0.24	-	0.00
DA #1B	26,195	0.60	26,195	0.60	-	0.00
DA #1C	87,805	2.02	87,805	2.02	-	0.00
DA #1D	15,920	0.37	15,920	0.37	-	0.00
DA #1E	94,956	2.18	94,956	2.18	-	0.00
DA #1F	46,830	1.08	46,830	1.08	-	0.00
DA #1G	59,930	1.38	59,930	1.38	-	0.00
DA #1H	10,740	0.25	10,740	0.25	-	0.00
DA #1I	64,095	1.47	64,095	1.47	-	0.00
DA #2A	61,900	1.42	61,900	1.42	-	0.00
DA #2B	17,665	0.41	17,665	0.41	-	0.00
DA #2C	135,065	3.10	135,065	3.10	-	0.00
DA #2D	10,651	0.24	10,651	0.24	-	0.00

Manning Equation:

$$Q = VA \qquad V = \frac{k}{n}\left(\frac{A}{P}\right)^{2/3} S^{1/2}$$

10yr Peak Hydrology Analysis

10yr Pre-Development					
Rational Analysis	Coefficient, C	Intensity (in/hr)	Area (ac)	Downstream Concentration Point	Q10 (cfs)
Area 1 - West	0.90	3.49	11.18	304XG	39.71
Area 2 -East	0.90	3.84	2.39	304XG	8.25
Area 3 - Central	0.90	4.06	1.18	334K	4.29
Existing Combined Flows to Downstream Concentration Point 304XG					47.96
Existing Combined Flows to Downstream Concentration Point 334K					4.29
10yr Post-Development					
Rational Analysis	Coefficient, C	Intensity (in/hr)	Area (ac)	Downstream Concentration Point	Q10 (cfs)
DA #1 (part of DMA #1)	0.90	2.72	9.57	304XG	31.66
DA #2 (part of DMA #1)	0.90	3.30	5.17	304XG	16.19
Proposed Combined Flows to Downstream Concentration Point 304XG					47.85
Proposed Combined Flows to Downstream Concentration Point 334K					0.00

25yr Peak Hydrology Analysis

25yr Pre-Development					
Rational Analysis	Coefficient, C	Intensity (in/hr)	Area (ac)	Downstream Concentration Point	Q25 (cfs)
Area 1 - West	0.90	4.16	11.18	304XG	47.23
Area 2 -East	0.90	4.57	2.39	304XG	9.81
Area 3 - Central	0.90	4.82	1.18	334K	5.10
Existing Combined Flows to Downstream Concentration Point 304XG					57.04
Existing Combined Flows to Downstream Concentration Point 334K					5.10
25yr Post-Development					
Rational Analysis	Coefficient, C	Intensity (in/hr)	Area (ac)	Downstream Concentration Point	Q25 (cfs)
DA #1 (part of DMA #1)	0.90	3.25	9.57	304XG	37.66
DA #2 (part of DMA #1)	0.90	3.93	5.17	304XG	19.28
Proposed Combined Flows to Downstream Concentration Point 304XG					56.94
Proposed Combined Flows to Downstream Concentration Point 334K					0.00

100yr Peak Hydrology Analysis

100yr Pre-Development					
Rational Analysis	Coefficient, C	Intensity (in/hr)	Area (ac)	Downstream Concentration Point	Q100 (cfs)
Area 1 - West	0.90	5.32	11.18	304XG	60.60
Area 2 -East	0.90	5.86	2.39	304XG	12.58
Area 3 - Central	0.90	6.19	1.18	334K	6.54
Existing Combined Flows to Downstream Concentration Point 304XG					73.18
Existing Combined Flows to Downstream Concentration Point 334K					6.54
100yr Post-Development					
Rational Analysis	Coefficient, C	Intensity (in/hr)	Area (ac)	Downstream Concentration Point	Q100 (cfs)
DA #1 (part of DMA #1)	0.90	4.15	9.57	304XG	48.26
DA #2 (part of DMA #1)	0.90	5.02	5.17	304XG	24.68
Proposed Combined Flows to Downstream Concentration Point 304XG					72.94
Proposed Combined Flows to Downstream Concentration Point 334K					0.00

Manning Equation:

$$Q = VA \qquad V = \frac{k}{n}\left(\frac{A}{P}\right)^{2/3} S^{1/2}$$

ode

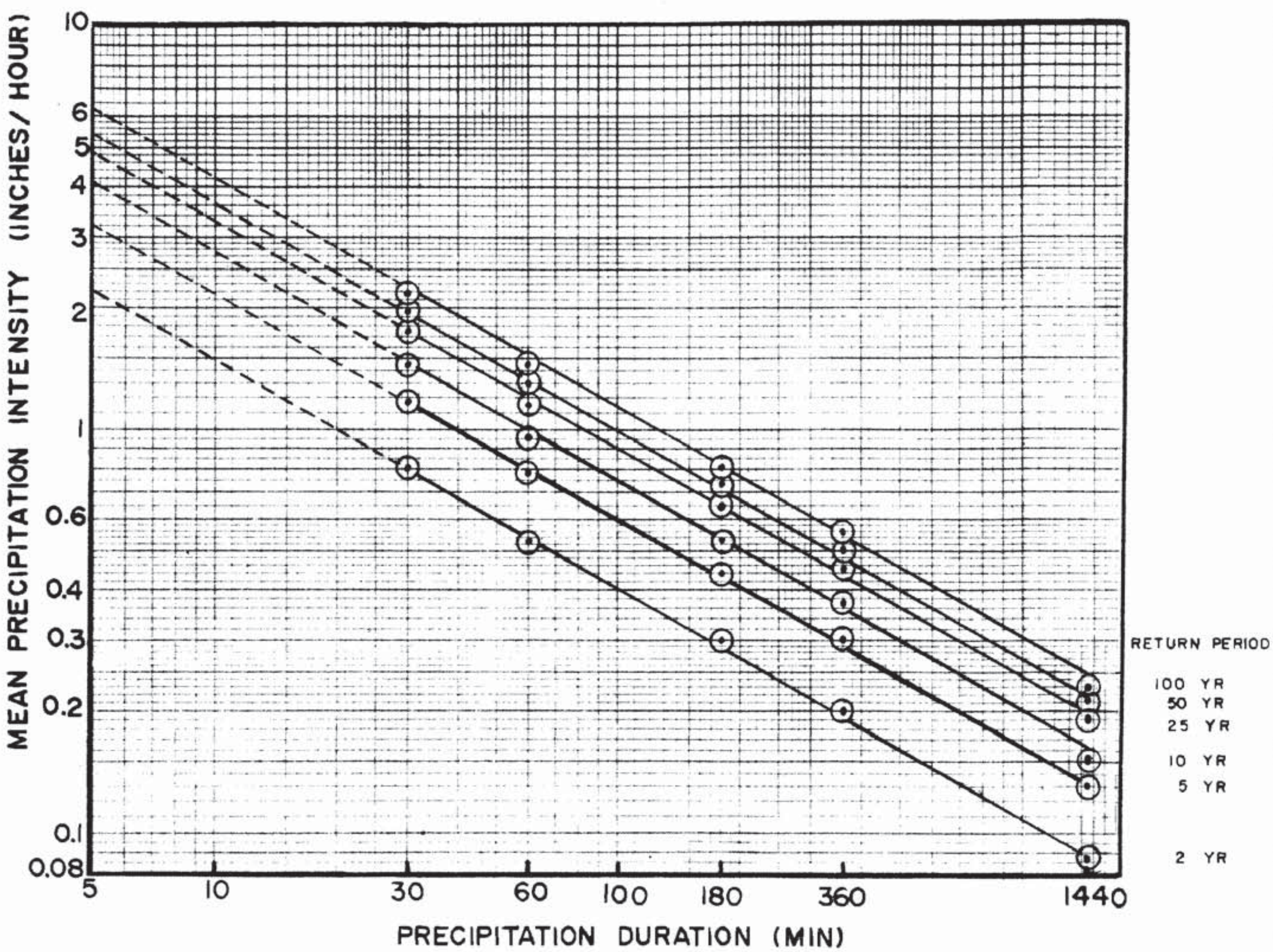
ode

ode

Regression Equations: $I(t) = at^b$

(I= Intensity in inches/hour, t= duration in minutes)

Return Frequency (years)	a	b
2	5.702	-0.574
5	7.870	-0.562
10	10.209	-0.573
25	11.995	-0.566
50	13.521	-0.566
100	15.560	-0.573



ORANGE COUNTY

HYDROLOGY MANUAL

MEAN PRECIPITATION INTENSITIES FOR NONMOUNTAINOUS AREAS

Figure B-3

C.6.4. Estimation of Maximum Loss Rates for Pervious Areas, F_p

Table C.2 lists the maximum loss rates (inch/hour), F_p, for pervious area as a function of soil group.

TABLE C.2.

MAXIMUM EFFECTIVE PERVIOUS AREA LOSS RATES (inch/hour), F_p

SOIL GROUP:	A	B	C	D
F_p:	0.40	0.30	0.25	0.20

Table C.2 reflects the model calibration assuming an F_p of 0.30 in/hr. for all the considered catchments and storm return frequencies. This mean value of F_p of 0.30 in/hr. was assigned to Hydrologic Soil Group B due to the actual average soil conditions in the reconstitution study areas. The F_p values for Hydrologic Soil Groups A, C, and D, were assigned to account for the different soil types that may be found in Orange County.

C.6.5. Estimation of Catchment Maximum Loss Rates, F_m

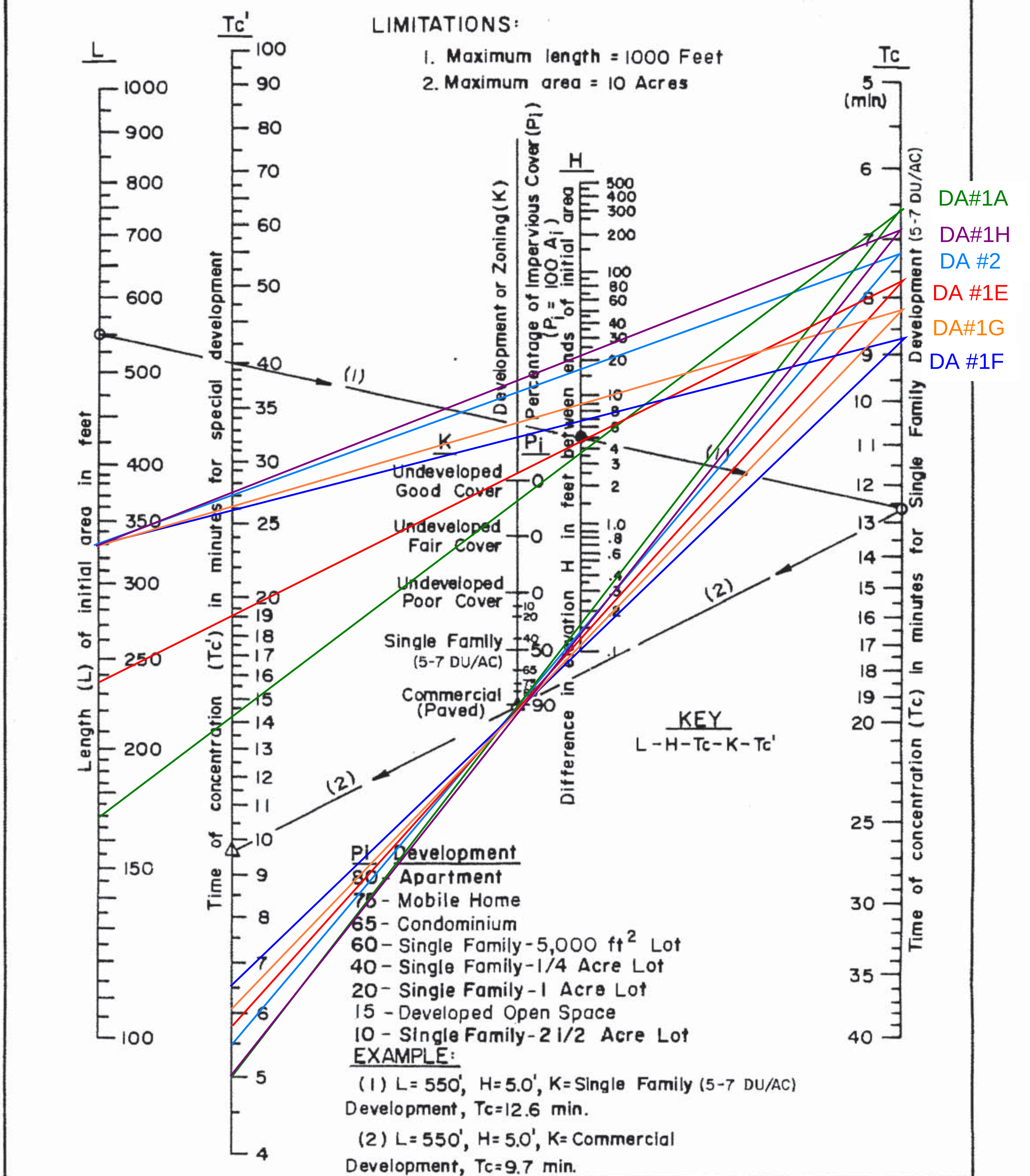
The maximum loss rate selected from Table C.2 applies to the pervious area fraction of the watershed. The loss rate assumed for an impervious surface is 0.0 inch/hour. The maximum loss rate, F_m, for a catchment is therefore given by

$$F_m = a_p F_p \tag{C.7}$$

where a_p is the pervious area fraction and F_p is the maximum loss rate for the pervious area (Section C.6.4).

Should a catchment contain several F_m values, the composite F_m value is determined as a simple area average of the several F_m values.

Existing - Initial Drainage Area limited to 330 ft per Orange County Hydrology Manual Addendum



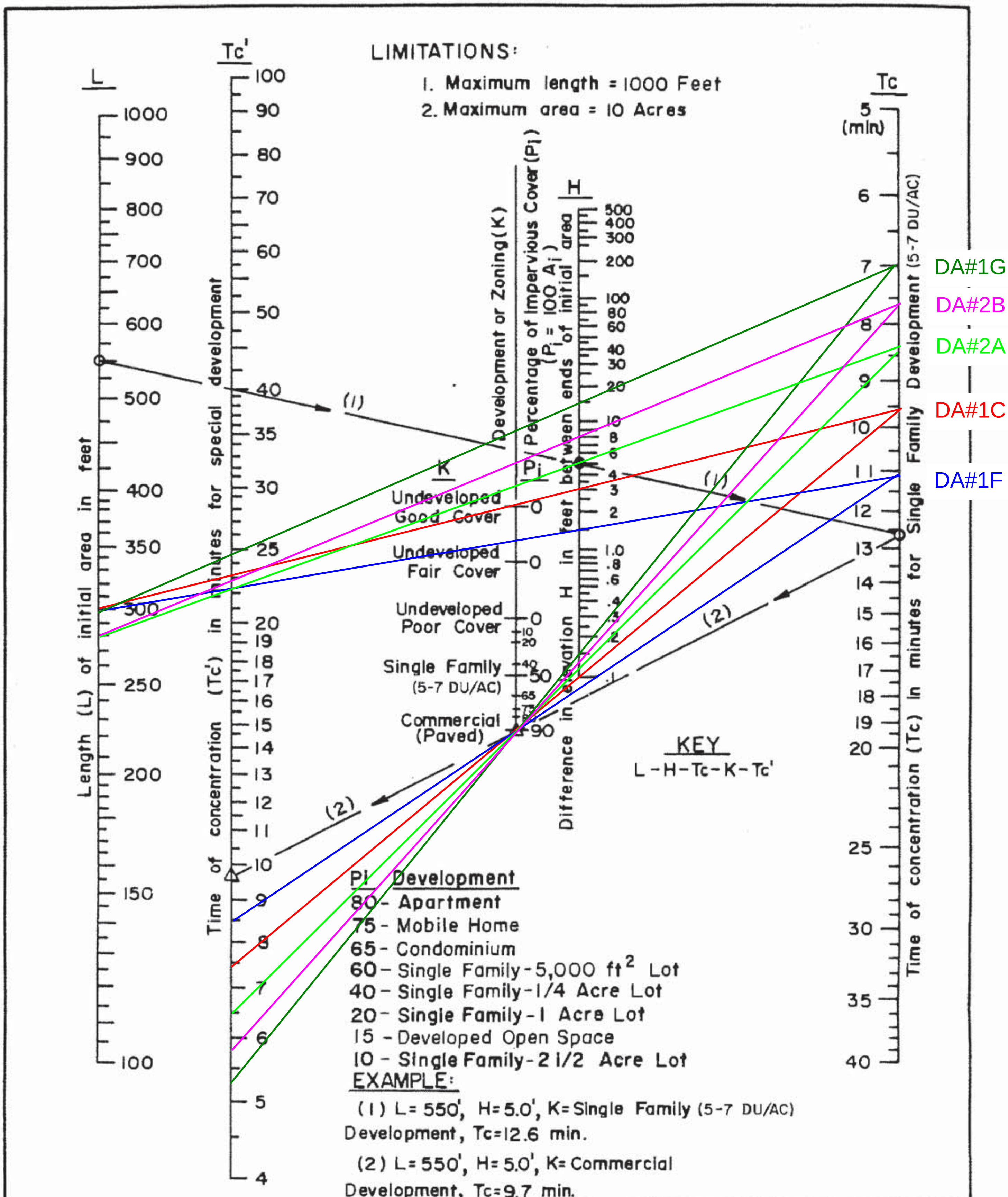
ORANGE COUNTY

HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

Proposed - Initial Drainage Area limited to 330 ft per Orange County Hydrology Manual Addendum



ORANGE COUNTY

HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

It is noted that the Tc computation procedure is based upon the summation of an initial subarea time of concentration with the several travel times estimated by normal depth flow-velocities through subsequent subareas.

D.4. INTENSITY-DURATION CURVES

The precipitation intensity-duration curves presented in Section B.3 (Figures B-3 and B-4) are appropriate for the rational method.

D.5. RUNOFF COEFFICIENT

The runoff coefficient (C) is the ratio of rate of runoff to the rate of rainfall at an average intensity (I) when the total drainage area is contributing. The selection of the runoff coefficient depends on rainfall intensity, soil infiltration rate (F_p), and impervious and pervious area fractions (a_i and a_p).

Since one acre-inch/hour is equal to 1.008 cfs, the rational formula is generally assumed to estimate a peak flowrate in cfs. Runoff coefficient curves are developed using the relationship:

$$C = \begin{cases} 0.90\left(a_i + \frac{(I - F_p)a_p}{I}\right), & \text{for I greater than } F_p; \\ 0.90\, a_i, & \text{for I less than or equal to } F_p \end{cases} \qquad (D.3)$$

where the proportion factor of 0.90 is a calibration constant determined by an average fit between the rational method and design storm unit hydrograph (see Section E) peak flow rate estimates, and where

C	=	runoff coefficient
I	=	rainfall intensity (inches/hour)
F_p	=	infiltration rate for pervious areas (inches/hour) (see Section C.6.4)
a_i	=	ratio of impervious area to total area (decimal fraction)
a_p	=	ratio of pervious area to total area (decimal fraction), ($a_p = 1 - a_i$)

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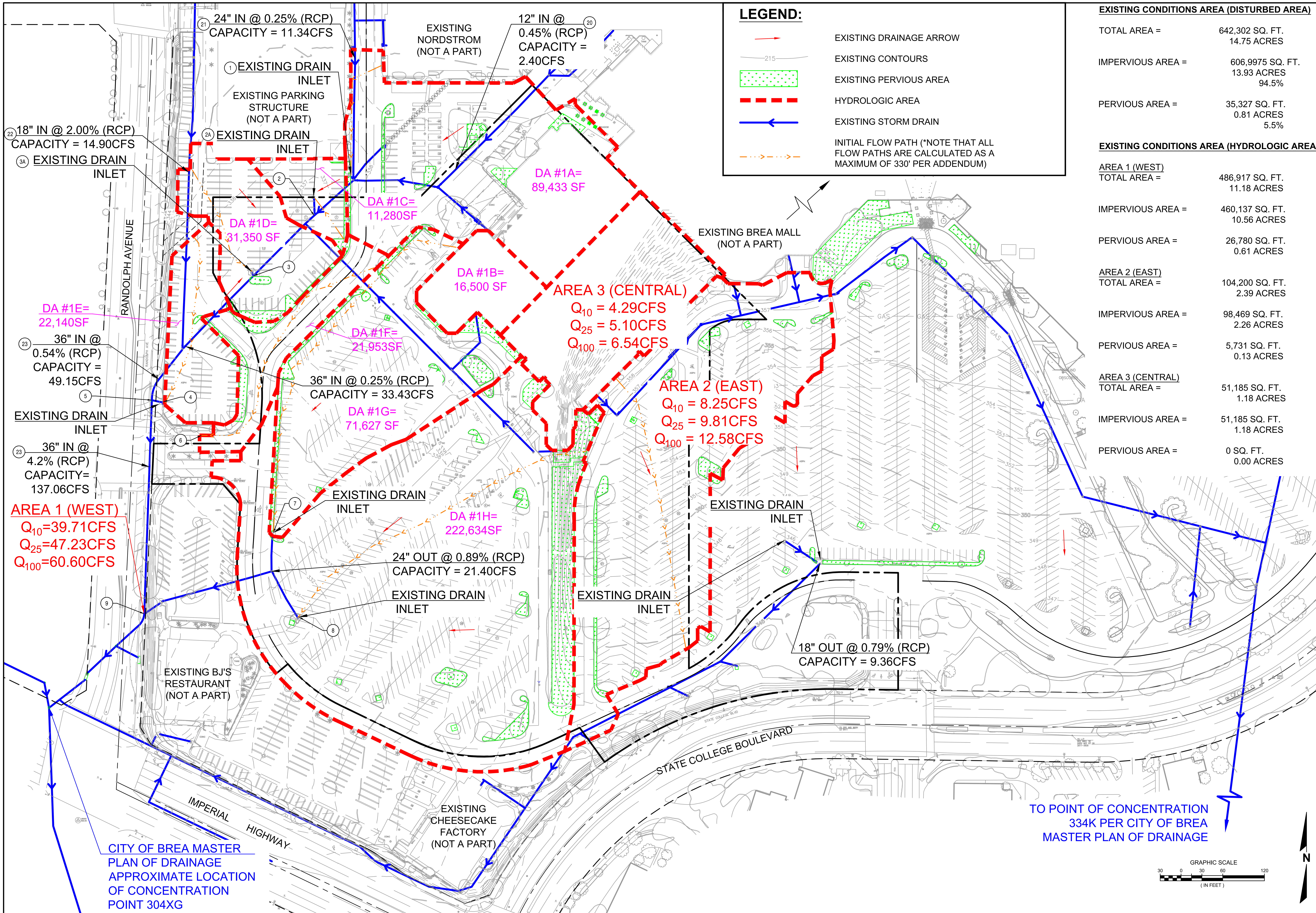


EXISTING CONDITIONS AREA (DISTURBED AREA)

TOTAL AREA =	642,302 SQ. FT. 14.75 ACRES
IMPERVIOUS AREA =	606,9975 SQ. FT. 13.93 ACRES 94.5%
PERVIOUS AREA =	35,327 SQ. FT. 0.81 ACRES 5.5%

EXISTING CONDITIONS AREA (HYDROLOGIC AREA)

AREA 1 (WEST)	
TOTAL AREA =	486,917 SQ. FT. 11.18 ACRES
IMPERVIOUS AREA =	460,137 SQ. FT. 10.56 ACRES
PERVIOUS AREA =	26,780 SQ. FT. 0.61 ACRES
AREA 2 (EAST)	
TOTAL AREA =	104,200 SQ. FT. 2.39 ACRES
IMPERVIOUS AREA =	98,469 SQ. FT. 2.26 ACRES
PERVIOUS AREA =	5,731 SQ. FT. 0.13 ACRES
AREA 3 (CENTRAL)	
TOTAL AREA =	51,185 SQ. FT. 1.18 ACRES
IMPERVIOUS AREA =	51,185 SQ. FT. 1.18 ACRES
PERVIOUS AREA =	0 SQ. FT. 0.00 ACRES

DESCRIPTION

DATE

8881 Research Drive
Irvine, CA 92618-4236
(949) 872-2378
rasmith.com

raSmith
CREATIVITY BEYOND ENGINEERING

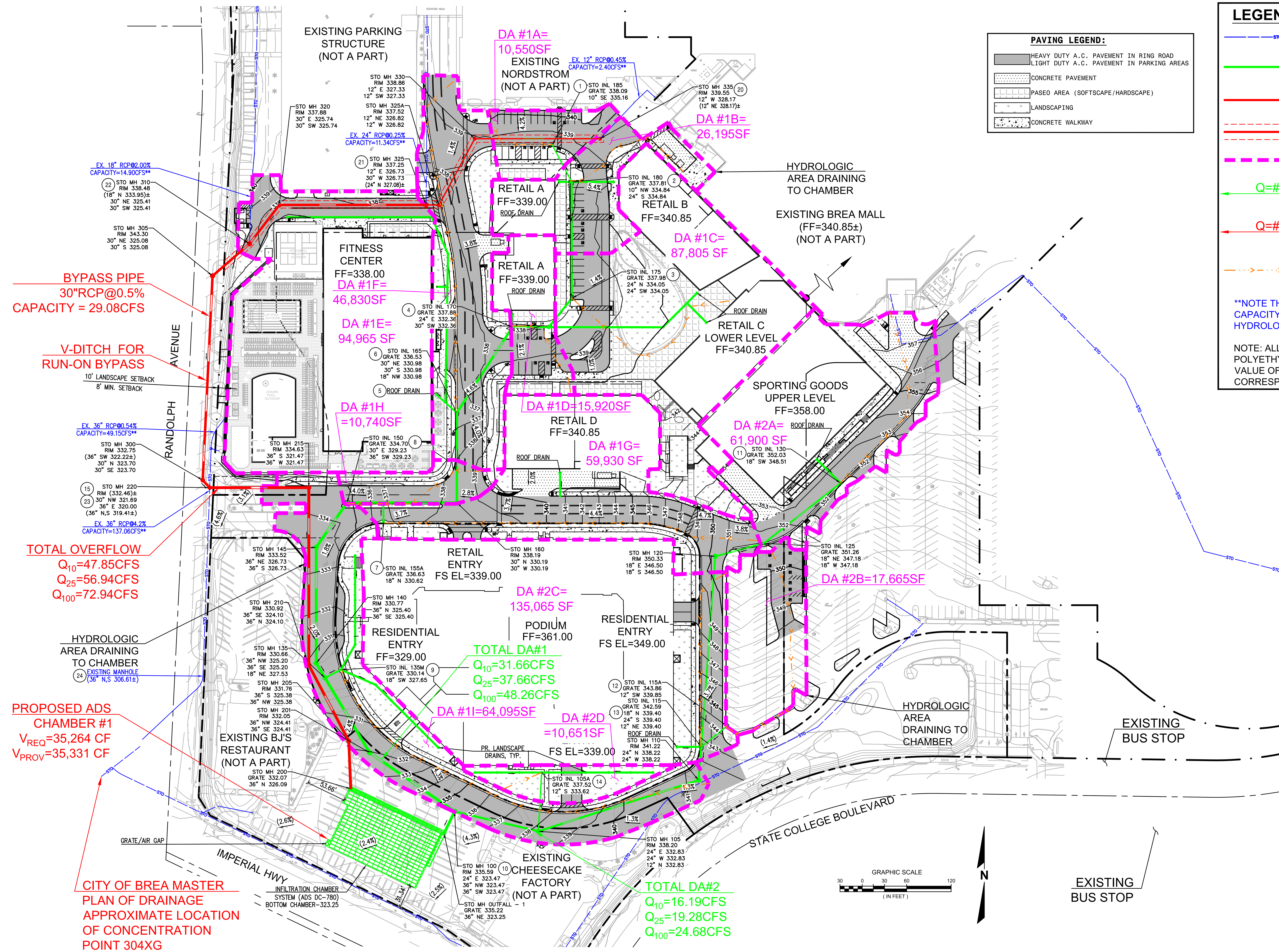
BREA MALL EXPANSION
1065 BREA MALL, BREA, CA 92821

EXISTING HYDROLOGY EXHIBIT

NOT FOR CONSTRUCTION

DATE: 8/22/22
SCALE: 1" = 60'
JOB NO. 3180011
PROJECT MANAGER: CHRIS T. BRATTY
DESIGNED BY: CJN
CHECKED BY: RMK

SHEET NUMBER
HYD-01



PAVING LEGEND:

- HEAVY DUTY A.C. PAVEMENT IN RING ROAD
- LIGHT DUTY A.C. PAVEMENT IN PARKING AREAS
- CONCRETE PAVEMENT
- PASEO AREA (SOFTSCAPE/HARDSCAPE)
- LANDSCAPING
- CONCRETE WALKWAY

LEGEND:

- EXISTING STORM DRAIN
- PROPOSED HDPE STORM DRAIN (TO CHAMBER SYSTEM-PRIVATE)
- PROPOSED HDPE STORM DRAIN (RUN-OFF DRAINS OFFSITE-PRIVATE)
- PROPOSED RCP STORM DRAIN (BYPASS DRAINS OFFSITE-PUBLIC)
- DRAINAGE AREA (DA)
- Q=##.##CFS — PEAK FLOWS DRAINING TOWARDS INFILTRATION CHAMBER
- Q=##.##CFS — PEAK FLOWS DRAINING TOWARDS PUBLIC STORM DRAIN IN RANDOLPH AVENUE.
- INITIAL FLOW PATH (*NOTE THAT ALL FLOW PATHS ARE CALCULATED AS A MAXIMUM OF 330' PER ADDENDUM)

**NOTE THAT EXISTING FLOWS PORTRAYED ARE THE MAXIMUM CAPACITY OF THE EXISTING UPSTREAM PIPES. SEE SECTION 4 OF HYDROLOGY STUDY FOR MORE INFORMATION.

NOTE: ALL PROPOSED PRIVATE PIPES ARE HIGH-DENSITY POLYETHYLENE (HDPE) WHICH CORRESPONDS TO A MANNING'S N VALUE OF 0.012. ALL PROPOSED PUBLIC PIPES ARE RCP WHICH CORRESPONDS TO A MANNING'S N VALUE OF 0.013.

NOT FOR CONSTRUCTION

RAS JOB NO. 3180011.03
PROJECT MANAGER: CHRIS T. BRATTY
DESIGNED BY: CJN
CHECKED BY: RMK

BREA MALL AND RESIDENCES AT BREA

1065 Brea Mall, Brea, CA 92821

PROPOSED HYDROLOGY EXHIBIT

raSmith
CREATIVITY BEYOND ENGINEERING
8911 Research Drive
Irvine, CA 92618-4237
(949) 872-2378
rasmith.com

HYD-02

Scale 1" = 60'
Job No. 2018-170
Date 8/22/22

PROJECT INFORMATION

ENGINEERED PRODUCT MANAGER	
ADS SALES REP	
PROJECT NO.	

ADS Advanced Drainage Systems, Inc.

ADS SiteAssist FOR STORMTECH INSTALLATION INSTRUCTIONS VISIT OUR APP

BREA MALL

BREA, CA

DC-780 STORMTECH CHAMBER SPECIFICATIONS

1. CHAMBERS SHALL BE STORMTECH DC-780.
2. CHAMBERS SHALL BE ARCH-SHAPED AND SHALL BE MANUFACTURED FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
3. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
4. CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORTS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
5. THE STRUCTURAL DESIGN OF THE CHAMBERS, THE STRUCTURAL BACKFILL, AND THE INSTALLATION REQUIREMENTS SHALL ENSURE THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET FOR: 1) LONG-DURATION DEAD LOADS AND 2) SHORT-DURATION LIVE LOADS, BASED ON THE AASHTO DESIGN TRUCK WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.
6. CHAMBERS SHALL BE DESIGNED, TESTED AND ALLOWABLE LOAD CONFIGURATIONS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS". LOAD CONFIGURATIONS SHALL INCLUDE: 1) INSTANTANEOUS (<1 MIN) AASHTO DESIGN TRUCK LIVE LOAD ON MINIMUM COVER 2) MAXIMUM PERMANENT (75-YR) COVER LOAD AND 3) ALLOWABLE COVER WITH PARKED (1-WEEK) AASHTO DESIGN TRUCK.
7. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 2".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT SHALL BE GREATER THAN OR EQUAL TO 550 LBS/FT/%. THE ASC IS DEFINED IN SECTION 6.2.8 OF ASTM F2418. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.
8. ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. UPON REQUEST BY THE SITE DESIGN ENGINEER OR OWNER, THE CHAMBER MANUFACTURER SHALL SUBMIT A STRUCTURAL EVALUATION FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE AS FOLLOWS:
   - THE STRUCTURAL EVALUATION SHALL BE SEALED BY A REGISTERED PROFESSIONAL ENGINEER.
   - THE STRUCTURAL EVALUATION SHALL DEMONSTRATE THAT THE SAFETY FACTORS ARE GREATER THAN OR EQUAL TO 1.95 FOR DEAD LOAD AND 1.75 FOR LIVE LOAD, THE MINIMUM REQUIRED BY ASTM F2787 AND BY SECTIONS 3 AND 12.12 OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS FOR THERMOPLASTIC PIPE.
   - THE TEST DERIVED CREEP MODULUS AS SPECIFIED IN ASTM F2418 SHALL BE USED FOR PERMANENT DEAD LOAD DESIGN EXCEPT THAT IT SHALL BE THE 75-YEAR MODULUS USED FOR DESIGN.
9. CHAMBERS AND END CAPS SHALL BE PRODUCED AT AN ISO 9001 CERTIFIED MANUFACTURING FACILITY.

IMPORTANT - NOTES FOR THE BIDDING AND INSTALLATION OF THE DC-780 CHAMBER SYSTEM

1. STORMTECH DC-780 CHAMBERS SHALL NOT BE INSTALLED UNTIL THE MANUFACTURER'S REPRESENTATIVE HAS COMPLETED A PRE-CONSTRUCTION MEETING WITH THE INSTALLERS.
2. STORMTECH DC-780 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH SC-310/SC-740/DC-780 CONSTRUCTION GUIDE".
3. CHAMBERS ARE NOT TO BE BACKFILLED WITH A DOZER OR AN EXCAVATOR SITUATED OVER THE CHAMBERS. STORMTECH RECOMMENDS 3 BACKFILL METHODS:
   - STONESHOOTER LOCATED OFF THE CHAMBER BED.
   - BACKFILL AS ROWS ARE BUILT USING AN EXCAVATOR ON THE FOUNDATION STONE OR SUBGRADE.
   - BACKFILL FROM OUTSIDE THE EXCAVATION USING A LONG BOOM HOE OR EXCAVATOR.
4. THE FOUNDATION STONE SHALL BE LEVELED AND COMPACTED PRIOR TO PLACING CHAMBERS.
5. JOINTS BETWEEN CHAMBERS SHALL BE PROPERLY SEATED PRIOR TO PLACING STONE.
6. MAINTAIN MINIMUM - 6" (150 mm) SPACING BETWEEN THE CHAMBER ROWS.
7. EMBEDMENT STONE SURROUNDING CHAMBERS MUST BE A CLEAN, CRUSHED, ANGULAR STONE 3/4-2" (20-50 mm).
8. THE CONTRACTOR MUST REPORT ANY DISCREPANCIES WITH CHAMBER FOUNDATION MATERIALS BEARING CAPACITIES TO THE SITE DESIGN ENGINEER.
9. ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUBSURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

NOTES FOR CONSTRUCTION EQUIPMENT

1. STORMTECH DC-780 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH SC-310/SC-740/DC-780 CONSTRUCTION GUIDE".
2. THE USE OF CONSTRUCTION EQUIPMENT OVER DC-780 CHAMBERS IS LIMITED:
   - NO EQUIPMENT IS ALLOWED ON BARE CHAMBERS.
   - NO RUBBER TIRED LOADERS, DUMP TRUCKS, OR EXCAVATORS ARE ALLOWED UNTIL PROPER FILL DEPTHS ARE REACHED IN ACCORDANCE WITH THE "STORMTECH SC-310/SC-740/DC-780 CONSTRUCTION GUIDE".
   - WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT CAN BE FOUND IN THE "STORMTECH SC-310/SC-740/DC-780 CONSTRUCTION GUIDE".
3. FULL 36" (900 mm) OF STABILIZED COVER MATERIALS OVER THE CHAMBERS IS REQUIRED FOR DUMP TRUCK TRAVEL OR DUMPING.

USE OF A DOZER TO PUSH EMBEDMENT STONE BETWEEN THE ROWS OF CHAMBERS MAY CAUSE DAMAGE TO THE CHAMBERS AND IS NOT AN ACCEPTABLE BACKFILL METHOD. ANY CHAMBERS DAMAGED BY THE "DUMP AND PUSH" METHOD ARE NOT COVERED UNDER THE STORMTECH STANDARD WARRANTY.

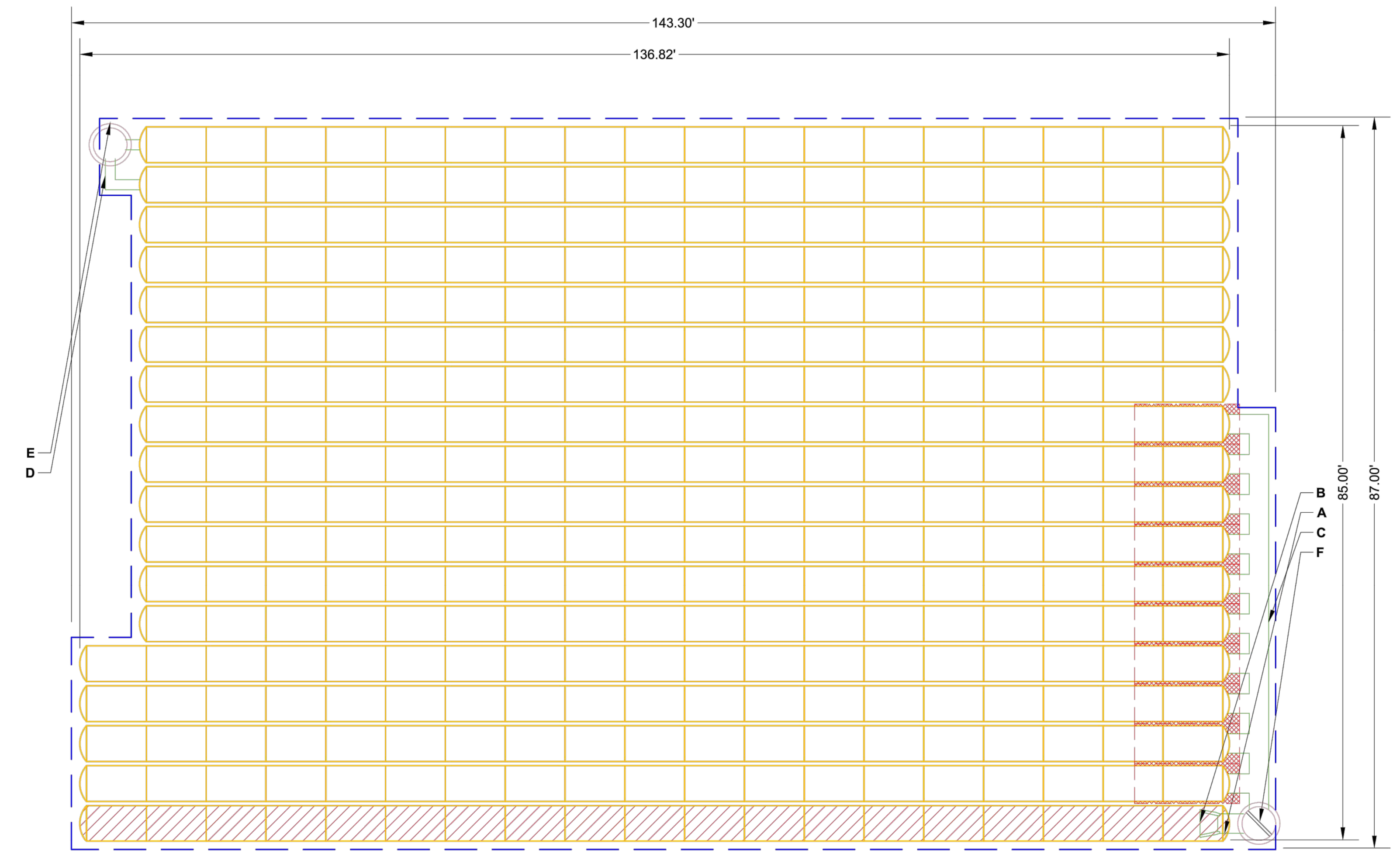
CONTACT STORMTECH AT 1-888-892-2694 WITH ANY QUESTIONS ON INSTALLATION REQUIREMENTS OR WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT.

PROPOSED LAYOUT	
329	STORMTECH DC-780 CHAMBERS
36	STORMTECH DC-780 END CAPS
12	STONE ABOVE (in)
24	STONE BELOW (in)
40	STONE VOID
35331	INSTALLED SYSTEM VOLUME (CF) (PERIMETER STONE INCLUDED) (COVER STONE INCLUDED) (BASE STONE INCLUDED)
11908	SYSTEM AREA (SF)
468.1	SYSTEM PERIMETER (ft)

CONCEPTUAL ELEVATIONS	
MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED):	16.50
MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC):	6.50
MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC):	6.00
MINIMUM ALLOWABLE GRADE (TOP OF RIGID CONCRETE PAVEMENT):	6.00
MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT):	6.00
TOP OF STONE:	5.50
TOP OF DC-780 CHAMBER:	4.50
12" x 12" BOTTOM MANIFOLD INVERT:	2.10
12" BOTTOM CONNECTION INVERT:	2.10
24" x 24" BOTTOM MANIFOLD INVERT:	2.01
24" ISOLATOR ROW PLUS INVERT:	2.01
BOTTOM OF DC-780 CHAMBER:	2.00
BOTTOM OF STONE:	0.00

*INVERT ABOVE BASE OF CHAMBER

PART TYPE	ITEM ON LAYOUT	DESCRIPTION	INVERT*	MAX FLOW
PREFABRICATED EZ END CAP	A	24" BOTTOM PREFABRICATED EZ END CAP, PART#: SC740ECEZ / TYP OF ALL 24" BOTTOM CONNECTIONS AND ISOLATOR PLUS ROWS	0.10"	
FLAMP	B	INSTALL FLAMP ON 24" ACCESS PIPE / PART#: SC74024RAMP		
MANIFOLD	C	24" x 24" BOTTOM MANIFOLD, ADS N-12	0.10"	
MANIFOLD	D	12" x 12" BOTTOM MANIFOLD, ADS N-12	1.20"	
CONCRETE STRUCTURE	E	OCS (DESIGN BY ENGINEER / PROVIDED BY OTHERS)		
CONCRETE STRUCTURE W/WEIR	F	(DESIGN BY ENGINEER / PROVIDED BY OTHERS)		



ISOLATOR ROW PLUS (SEE DETAIL)

PLACE MINIMUM 12.50' OF ADSPLUS125 WOVEN GEOTEXTILE OVER BEDDING STONE AND UNDERNEATH CHAMBER FEET FOR SCOUR PROTECTION AT ALL CHAMBER INLET ROWS

BED LIMITS

NOTES

- MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER. SEE TECH NOTE #6.32 FOR MANIFOLD SIZING GUIDANCE.
- DUE TO THE ADAPTATION OF THIS CHAMBER SYSTEM TO SPECIFIC SITE AND DESIGN CONSTRAINTS, IT MAY BE NECESSARY TO CUT AND COUPLE ADDITIONAL PIPE TO STANDARD MANIFOLD COMPONENTS IN THE FIELD.
- THE SITE DESIGN ENGINEER MUST REVIEW ELEVATIONS AND IF NECESSARY ADJUST GRADING TO ENSURE THE CHAMBER COVER REQUIREMENTS ARE MET.
- THIS CHAMBER SYSTEM WAS DESIGNED WITHOUT SITE-SPECIFIC INFORMATION ON SOIL CONDITIONS OR BEARING CAPACITY. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR DETERMINING THE SUITABILITY OF THE SOIL AND PROVIDING THE BEARING CAPACITY OF THE INSITU SOILS. THE BASE STONE DEPTH MAY BE INCREASED OR DECREASED ONCE THIS INFORMATION IS PROVIDED.
- **NOT FOR CONSTRUCTION:** THIS LAYOUT IS FOR DIMENSIONAL PURPOSES ONLY TO PROVE CONCEPT & THE REQUIRED STORAGE VOLUME CAN BE ACHIEVED ON SITE.

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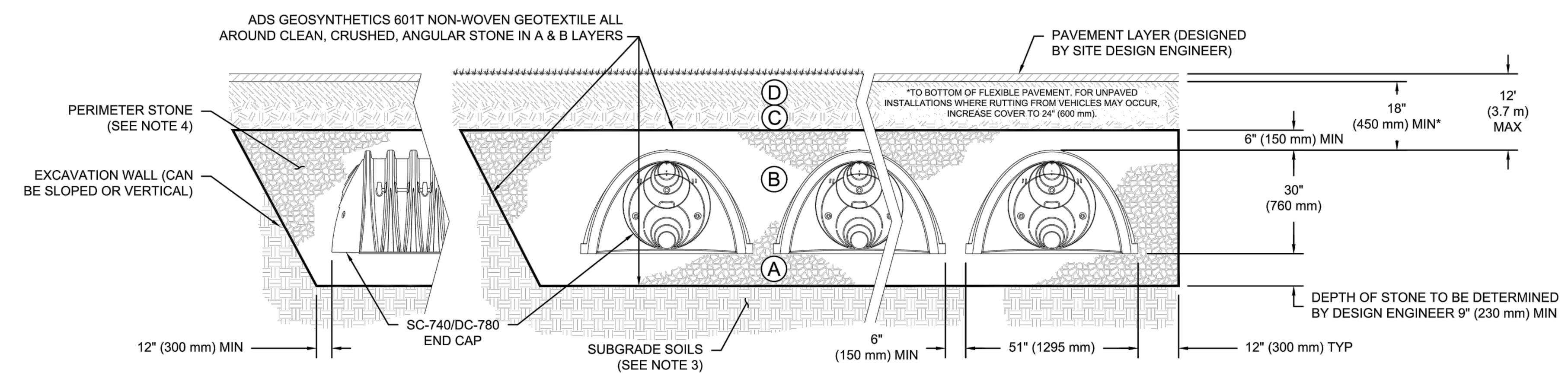
SHEET 2 OF 5

ACCEPTABLE FILL MATERIALS: STORMTECH DC-780 CHAMBER SYSTEMS

	MATERIAL LOCATION	DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	**FINAL FILL:** FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUBBASE MAY BE PART OF THE 'D' LAYER	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	**INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 18" (450 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUBBASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145[1] A-1, A-2-4, A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS AFTER 12" (300 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 6" (150 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS. ROLLER GROSS VEHICLE WEIGHT NOT TO EXCEED 12,000 lbs (53 kN). DYNAMIC FORCE NOT TO EXCEED 20,000 lbs (89 kN).
B	**EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57	NO COMPACTION REQUIRED.
A	**FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE.[2,3]

PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 9" (230 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.
4. ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUBBASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.



NOTES:

1. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
2. DC-780 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
3. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUBGRADE SOILS AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS.
4. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
5. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 2".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT SHALL BE GREATER THAN OR EQUAL TO 550 LBS/FT/%. THE ASC IS DEFINED IN SECTION 6.2.8 OF ASTM F2418. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.

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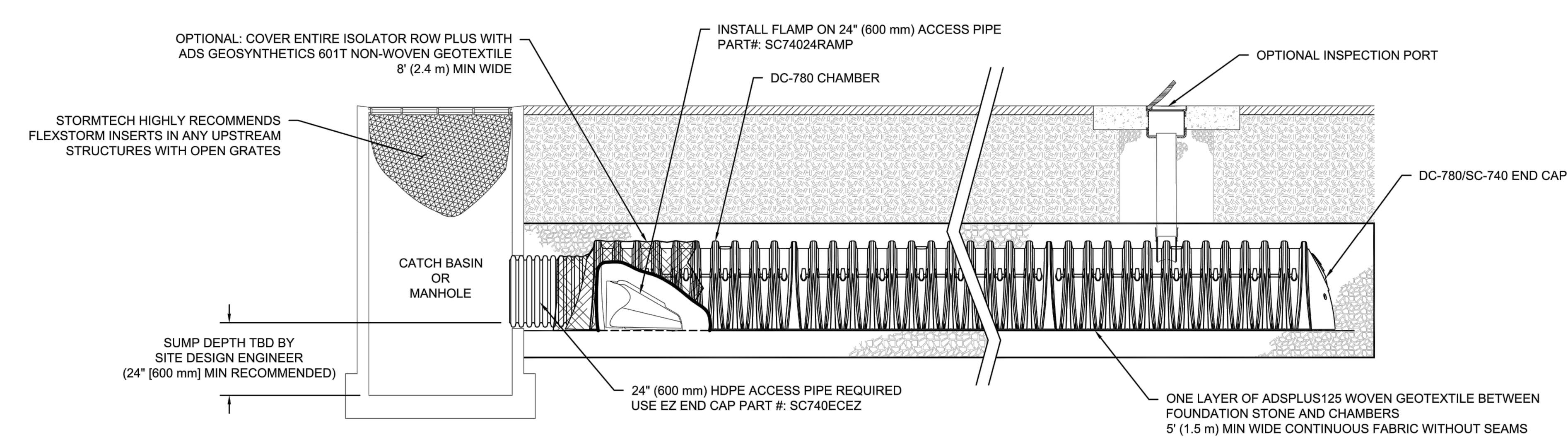
SHEET 3 OF 5



DC-780 ISOLATOR ROW PLUS DETAIL

NTS

INSPECTION & MAINTENANCE

STEP 1) INSPECT ISOLATOR ROW PLUS FOR SEDIMENT
- A. INSPECTION PORTS (IF PRESENT)
  - A.1. REMOVE/OPEN LID ON NYLOPLAST INLINE DRAIN
  - A.2. REMOVE AND CLEAN FLEXSTORM FILTER IF INSTALLED
  - A.3. USING A FLASHLIGHT AND STADIA ROD, MEASURE DEPTH OF SEDIMENT AND RECORD ON MAINTENANCE LOG
  - A.4. LOWER A CAMERA INTO ISOLATOR ROW PLUS FOR VISUAL INSPECTION OF SEDIMENT LEVELS (OPTIONAL)
  - A.5. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.
- B. ALL ISOLATOR PLUS ROWS
  - B.1. REMOVE COVER FROM STRUCTURE AT UPSTREAM END OF ISOLATOR ROW PLUS
  - B.2. USING A FLASHLIGHT, INSPECT DOWN THE ISOLATOR ROW PLUS THROUGH OUTLET PIPE
    - i) MIRRORS ON POLES OR CAMERAS MAY BE USED TO AVOID A CONFINED SPACE ENTRY
    - ii) FOLLOW OSHA REGULATIONS FOR CONFINED SPACE ENTRY IF ENTERING MANHOLE
  - B.3. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.

STEP 2) CLEAN OUT ISOLATOR ROW PLUS USING THE JETVAC PROCESS
- A. A FIXED CULVERT CLEANING NOZZLE WITH REAR FACING SPREAD OF 45" (1.1 m) OR MORE IS PREFERRED
- B. APPLY MULTIPLE PASSES OF JETVAC UNTIL BACKFLUSH WATER IS CLEAN
- C. VACUUM STRUCTURE SUMP AS REQUIRED

STEP 3) REPLACE ALL COVERS, GRATES, FILTERS, AND LIDS; RECORD OBSERVATIONS AND ACTIONS.

STEP 4) INSPECT AND CLEAN BASINS AND MANHOLES UPSTREAM OF THE STORMTECH SYSTEM.

NOTES

1. INSPECT EVERY 6 MONTHS DURING THE FIRST YEAR OF OPERATION. ADJUST THE INSPECTION INTERVAL BASED ON PREVIOUS OBSERVATIONS OF SEDIMENT ACCUMULATION AND HIGH WATER ELEVATIONS.
2. CONDUCT JETTING AND VACTORING ANNUALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.

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SHEET 4 OF 5

NOT FOR CONSTRUCTION

RAS JOB NO. 3180011.03

PROJECT MANAGER: CHRIS T. BRATTY

DESIGNED BY: CJN

CHECKED BY: RMK

BREA MALL AND RESIDENCES AT BREA

1065 Brea Mall, Brea, CA 92821

HYDROLOGY DETAILS

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Irvine, CA 92618-4237
(949) 872-2378
rasmith.com

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Job No. 2018-170
Date 8/22/22

DC-780 TECHNICAL SPECIFICATION

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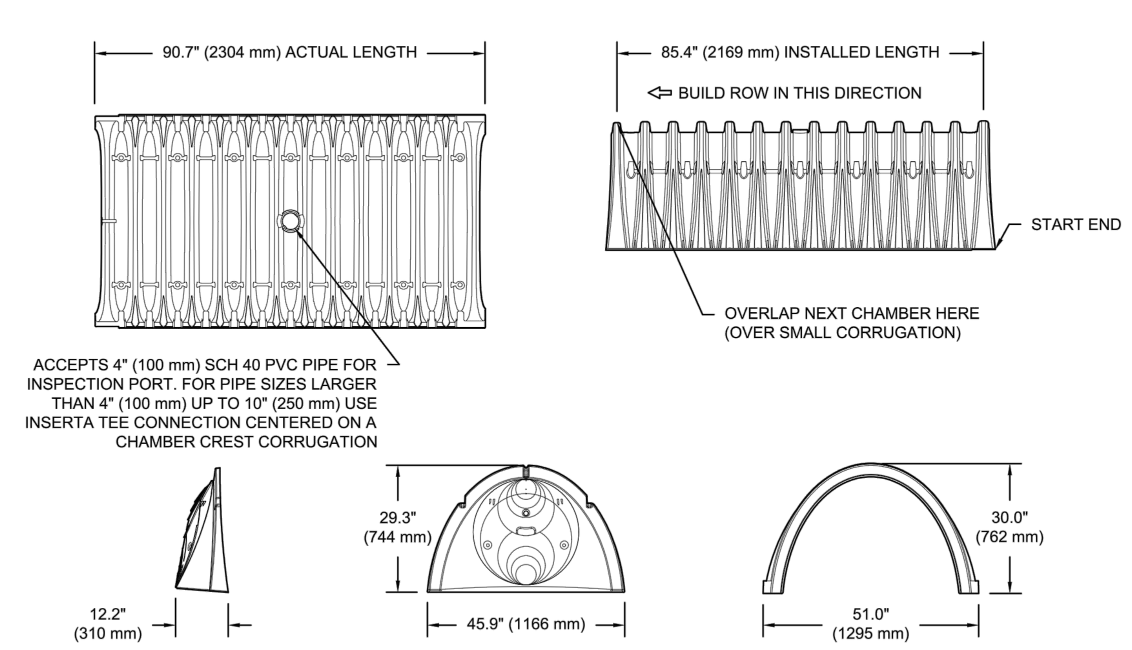
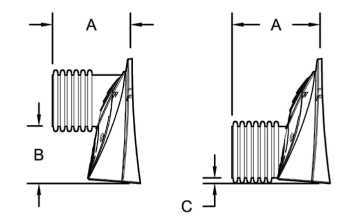


NOMINAL CHAMBER SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	51.0" X 30.0" X 85.4"	(1295 mm X 762 mm X 2169 mm)
CHAMBER STORAGE	46.2 CUBIC FEET	(1.30 m³)
MINIMUM INSTALLED STORAGE*	78.4 CUBIC FEET	(2.20 m³)
WEIGHT	75.0 lbs.	(33.6 kg)

*ASSUMES 6" (152 mm) STONE ABOVE, 9" (229 mm) BELOW, AND 6" (152 mm) BETWEEN CHAMBERS



STUBS AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "B"
STUBS AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "T"

PART #	STUB	A	B	C
SC740EPE06T / SC740EPE06TPC	6" (150 mm)	10.9" (277 mm)	18.5" (470 mm)	---
SC740EPE06B / SC740EPE06BPC			---	0.5" (13 mm)
SC740EPE08T / SC740EPE08TPC	8" (200 mm)	12.2" (310 mm)	16.5" (419 mm)	---
SC740EPE08B / SC740EPE08BPC			---	0.6" (15 mm)
SC740EPE10T / SC740EPE10TPC	10" (250 mm)	13.4" (340 mm)	14.5" (368 mm)	---
SC740EPE10B / SC740EPE10BPC			---	0.7" (18 mm)
SC740EPE12T / SC740EPE12TPC	12" (300 mm)	14.7" (373 mm)	12.5" (318 mm)	---
SC740EPE12B / SC740EPE12BPC			---	1.2" (30 mm)
SC740EPE15T / SC740EPE15TPC	15" (375 mm)	18.4" (467 mm)	9.0" (229 mm)	---
SC740EPE15B / SC740EPE15BPC			---	1.3" (33 mm)
SC740EPE18T/ SC740EPE18TPC	18" (450 mm)	19.7" (500 mm)	5.0" (127 mm)	---
SC740EPE18B / SC740EPE18BPC			---	1.6" (41 mm)
SC740ECEZ*	24" (600 mm)	18.5" (470 mm)	---	0.1" (3 mm)

ALL STUBS, EXCEPT FOR THE SC740ECEZ ARE PLACED AT BOTTOM OF END CAP SUCH THAT THE OUTSIDE DIAMETER OF THE STUB IS FLUSH WITH THE BOTTOM OF THE END CAP. FOR ADDITIONAL INFORMATION CONTACT STORMTECH AT 1-888-892-2694.

* FOR THE SC740ECEZ THE 24" (600 mm) STUB LIES BELOW THE BOTTOM OF THE END CAP APPROXIMATELY 1.75" (44 mm). BACKFILL MATERIAL SHOULD BE REMOVED FROM BELOW THE N-12 STUB SO THAT THE FITTING SITS LEVEL.

NOTE: ALL DIMENSIONS ARE NOMINAL

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BREA, CA
DATE: | PROJECT #: | DRAWN: CN | CHECKED: N/A
DATE | DRW | CHK | DESCRIPTION

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Chamber System
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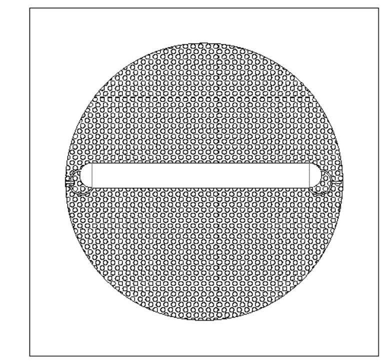
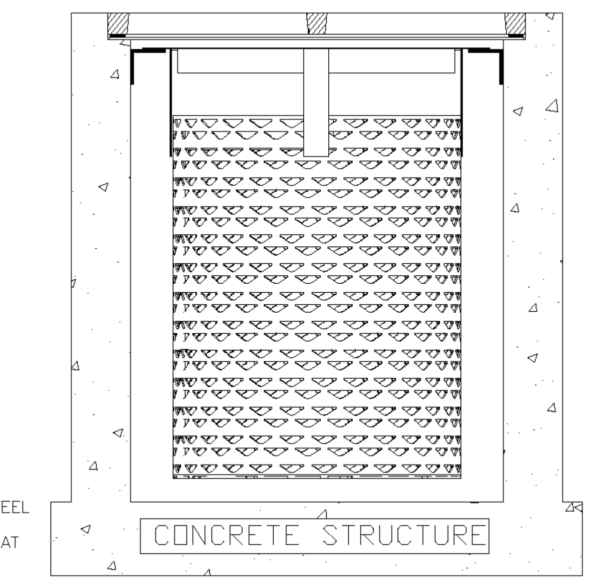
SHEET
5 OF 5

BIO CLEAN FULL CAPTURE FILTER

FOR USE IN GRATE INLETS



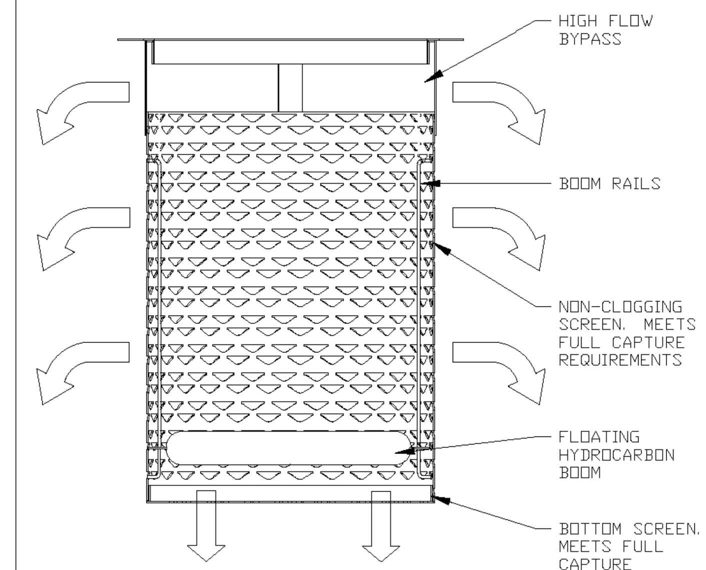
TOP VIEW



CONCRETE STRUCTURE

NOTES:

1. ALL HARDWARE, FLANGE, FRAME, SCREENS SHALL BE STAINLESS STEEL
2. HYDROCARBON BOOM SHALL BE 2" DIAMETER AND CONNECTED, MECHANICALLY TO THE FILTER FRAME WITH RAILS ALLOWING IT TO FLOAT ON THE WATER SURFACE REGARDLESS OF HEIGHT
3. SEE PERFORMANCE REPORTS IN MANUFACTURES SPECIFICATIONS
4. OTHER STANDARD AND CUSTOM MODEL SIZES AVAILABLE – CONTACT BIO CLEAN FOR MORE INFORMATION.
5. BASED ON 37% OPEN AREA.
6. CONSIDERS A SAFETY FACTOR OF 2.0.
7. CONSIDERS A LOCAL DEPRESSION PONDIING DEPTH OF 6 INCHES.
8. STORAGE CAPACITY BASED ON THE BASKET HALF FULL.



FLOW SCHEMATIC

MODEL #	TREATMENT FLOW (CFS)	BYPASS FLOW (CFS)	SOLIDS STORAGE CAPACITY (CF)
BC-GRATE-FC 12-12-12	1.55	1.55	0.27
BC-GRATE-FC 18-18-18	4.32	3.68	1.05
BC-GRATE-FC 24-24-24	7.67	4.83	2.41
BC-GRATE-FC 30-30-24	12.97	6.21	3.98
BC-GRATE-FC 25-38-24	13.53	6.59	4.16
BC-GRATE-FC 36-36-24	19.64	7.60	5.94
BC-GRATE-FC 48-48-18	25.59	10.13	7.92

DRAWING: BIO CLEAN GRATE INLET FILTER DETAILS		MEETS FULL CAPTURE REQUIREMENTS	
TYPICAL MODEL DETAIL			
WARRANTY: 5 YEAR MANUFACTURERS		PROJECT:	
BIO CLEAN ENVIRONMENTAL SERVICES, INC. 398 VIA EL CENTRO, OCEANSIDE CA 92058 PHONE: 760-433-7640 FAX: 760-433-3176		REVISIONS:	DATE:
		REVISIONS:	DATE:
DATE: 10/12/17	SCALE: SF = 15	REVISIONS:	DATE:
DRAFTER: M.C.P.	UNITS = INCHES	REVISIONS:	DATE:

Bio Clean
A Forterra Company

PAGE 1

NOTE:

ALL DRAIN INLETS THAT DISCHARGE INTO AN EXISTING OR PROPOSED STORM DRAIN MUST BE LABELED TO DISCOURAGE ILLEGAL DUMPING OF POLLUTANTS WITH THE STENCIL ABOVE IN A VISIBLE AREA. 2 COATS MINIMUM.

BAYSAVER BARRACUDA SPECIFICATIONS

MATERIALS AND DESIGN

CONCRETE STRUCTURES: DESIGNED FOR H-20 TRAFFIC LOADING AND APPLICABLE SOIL LOADS OR AS OTHERWISE DETERMINED BY A LICENSED PROFESSIONAL ENGINEER. THE MATERIALS AND STRUCTURAL DESIGN OF THE DEVICES SHALL BE PER ASTM C857 AND ASTM C858.

48" HP MANHOLE STRUCTURES: MADE FROM AN IMPACT MODIFIED COPOLYMER POLYPROPYLENE MEETING THE MATERIAL REQUIREMENTS OF ASTM F2764. THE ECCENTRIC CONE REDUCER SHALL BE MANUFACTURED FROM POLYETHYLENE MATERIAL MEETING ASTM D3350 CELL CLASS 213320C. GASKETS SHALL BE MADE OF MATERIAL MEETING THE REQUIREMENTS OF ASTM F477.

SEPARATOR INTERNALS SHALL BE SUBSTANTIALLY CONSTRUCTED OF STAINLESS STEEL, POLYETHYLENE, OR OTHER THERMOPLASTIC MATERIAL APPROVED BY THE MANUFACTURER.

PERFORMANCE

THE STORMWATER TREATMENT UNIT SHALL BE AN INLINE UNIT CAPABLE OF CONVEYING 100% OF THE DESIGN PEAK FLOW. IF PEAK FLOW RATES EXCEED MAXIMUM HYDRAULIC RATE, THE UNIT SHALL BE INSTALLED OFFLINE.

THE STORMWATER TREATMENT UNIT INTERNALS SHALL CONSIST OF(1)SEPARATOR CONE ASSEMBLY, AND (1)SUMP ASSEMBLY WHICH INCLUDES(4) LEGS WITH "TEETH".

THE BARRACUDA UNIT SHALL BE DESIGNED TO REMOVE AT LEAST 80% OF THE SUSPENDED SOLIDS ON AN ANNUAL AGGREGATE REMOVAL BASIS. SAID REMOVAL SHALL BE BASED ON FULL-SCALE THIRD PARTY TESTING USING OK-110 MEDIA GRADATION OR EQUIVALENT AND 300 mg/L INFLUENT CONCENTRATION. SAID FULL SCALE TESTING SHALL HAVE INCLUDED SEDIMENT CAPTURE BASED ON ACTUAL TOTAL MASS COLLECTED BY THE STORMWATER TREATMENT UNIT.

-OR -

THE BARRACUDA UNIT SHALL BE DESIGNED TO REMOVE AT LEAST 50% OF TSS USING A MEDIA MIX WITH d_{50}=75 MICRON AND 200 MG/L INFLUENT CONCENTRATION.

-OR -

THE BARRACUDA UNIT SHALL BE DESIGNED TO REMOVE AT LEAST 50% OF TSS PER CURRENT NJDEP/NJCAT HDS PROTOCOL .

MANUFACTURER

EACH STORMWATER TREATMENT SYSTEM SHALL BE A BARRACUDA SYSTEM AS MANUFACTURED BY BAYSAVER, LLC, 1030 DEER HOLLOW DR., MOUNT AIRY, MD 21771, PHONE (301) 829-6470, FAX (301) 829-3747, TOLL FREE 1-800-229-7283 (1-800-BAYSAVER), EMAIL INFO@BAYSAVER.COM

BARRACUDA MAINTENANCE

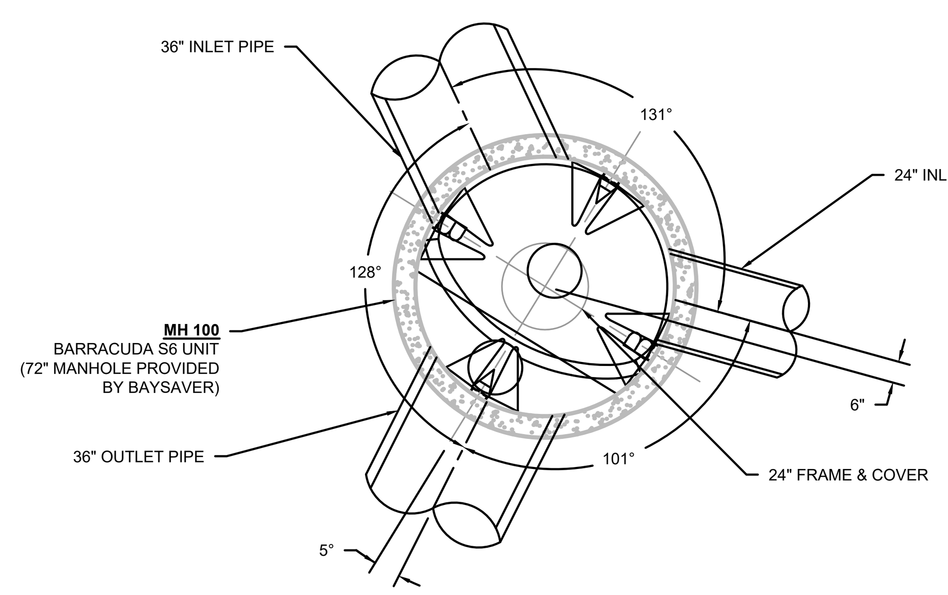
BARRACUDA SYSTEMS MUST BE INSPECTED AND MAINTAINED PERIODICALLY. INSPECTION IS MADE BY CHECKING THE DEPTH OF SEDIMENT IN EACH MANHOLE WITH A GRADE STICK OR SIMILAR DEVICE. MAINTENANCE IS REQUIRED WHEN THE SEDIMENT DEPTH IN EXCEEDS 20 INCHES. MINIMUM INSPECTION IS RECOMMENDED TWICE A YEAR TO MAINTAIN OPERATION AND FUNCTION OF THE UNIT.

MAINTENANCE INSTRUCTIONS

1. REMOVE THE MANHOLE COVER TO PROVIDE ACCESS TO THE POLLUTANT STORAGE. POLLUTANTS ARE STORED IN THE SUMP, BELOW THE BOWL ASSEMBLY VISIBLE FROM THE SURFACE. YOU'LL ACCESS THIS AREA THROUGH THE 10" DIAMETER ACCESS CYLINDER.
2. USE A VACUUM TRUCK OR OTHER SIMILAR EQUIPMENT TO REMOVE ALL WATER, DEBRIS, OILS AND SEDIMENT.
3. USE A HIGH PRESSURE HOSE TO CLEAN THE MANHOLE OF ALL THE REMAINING SEDIMENT AND DEBRIS. THEN, USE THE VACUUM TRUCK TO REMOVE THE WATER.
4. FILL THE CLEANED MANHOLE WITH WATER UNTIL THE LEVEL REACHES THE INVERT OF THE OUTLET PIPE.
5. REPLACE THE MANHOLE COVER.
6. DISPOSE OF THE POLLUTED WATER, OILS, SEDIMENT AND TRASH AT AN APPROVED FACILITY.
   - LOCAL REGULATIONS PROHIBIT THE DISCHARGE OF SOLID MATERIAL INTO THE SANITARY SYSTEM. CHECK WITH THE LOCAL SEWER AUTHORITY FOR AUTHORITY TO DISCHARGE THE LIQUID.
   - SOME LOCALITIES TREAT THE POLLUTANTS AS LEACHATE. CHECK WITH LOCAL REGULATORS ABOUT DISPOSAL REQUIREMENTS.
   - ADDITIONAL LOCAL REGULATIONS MAY APPLY TO THE MAINTENANCE PROCEDURE.

BARRACUDA INSTALLATION NOTES

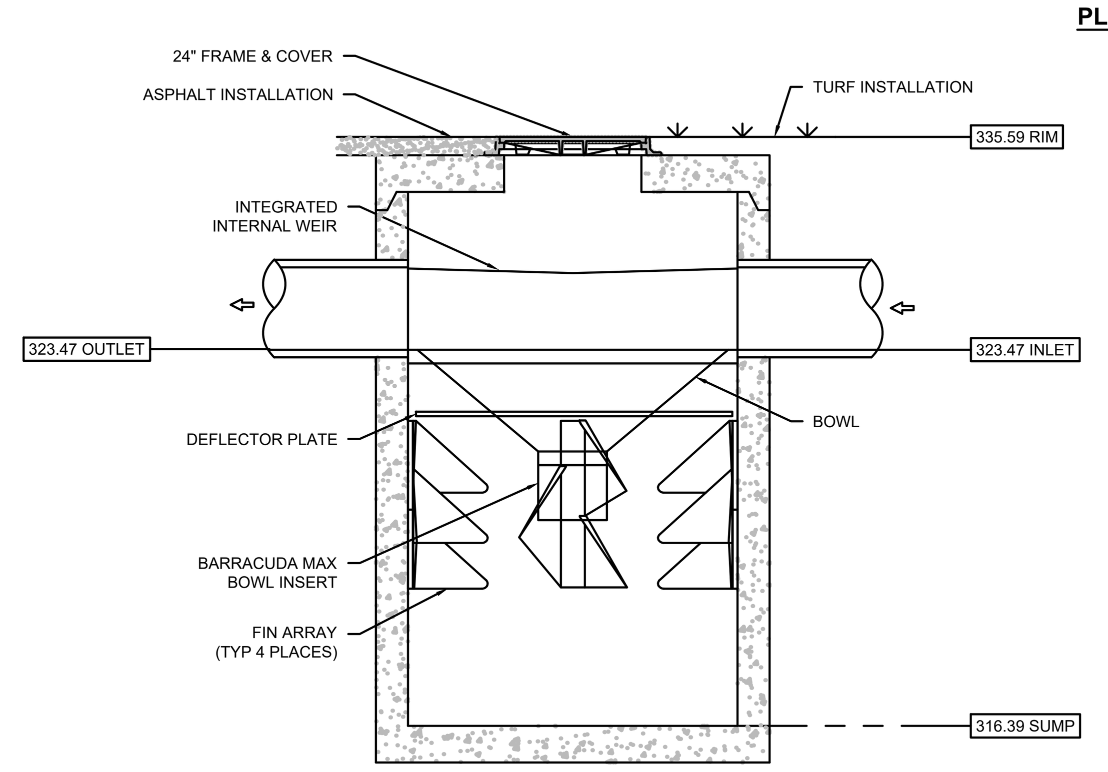
INSTALLATION OF THE STORMWATER TREATMENT UNIT(S) SHALL BE PERFORMED PER MANUFACTURER'S INSTALLATION INSTRUCTIONS. SUCH INSTRUCTIONS CAN BE OBTAINED BY CALLING ADVANCED DRAINAGE SYSTEMS AT (800) 821-6710 OR BY LOGGING ON TO WWW.ADS-PIPE.COM OR WWW.BAYSAVER.COM.



PLAN VIEW

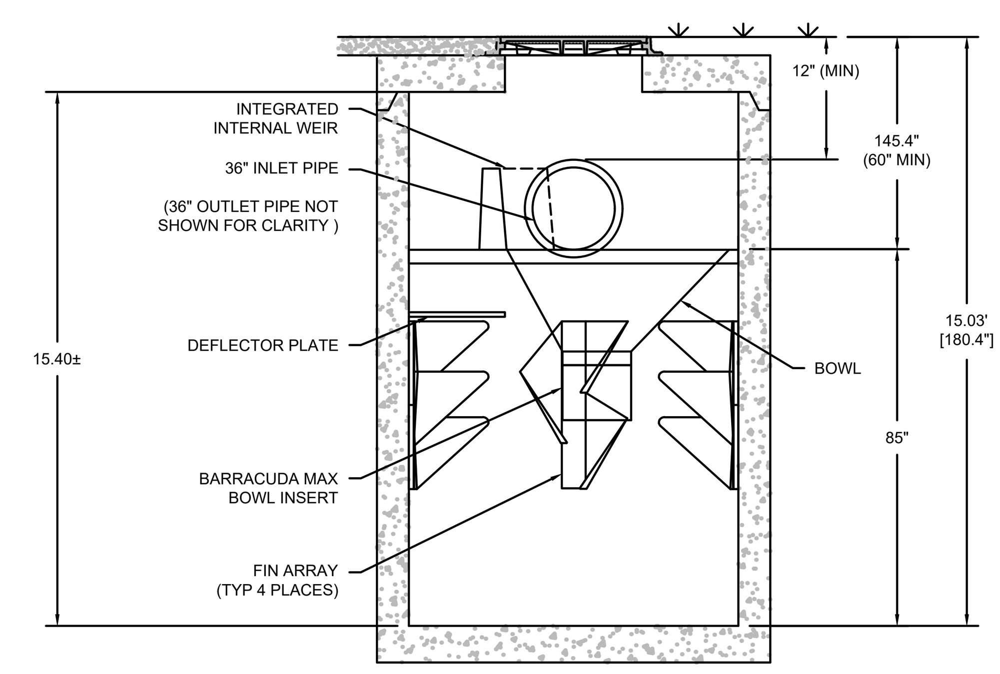
NTS

BARRACUDA MAX S6	
UNIT ID	MH 100
PEAK FLOW RATE (CFS)	
TREATMENT FLOW RATE (CFS)	3.40



SECTION VIEW A-A

NTS



SECTION VIEW B-B

NTS

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RAS JOB NO. 3180011.03

PROJECT MANAGER: CHRIS T. BRATTY

DESIGNED BY: CJN

CHECKED BY: RMK

BREA MALL AND RESIDENCES AT BREA

1065 Brea Mall, Brea, CA 92821

HYDROLOGY DETAILS

raSmith
CREATIVITY BEYOND ENGINEERING

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Irvine, CA 92618-4237
(949) 872-2378
rasmith.com

HYD-04

Scale AS SHOWN
Job No. 2018-170
Date 8/22/22

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ADAPTED FROM ORANGE COUNTY HYDROLOGY MANUAL																			CJN		10/27/2022
CITY OF BREA																					
HYDROLOGY MANUAL			10 - Year Rainfall Analysis																PAGE	1	OF 1
														SHEET FLOW				PIPE HYDRAULICS			
NODE/CONTROLING PATH	DRAINAGE AREA NAME	AREA SF	AREA (ACRES) SUBAREA	TOTAL	SOIL TYPE	DEV. TYPE	Tt MIN	Ai %	TC MIN	I IN/HR	C Page D-3	Fp C.6.4	Q(TOTAL)	FLOW PATH LENGTH (FT)	SLOPE FT/FT	HYDRAULICS AND NOTES	PIPE DIA (IN)	LENGTH	SLOPE FT/FT	n	VEL. FPS
Sheet Flow to Node 1	Existing Area 1A	89,433	2.05	2.05	C	MIX		94.5%	5.00	4.06	0.90	0.25	7.48	185	0.01	Q=7.48CAP=33.44					
							0.247									OK	36	70	0.0025	0.013	4.731
Roof Drainage to Node 2	Existing Area 1B	16,500	0.38	0.38	C	MIX		100.0%	5.00	4.06	0.90	0.25	1.38	-	-	Q=1.38CAP=2.1					
							1.053									OK	8	380	0.03	0.013	6.012
Sheet at 2A + Pipe at Node 2	Existing Area 1C	11,280	0.26	2.69	C	MIX		96.0%	5.00	4.06	0.90	0.25	9.80	70	0.02	Q=9.8CAP=33.44					
							0.437									OK	36	124	0.0025	0.013	4.731
Sheet at 3A + Pipe at Node 3	Existing Area 1D	31,350	0.72	3.41	C	MIX		94.5%	5.00	4.06	0.90	0.25	12.42	175	0.01	Q=12.42CAP=33.44					
							0.803									OK	36	228	0.0025	0.013	4.731
Sheet Flow to Node 4	Existing Area 1E	22,140	0.51	0.51	C	MIX		94.5%	5.75	3.75	0.90	0.25	1.71	250	0.01	Q=1.71CAP=1.79					
							0.095									OK	12	13	0.0025	0.013	2.274
Total at Node 5	Total DA 1A-1E	-	-	3.92	C	MIX		94.5%	5.80	3.73	0.90	0.25	14.13	--	--	Q=14.13CAP=137.06					
																OK	36	307	0.042	0.013	19.390
Sheet Flow at Node 6	Existing Area 1F	21,953	0.50	0.50	C	MIX		94.5%	6.50	3.49	0.90	0.25	1.58	330	0.02						
																	-	-			
Sheet Flow at Node 7	Existing Area 1G	71,627	1.64	1.64	C	MIX		94.5%	6.00	3.66	0.90	0.25	5.39	330	0.03	Q=5.39CAP=3.37					
																BAD	12	52	0.0089	0.013	4.291
Sheet Flow at Node 8	Existing Area 1H	222,634	5.11	5.11	C	MIX		94.5%	5.00	4.06	0.90	0.25	18.61	330	0.05	Q=18.61CAP=9.94					
																BAD	18	81	0.0089	0.013	5.623
Pipe at Node 9	Existing Area 1	-	-	11.18								0.25	39.71								
																	-	-			
Sheet Flow	Existing Area 2	104,200	2.39	2.39	C	MIX		94.5%	5.50	3.84	0.90	0.25	8.25	330	0.05						
																	-	-			
Sheet Flow	Existing Area 3	51,185	1.18	1.18	C	MIX		100.0%	5.00	4.06	0.90	0.25	4.29	--	--						
																	-	-			
Sheet Flow to Node 1	DA #1A	10,550	0.24	0.24	C	MIX		100.0%	5.00	4.06	0.90	0.25	0.88	125	0.04	Q=0.88CAP=1.68					
							0.351									OK	10	65	0.005	0.012	3.086
Sheet + Pipe at Node 2	DA #1B	26,195	0.60	0.84	C	MIX		100.0%	5.35	3.90	0.90	0.25	3.00	160	0.02	Q=3CAP=17.38					
							0.500									OK	24	166	0.005	0.012	5.531
Sheet + Pipe at Node 3	DA #1C	87,805	2.02	2.86	C	MIX		100.0%	7.50	3.22	0.90	0.25	8.84	330	0.01	Q=8.84CAP=17.38					
							0.259									OK	24	86	0.005	0.012	5.531
Sheet + Pipe at Node 4	DA #1D	15,920	0.37	3.22	C	MIX		100.0%	7.76	3.16	0.90	0.25	9.87	100	0.02	Q=9.87CAP=17.38					
							0.416									OK	24	138	0.005	0.012	5.531
Sheet + Pipe at Node 5	DA #1E	94,956	2.18	2.18	C	MIX		100.0%	5.00	4.06	0.90	0.25	7.96	-	-	Q=7.96CAP=13.97					
							0.048									OK	18	23	0.015	0.012	7.908
Sheet + Pipe at Node 6	DA #1F	46,830	1.08	6.48	C	MIX		100.0%	8.50	3.00	0.90	0.25	20.74	330	0.005	Q=20.74CAP=35.92					
							0.569									OK	30	250	0.0065	0.012	7.318
Sheet Flow at Node 7	DA #1G	59,930	1.38	1.38	C	MIX		100.0%	5.25	3.95	0.90	0.25	4.89	330	0.045	Q=4.89CAP=8.84					
							0.087									OK	18	26	0.006	0.012	5.002
Sheet + Pipe at Node 8	DA #1H	10,740	0.25	8.10	C	MIX		100.0%	8.59	2.98	0.90	0.25	26.29	125	0.036	Q=26.29CAP=41.08					
							0.052									OK	30	26	0.0085	0.012	8.368
Sheet + Pipe at Node 9	DA #1I	64,095	1.47	1.47	C	MIX		100.0%	5.00	4.06	0.90	0.25	5.38	330	0.05	Q=5.38CAP=15.81					
							0.061									OK	18	33	0.0192	0.012	8.947
Total to Chamber at Node 10	Total DA#1 (lower)	-	-	9.57	C	MIX		100.0%	10.06	2.72	0.90	0.25	31.66	-	-	Q=31.66CAP=58.41					
																OK	36	168	0.0065	0.012	8.264
Sheet + Pipe at Node 11	DA #2A	61,900	1.42	1.42	C	MIX		100.0%	6.50	3.49	0.90	0.25	4.47	280	0.018	Q=4.47CAP=11.41					
							0.343									OK	18	133	0.01	0.012	6.457
Sheet Flow at Node 12	DA #2B	17,665	0.41	0.41	C	MIX		100.0%	5.75	3.75	0.90	0.25	1.37	275	0.029	Q=1.37CAP=3.87					
							0.152									OK	12	45	0.01	0.012	4.928
Sheet + Pipe at Node 13	DA #2C	135,065	3.10	4.93	C	MIX		100.0%	6.84	3.39	0.90	0.25	15.30	200	0.045	Q=15.3CAP=39.78					
							0.353									OK	24	268	0.0262	0.012	12.661
Sheet Flow at Node 14	DA #2D	10,651	0.24	0.24	C	MIX		100.0%	5.00	4.06	0.90	0.25	0.89	50	0.02	Q=0.89CAP=2.38					
							0.302									OK	10	79	0.01	0.012	4.364
Total to Chamber at Node 10	Total DA #2 (upper)	-	-	5.17	C	MIX		100.0%	7.20	3.30	0.90	0.25	16.19	-	-	Q=16.19CAP=30.1					
																OK	24	237	0.015	0.012	9.580
Overflow to Public Drain at Node 15	Total DA#1 & DA#2	-	-	14.75	C	MIX		100.0%	10.06	2.72	0.90	0.25	47.85	-	-	Q=47.85CAP=75.99					
							0.611		10.67							OK	36	394	0.011	0.012	10.750

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														SHEET FLOW			PIPE HYDRAULICS				
NODE/CONTROLING PATH	DRAINAGE AREA NAME	AREA SF	AREA (ACRES) SUBAREA	TOTAL	SOIL TYPE	DEV. TYPE	Tt MIN	Ai %	TC MIN	I IN/HR	C Page D-3	Fp C.6.4	Q(TOTAL)	FLOW PATH LENGTH (FT)	SLOPE FT/FT	HYDRAULICS AND NOTES	PIPE DIA (IN)	LENGTH	SLOPE FT/FT	n	VEL. FPS
Sheet Flow to Node 1	Existing Area 1A	89,433	2.05	2.05	C	MIX		94.5%	5.00	4.82	0.90	0.25	8.89	185	0.01	Q=8.89CAP=33.44					
							0.247									OK	36	70	0.0025	0.013	4.731
Roof Drainage to Node 2	Existing Area 1B	16,500	0.38	0.38	C	MIX		100.0%	5.00	4.82	0.90	0.25	1.64	-	-	Q=1.64CAP=2.1					
							1.053									OK	8	380	0.03	0.013	6.012
Sheet at 2A + Pipe at Node 2	Existing Area 1C	11,280	0.26	2.69	C	MIX		96.0%	5.00	4.82	0.90	0.25	11.65	70	0.02	Q=11.65CAP=33.44					
							0.437									OK	36	124	0.0025	0.013	4.731
Sheet at 3A + Pipe at Node 3	Existing Area 1D	31,350	0.72	3.41	C	MIX		94.5%	5.00	4.82	0.90	0.25	14.77	175	0.01	Q=14.77CAP=33.44					
							0.803									OK	36	228	0.0025	0.013	4.731
Sheet Flow to Node 4	Existing Area 1E	22,140	0.51	0.51	C	MIX		94.5%	5.75	4.46	0.90	0.25	2.03	250	0.01	Q=2.03CAP=1.79					
							0.095									BAD	12	13	0.0025	0.013	2.274
Total at Node 5	Total DA 1A-1E	-	-	3.92	C	MIX		94.5%	5.80	4.43	0.90	0.25	16.80	--	--	Q=16.8CAP=137.06					
																OK	36	307	0.042	0.013	19.390
Sheet Flow at Node 6	Existing Area 1F	21,953	0.50	0.50	C	MIX		94.5%	6.50	4.16	0.90	0.25	1.88	330	0.02						
																	-	-			
Sheet Flow at Node 7	Existing Area 1G	71,627	1.64	1.64	C	MIX		94.5%	6.00	4.35	0.90	0.25	6.42	330	0.03	Q=6.42CAP=3.37					
																BAD	12	52	0.0089	0.013	4.291
Sheet Flow at Node 8	Existing Area 1H	222,634	5.11	5.11	C	MIX		94.5%	5.00	4.82	0.90	0.25	22.13	330	0.05	Q=22.13CAP=9.94					
																BAD	18	81	0.0089	0.013	5.623
Pipe at Node 9	Existing Area 1	-	-	11.18								0.25	47.23								
																	-	-			
Sheet Flow	Existing Area 2	104,200	2.39	2.39	C	MIX		94.5%	5.50	4.57	0.90	0.25	9.81	330	0.05						
																	-	-			
Sheet Flow	Existing Area 3	51,185	1.18	1.18	C	MIX		100.0%	5.00	4.82	0.90	0.25	5.10	--	--						
																	-	-			
Sheet Flow to Node 1	DA #1A	10,550	0.24	0.24	C	MIX		100.0%	5.00	4.82	0.90	0.25	1.05	125	0.04	Q=1.05CAP=1.68					
							0.351									OK	10	65	0.005	0.012	3.086
Sheet + Pipe at Node 2	DA #1B	26,195	0.60	0.84	C	MIX		100.0%	5.35	4.64	0.90	0.25	3.56	160	0.02	Q=3.56CAP=17.38					
							0.500									OK	24	166	0.005	0.012	5.531
Sheet + Pipe at Node 3	DA #1C	87,805	2.02	2.86	C	MIX		100.0%	7.50	3.83	0.90	0.25	10.52	330	0.01	Q=10.52CAP=17.38					
							0.259									OK	24	86	0.005	0.012	5.531
Sheet + Pipe at Node 4	DA #1D	15,920	0.37	3.22	C	MIX		100.0%	7.76	3.76	0.90	0.25	11.76	100	0.02	Q=11.76CAP=17.38					
							0.416									OK	24	138	0.005	0.012	5.531
Sheet + Pipe at Node 5	DA #1E	94,956	2.18	2.18	C	MIX		100.0%	5.00	4.82	0.90	0.25	9.46	-	-	Q=9.46CAP=13.97					
							0.048									OK	18	23	0.015	0.012	7.908
Sheet + Pipe at Node 6	DA #1F	46,830	1.08	6.48	C	MIX		100.0%	8.50	3.57	0.90	0.25	24.68	330	0.005	Q=24.68CAP=35.92					
							0.569									OK	30	250	0.0065	0.012	7.318
Sheet Flow at Node 7	DA #1G	59,930	1.38	1.38	C	MIX		100.0%	5.25	4.69	0.90	0.25	5.81	330	0.045	Q=5.81CAP=8.84					
							0.087									OK	18	26	0.006	0.012	5.002
Sheet + Pipe at Node 8	DA #1H	10,740	0.25	8.10	C	MIX		100.0%	8.59	3.55	0.90	0.25	31.28	125	0.036	Q=31.28CAP=41.08					
							0.052									OK	30	26	0.0085	0.012	8.368
Sheet + Pipe at Node 9	DA #1I	64,095	1.47	1.47	C	MIX		100.0%	5.00	4.82	0.90	0.25	6.39	330	0.05	Q=6.39CAP=15.81					
							0.061									OK	18	33	0.0192	0.012	8.947
Total to Chamber at Node 10	Total DA#1 (lower)	-	-	9.57	C	MIX		100.0%	10.06	3.25	0.90	0.25	37.66	-	-	Q=37.66CAP=58.41					
																OK	36	168	0.0065	0.012	8.264
Sheet + Pipe at Node 11	DA #2A	61,900	1.42	1.42	C	MIX		100.0%	6.50	4.16	0.90	0.25	5.32	280	0.018	Q=5.32CAP=11.41					
							0.343									OK	18	133	0.01	0.012	6.457
Sheet Flow at Node 12	DA #2B	17,665	0.41	0.41	C	MIX		100.0%	5.75	4.46	0.90	0.25	1.63	275	0.029	Q=1.63CAP=3.87					
							0.152									OK	12	45	0.01	0.012	4.928
Sheet + Pipe at Node 13	DA #2C	135,065	3.10	4.93	C	MIX		100.0%	6.84	4.04	0.90	0.25	18.21	200	0.045	Q=18.21CAP=39.78					
							0.353									OK	24	268	0.0262	0.012	12.661
Sheet Flow at Node 14	DA #2D	10,651	0.24	0.24	C	MIX		100.0%	5.00	4.82	0.90	0.25	1.06	50	0.02	Q=1.06CAP=2.38					
							0.302									OK	10	79	0.01	0.012	4.364
Total to Chamber at Node 10	Total DA #2 (upper)	-	-	5.17	C	MIX		100.0%	7.20	3.93	0.90	0.25	19.28	-	-	Q=19.28CAP=30.1					
																OK	24	237	0.015	0.012	9.580
Overflow to Public Drain at Node 15	Total DA#1 & DA#2	-	-	14.75	C	MIX		100.0%	10.06	3.25	0.90	0.25	56.94	-	-	Q=56.94CAP=75.99					
							0.611		10.67							OK	36	394	0.011	0.012	10.750

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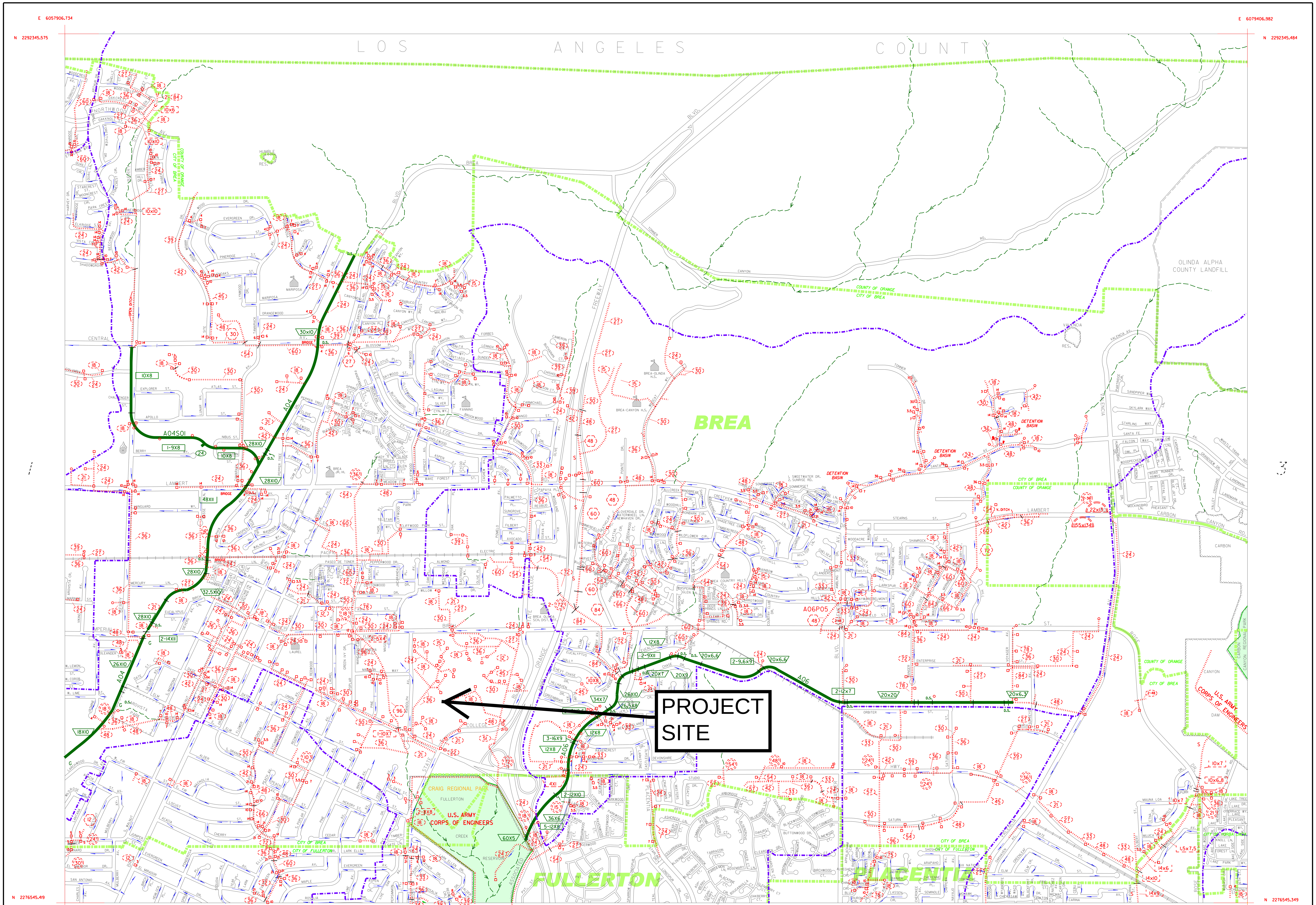
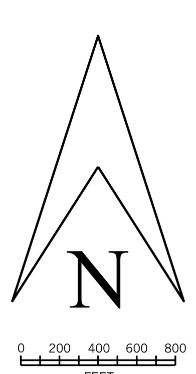
100 - Year Rainfall Analysis

CJN 10/27/2022

NODE/CONTROLING PATH	DRAINAGE AREA NAME	AREA SF	AREA (ACRES) SUBAREA	TOTAL	SOIL TYPE	DEV. TYPE	Tt MIN	Ai %	TC MIN	I IN/HR	C Page D-3	Fp C.6.4	Q(TOTAL)	SHEET FLOW: FLOW PATH LENGTH (FT)	SLOPE FT/FT	HYDRAULICS AND NOTES	PIPE HYDRAULICS: PIPE DIA (IN)	LENGTH	SLOPE FT/FT	n	VEL. FPS
Sheet Flow to Node 1	Existing Area 1A	89,433	2.05	2.05	C	MIX		94.5%	5.00	6.19	0.90	0.25	11.41	185	0.01	Q=11.41CAP=33.44					
							0.247									OK	36	70	0.0025	0.013	4.731
Roof Drainage to Node 2	Existing Area 1B	16,500	0.38	0.38	C	MIX		100.0%	5.00	6.19	0.90	0.25	2.11	-	-	Q=2.11CAP=2.1					
							1.053									BAD	8	380	0.03	0.013	6.012
Sheet at 2A + Pipe at Node 2	Existing Area 1C	11,280	0.26	2.69	C	MIX		96.0%	5.00	6.19	0.90	0.25	14.96	70	0.02	Q=14.96CAP=33.44					
							0.437									OK	36	124	0.0025	0.013	4.731
Sheet at 3A + Pipe at Node 3	Existing Area 1D	31,350	0.72	3.41	C	MIX		94.5%	5.00	6.19	0.90	0.25	18.96	175	0.01	Q=18.96CAP=33.44					
							0.803									OK	36	228	0.0025	0.013	4.731
Sheet Flow to Node 4	Existing Area 1E	22,140	0.51	0.51	C	MIX		94.5%	5.75	5.71	0.90	0.25	2.61	250	0.01	Q=2.61CAP=1.79					
							0.095									BAD	12	13	0.0025	0.013	2.274
Total at Node 5	Total DA 1A-1E	-	-	3.92	C	MIX		94.5%	5.80	5.68	0.90	0.25	21.56	--	--	Q=21.56CAP=137.06					
																OK	36	307	0.042	0.013	19.390
Sheet Flow at Node 6	Existing Area 1F	21,953	0.50	0.50	C	MIX		94.5%	6.50	5.32	0.90	0.25	2.41	330	0.02						
																	-	-			
Sheet Flow at Node 7	Existing Area 1G	71,627	1.64	1.64	C	MIX		94.5%	6.00	5.57	0.90	0.25	8.23	330	0.03	Q=8.23CAP=3.37					
																BAD	12	52	0.0089	0.013	4.291
Sheet Flow at Node 8	Existing Area 1H	222,634	5.11	5.11	C	MIX		94.5%	5.00	6.19	0.90	0.25	28.40	330	0.05	Q=28.4CAP=9.94					
																BAD	18	81	0.0089	0.013	5.623
Pipe at Node 9	Existing Area 1	-	-	11.18								0.25	60.60								
																	-	-			
Sheet Flow	Existing Area 2	104,200	2.39	2.39	C	MIX		94.5%	5.50	5.86	0.90	0.25	12.58	330	0.05						
																	-	-			
Sheet Flow	Existing Area 3	51,185	1.18	1.18	C	MIX		100.0%	5.00	6.19	0.90	0.25	6.54	--	--						
																	-	-			
Sheet Flow to Node 1	DA #1A	10,550	0.24	0.24	C	MIX		100.0%	5.00	6.19	0.90	0.25	1.35	125	0.04	Q=1.35CAP=1.68					
							0.351									OK	10	65	0.005	0.012	3.086
Sheet + Pipe at Node 2	DA #1B	26,195	0.60	0.84	C	MIX		100.0%	5.35	5.95	0.90	0.25	4.57	160	0.02	Q=4.57CAP=17.38					
							0.500									OK	24	166	0.005	0.012	5.531
Sheet + Pipe at Node 3	DA #1C	87,805	2.02	2.86	C	MIX		100.0%	7.50	4.90	0.90	0.25	13.47	330	0.01	Q=13.47CAP=17.38					
							0.259									OK	24	86	0.005	0.012	5.531
Sheet + Pipe at Node 4	DA #1D	15,920	0.37	3.22	C	MIX		100.0%	7.76	4.81	0.90	0.25	15.05	100	0.02	Q=15.05CAP=17.38					
							0.416									OK	24	138	0.005	0.012	5.531
Sheet + Pipe at Node 5	DA #1E	94,956	2.18	2.18	C	MIX		100.0%	5.00	6.19	0.90	0.25	12.14	-	-	Q=12.14CAP=13.97					
							0.048									OK	18	23	0.015	0.012	7.908
Sheet + Pipe at Node 6	DA #1F	46,830	1.08	6.48	C	MIX		100.0%	8.50	4.57	0.90	0.25	31.61	330	0.005	Q=31.61CAP=35.92					
							0.569									OK	30	250	0.0065	0.012	7.318
Sheet Flow at Node 7	DA #1G	59,930	1.38	1.38	C	MIX		100.0%	5.25	6.02	0.90	0.25	7.45	330	0.045	Q=7.45CAP=8.84					
							0.087									OK	18	26	0.006	0.012	5.002
Sheet + Pipe at Node 8	DA #1H	10,740	0.25	8.10	C	MIX		100.0%	8.59	4.54	0.90	0.25	40.06	125	0.036	Q=40.06CAP=41.08					
							0.052									OK	30	26	0.0085	0.012	8.368
Sheet + Pipe at Node 9	DA #1I	64,095	1.47	1.47	C	MIX		100.0%	5.00	6.19	0.90	0.25	8.19	330	0.05	Q=8.19CAP=15.81					
							0.061									OK	18	33	0.0192	0.012	8.947
Total to Chamber at Node 10	Total DA#1 (lower)	-	-	9.57	C	MIX		100.0%	10.06	4.15	0.90	0.25	48.26	-	-	Q=48.26CAP=58.41					
																OK	36	168	0.0065	0.012	8.264
Sheet + Pipe at Node 11	DA #2A	61,900	1.42	1.42	C	MIX		100.0%	6.50	5.32	0.90	0.25	6.81	280	0.018	Q=6.81CAP=11.41					
							0.343									OK	18	133	0.01	0.012	6.457
Sheet Flow at Node 12	DA #2B	17,665	0.41	0.41	C	MIX		100.0%	5.75	5.71	0.90	0.25	2.08	275	0.029	Q=2.08CAP=3.87					
							0.152									OK	12	45	0.01	0.012	4.928
Sheet + Pipe at Node 13	DA #2C	135,065	3.10	4.93	C	MIX		100.0%	6.84	5.17	0.90	0.25	23.32	200	0.045	Q=23.32CAP=39.78					
							0.353									OK	24	268	0.0262	0.012	12.661
Sheet Flow at Node 14	DA #2D	10,651	0.24	0.24	C	MIX		100.0%	5.00	6.19	0.90	0.25	1.36	50	0.02	Q=1.36CAP=2.38					
							0.302									OK	10	79	0.01	0.012	4.364
Total to Chamber at Node 10	Total DA #2 (upper)	-	-	5.17	C	MIX		100.0%	7.20	5.02	0.90	0.25	24.68	-	-	Q=24.68CAP=30.1					
																OK	24	237	0.015	0.012	9.580
Overflow to Public Drain at Node 15	Total DA#1 & DA#2	-	-	14.75	C	MIX		100.0%	10.06	4.15	0.90	0.25	72.94	-	-	Q=72.94CAP=75.99					
							0.611		10.67							OK	36	394	0.011	0.012	10.750





NOTICE

The drainage information has been prepared for information purposes only. The location, ownership, facility information and limits have been determined from available information provided by public agencies, but may not be exact, accurate, or up–to–date. The user of this information is responsible for verifying exact location, ownership, accuracy, and the regional versus local character of drainage facilities.

Additional information may be obtained from public plans and recorded deeds. Facility designations included with this information are for convenience only and are not controlling or intended to imply ownership by the County or the Orange County Flood Control District (OCFCD). The information is being provided as a courtesy and neither the County of Orange nor OCFCD assume any liabilities for inaccuracy of the information.

To notify OC Public Works Flood Control Section of additions or corrections, please contact Sal Gutierrez at (714) 834–5396 or by email at sal.gutierrez@ocpw.ocgov.com

ORANGE COUNTY FLOOD CONTROL DISTRICT

BASE MAP OF DRAINAGE FACILITIES IN ORANGE COUNTY

REVISION	DATE	SHEET NO.	DWG. NO.
S. GUTIERREZ	DEC. 22, 2010	2	MAPS–113–3

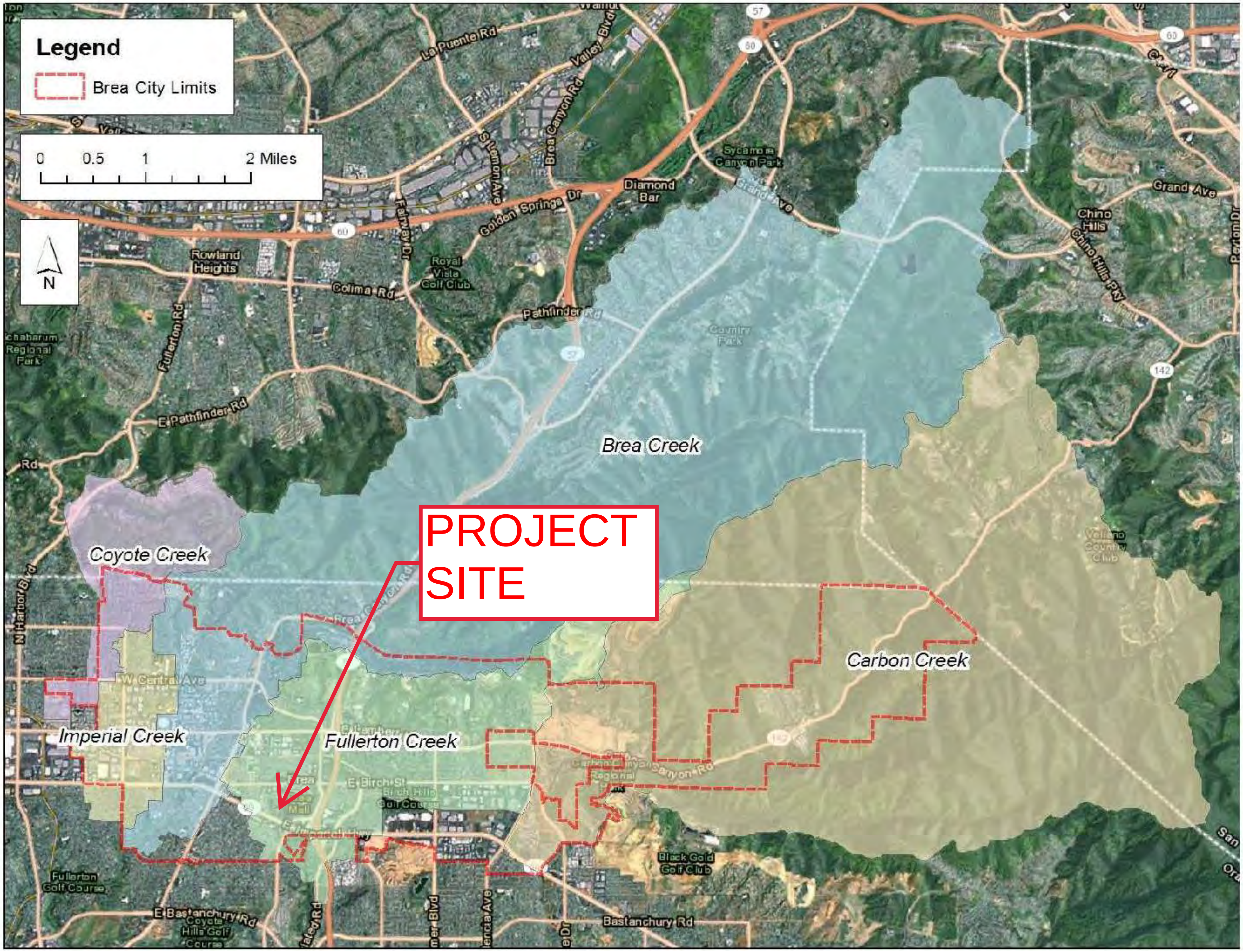
Channel Drainage Area Boundary
Major Sub–Area Drainage Boundary
Minor Sub–Area Drainage Boundary
Existing O.C.F.C.D. Facility
Existing Local Facility
Existing Retarding Basin or Reservoir
Natural Watercourse
City Limits
G G Greenbelt
P.S. P.S. Pump Station
Catch Basin (length in feet)
Drop Inlet or Other Entry
OCFCD Basins or Reservoirs

Ownership (If other than City or County): Private = P State = S Federal = F

EXISTING FACILITIES

O.C.F.C.D. LOCAL

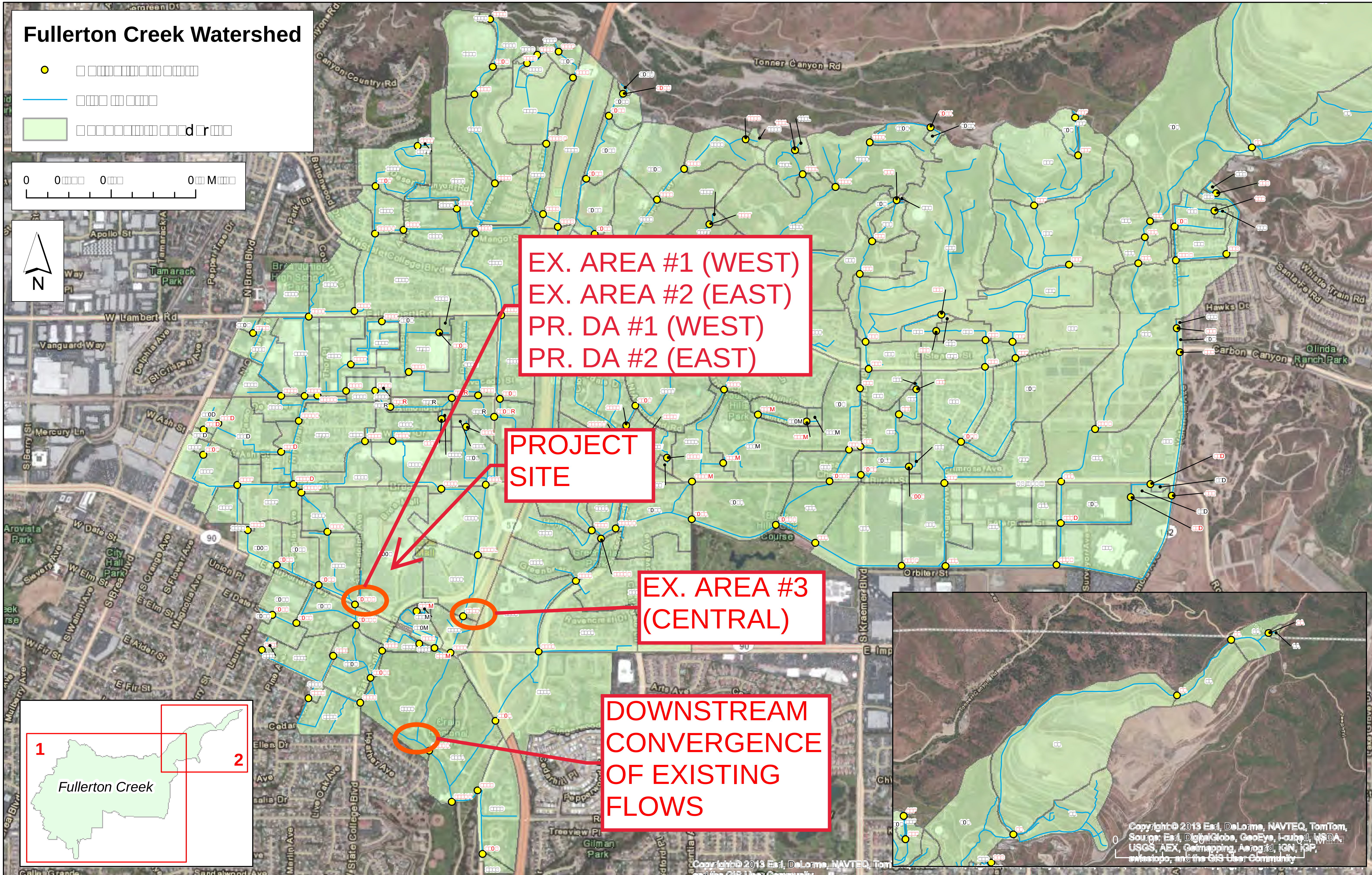
Earth Trapezoidal Channel (base width by height in feet)
Reinforced Concrete Trapezoidal Channel (base width by height in feet)
Reinforced Concrete Rectangular Channel (base width by height in feet)
Reinforced Concrete Box (RCB) (number of barrels–span by height in feet)
Reinforced Concrete Pipe (RCP) (diameter in inches)
Metal Sheet Channel (MSC) (Base width by pile height in feet/Sheet pile total length)
Corrugated Metal Pipe (CMP) (diameter in inches)
Concrete Pipe (diameter in inches)
Concrete Oval Pipe (width by height in inches)
Steel Pipe (diameter in inches)
Reinforced Concrete Arch (base span by height in inches)
Corrugated Metal Arch (base span by height in inches)



Appendix B: *Major watersheds crossing Brea City limits*

APPENDIX C
CITY OF BREA
STORM DRAIN SYSTEM
CITY DRAINAGE AREAS
SHOWING
CIP PROJECT LOCATIONS
AND
PRESSURIZED PIPE SEGMENTS
WILLDAN Engineering
Legend
Watershed Boundaries
Drainage Sub-Basin Areas
CIP Project Locations
Pressurized Pipe Sections
Storm Drain Pipes
Storm Drain Structures
OCFCD Facility
City Boundaries
COUNTY OF LOS ANGELES
COUNTY OF ORANGE
Coyote Creek Watershed
Brea Creek Watershed
Fullerton Creek Watershed
Imperial Creek Watershed
Carbon Creek Watershed
LA HABRA
FULLERTON
PLACENTIA
YORBA LINDA
CHINO HILLS STATE PARK
PROJECT SITE
DRAINAGE AREAS EAST OF THIS LOCATION ARE TRIBUTARY TO CARBON CREEK.
NO CITY-MAINTAINED STORM DRAINS EAST OF THIS LOCATION.

APPENDIX D: CITY OF BREA STORM DRAIN SYSTEM - CCTV INSPECTION IDENTIFIED STRUCTURAL AND MAINTENANCE DEFECTS - LOCAL STREET PONDING LOCATIONS


Fullerton Creek Watershed
0
N
EX. AREA #1 (WEST)
EX. AREA #2 (EAST)
PR. DA #1 (WEST)
PR. DA #2 (EAST)
PROJECT SITE
EX. AREA #3 (CENTRAL)
DOWNSTREAM CONVERGENCE OF EXISTING FLOWS
1
2
Fullerton Creek
Tonner Canyon Rd
Carbon Canyon Rd
W Lambert Rd
Vanguard Way
Apollo St
Mercury Ln
Tamarack Park
Olinda Ranch Park
Hawks Dr
City Hall Park
Arovista Park
Orbiter St
Gilman Park
Calle Grande
Sandalwood Ave
N State College Blvd
N Brea Blvd
Copyright:© 2013 Esri, DeLorme, NAVTEQ, TomTom, Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Fullerton Creek 10-year Storm Rational Method Study

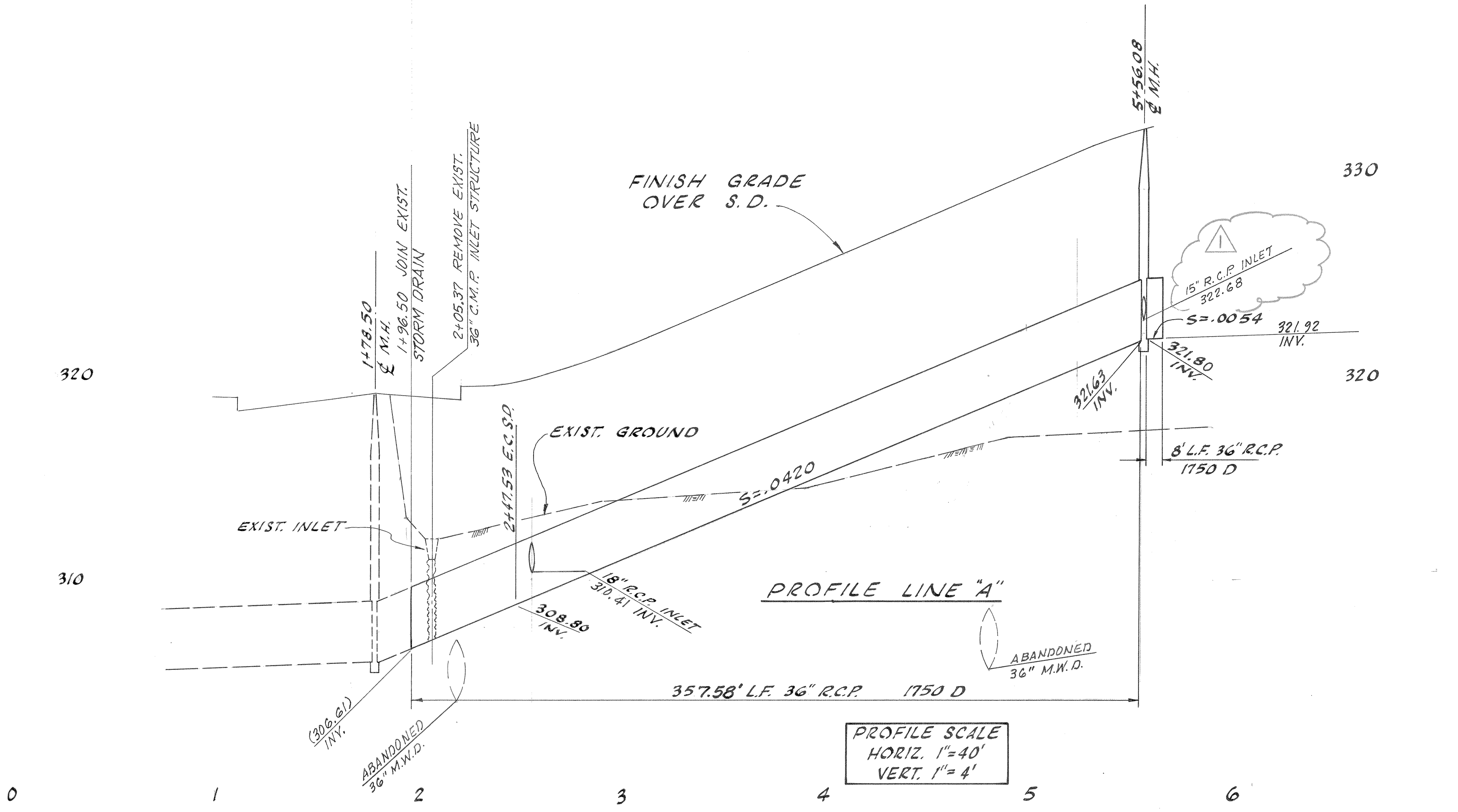
Concentration Point / Outlet	Subarea / Basin Area (ac)	Effective Area (ac)	Total area (ac)	Fp	Ap	Tt (min)	Tc (min)	I (in/hr)	Fm	Fm avg.	Q Total (cfs)	Flow Path Length (ft)	Slope (ft/ft)	Velocity (fps)	Depth of Flow (ft)	Comments
350O	2.2	2.2	2.2	0.3	0.35		14.8	1.73	0.11	0.11	3.3	303.9	0.09239			
352O	24.2	26.4	26.4	0.3	0.47	2.5	17.3	1.58	0.14	0.14	34.7	1067.1	0.02936	7.1(PUG)	0.41(PUG)	
354AX		26.4		0.3	0.46	1.43	18.7	1.52		0.14	34.7	494.5	0.00335	5.8(AG)	1.82(AG)	Warning: Trapezoidal channel OVERFLOW
343N	1.2	1.2	1.2	0.3	0.45		11.5	1.99	0.14	0.14	2	328	0.00424			
345N	13.7													3.5(AG)	0.45(AG)	Warning: Local street (< 500 ADT) OVERFLOW (crown)
348XK														3.6(AG)	0.79(AG)	
312I	1.4															
314I	12.9													2.8(AG)	0.46(AG)	Warning: Local street (< 500 ADT) OVERFLOW (crown)
320XI														15.9(PUG)	0.82(PUG)	Warning: Pipe OVERFLOW
306H	1.4															
308H	13.9													3.8(AG)	0.57(AG)	Warning: Local street (< 500 ADT) OVERFLOW (crown)
309XH														9.1(PUG)	1.23(PUG)	Warning: Pipe OVERFLOW
299G	0.8															
301G	10.3	11.1	11.1	0.3	0.34	9.02	15	1.72	0.1	0.11	16.3	834.6	0.00159	1.7(AG)	0.64(AG)	Warning: Local street (< 500 ADT) OVERFLOW (crown)
303G	11.7	22.8	22.8	0.3	0.29	1.65	16.6	1.62	0.09	0.1	31.6	723.2	0.00943	7.3(PUG)	1.16(PUG)	
304XG		22.8		0.3	0.32	0.76	17.4	1.58		0.1	31.6	650.9	0.03626	14.3(PUG)	1.15(PUG)	
290F	0.6	0.6	0.6	0.3	0.27		7	2.63	0.08	0.08	1.4	155.1	0.00645			
293F	22.2	22.8	22.8			6.86	13.9	1.79		0.1	35.1	1143.5	0.00758	3.3(AG)	0.55(AG)	Warning: Local street (< 500 ADT) OVERFLOW (crown)
295XF	15.9	38.7	38.7	0.3	0.4	1.53	15.4	1.69	0.12	0.11	55.7	1057.9	0.0228	11.5(PUG)	1.64(PUG)	Warning: Pipe OVERFLOW
285E	0.8	0.8	0.8	0.3	0.45		5.3	3.08	0.14	0.14	2.2	154.1	0.04509			
288XD	14.7	15.5	15.5	0.3	0.17	8.55	13.9	1.8	0.05	0.05	24.5	1624.2	0.01621	3.6(AG)	0.46(AG)	
279D	1.2	1.2	1.2	0.3	0.32		6.1	2.86	0.1	0.1	3	163.3	0.01788			
281D	4.8	6.1	6.1	0.3	0.24	3.48	9.5	2.22	0.07	0.08	11.8	336.2	0.01899	1.8(AG)	0.33(AG)	
283D	16.5	22.6	22.6	0.3	0.23	2.6	12.1	1.94	0.07	0.07	38.2	1337	0.01805	8.6(PUG)	0.90(PUG)	
288XD		22.6		0.3	0.24	1.61	13.7	1.8		0.07	38.2	661.5	0.00597	6.8(PUG)	2.05(PUG)	Warning: Pipe OVERFLOW
271C	1.8	1.8	1.8	0.3	0.2		7.3	2.58	0.06	0.06	4.1	226.1	0.00884			

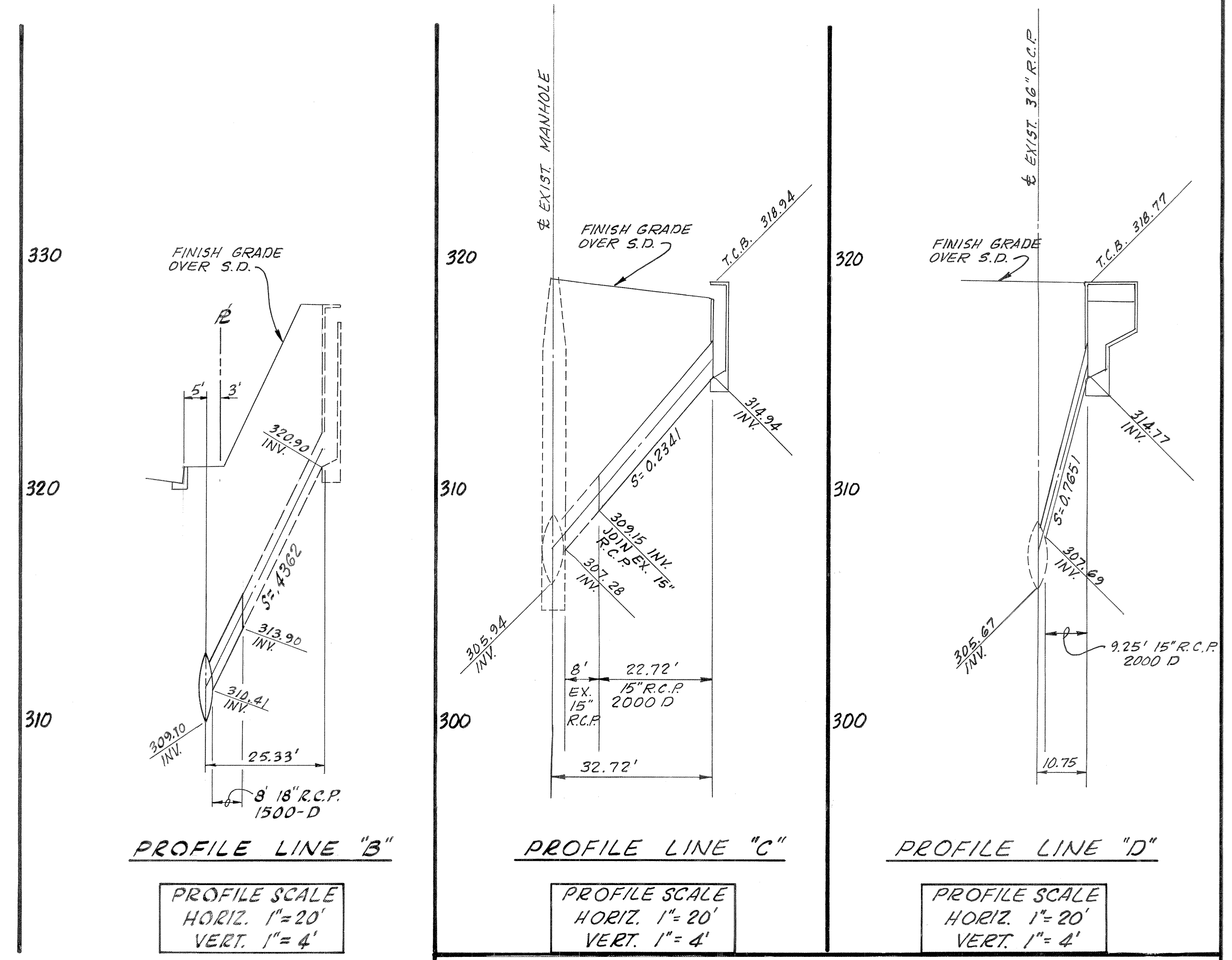
Regression Equations: $I(t) = at^b$

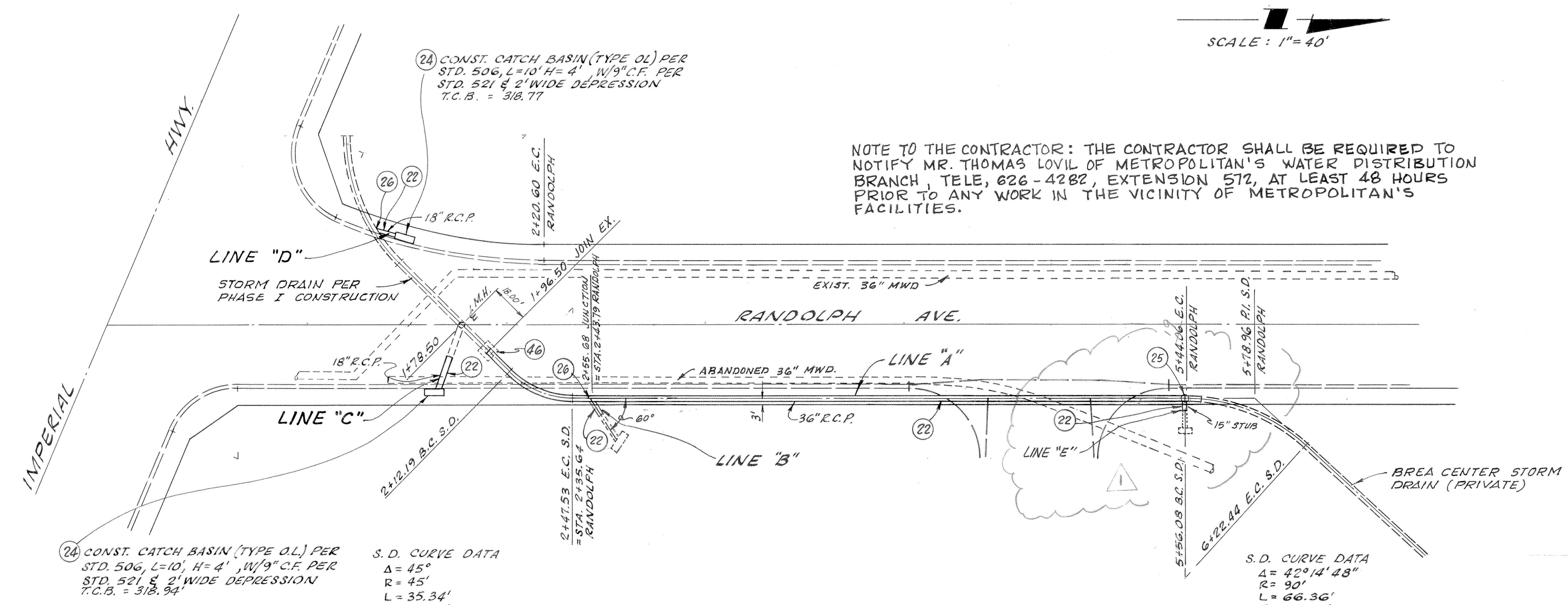
(I= Intensity in inches/hour, t= duration in minutes)

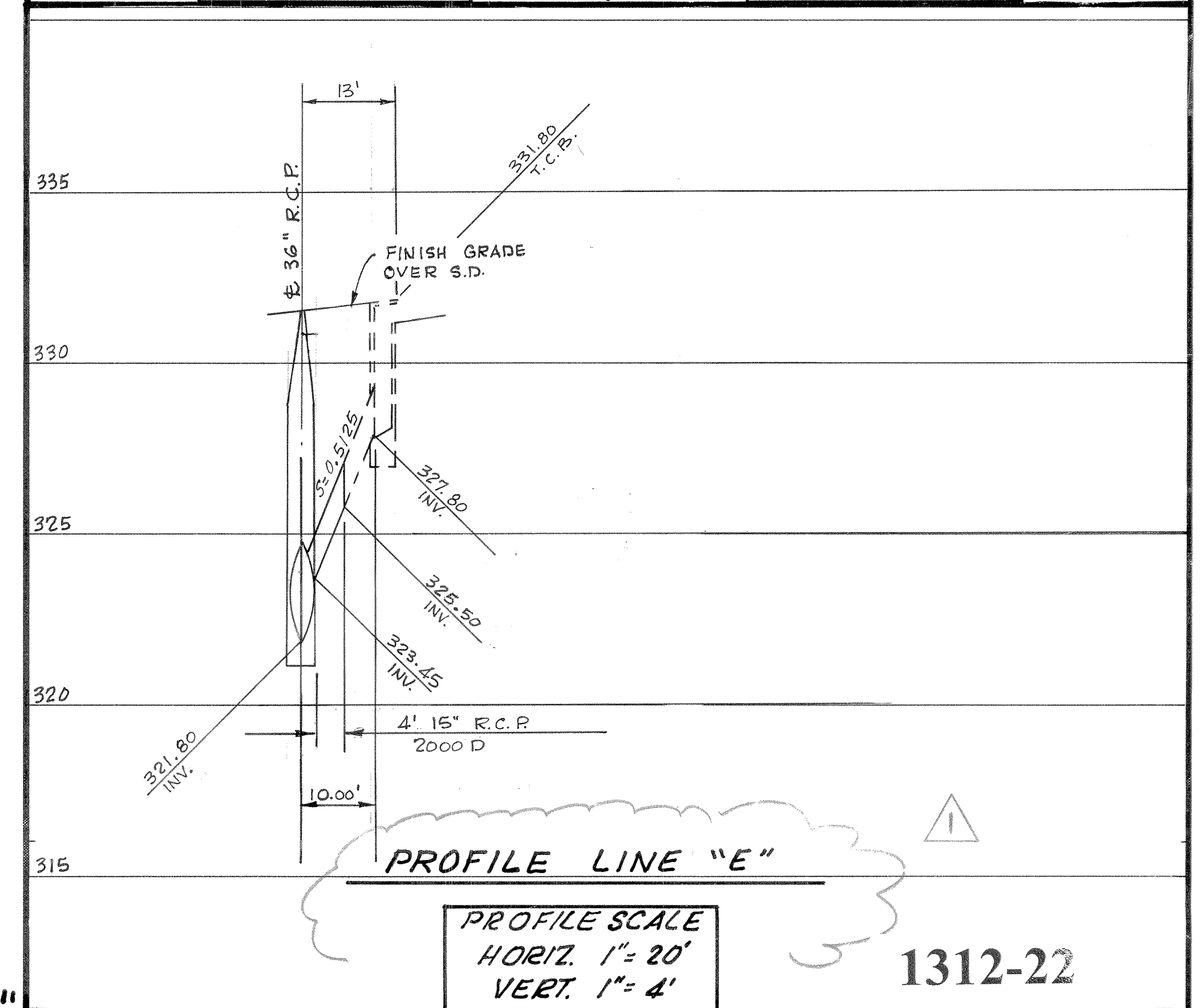
Return Frequency (years)	a	b
2	5.702	-0.574
5	7.870	-0.562
10	10.209	-0.573
25	11.995	-0.566
50	13.521	-0.566
100	15.560	-0.573

Concentration Point / Outlet	Subarea / Basin Area (ac)	Effective Area (ac)	Total area (ac)	Fp	Ap	Tt (min)	Tc (min)	I (in/hr)	Fm	Fm avg.	Q Total (cfs)	Flow Path Length (ft)	Slope (ft/ft)	Velocity (fps)	Depth of Flow (ft)	Comments
Head Node - 274C		218.9		0.31	0.32	0	15.2	1.71		0.1	321.5					Confluence Details
Head Node - 283D		225.5		0.31	0.31	0	13.7	1.8		0.1	353					Confluence Details
Head Node - 285E		225.1		0.31	0.31	0	13.9	1.8		0.1	350.5					Confluence Details
288XD - Confluence		261.5	274.6	0.31	0.31	0	15.5	1.69		0.1	379.5					Confluence Results
Head Node - 293F		273.4		0.31	0.32	0	15.4	1.69		0.1	398.6					Confluence Details
Head Node - 268B		259.9		0.31	0.32	0	13.1	1.85		0.1	418.5					Confluence Details
Head Node - 263Z		313.4		0.31	0.3	0	27.4	1.22		0.09	323.8					Confluence Details
Head Node - 245X		300.8		0.31	0.32	0	15.9	1.67		0.1	432					Confluence Details
Head Node - 250Y		300.3		0.31	0.32	0	15.6	1.68		0.1	434.8					Confluence Details
Head Node - 274C		257.3		0.31	0.33	0	15.3	1.7		0.1	377					Confluence Details
Head Node - 283D		260.3		0.31	0.31	0	13.9	1.8		0.1	406.4					Confluence Details
Head Node - 285E		260.2		0.31	0.31	0	14	1.79		0.1	404					Confluence Details
295XF - Confluence		300.3	313.4	0.31	0.32	0	15.6	1.68		0.1	434.8					Confluence Results
Head Node - 293F		282.1		0.31	0.31	1.01	16.4	1.63		0.1	398.6					Confluence Details
Head Node - 268B		268.6		0.31	0.31	1	14.1	1.78		0.1	418.5					Confluence Details
Head Node - 263Z		322.1		0.31	0.3	1.05	28.5	1.2		0.09	323.8					Confluence Details
Head Node - 245X		309.5		0.31	0.31	1	16.9	1.61		0.1	432					Confluence Details
Head Node - 250Y		309		0.31	0.31	0.99	16.6	1.62		0.1	434.8					Confluence Details
Head Node - 274C		266		0.31	0.33	1.02	16.3	1.64		0.1	377					Confluence Details
Head Node - 283D		269		0.31	0.31	1.01	14.9	1.73		0.1	406.4					Confluence Details
Head Node - 285E		268.9		0.31	0.31	1.01	15	1.72		0.1	404					Confluence Details
297X	8.7	309	322.1	0.3	0.2	0.99	16.6	1.62	0.06	0.1	434.8	751	0.00477	12.6(PUG)	5.47(PUG)	
Head Node - 303G		353		0.31	0.27	0	17.4	1.58		0.08	479.7					Confluence Details
Head Node - 293F		367.9		0.31	0.27	0	18	1.55		0.08	489.1					Confluence Details
Head Node - 268B		352.2		0.31	0.27	0	15.7	1.67		0.08	508.4					Confluence Details
Head Node - 263Z		407.8		0.31	0.27	0	30.2	1.16		0.08	398.7					Confluence Details
Head Node - 245X		395.2		0.31	0.27	0	18.4	1.53		0.09	518.4					Confluence Details
Head Node - 250Y		394.7		0.31	0.27	0	18.2	1.54		0.09	521.4					Confluence Details
Head Node - 274C		351.8		0.31	0.28	0	17.9	1.55		0.09	468.3					Confluence Details
Head Node - 283D		353.6		0.31	0.27	0	16.5	1.63		0.08	496.5					Confluence Details
Head Node - 285E		353.6		0.31	0.27	0	16.6	1.62		0.08	494.2					Confluence Details
304XG - Confluence		394.7	407.8	0.31	0.27	0	18.2	1.54		0.09	521.4					Confluence Results
Head Node - 308H		249.2		0.31	0.26	0	10.3	2.13		0.08	466.5					Confluence Details
Head Node - 303G		383.8		0.31	0.26	0	17.8	1.56		0.08	517.7					Confluence Details
Head Node - 293F		398.7		0.31	0.26	0	18.5	1.53		0.08	526.3					Confluence Details
Head Node - 268B		383		0.31	0.26	0	16.1	1.65		0.08	548					Confluence Details
Head Node - 263Z		438.7		0.31	0.26	0	30.6	1.15		0.08	427.8					Confluence Details
Head Node - 245X		426.1		0.31	0.27	0	18.9	1.51		0.08	554.9					Confluence Details
Head Node - 250Y		425.6		0.31	0.27	0	18.6	1.52		0.08	558.1					Confluence Details
Head Node - 274C		382.7		0.31	0.27	0	18.4	1.53		0.08	505.7					Confluence Details
Head Node - 283D		384.4		0.31	0.26	0	16.9	1.61		0.08	535.3					Confluence Details
Head Node - 285E		384.5		0.31	0.26	0	17	1.6		0.08	532.9					Confluence Details
309XH - Confluence		425.6	438.7	0.31	0.27	0	18.6	1.52		0.08	558.1					Confluence Results









NOTES :

1. FOR CONSTRUCTION NOTES SEE SHEET NO. 2.

1312-22

"AS BUILT"

9/23/77

REVISIONS

DATE	INITIAL	DESCRIPTION	APP'D.
6/9/76	G.T.	⚠ CHANGED LOCATION & LENGTH OF LINE "E"	S.W.P.

ENGINEERING DEPARTMENT

CITY OF BREA CALIFORNIA

RANDOLPH AVENUE STORM DRAIN PLAN

PHASE II

DRAWN BY: E.F.W.

CHECKED BY: C.R.A.

DATE: MAY 3, 1976

Milo K Keith
CITY ENGINEER

SCALE: 1"=40'

SHEET 20 OF 44


BIRCH STREET
RANDOLPH AVE.
CITY OF BREA PARCEL
FUTURE EXPANSION
BREA MALL
CENTRAL TENANT BLDG.
MAY CO.
UPPER LEVEL FIN. FLR. 56.00
LOWER LEVEL FIN. FLR. 38.50
SUBGRADE ELEV. 37.85
SEARS
UPPER LEVEL FIN. FLR. 56.00
LOWER LEVEL FIN. FLR. 38.50
EXIST. SUB GRADE 37.85
BROADWAY
UPPER LEVEL FIN. FLR. 56.00
LOWER LEVEL FIN. FLR. 38.50
SUB-GRADE ELEV. 37.85
TRUCK COURT NO. 1
TRUCK COURT NO. 2 DET.
TRUCK COURT NO. 4
TRUCK COURT NO. 5 DET.
NOTE: SITEWORK CONTRACTOR SHALL COORDINATE HIS WORK & CURB, AROUND EACH BLDG., WITH THE RESPECTIVE CONTRACTOR.
SEE SHEET SW-6
SEE SHEET SW-7
N. 10,750
N. 10,500
N. 10,250
N. 10,000
N. 9,750
N. 9,500
E. 11,250
E. 11,500
E. 11,750
E. 12,000
E. 12,250
E. 12,500
E. 12,750
AS BUILT
6 6/7/77 ADDED A.C. RAMPS C.K.
5 5/5/77 ADDED S.D. & A.C. PVMT @ ICE RINK C.K.
4 3/28/77 REV. BROADWAY BLDG. C.K.
3 12/15/76 MISC. CURBED ISLAND REVISIONS C.K.
2 8-27-76 REVISED CITY PARCEL LOCATION, GRADES & S.D. C.K.
1 6-7-76 ADDENDUM NO. 3
8/12/77 "AS BUILT"
NO. DATE REVISION BY
PLANS PREPARED UNDER THE SUPERVISION OF:
R.C.E. 17643
PSOMAS & ASSOCIATES
CIVIL ENGINEERS · LAND SURVEYORS
1617 PONTIUS AVENUE · LOS ANGELES, CALIFORNIA. 90025 · (213) 478-3081
NORTH
1" = 50'
SITE GRADING & DRAINAGE PLAN
BREA MALL
IMPERIAL HIGHWAY AT ORANGE FREEWAY
BREA, CALIFORNIA
HOMART DEVELOPMENT CO.
PROJECT NO. 75278
DRAWN APPROVED
SW-5
DATE 5-17-76

AS BUILT

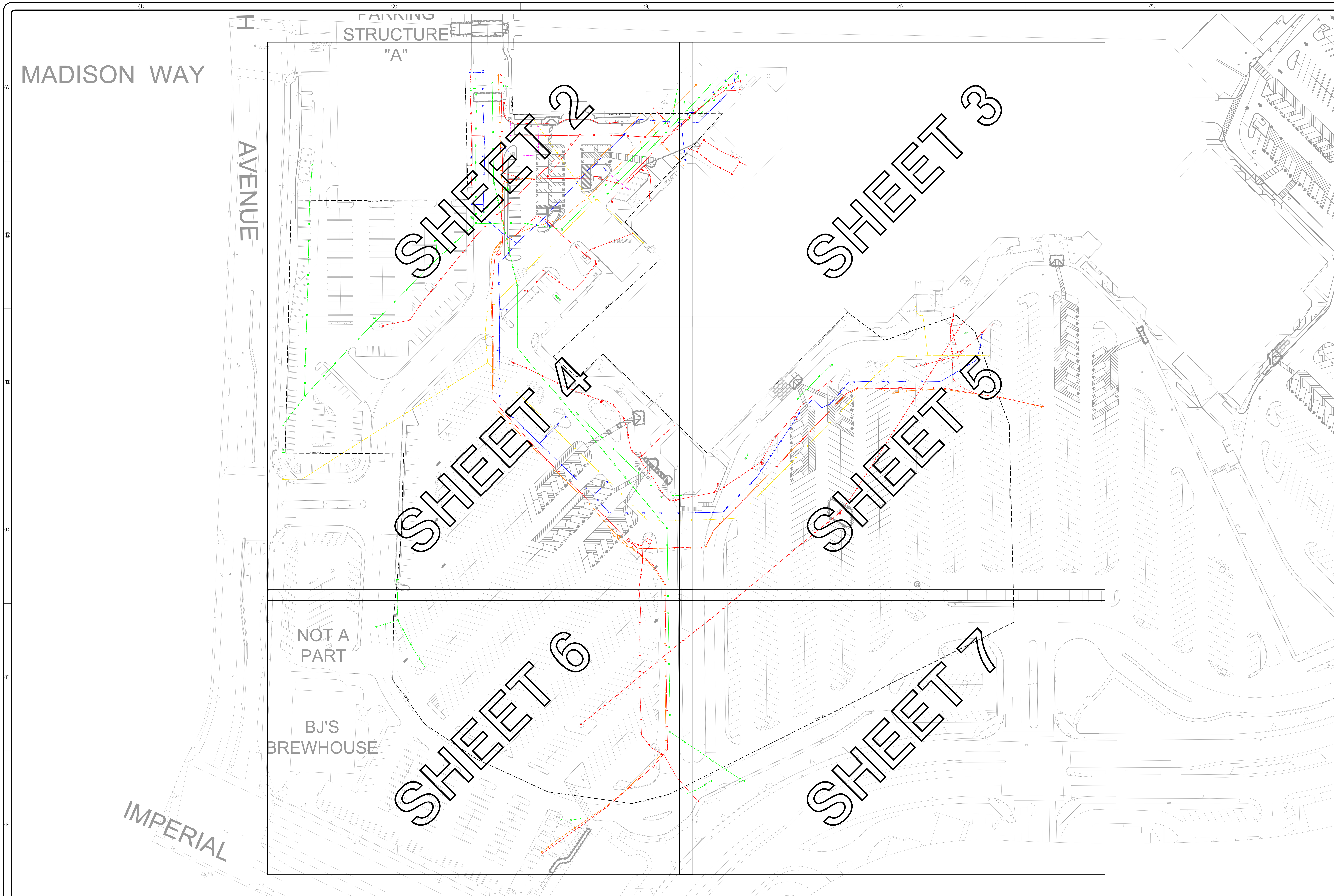
NO.	DATE	REVISION	APP.
1	8/31/76	REVISED S.D. LINES NO. 17, 17A, 18 & 26	C.K.
2	8/12/77	"AS BUILT"	B.M.M.

PLANS PREPARED UNDER THE SUPERVISION OF: Timothy Psomas R.C.E. 17643

PSOMAS & ASSOCIATES
CIVIL ENGINEERS · LAND SURVEYORS
1617 PONTIUS AVENUE · LOS ANGELES, CALIFORNIA · 90025 · (213) 478-3081

STORM DRAIN PROFILES
BREA MALL
IMPERIAL HIGHWAY AT ORANGE FREEWAY
BREA, CALIFORNIA
HOMART DEVELOPMENT CO.

PROJECT NO. 75278
DRAWN C.K. APPROVED
SW-12
DATE 5-17-76



UTILITY NOTES

1. FACILITIES (UTILITY LINES) SHALL BE LOCATED AND MARKED PRIOR TO EXCAVATION. CALL (800) 90-BELOW.
2. CONTRACTOR SHALL HAND-EXPOSE TO A POINT OF NO CONFLICT 24" ON EITHER SIDE OF THE UNDERGROUND FACILITY, REGARDLESS OF THE ESTIMATED DEPTH.
3. DEPTHS SHOWN ARE APPROXIMATE. ESTIMATED DEPTHS ARE FROM THE GROUND SURFACE TO THE CENTER OF THE FACILITY, INVERT OF WASTE LINES, OR TO THE FACILITY TRACER WIRE. DEPTH ESTIMATES SHOULD BE USED WITH CAUTION AND MAY VARY ALONG THE LENGTH OF THE FACILITY.
4. THE SCOPE OF THIS SURVEY DOES NOT INCLUDE FACILITY SIZE OR NUMBER OF CONDUIT IN MULTIPLE CONDUIT RUNS. IRRIGATION LINES ARE NOT INCLUDED IN THIS SURVEY.
5. THE BACKGROUND SITE PLAN USED IN PREPARING THIS MAP WAS PREPARED BY OTHERS AND PROVIDED TO C BELOW BY THE CLIENT. C BELOW MAKES NO REPRESENTATION AS TO THE ACCURACY OF THE PLAN.
6. IN THE EVENT THE INFORMATION SHOWN IN THIS PLAN VARIES FROM THE ACTUAL SITE CONDITIONS, C BELOW SHALL BE NOTIFIED WITHIN 24 HOURS AFTER DISCOVERY OF THE CONFLICT.

LEGEND

ELECTRICAL	E
GAS	G
COMMUNICATION	C
WATER	W
SANITARY SEWER	SS
STORM DRAIN	SD
POSSIBLE LINE LOCATION	U
STREET LIGHT	SL
AIR	AIR
TRAFFIC SIGNAL	TS
FIRE WATER	FW
CHILLED WATER	CHW
DOMESTIC WATER	DW
HOT WATER	HW

C BELOW SUBSURFACE IMAGING
14280 EUCLID AVE
CHINO, CA 91710

P: 888-902-3569
F: 909-606-6555
www.cbelow.com

GROUND PENETRATING RADAR (GPR)
UTILITY LOCATING
RADIOGRAPHY
POTHOLING
MAPPING

NOTES: The services provided by C Below, Inc. do not relieve the Client and/or property owner of the responsibility of having to comply with California Government Code §§4216-4216.9. It is expressly understood by the Client and/or owner that CBSI services are not a substitute for compliance with California Code §§4216-4216.9.

PROJECT:

PARTIAL UNDERGROUND UTILITY MAP FOR:
BREA MALL
1065 BREA MALL
BREA, CA 92821

CLIENT:

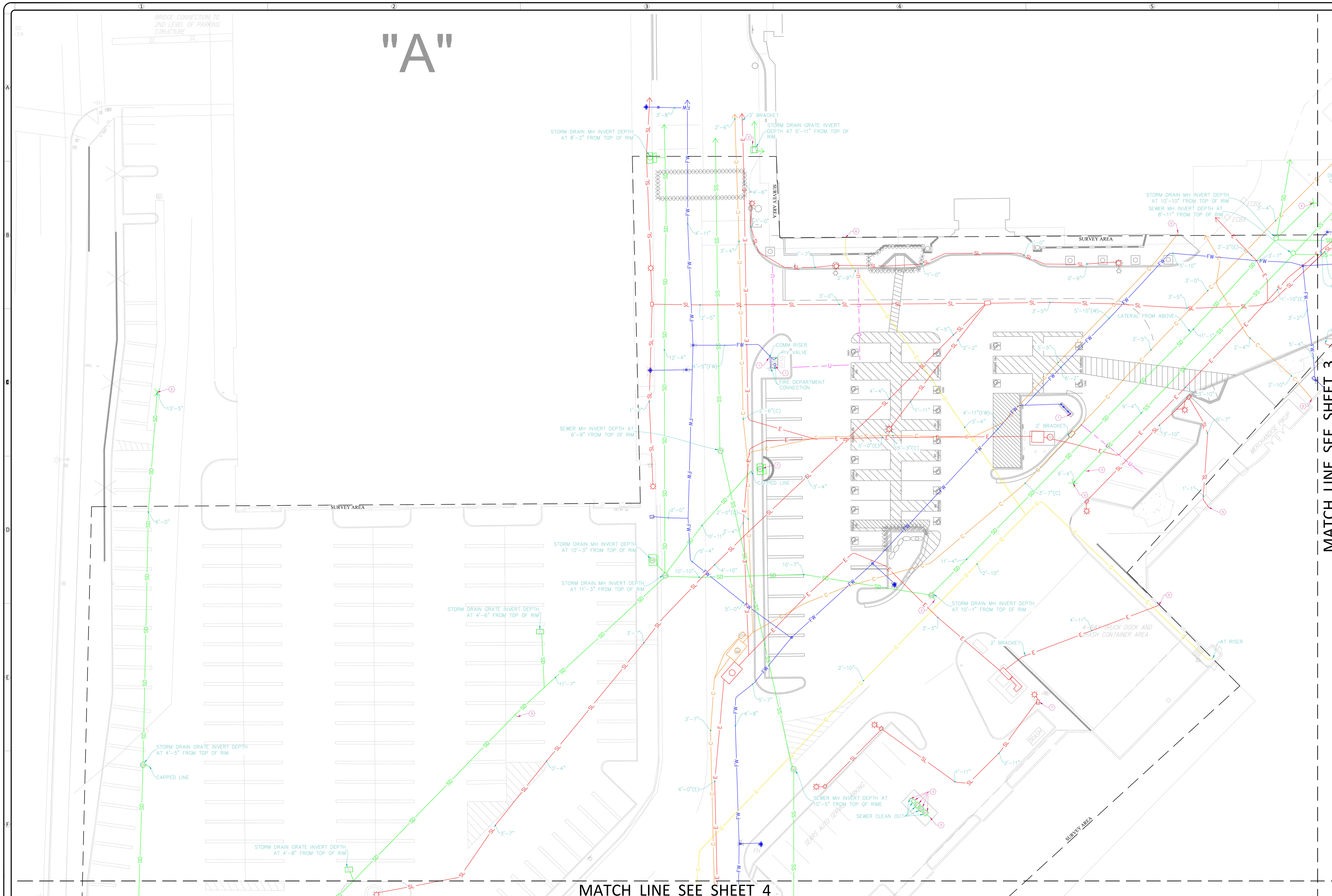
RA SMITH NATIONAL, LLC
8881 RESEARCH DR.
IRVINE, CA 92618

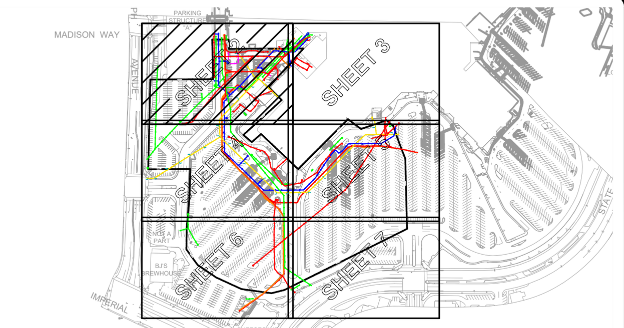
REVISIONS

NO	DATE	BY	DESCRIPTION

DATE LOCATED: 02/2018
DRAWN BY/DATE: JP 02/20/2018
TECHNICIAN CHECK BY/DATE: B. TRAHAN
QC CHECKED BY/DATE: OG 02/23/2018
SCALE: N.T.S
PROJECT NO: 17-1578

SHEET 1 OF 7





VICINITY MAP

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LEGEND

ELECTRICAL	E
GAS	G
COMMUNICATION	C
WATER	W
SANITARY SEWER	SS
STORM DRAIN	SD
POSSIBLE LINE LOCATION	U
STREET LIGHT	SL
AIR	AIR
TRAFFIC SIGNAL	TS
FIRE WATER	FW
CHILLED WATER	CHW
DOMESTIC WATER	DW
HOT WATER	HW
OFFSET FROM REFERENCE	10'-8"
DEPTH FROM SURFACE	1'-6"

KEY NOTES

1. NON-CONDUCTIVE, UNABLE TO LOCATE PAST THIS POINT.
2. BLOCKED
3. NO ACCESS, UNABLE TO LOCATE PAST THIS POINT.
4. CANNOT PUSH FURTHER PAST THIS POINT.
5. AT BUILDING
6. AT DROP
7. CANNOT OPEN, UNABLE TO LOCATE PAST THIS POINT.

20 10 0 20 40

SCALE IN FEET
1 inch =20 ft.

C BELOW SUBSURFACE IMAGING
14280 EUCLID AVE
CHINO, CA 91710

P: 888-902-3569
F: 909-606-6555
www.cbelow.com

GROUND PENETRATING RADAR (GPR)
UTILITY LOCATING
RADIOGRAPHY
POTHOLING
MAPPING

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PROJECT:
PARTIAL UNDERGROUND UTILITY MAP FOR:
BREA MALL
1065 BREA MALL
BREA, CA 92821

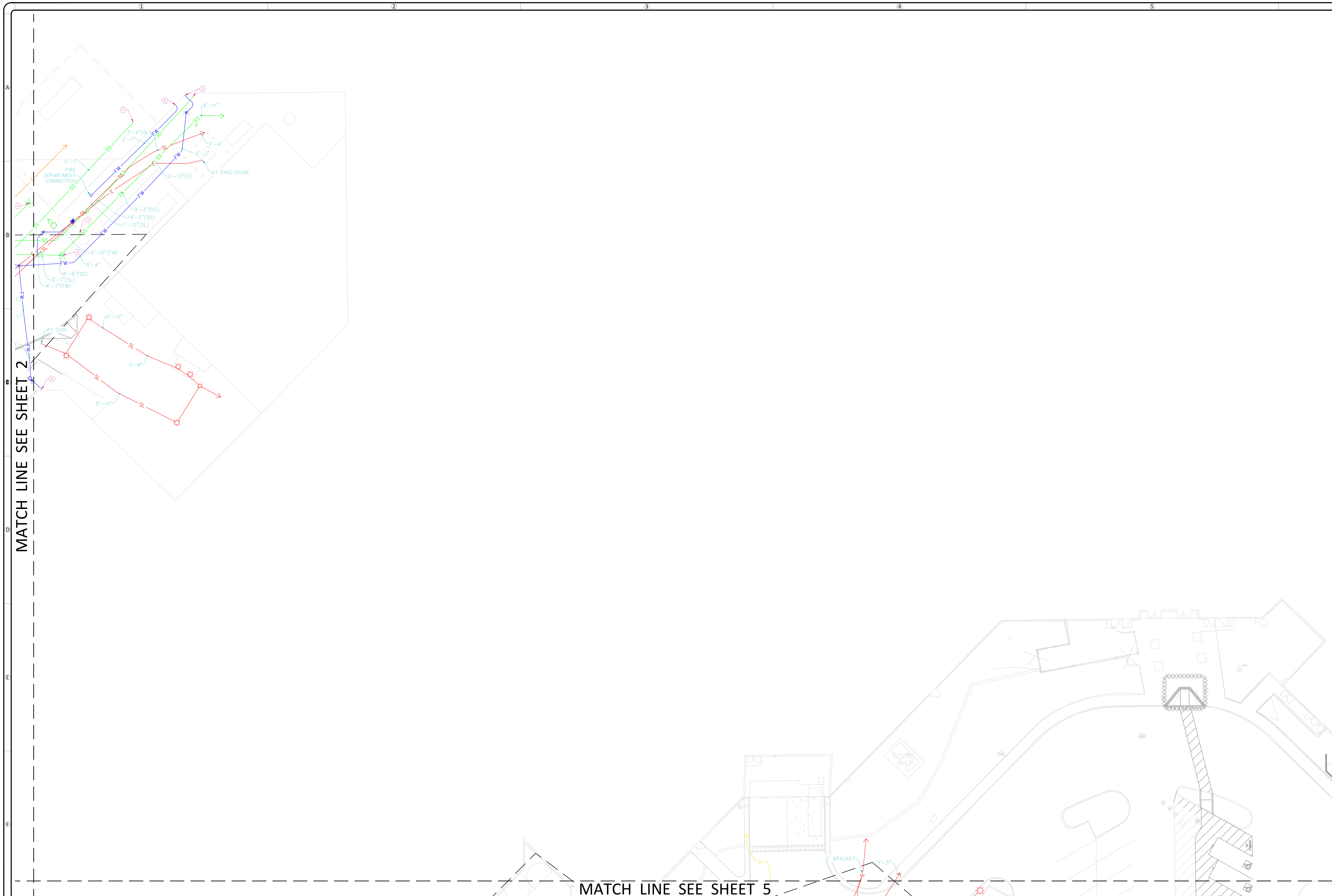
CLIENT:
RA SMITH NATIONAL, LLC
8881 RESEARCH DR.
IRVINE, CA 92618

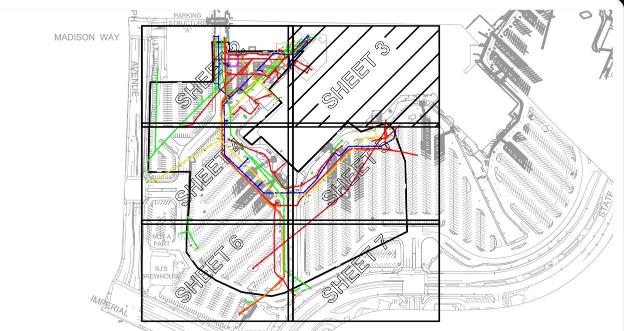
REVISIONS

NO	DATE	BY	DESCRIPTION

DATE LOCATED:	02/2018
DRAWN BY/DATE:	JP 02/20/2018
TECHNICIAN CHECK BY/DATE:	B. TRAHAN
QC CHECKED BY/DATE:	OG 02/23/2018
SCALE:	1" = 20'
PROJECT NO:	17-1578

SHEET 2 OF 7





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LEGEND

ELECTRICAL	E
GAS	G
COMMUNICATION	C
WATER	W
SANITARY SEWER	SS
STORM DRAIN	SD
POSSIBLE LINE LOCATION	U
STREET LIGHT	SL
AIR	AIR
TRAFFIC SIGNAL	TS
FIRE WATER	FW
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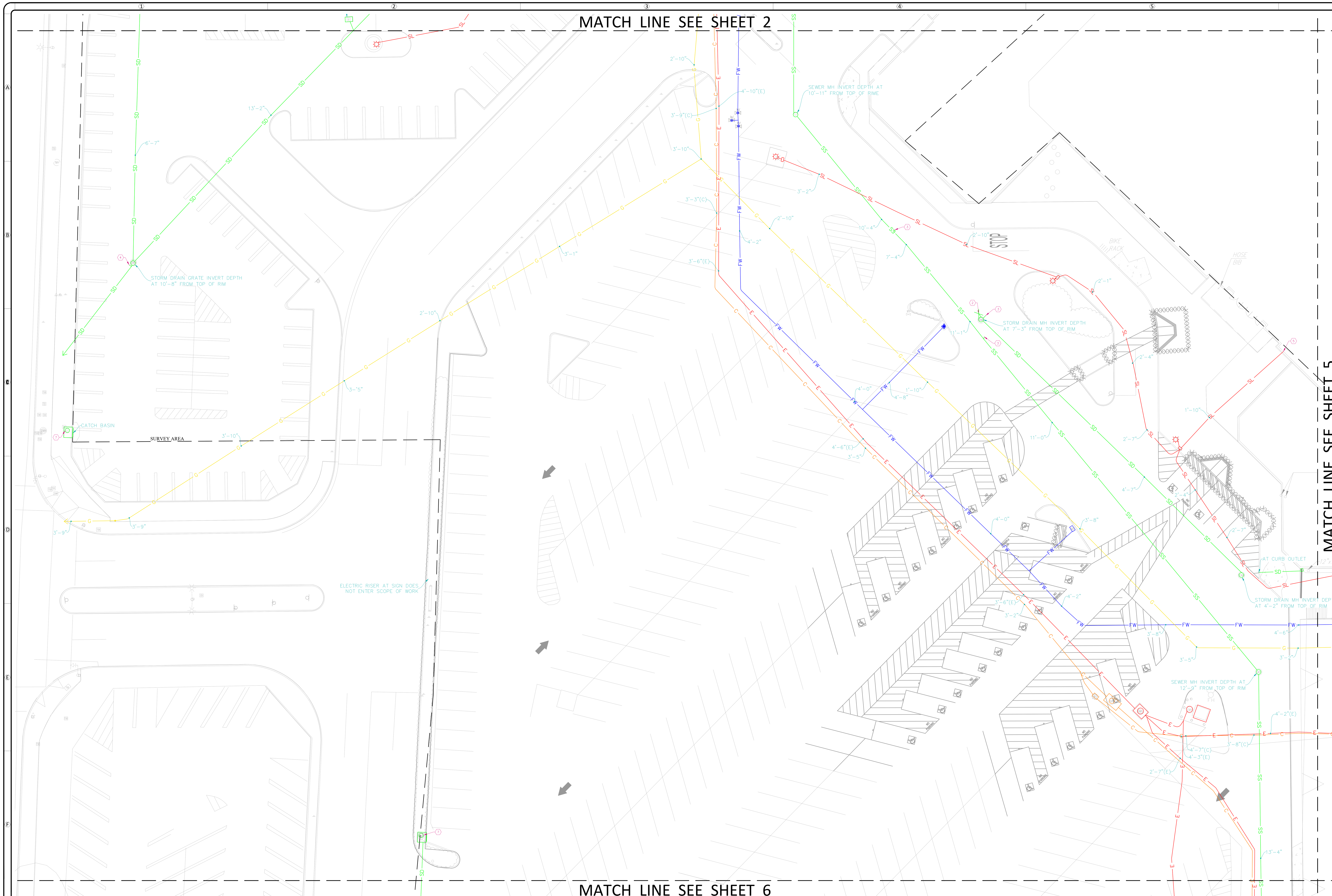
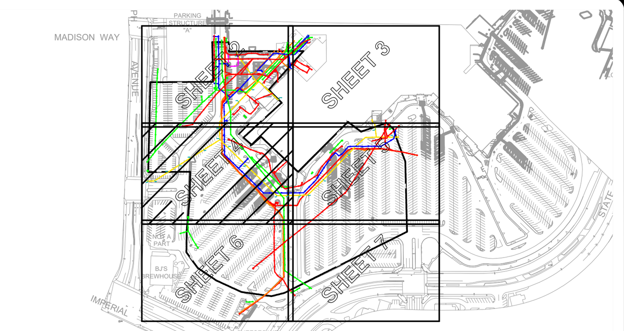
SHEET 3 OF 7





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LEGEND

ELECTRICAL	E
GAS	G
COMMUNICATION	C
WATER	W
SANITARY SEWER	SS
STORM DRAIN	SD
POSSIBLE LINE LOCATION	U
STREET LIGHT	SL
AIR	AIR
TRAFFIC SIGNAL	TS
FIRE WATER	FW
CHILLED WATER	CHW
DOMESTIC WATER	DW
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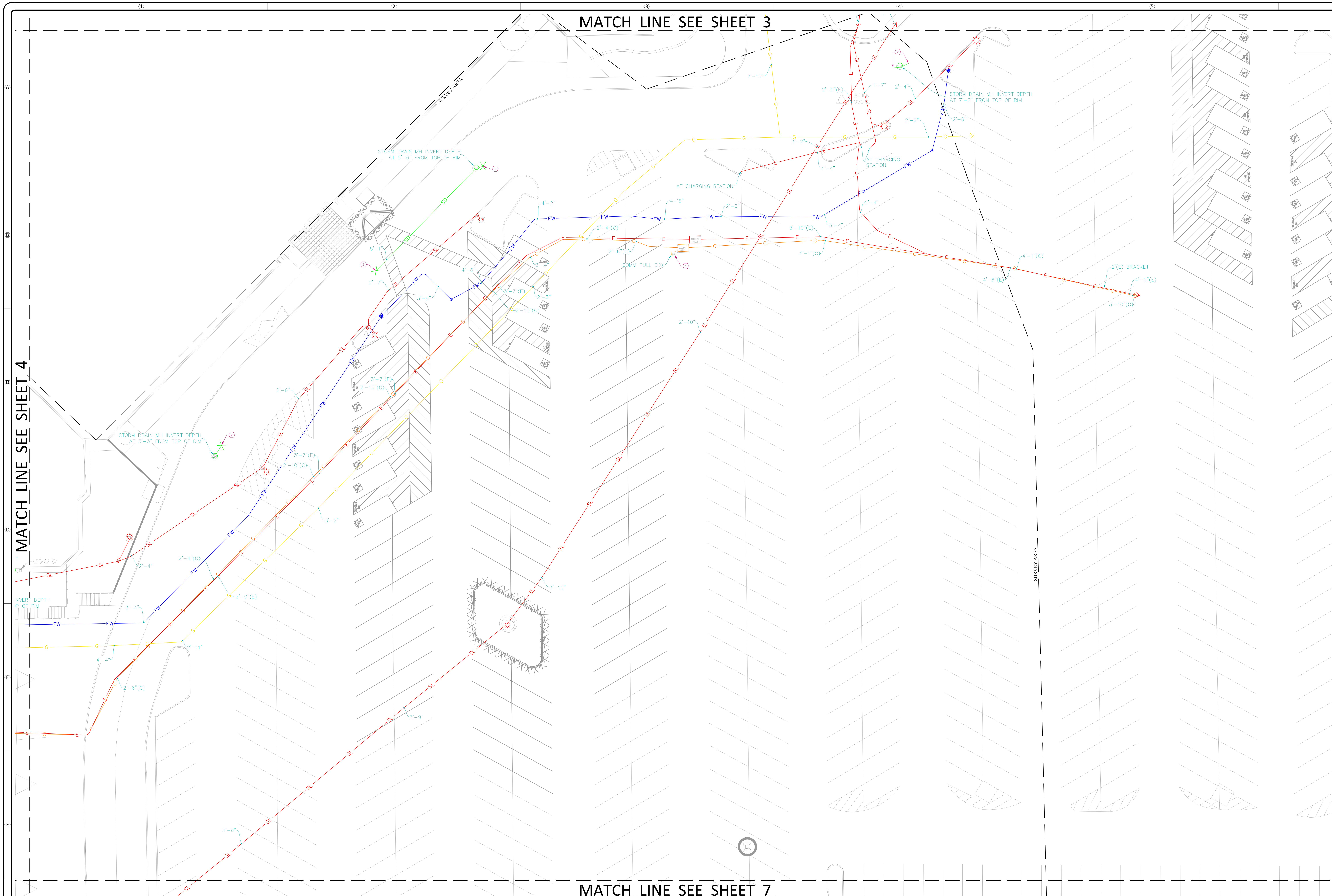
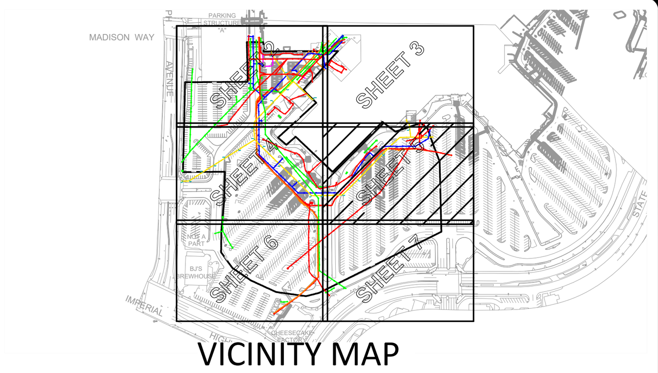
SHEET 4 OF 7

MATCH LINE SEE SHEET 3





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GAS	G
COMMUNICATION	C
WATER	W
SANITARY SEWER	SS
STORM DRAIN	SD
POSSIBLE LINE LOCATION	U
STREET LIGHT	SL
AIR	AIR
TRAFFIC SIGNAL	TS
FIRE WATER	FW
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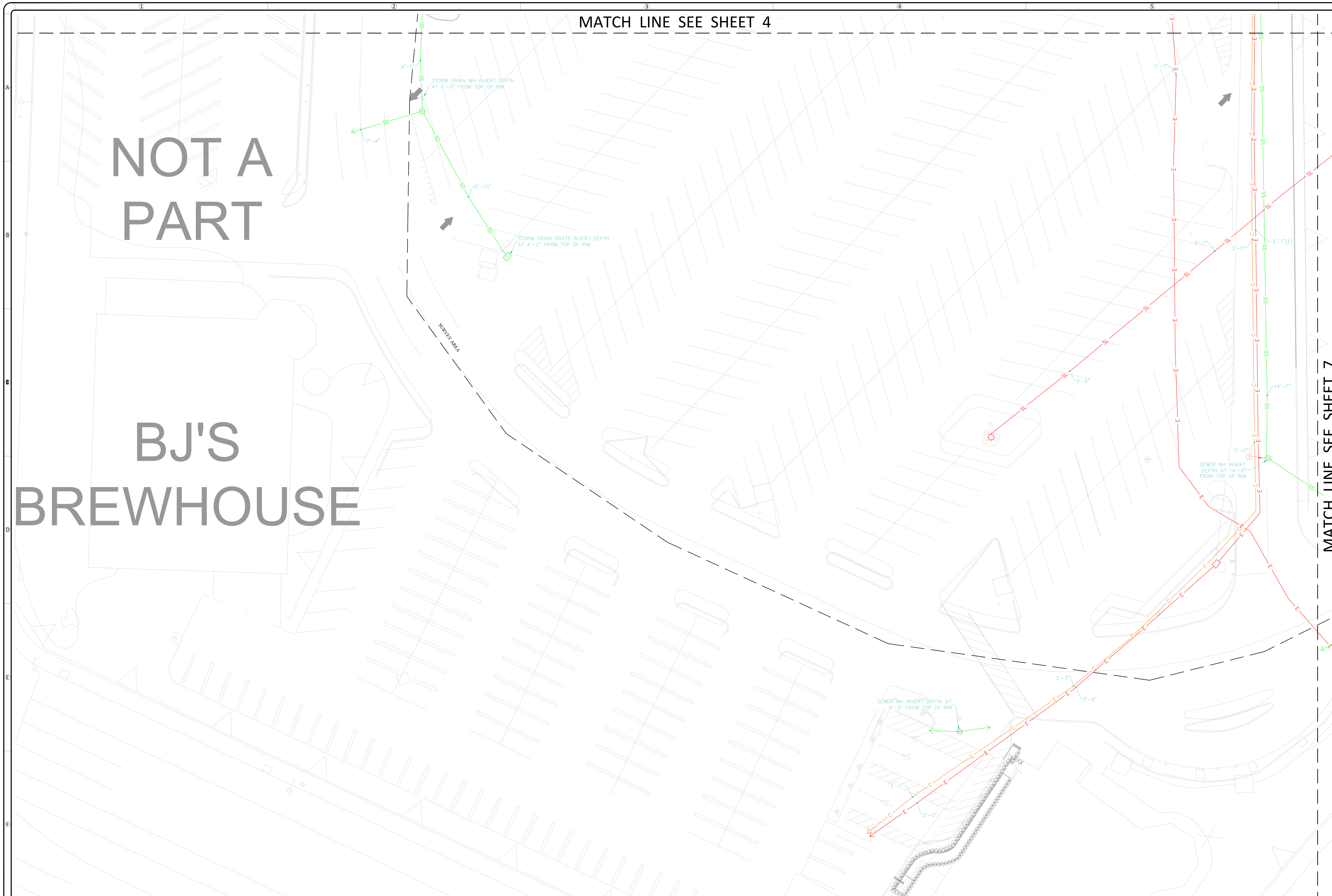

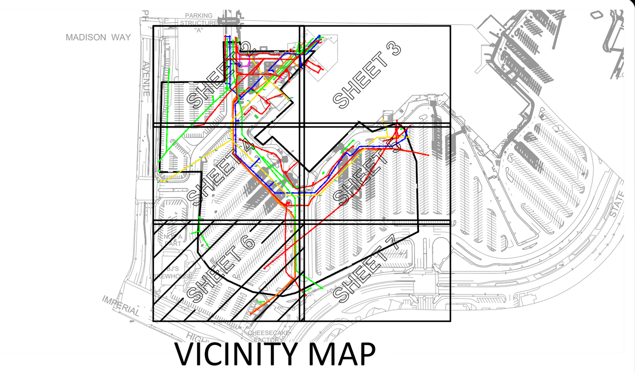

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GAS	G
COMMUNICATION	C
WATER	W
SANITARY SEWER	SS
STORM DRAIN	SD
POSSIBLE LINE LOCATION	U
STREET LIGHT	SL
AIR	AIR
TRAFFIC SIGNAL	TS
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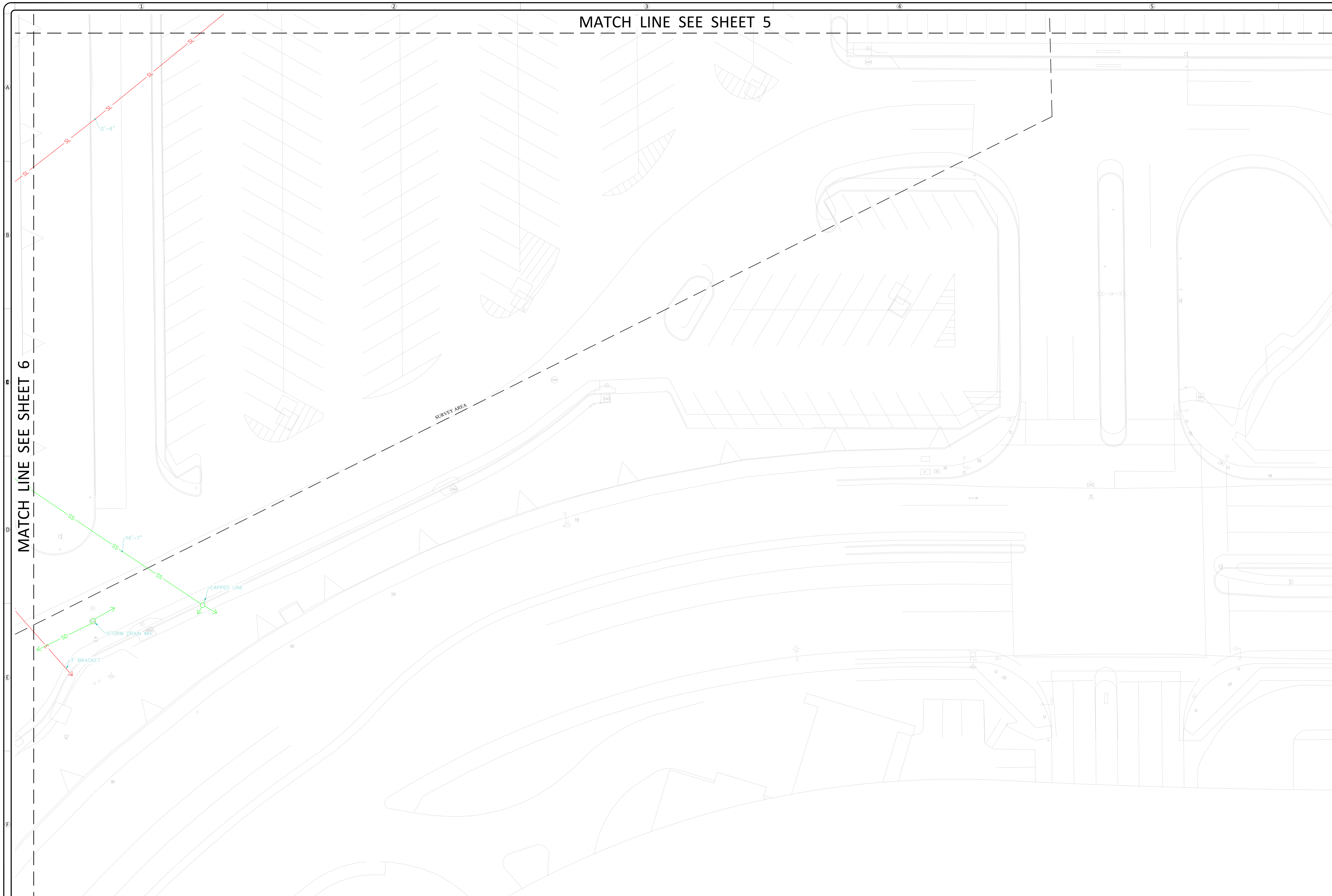
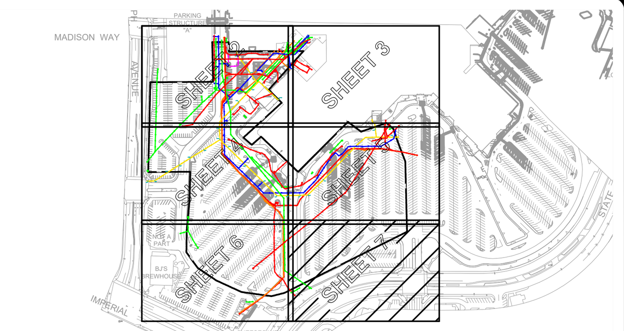
SHEET 6 OF 7





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GAS	G
COMMUNICATION	C
WATER	W
SANITARY SEWER	SS
STORM DRAIN	SD
POSSIBLE LINE LOCATION	U
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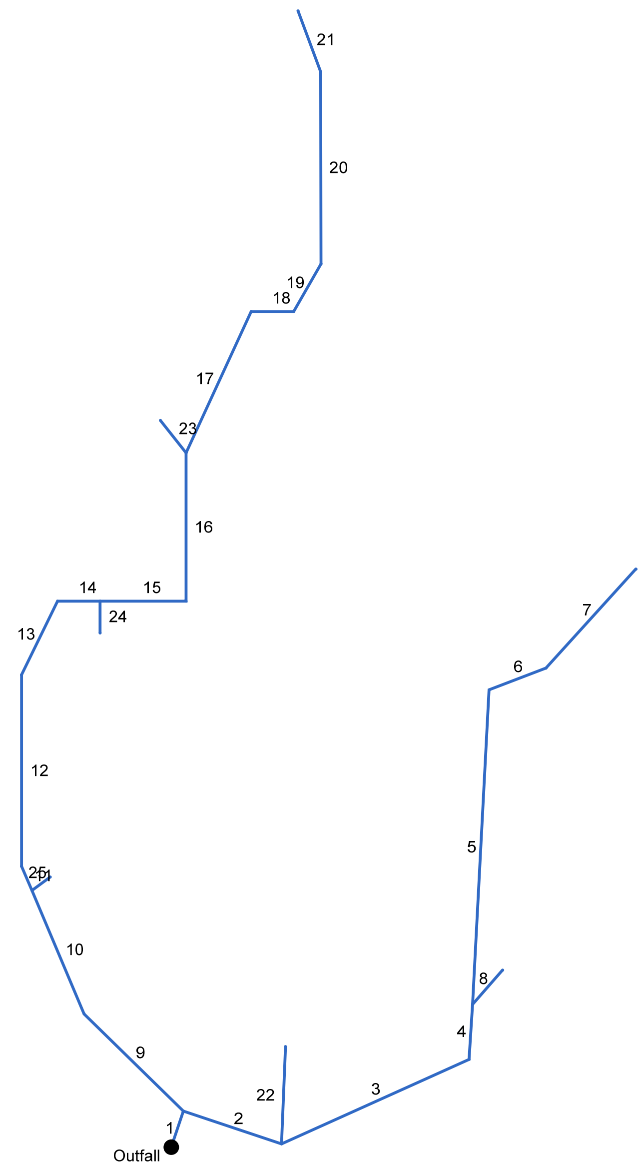
SHEET 7 OF 7

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: STO 100.stm	Number of lines: 25	Date: 10/28/2022

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
1	36	47.85	323.25	326.25	3.00	7.07	6.77	0.71	326.96	0.439	32.660	323.47	326.37	2.90	7.00	6.84	0.73	327.10	0.385	0.412	0.134	0.99	0.72
2	24	16.19	323.47	327.09	2.00	2.44	5.15	0.41	327.50	0.437	116.261	332.83	334.28 j	1.45**	2.44	6.64	0.69	334.96	0.570	0.503	n/a	1.00	0.69
3	24	15.30	332.83	334.28	1.45	2.37	6.27	0.65	334.93	0.000	226.794	338.22	339.63 j	1.41**	2.37	6.47	0.65	340.28	0.000	0.000	n/a	0.94	0.61
4	24	15.30	338.22	339.63	1.41*	2.37	6.47	0.65	340.28	0.000	45.131	339.40	340.81	1.41**	2.37	6.47	0.65	341.46	0.000	0.000	n/a	0.77	0.50
5	18	4.47	339.40	340.81	1.41	0.97	2.59	0.33	341.14	0.000	257.835	346.50	347.31 j	0.81**	0.97	4.59	0.33	347.64	0.000	0.000	n/a	0.95	0.31
6	18	4.47	346.50	347.31	0.81*	0.97	4.59	0.33	347.64	0.000	67.990	347.18	347.99	0.81**	0.97	4.59	0.33	348.32	0.000	0.000	n/a	0.45	0.15
7	18	4.47	347.18	347.99	0.81*	0.97	4.59	0.33	348.32	0.000	131.407	348.51	349.32	0.81**	0.97	4.59	0.33	349.65	0.000	0.000	n/a	1.00	0.33
8	12	1.37	339.40	340.81	1.00	0.79	1.74	0.05	340.86	0.126	44.656	339.85	340.85	1.00	0.79	1.74	0.05	340.90	0.124	0.125	0.056	1.00	0.05
9	36	31.66	323.47	327.09	3.00	7.07	4.48	0.31	327.40	0.192	139.574	324.41	327.34	2.93	7.03	4.51	0.32	327.65	0.171	0.181	0.253	0.47	0.15
10	36	31.66	324.41	327.49	3.00	7.07	4.48	0.31	327.80	0.192	117.356	325.20	327.61	2.41	6.09	5.20	0.42	328.03	0.199	0.196	0.230	1.00	0.42
11	36	26.28	325.20	328.03	2.83	4.00	3.80	0.67	328.70	0.000	23.122	325.40	327.05	1.65**	4.00	6.58	0.67	327.73	0.000	0.000	n/a	0.57	n/a
12	36	26.28	325.40	327.05	1.65*	4.00	6.58	0.67	327.73	0.000	156.495	326.73	328.38	1.65**	4.00	6.58	0.67	329.06	0.000	0.000	n/a	0.62	n/a
13	36	26.28	326.73	328.38	1.65*	4.00	6.58	0.67	329.06	0.000	73.206	329.23	330.88	1.65**	4.00	6.58	0.67	331.56	0.000	0.000	n/a	0.85	n/a
14	30	26.28	329.23	330.88	1.65	3.45	7.62	0.80	331.69	0.000	49.040	329.55	331.30	1.75**	3.66	7.18	0.80	332.10	0.000	0.000	n/a	1.00	0.80
15	30	20.73	329.55	331.30	1.75	3.19	5.66	0.66	331.95	0.000	99.004	330.19	331.74 j	1.55**	3.19	6.51	0.66	332.39	0.000	0.000	n/a	1.00	n/a
16	30	20.73	330.19	331.74	1.55*	3.19	6.51	0.66	332.39	0.000	121.184	330.98	332.53	1.55**	3.19	6.51	0.66	333.18	0.000	0.000	n/a	0.78	n/a
17	30	9.87	330.98	332.53	1.55	1.95	3.10	0.40	332.92	0.000	137.819	332.36	333.41 j	1.05**	1.95	5.05	0.40	333.81	0.000	0.000	n/a	0.87	n/a
18	24	8.83	332.36	333.41	1.05	1.67	5.29	0.42	333.83	0.000	49.000	333.53	334.59	1.06**	1.69	5.23	0.42	335.01	0.000	0.000	n/a	0.81	0.34
19	24	8.83	333.53	334.59	1.06*	1.69	5.23	0.42	335.01	0.000	49.983	334.05	335.11	1.06**	1.69	5.23	0.42	335.53	0.000	0.000	n/a	0.68	0.29
20	24	2.99	334.06	335.11	1.05	0.80	1.79	0.22	335.33	0.000	157.000	334.84	335.44 j	0.60**	0.80	3.75	0.22	335.66	0.000	0.000	n/a	0.52	0.11
21	10	0.88	334.84	335.44	0.60	0.27	2.08	0.16	335.61	0.000	56.246	335.16	335.58 j	0.42**	0.27	3.24	0.16	335.74	0.000	0.000	n/a	1.00	n/a

Project File: STO 100.stm	Number of lines: 25	Run Date: 10/28/2022

Notes: * depth assumed; ** Critical depth.; j-Line contains hyd. jump ; c = cir e = ellip b = box

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
22	12	0.89	332.83	334.28	1.00	0.79	1.13	0.02	334.30	0.053	79.422	333.62	334.31	0.69	0.58	1.53	0.04	334.35	0.078	0.065	0.052	1.00	0.04
23	18	7.96	330.98	332.53	1.50	1.77	4.51	0.32	332.84	0.490	39.795	331.37	332.65	1.28	1.60	4.97	0.38	333.03	0.460	0.475	0.189	1.00	0.38
24	18	4.89	329.05	331.30	1.50	1.03	2.77	0.12	331.42	0.185	26.044	330.62	331.47 j	0.85**	1.03	4.74	0.35	331.82	0.490	0.337	n/a	1.00	n/a
25	18	5.38	327.53	328.43	0.90*	1.10	4.86	0.37	328.80	0.496	24.166	327.65	328.55	0.90**	1.11	4.86	0.37	328.92	0.494	0.495	0.120	1.00	0.37

Project File: STO 100.stm | Number of lines: 25 | Run Date: 10/28/2022

Notes: * depth assumed; ** Critical depth.; j-Line contains hyd. jump ; c = cir e = ellip b = box

Hydraflow HGL Computation Procedure

General Procedure:

Hydraflow computes the HGL using the Bernoulli energy equation. Manning's equation is used to determine energy losses due to pipe friction. In a standard step, iterative procedure, Hydraflow assumes upstream HGLs until the energy equation balances. If the energy equation cannot balance, supercritical flow exists and critical depth is temporarily assumed at the upstream end. A supercritical flow Profile is then computed using the same procedure in a downstream direction using momentum principles.

Col. 1 The line number being computed. Calculations begin at Line 1 and proceed upstream.

Col. 2 The line size. In the case of non-circular pipes, the line rise is printed above the span.

Col. 3 Total flow rate in the line.

Col. 4 The elevation of the downstream invert.

Col. 5 Elevation of the hydraulic grade line at the downstream end. This is computed as the upstream HGL + Minor loss of this line's downstream line.

Col. 6 The downstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

Col. 7 Cross-sectional area of the flow at the downstream end.

Col. 8 The velocity of the flow at the downstream end, (Col. 3 / Col. 7).

Col. 9 Velocity head (Velocity squared / 2g).

Col. 10 The elevation of the energy grade line at the downstream end, HGL + Velocity head, (Col. 5 + Col. 9).

Col. 11 The friction slope at the downstream end (the S or Slope term in Manning's equation).

Col. 12 The line length.

Col. 13 The elevation of the upstream invert.

Col. 14 Elevation of the hydraulic grade line at the upstream end.

Col. 15 The upstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

Col. 16 Cross-sectional area of the flow at the upstream end.

Col. 17 The velocity of the flow at the upstream end, (Col. 3 / Col. 16).

Col. 18 Velocity head (Velocity squared / 2g).

Col. 19 The elevation of the energy grade line at the upstream end, HGL + Velocity head, (Col. 14 + Col. 18) .

Col. 20 The friction slope at the upstream end (the S or Slope term in Manning's equation).

Col. 21 The average of the downstream and upstream friction slopes.

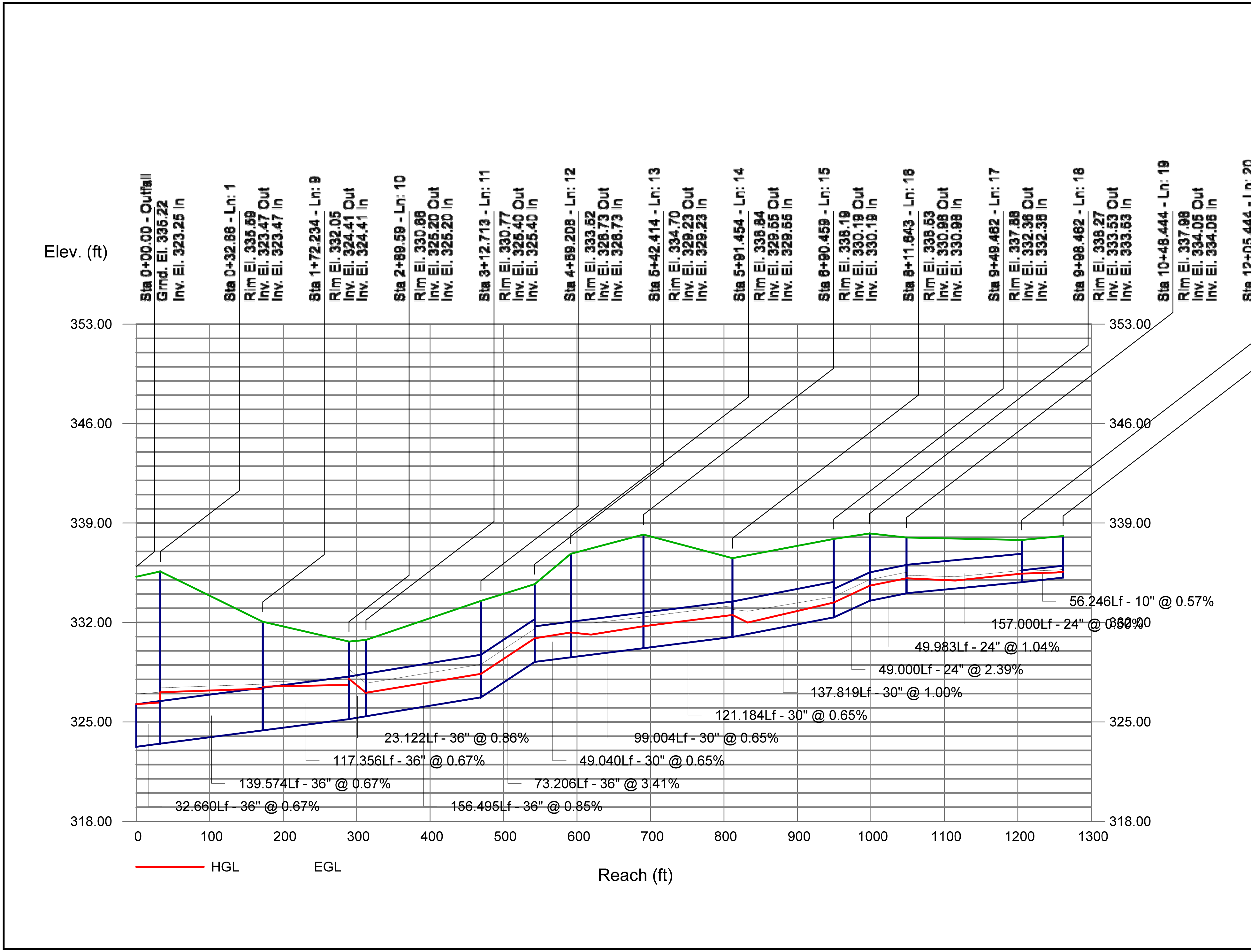
Col. 22 Energy loss. Average Sf/100 x Line Length (Col. 21/100 x Col. 12). Equals (EGL upstream - EGL downstream) +/- tolerance.

Col. 23 The junction loss coefficient (K).

Col. 24 Minor loss. (Col. 23 x Col. 18). Is added to upstream HGL and used as the starting HGL for the next upstream line(s).

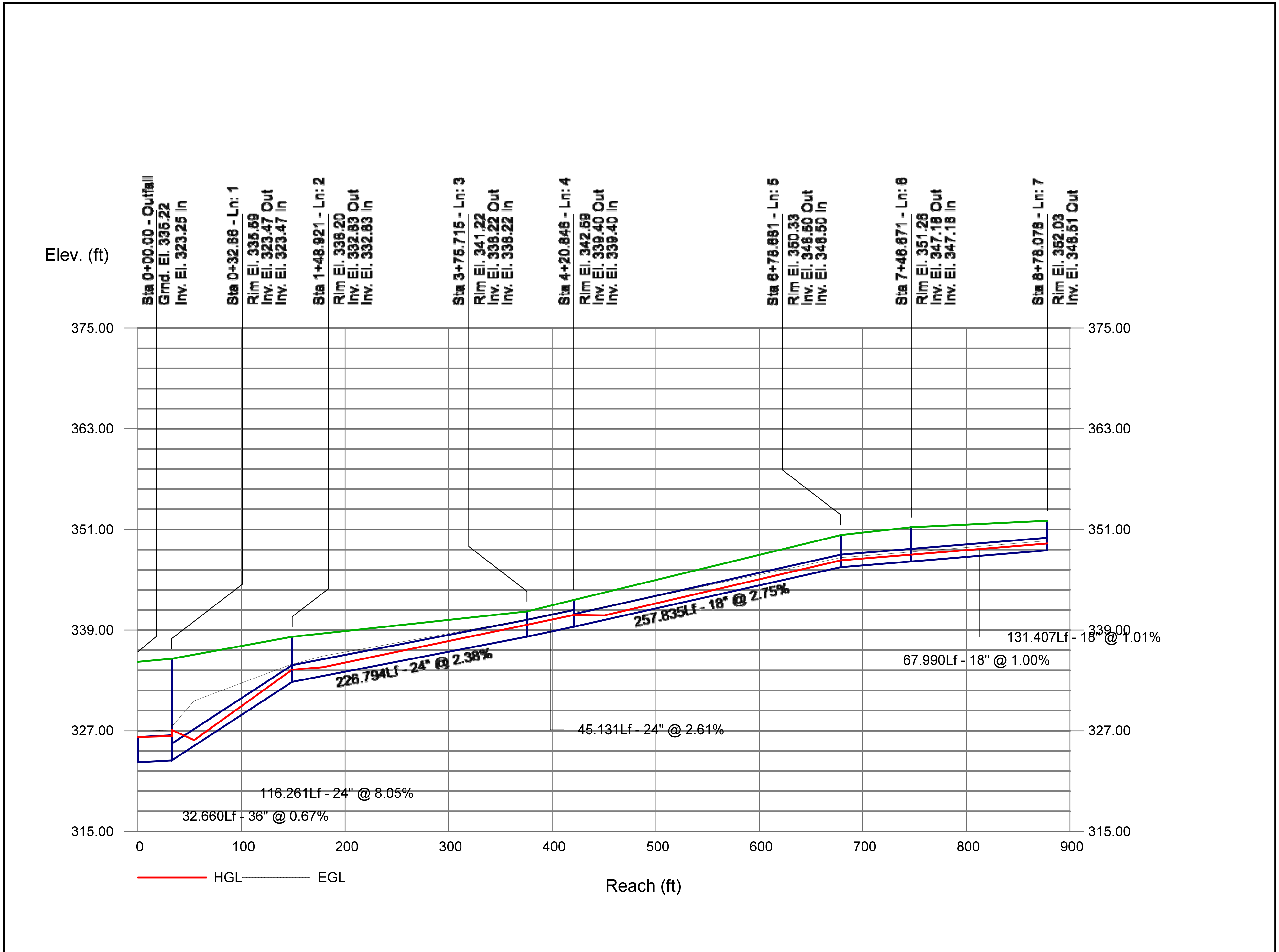
Storm Sewer Profile

Proj. file: STO 100.stm

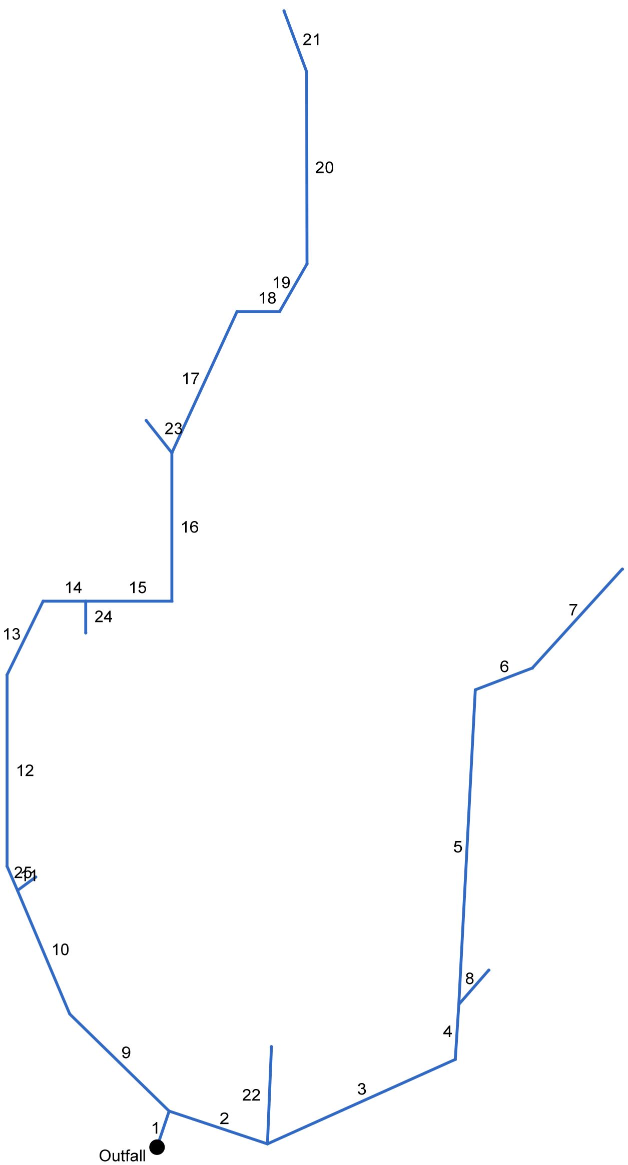


Storm Sewer Profile

Proj. file: STO 100.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: STO 100.stm	Number of lines: 25	Date: 10/28/2022

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
(1)	(in) (2)	(cfs) (3)	Invert elev (ft) (4)	HGL elev (ft) (5)	Depth (ft) (6)	Area (sqft) (7)	Vel (ft/s) (8)	Vel head (ft) (9)	EGL elev (ft) (10)	Sf (%) (11)	(ft) (12)	Invert elev (ft) (13)	HGL elev (ft) (14)	Depth (ft) (15)	Area (sqft) (16)	Vel (ft/s) (17)	Vel head (ft) (18)	EGL elev (ft) (19)	Sf (%) (20)	Ave Sf (%) (21)	Enrgy loss (ft) (22)	(K) (23)	(ft) (24)
1	36	56.95	323.25	326.25	3.00	7.07	8.06	1.01	327.26	0.622	32.660	323.47	326.44	2.97	7.06	8.07	1.01	327.46	0.574	0.598	0.195	0.99	1.00
2	24	19.28	323.47	327.44	2.00	2.66	6.14	0.59	328.03	0.619	116.261	332.83	334.41 j	1.58**	2.66	7.25	0.82	335.23	0.666	0.643	n/a	1.00	n/a
3	24	18.22	332.83	334.41	1.58	2.59	6.85	0.77	335.18	0.000	226.794	338.22	339.76 j	1.54**	2.59	7.04	0.77	340.53	0.000	0.000	n/a	0.94	n/a
4	24	18.22	338.22	339.76	1.54*	2.59	7.04	0.77	340.53	0.000	45.131	339.40	340.94	1.54**	2.59	7.04	0.77	341.71	0.000	0.000	n/a	0.77	n/a
5	18	5.32	339.40	340.94	1.50	1.09	3.01	0.14	341.08	0.219	257.835	346.50	347.39 j	0.89**	1.09	4.89	0.37	347.76	0.505	0.362	n/a	0.95	0.35
6	18	5.32	346.50	347.39	0.89*	1.09	4.89	0.37	347.76	0.000	67.990	347.18	348.07	0.89**	1.09	4.89	0.37	348.44	0.000	0.000	n/a	0.45	0.17
7	18	5.32	347.18	348.07	0.89*	1.09	4.89	0.37	348.44	0.000	131.407	348.51	349.40	0.89**	1.09	4.89	0.37	349.77	0.000	0.000	n/a	1.00	0.37
8	12	1.63	339.40	340.94	1.00	0.79	2.08	0.07	341.00	0.179	44.656	339.85	341.02	1.00	0.79	2.08	0.07	341.08	0.179	0.179	0.080	1.00	0.07
9	36	37.67	323.47	327.44	3.00	7.07	5.33	0.44	327.89	0.272	139.574	324.41	327.82	3.00	7.07	5.33	0.44	328.27	0.272	0.272	0.379	0.47	0.21
10	36	37.67	324.41	328.03	3.00	7.07	5.33	0.44	328.47	0.272	117.356	325.20	328.35	3.00	7.07	5.33	0.44	328.79	0.272	0.272	0.319	1.00	0.44
11	36	31.28	325.20	328.79	3.00	7.07	4.43	0.30	329.10	0.188	23.122	325.40	328.84	3.00	7.07	4.43	0.30	329.14	0.187	0.187	0.043	0.57	0.17
12	36	31.28	325.40	329.01	3.00	7.07	4.43	0.30	329.31	0.188	156.495	326.73	329.22	2.49	6.27	4.99	0.39	329.61	0.184	0.186	0.290	0.62	0.24
13	36	31.28	326.73	329.46	2.73	4.46	4.63	0.76	330.22	0.000	73.206	329.23	331.04 j	1.81**	4.46	7.01	0.76	331.81	0.000	0.000	n/a	0.85	n/a
14	30	31.28	329.23	331.04	1.81	3.81	8.21	0.95	331.99	0.000	49.040	329.55	331.45	1.90**	4.01	7.80	0.95	332.40	0.000	0.000	n/a	1.00	0.95
15	30	24.68	329.55	331.45	1.90	3.53	6.15	0.76	332.21	0.000	99.004	330.19	331.88 j	1.69**	3.53	6.98	0.76	332.64	0.000	0.000	n/a	1.00	n/a
16	30	24.68	330.19	331.88	1.69*	3.53	6.98	0.76	332.64	0.000	121.184	330.98	332.67	1.69**	3.53	6.98	0.76	333.43	0.000	0.000	n/a	0.78	n/a
17	30	11.76	330.98	332.67	1.69	2.20	3.33	0.44	333.11	0.000	137.819	332.36	333.51 j	1.15**	2.20	5.34	0.44	333.95	0.000	0.000	n/a	0.87	n/a
18	24	10.52	332.36	333.51	1.15	1.87	5.63	0.48	333.99	0.000	49.000	333.53	334.69	1.16**	1.89	5.56	0.48	335.17	0.000	0.000	n/a	0.81	0.39
19	24	10.52	333.53	334.69	1.16*	1.89	5.56	0.48	335.17	0.000	49.983	334.05	335.21	1.16**	1.89	5.56	0.48	335.69	0.000	0.000	n/a	0.68	0.33
20	24	3.56	334.06	335.21	1.15	0.90	1.90	0.24	335.45	0.000	157.000	334.84	335.50 j	0.66**	0.90	3.94	0.24	335.74	0.000	0.000	n/a	0.52	n/a
21	10	1.05	334.84	335.50	0.66	0.30	2.27	0.08	335.58	0.209	56.246	335.16	335.62 j	0.46**	0.31	3.43	0.18	335.80	0.575	0.392	0.221	1.00	0.18

Project File: STO 100.stm | Number of lines: 25 | Run Date: 10/28/2022

Notes: * depth assumed; ** Critical depth.; j-Line contains hyd. jump ; c = cir e = ellip b = box

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
22	12	1.06	332.83	334.41	1.00	0.79	1.35	0.03	334.44	0.076	79.422	333.62	334.46	0.84	0.70	1.51	0.04	334.49	0.073	0.074	0.059	1.00	0.04
23	18	9.46	330.98	332.67	1.50	1.77	5.35	0.45	333.12	0.692	39.795	331.37	332.95	1.50	1.77	5.35	0.45	333.39	0.692	0.692	0.275	1.00	0.45
24	18	5.81	329.05	331.45	1.50	1.15	3.29	0.17	331.62	0.261	26.044	330.62	331.55 j	0.93**	1.15	5.05	0.40	331.95	0.524	0.393	n/a	1.00	n/a
25	18	6.39	327.53	328.79	1.26	1.59	4.02	0.25	329.04	0.302	24.166	327.65	328.84	1.19	1.50	4.25	0.28	329.12	0.336	0.319	0.077	1.00	0.28

Project File: STO 100.stm	Number of lines: 25	Run Date: 10/28/2022

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Col. 3 Total flow rate in the line.

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Col. 6 The downstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

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Col. 8 The velocity of the flow at the downstream end, (Col. 3 / Col. 7).

Col. 9 Velocity head (Velocity squared / 2g).

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Col. 11 The friction slope at the downstream end (the S or Slope term in Manning's equation).

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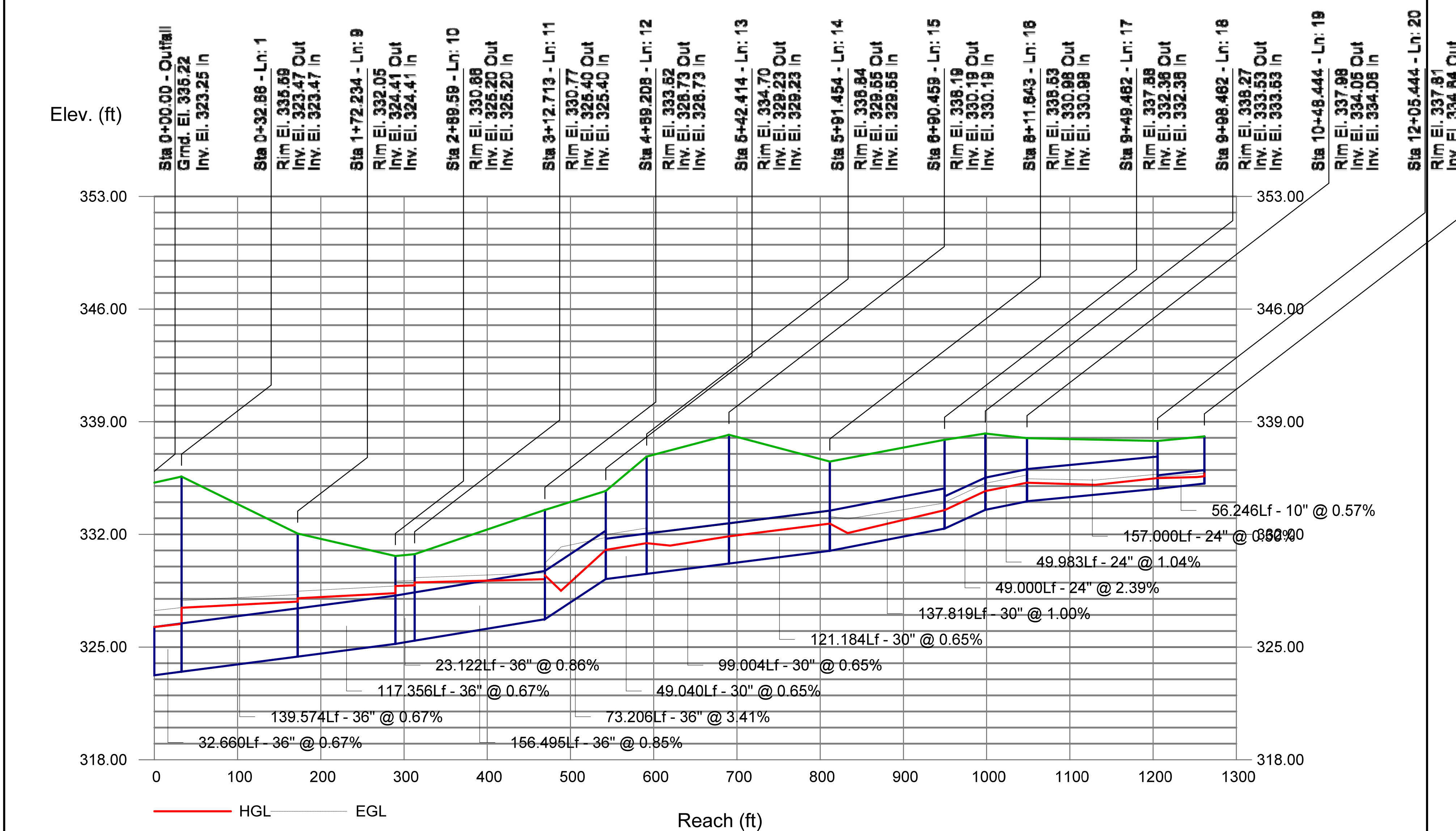
Storm Sewer Profile

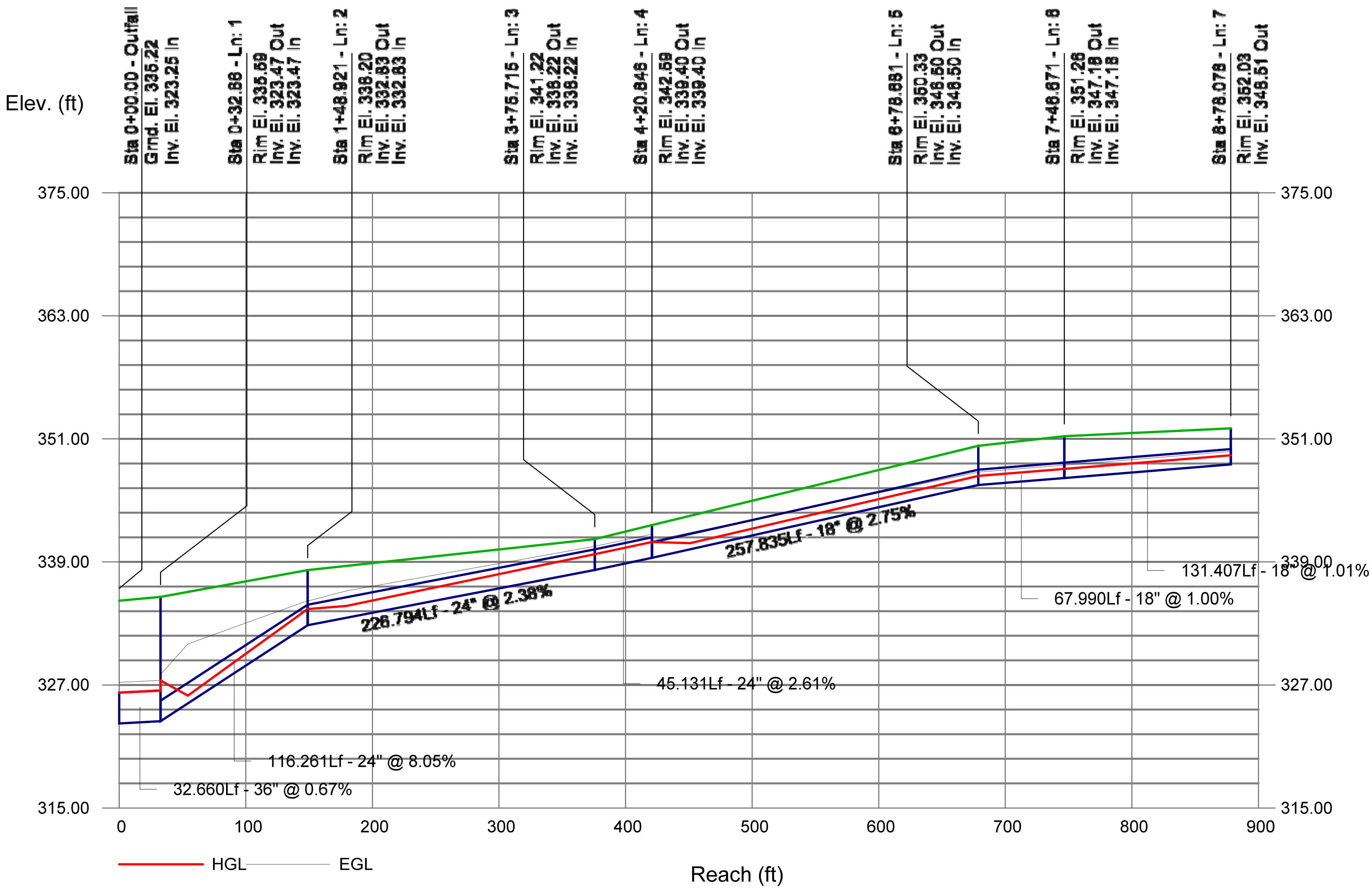
Proj. file: STO 100.stm



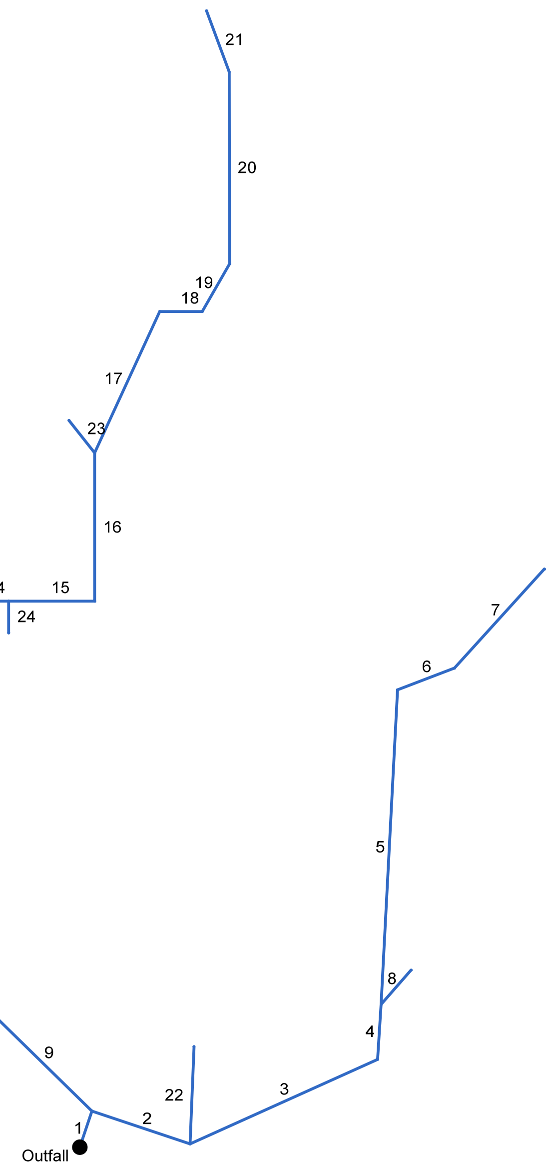
Storm Sewers

Storm Sewer Profile

Proj. file: STO 100.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: STO 100.stm	Number of lines: 25	Date: 10/28/2022

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
1	36	72.93	323.25	326.25	3.00	7.07	10.32	1.66	327.91	1.019	32.660	323.47	326.58	3.00	7.07	10.32	1.66	328.24	1.019	1.019	0.333	0.99	1.64
2	24	24.67	323.47	328.22	2.00	2.92	7.85	0.96	329.18	1.014	116.261	332.83	334.58 j	1.75**	2.92	8.46	1.11	335.69	0.917	0.966	n/a	1.00	n/a
3	24	23.31	332.83	334.58	1.75	2.87	7.99	1.03	335.61	0.000	226.794	338.22	339.93 j	1.71**	2.87	8.13	1.03	340.96	0.000	0.000	n/a	0.94	n/a
4	24	23.31	338.22	339.93	1.71*	2.87	8.13	1.03	340.96	0.000	45.131	339.40	341.11	1.71**	2.87	8.13	1.03	342.14	0.000	0.000	n/a	0.77	n/a
5	18	6.81	339.40	341.11	1.50	1.26	3.85	0.23	341.35	0.358	257.835	346.50	347.51 j	1.01**	1.26	5.39	0.45	347.96	0.569	0.464	n/a	0.95	n/a
6	18	6.81	346.50	347.51	1.01*	1.26	5.39	0.45	347.96	0.000	67.990	347.18	348.19	1.01**	1.26	5.39	0.45	348.64	0.000	0.000	n/a	0.45	n/a
7	18	6.81	347.18	348.19	1.01*	1.26	5.39	0.45	348.64	0.000	131.407	348.51	349.52	1.01**	1.26	5.39	0.45	349.97	0.000	0.000	n/a	1.00	n/a
8	12	2.08	339.40	341.11	1.00	0.79	2.65	0.11	341.22	0.291	44.656	339.85	341.24	1.00	0.79	2.65	0.11	341.35	0.291	0.291	0.130	1.00	0.11
9	36	48.26	323.47	328.22	3.00	7.07	6.83	0.72	328.95	0.446	139.574	324.41	328.85	3.00	7.07	6.83	0.72	329.57	0.446	0.446	0.623	0.47	0.34
10	36	48.26	324.41	329.19	3.00	7.07	6.83	0.72	329.91	0.446	117.356	325.20	329.71	3.00	7.07	6.83	0.72	330.43	0.446	0.446	0.524	1.00	0.72
11	36	40.07	325.20	330.43	3.00	7.07	5.67	0.50	330.93	0.308	23.122	325.40	330.51	3.00	7.07	5.67	0.50	331.01	0.308	0.308	0.071	0.57	0.28
12	36	40.07	325.40	330.79	3.00	7.07	5.67	0.50	331.29	0.308	156.495	326.73	331.27	3.00	7.07	5.67	0.50	331.77	0.308	0.308	0.481	0.62	0.31
13	36	40.07	326.73	331.58	3.00	7.07	5.67	0.50	332.08	0.308	73.206	329.23	331.63	2.40	6.07	6.60	0.68	332.31	0.321	0.314	0.230	0.85	0.58
14	30	40.07	329.23	332.21	2.50	4.91	8.16	1.04	333.25	0.814	49.040	329.55	332.61	2.50	4.91	8.16	1.04	333.65	0.813	0.814	0.399	1.00	1.04
15	30	31.61	329.55	333.65	2.50	4.91	6.44	0.64	334.29	0.506	99.004	330.19	334.15	2.50	4.91	6.44	0.64	334.79	0.506	0.506	0.501	1.00	0.64
16	30	31.61	330.19	334.79	2.50	4.91	6.44	0.64	335.44	0.506	121.184	330.98	335.41	2.50	4.91	6.44	0.64	336.05	0.506	0.506	0.614	0.78	0.50
17	30	15.05	330.98	335.91	2.50	4.91	3.07	0.15	336.05	0.115	137.819	332.36	336.07	2.50	4.91	3.07	0.15	336.21	0.115	0.115	0.158	0.87	0.13
18	24	13.47	332.36	336.19	2.00	3.14	4.29	0.29	336.48	0.302	49.000	333.53	336.34	2.00	3.14	4.29	0.29	336.63	0.302	0.302	0.148	0.81	0.23
19	24	13.47	333.53	336.57	2.00	3.14	4.29	0.29	336.86	0.302	49.983	334.05	336.72	2.00	3.14	4.29	0.29	337.01	0.302	0.302	0.151	0.68	0.19
20	24	4.57	334.06	336.92	2.00	3.14	1.45	0.03	336.95	0.035	157.000	334.84	336.97	2.00	3.14	1.45	0.03	337.01	0.035	0.035	0.055	0.52	0.02
21	10	1.35	334.84	336.99	0.83	0.55	2.48	0.10	337.09	0.324	56.246	335.16	337.17	0.83	0.55	2.48	0.10	337.27	0.324	0.324	0.182	1.00	0.10

Project File: STO 100.stm	Number of lines: 25	Run Date: 10/28/2022

Notes: * depth assumed; ** Critical depth.; j-Line contains hyd. jump ; c = cir e = ellip b = box

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
22	12	1.36	332.83	334.58	1.00	0.79	1.73	0.05	334.63	0.124	79.422	333.62	334.68	1.00	0.79	1.73	0.05	334.73	0.124	0.124	0.099	1.00	0.05
23	18	12.14	330.98	335.91	1.50	1.77	6.87	0.73	336.64	1.139	39.795	331.37	336.36	1.50	1.77	6.87	0.73	337.10	1.139	1.139	0.453	1.00	0.73
24	18	7.45	329.05	333.65	1.50	1.77	4.22	0.28	333.92	0.429	26.044	330.62	333.76	1.50	1.77	4.22	0.28	334.03	0.429	0.429	0.112	1.00	0.28
25	18	8.19	327.53	330.43	1.50	1.77	4.64	0.33	330.77	0.519	24.166	327.65	330.56	1.50	1.77	4.63	0.33	330.89	0.518	0.518	0.125	1.00	0.33

Project File: STO 100.stm	Number of lines: 25	Run Date: 10/28/2022

Notes: * depth assumed; ** Critical depth.; j-Line contains hyd. jump ; c = cir e = ellip b = box

Hydraflow HGL Computation Procedure

General Procedure:

Hydraflow computes the HGL using the Bernoulli energy equation. Manning's equation is used to determine energy losses due to pipe friction. In a standard step, iterative procedure, Hydraflow assumes upstream HGLs until the energy equation balances. If the energy equation cannot balance, supercritical flow exists and critical depth is temporarily assumed at the upstream end. A supercritical flow Profile is then computed using the same procedure in a downstream direction using momentum principles.

Col. 1 The line number being computed. Calculations begin at Line 1 and proceed upstream.

Col. 2 The line size. In the case of non-circular pipes, the line rise is printed above the span.

Col. 3 Total flow rate in the line.

Col. 4 The elevation of the downstream invert.

Col. 5 Elevation of the hydraulic grade line at the downstream end. This is computed as the upstream HGL + Minor loss of this line's downstream line.

Col. 6 The downstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

Col. 7 Cross-sectional area of the flow at the downstream end.

Col. 8 The velocity of the flow at the downstream end, (Col. 3 / Col. 7).

Col. 9 Velocity head (Velocity squared / 2g).

Col. 10 The elevation of the energy grade line at the downstream end, HGL + Velocity head, (Col. 5 + Col. 9).

Col. 11 The friction slope at the downstream end (the S or Slope term in Manning's equation).

Col. 12 The line length.

Col. 13 The elevation of the upstream invert.

Col. 14 Elevation of the hydraulic grade line at the upstream end.

Col. 15 The upstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

Col. 16 Cross-sectional area of the flow at the upstream end.

Col. 17 The velocity of the flow at the upstream end, (Col. 3 / Col. 16).

Col. 18 Velocity head (Velocity squared / 2g).

Col. 19 The elevation of the energy grade line at the upstream end, HGL + Velocity head, (Col. 14 + Col. 18) .

Col. 20 The friction slope at the upstream end (the S or Slope term in Manning's equation).

Col. 21 The average of the downstream and upstream friction slopes.

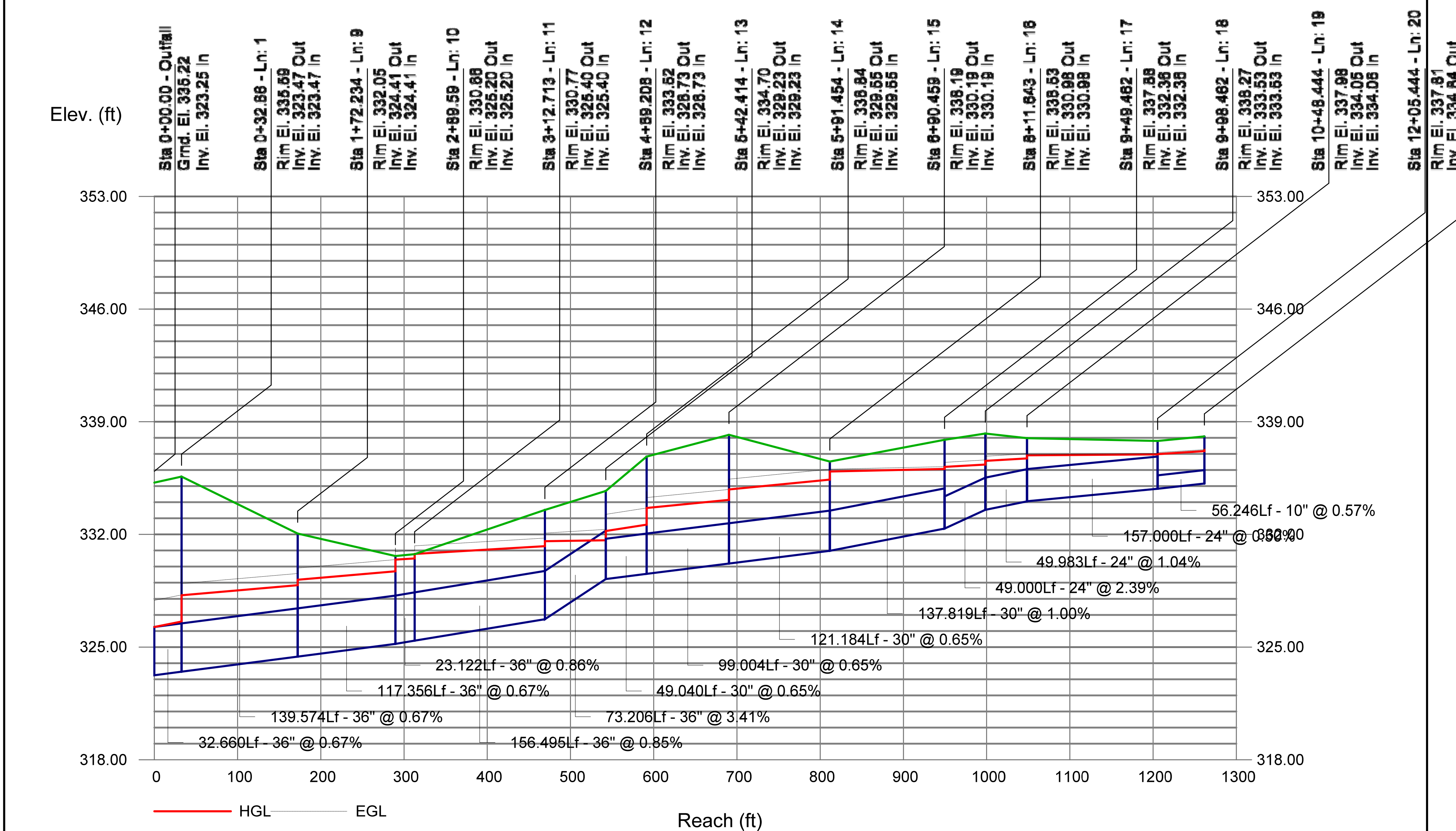
Col. 22 Energy loss. Average Sf/100 x Line Length (Col. 21/100 x Col. 12). Equals (EGL upstream - EGL downstream) +/- tolerance.

Col. 23 The junction loss coefficient (K).

Col. 24 Minor loss. (Col. 23 x Col. 18). Is added to upstream HGL and used as the starting HGL for the next upstream line(s).

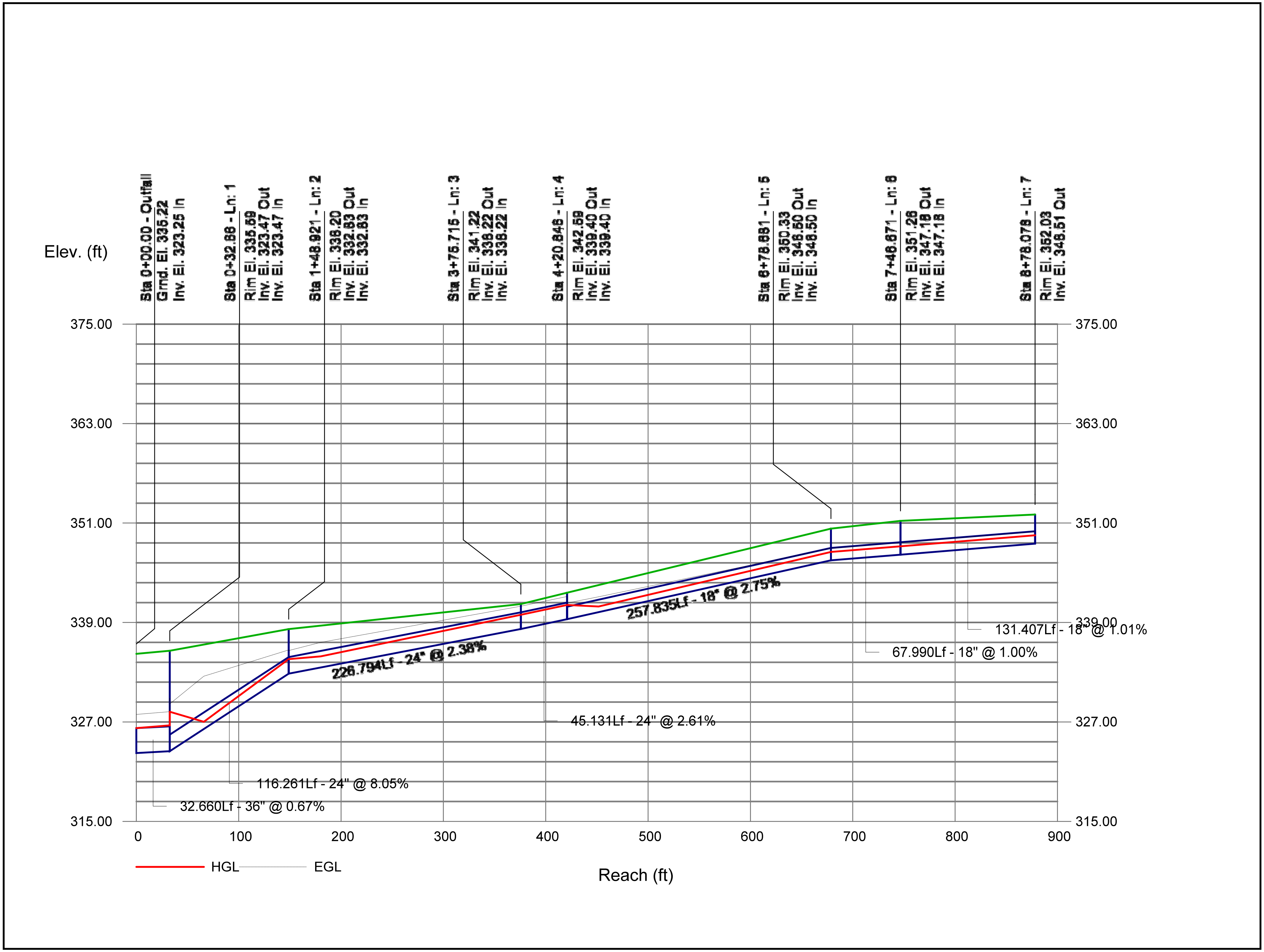
Storm Sewer Profile

Proj. file: STO 100.stm

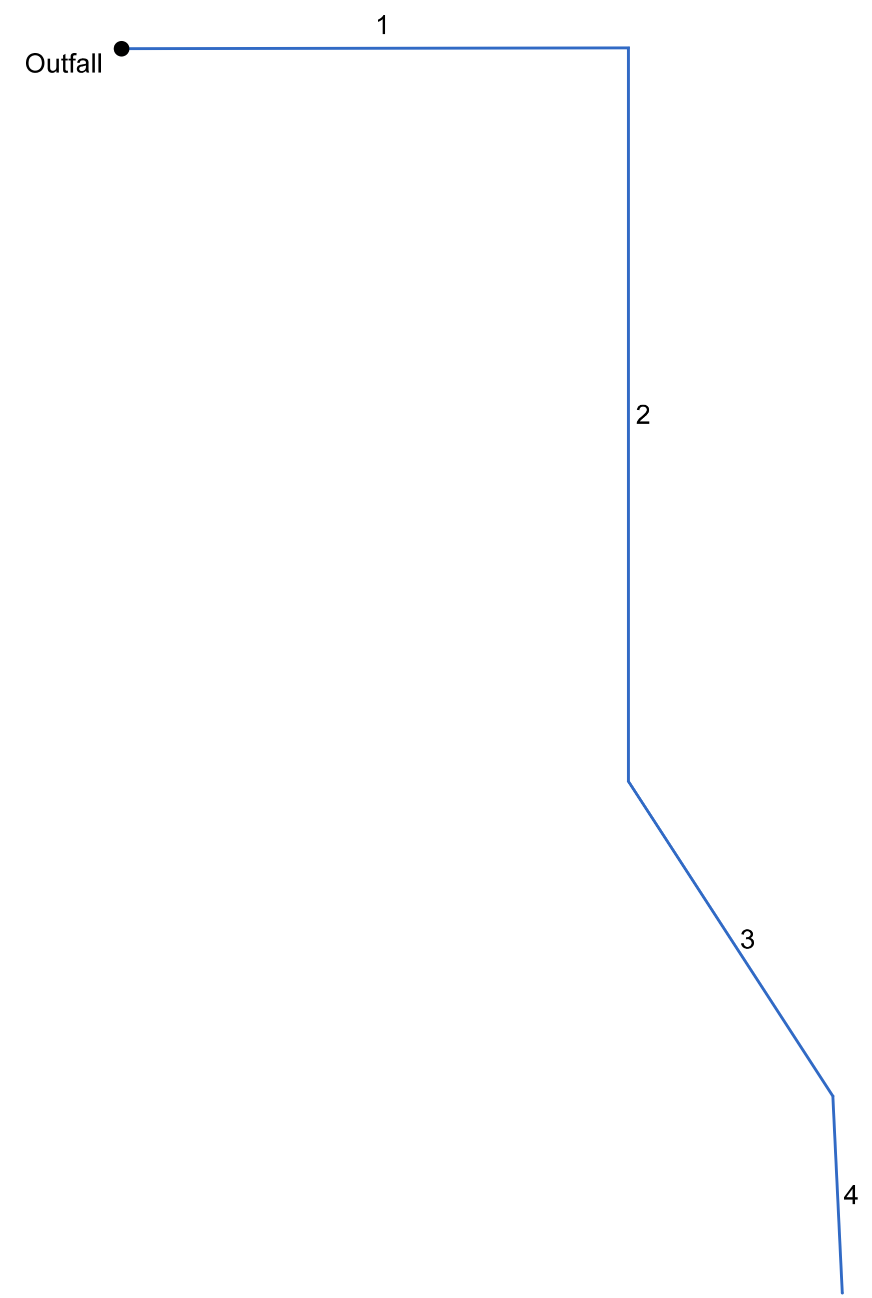


Storm Sewer Profile

Proj. file: STO 100.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: STO 200.stm	Number of lines: 4	Date: 10/28/2022

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
1	36	47.85	320.00	323.00	3.00	5.69	6.77	0.71	323.71	0.439	133.973	321.47	323.72	2.25**	5.69	8.41	1.10	324.82	0.527	0.483	n/a	1.00	n/a
2	36	47.85	321.47	323.72	2.25*	5.69	8.41	1.10	324.82	0.000	239.397	324.10	326.35	2.25**	5.69	8.41	1.10	327.45	0.000	0.000	n/a	0.52	n/a
3	36	47.85	324.10	326.35	2.25*	5.69	8.41	1.10	327.45	0.000	116.018	325.38	327.63	2.25**	5.69	8.41	1.10	328.73	0.000	0.000	n/a	0.48	n/a
4	36	47.85	325.38	327.63	2.25*	5.69	8.41	1.10	328.73	0.000	64.419	326.09	328.34	2.25**	5.69	8.41	1.10	329.44	0.000	0.000	n/a	1.00	n/a

Project File: STO 200.stm	Number of lines: 4	Run Date: 10/28/2022

Notes: * depth assumed; ** Critical depth. ; c = cir e = ellip b = box

Hydraflow HGL Computation Procedure

General Procedure:

Hydraflow computes the HGL using the Bernoulli energy equation. Manning's equation is used to determine energy losses due to pipe friction. In a standard step, iterative procedure, Hydraflow assumes upstream HGLs until the energy equation balances. If the energy equation cannot balance, supercritical flow exists and critical depth is temporarily assumed at the upstream end. A supercritical flow Profile is then computed using the same procedure in a downstream direction using momentum principles.

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Col. 2 The line size. In the case of non-circular pipes, the line rise is printed above the span.

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Col. 4 The elevation of the downstream invert.

Col. 5 Elevation of the hydraulic grade line at the downstream end. This is computed as the upstream HGL + Minor loss of this line's downstream line.

Col. 6 The downstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

Col. 7 Cross-sectional area of the flow at the downstream end.

Col. 8 The velocity of the flow at the downstream end, (Col. 3 / Col. 7).

Col. 9 Velocity head (Velocity squared / 2g).

Col. 10 The elevation of the energy grade line at the downstream end, HGL + Velocity head, (Col. 5 + Col. 9).

Col. 11 The friction slope at the downstream end (the S or Slope term in Manning's equation).

Col. 12 The line length.

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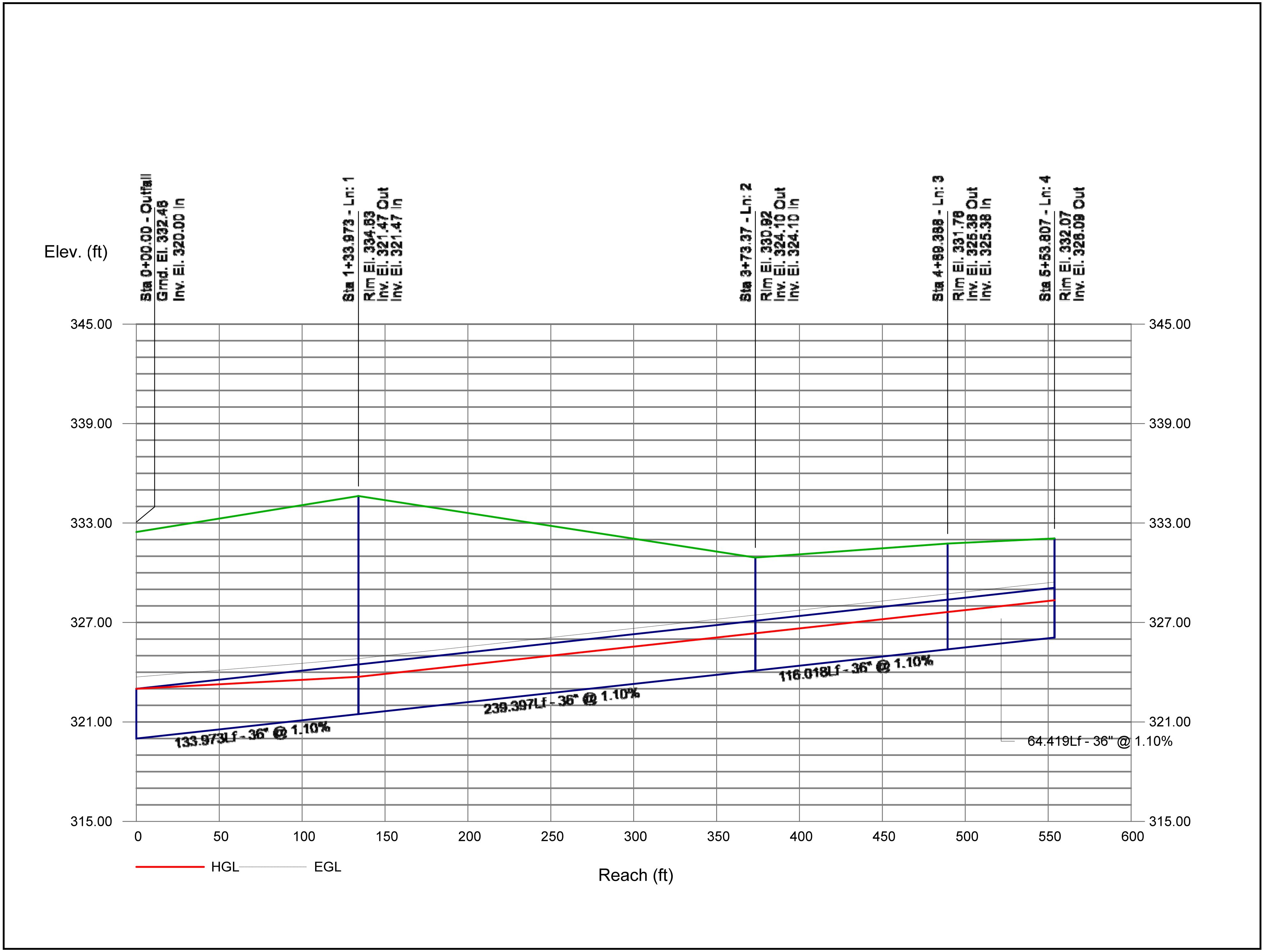
Col. 23 The junction loss coefficient (K).

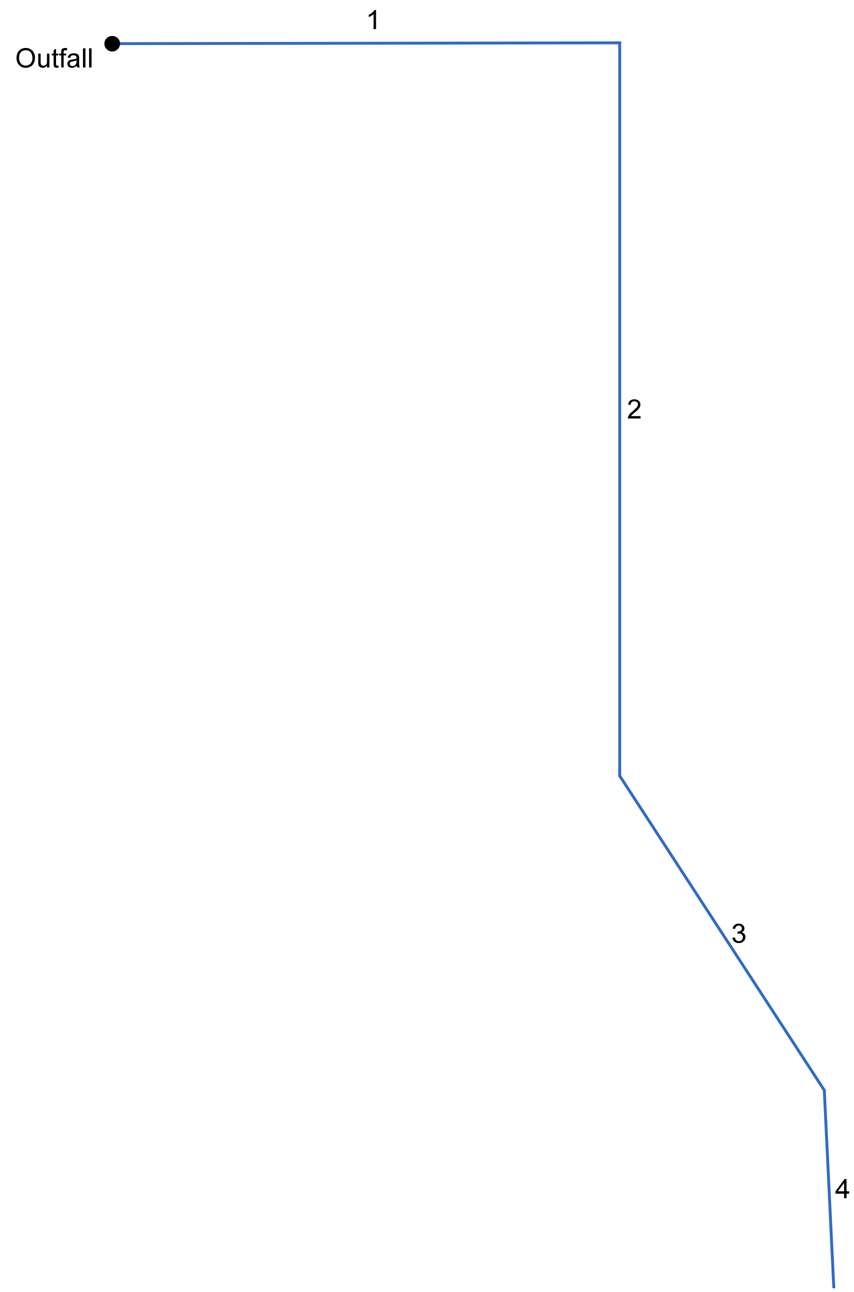
Col. 24 Minor loss. (Col. 23 x Col. 18). Is added to upstream HGL and used as the starting HGL for the next upstream line(s).

Storm Sewer Profile

Proj. file: STO 200.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: STO 200.stm	Number of lines: 4	Date: 10/28/2022

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
1	36	56.94	320.00	323.00	3.00	6.16	8.06	1.01	324.01	0.621	133.973	321.47	323.91	2.44**	6.16	9.24	1.33	325.24	0.628	0.625	n/a	1.00	n/a
2	36	56.94	321.47	323.91	2.44*	6.16	9.24	1.33	325.24	0.000	239.397	324.10	326.54	2.44**	6.16	9.24	1.33	327.87	0.000	0.000	n/a	0.52	n/a
3	36	56.94	324.10	326.54	2.44*	6.16	9.24	1.33	327.87	0.000	116.018	325.38	327.82	2.44**	6.16	9.24	1.33	329.15	0.000	0.000	n/a	0.48	n/a
4	36	56.94	325.38	327.82	2.44*	6.16	9.24	1.33	329.15	0.000	64.419	326.09	328.53	2.44**	6.16	9.24	1.33	329.86	0.000	0.000	n/a	1.00	n/a

Project File: STO 200.stm	Number of lines: 4	Run Date: 10/28/2022

Notes: * depth assumed; ** Critical depth. ; c = cir e = ellip b = box

Hydraflow HGL Computation Procedure

General Procedure:

Hydraflow computes the HGL using the Bernoulli energy equation. Manning's equation is used to determine energy losses due to pipe friction. In a standard step, iterative procedure, Hydraflow assumes upstream HGLs until the energy equation balances. If the energy equation cannot balance, supercritical flow exists and critical depth is temporarily assumed at the upstream end. A supercritical flow Profile is then computed using the same procedure in a downstream direction using momentum principles.

Col. 1 The line number being computed. Calculations begin at Line 1 and proceed upstream.

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Col. 3 Total flow rate in the line.

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Col. 5 Elevation of the hydraulic grade line at the downstream end. This is computed as the upstream HGL + Minor loss of this line's downstream line.

Col. 6 The downstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

Col. 7 Cross-sectional area of the flow at the downstream end.

Col. 8 The velocity of the flow at the downstream end, (Col. 3 / Col. 7).

Col. 9 Velocity head (Velocity squared / 2g).

Col. 10 The elevation of the energy grade line at the downstream end, HGL + Velocity head, (Col. 5 + Col. 9).

Col. 11 The friction slope at the downstream end (the S or Slope term in Manning's equation).

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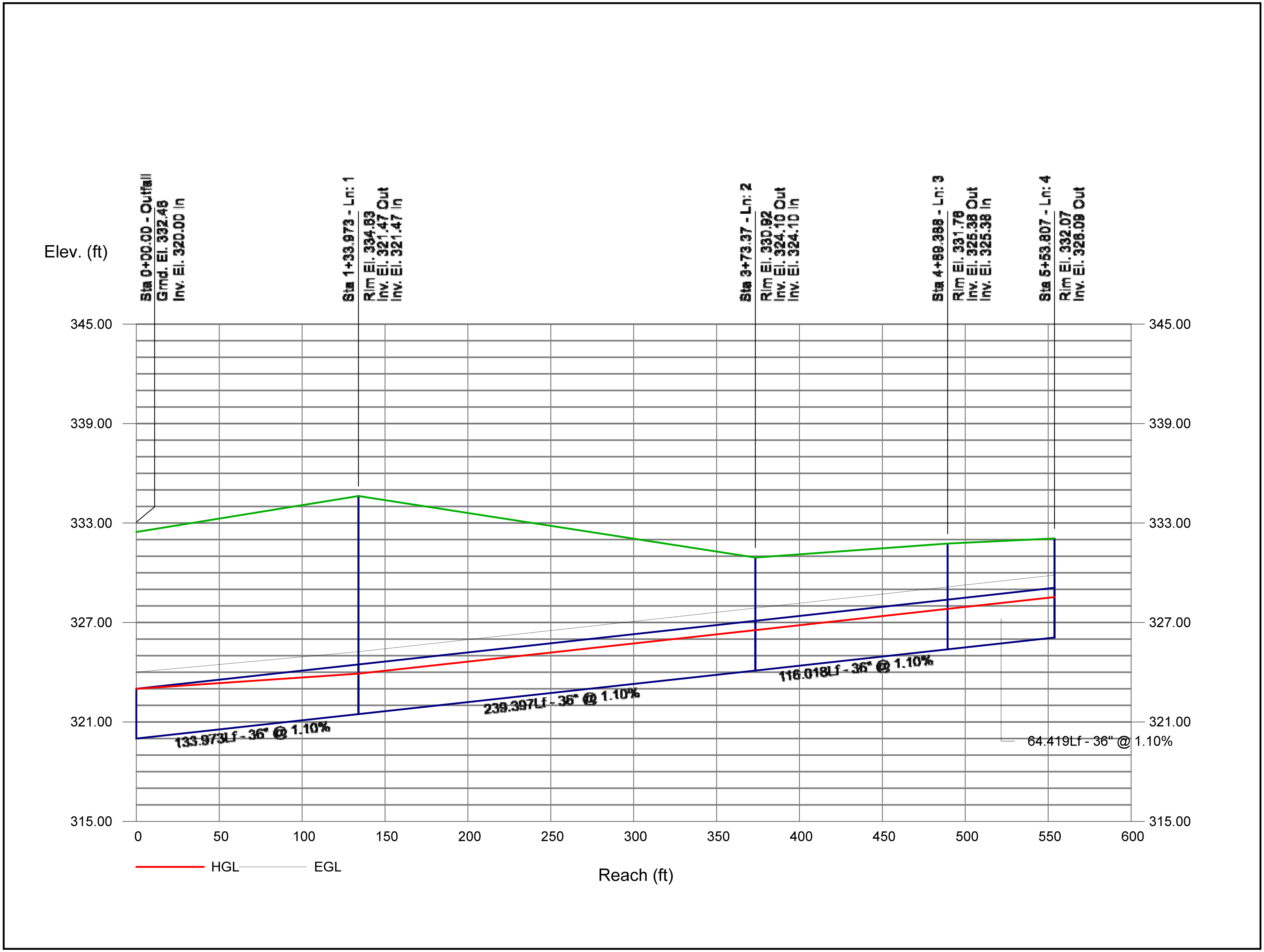
Col. 23 The junction loss coefficient (K).

Col. 24 Minor loss. (Col. 23 x Col. 18). Is added to upstream HGL and used as the starting HGL for the next upstream line(s).

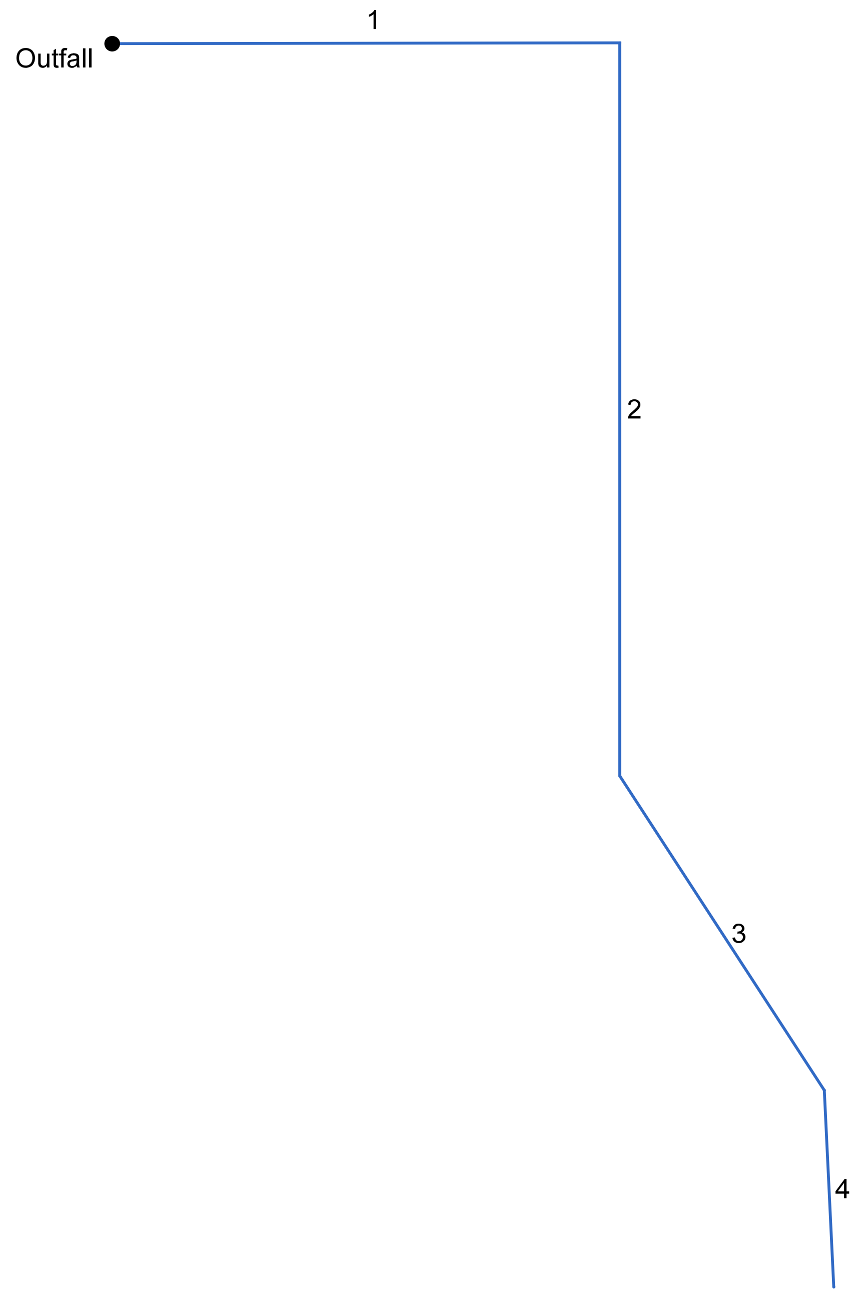
Storm Sewer Profile

Proj. file: STO 200.stm



Storm Sewers

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: New.stm	Number of lines: 4	Date: 10/28/2022

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
1	36	72.94	320.00	323.00	3.00	6.69	10.32	1.66	324.66	1.020	133.973	321.47	324.16	2.69**	6.69	10.90	1.85	326.01	0.899	0.959	n/a	1.00	1.85
2	36	72.94	321.47	324.16	2.69*	6.69	10.90	1.85	326.01	0.000	239.397	324.10	326.79	2.69**	6.69	10.90	1.85	328.64	0.000	0.000	n/a	0.52	0.96
3	36	72.94	324.10	326.79	2.69*	6.69	10.90	1.85	328.64	0.000	116.018	325.38	328.07	2.69**	6.69	10.90	1.85	329.92	0.000	0.000	n/a	0.48	0.89
4	36	72.94	325.38	328.07	2.69*	6.69	10.90	1.85	329.92	0.000	64.419	326.09	328.78	2.69**	6.69	10.90	1.85	330.63	0.000	0.000	n/a	1.00	1.85

Project File: New.stm	Number of lines: 4	Run Date: 10/28/2022

Notes: * depth assumed; ** Critical depth. ; c = cir e = ellip b = box

Hydraflow HGL Computation Procedure

General Procedure:

Hydraflow computes the HGL using the Bernoulli energy equation. Manning's equation is used to determine energy losses due to pipe friction. In a standard step, iterative procedure, Hydraflow assumes upstream HGLs until the energy equation balances. If the energy equation cannot balance, supercritical flow exists and critical depth is temporarily assumed at the upstream end. A supercritical flow Profile is then computed using the same procedure in a downstream direction using momentum principles.

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Col. 7 Cross-sectional area of the flow at the downstream end.

Col. 8 The velocity of the flow at the downstream end, (Col. 3 / Col. 7).

Col. 9 Velocity head (Velocity squared / 2g).

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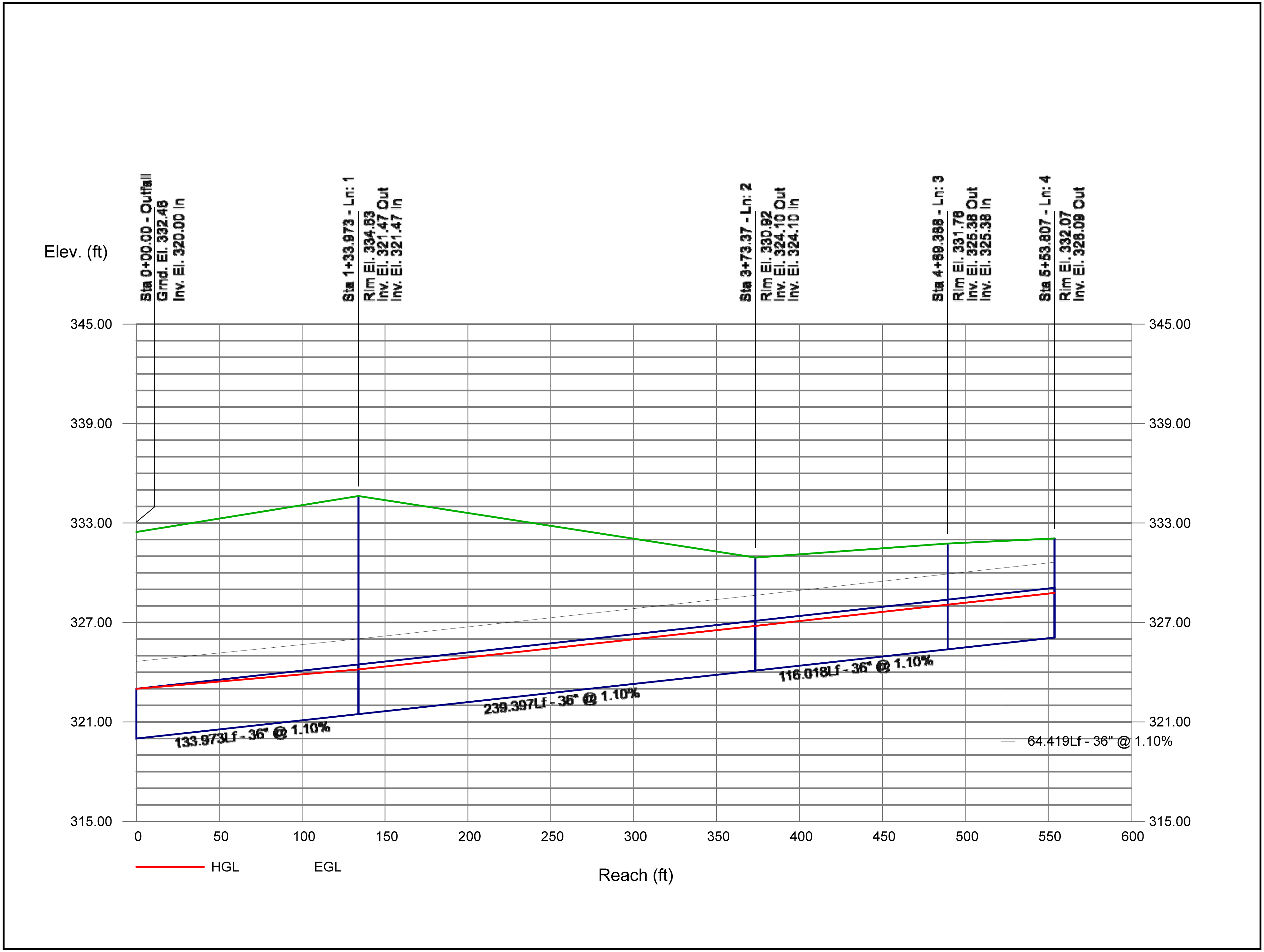
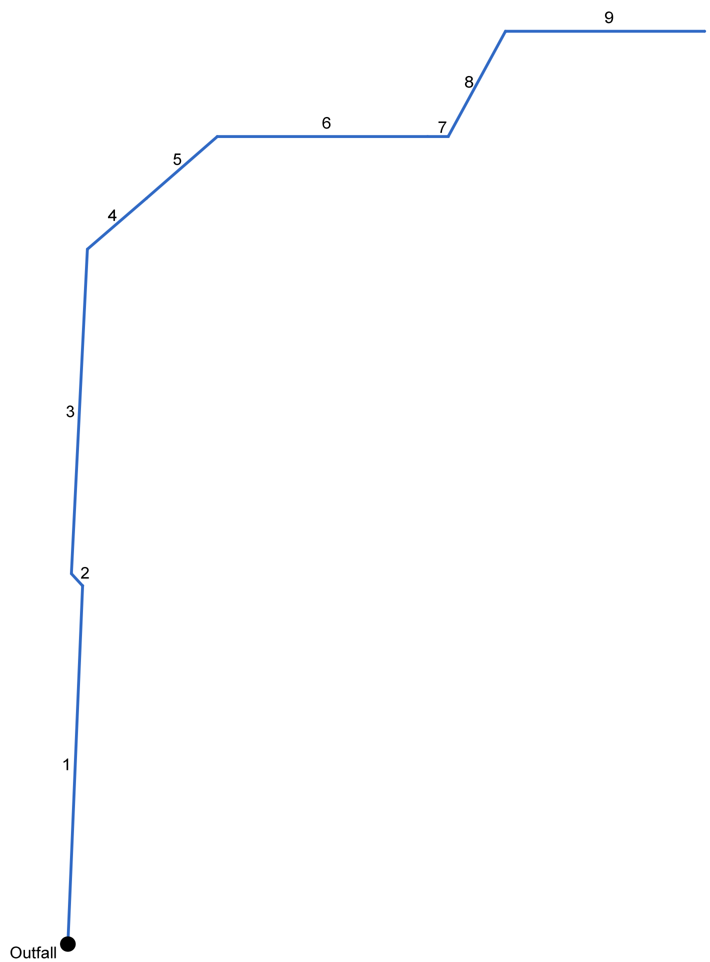
Proj. file: New.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: STO 300.stm	Number of lines: 9	Date: 6/9/2022

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
1	36	76.49	306.61	309.61	3.00	6.76	10.82	1.82	311.43	1.316	304.765	319.41	322.14	2.73**	6.76	11.31	1.99	324.13	1.148	1.232	n/a	0.75	n/a
2	30	28.64	319.66	322.14	2.48	3.83	5.84	0.87	323.01	0.000	13.827	323.73	325.55 j	1.82**	3.83	7.47	0.87	326.42	0.000	0.000	n/a	0.76	n/a
3	30	28.64	323.73	325.75	2.02*	4.25	6.73	0.70	326.46	0.500	276.043	325.11	327.13	2.02	4.25	6.73	0.70	327.84	0.500	0.500	1.379	0.76	0.54
4	30	28.64	325.11	327.67	2.50	4.91	5.84	0.53	328.20	0.488	66.081	325.44	327.94	2.50	4.91	5.83	0.53	328.47	0.476	0.482	0.319	0.15	0.08
5	30	13.74	325.44	328.02	2.50	4.91	2.80	0.12	328.14	0.112	79.823	325.84	328.09	2.25	4.65	2.96	0.14	328.22	0.099	0.106	0.084	0.70	0.10
6	30	13.74	325.84	328.18	2.34	2.45	2.88	0.49	328.67	0.000	178.044	326.73	327.98	1.25**	2.45	5.62	0.49	328.47	0.000	0.000	n/a	0.15	0.07
7	12	2.40	326.73	327.98	1.00	0.79	3.06	0.15	328.12	0.454	17.440	326.82	328.06	1.00	0.79	3.06	0.15	328.20	0.454	0.454	0.079	0.90	0.13
8	12	2.40	326.82	328.19	1.00	0.79	3.06	0.15	328.33	0.454	101.578	327.33	328.65	1.00	0.79	3.06	0.15	328.79	0.454	0.454	0.461	0.90	0.13
9	12	2.40	327.33	328.78	1.00	0.79	3.06	0.15	328.92	0.454	168.945	328.17	329.55	1.00	0.79	3.06	0.15	329.69	0.454	0.454	0.767	1.00	0.15

Project File: STO 300.stm | Number of lines: 9 | Run Date: 6/9/2022

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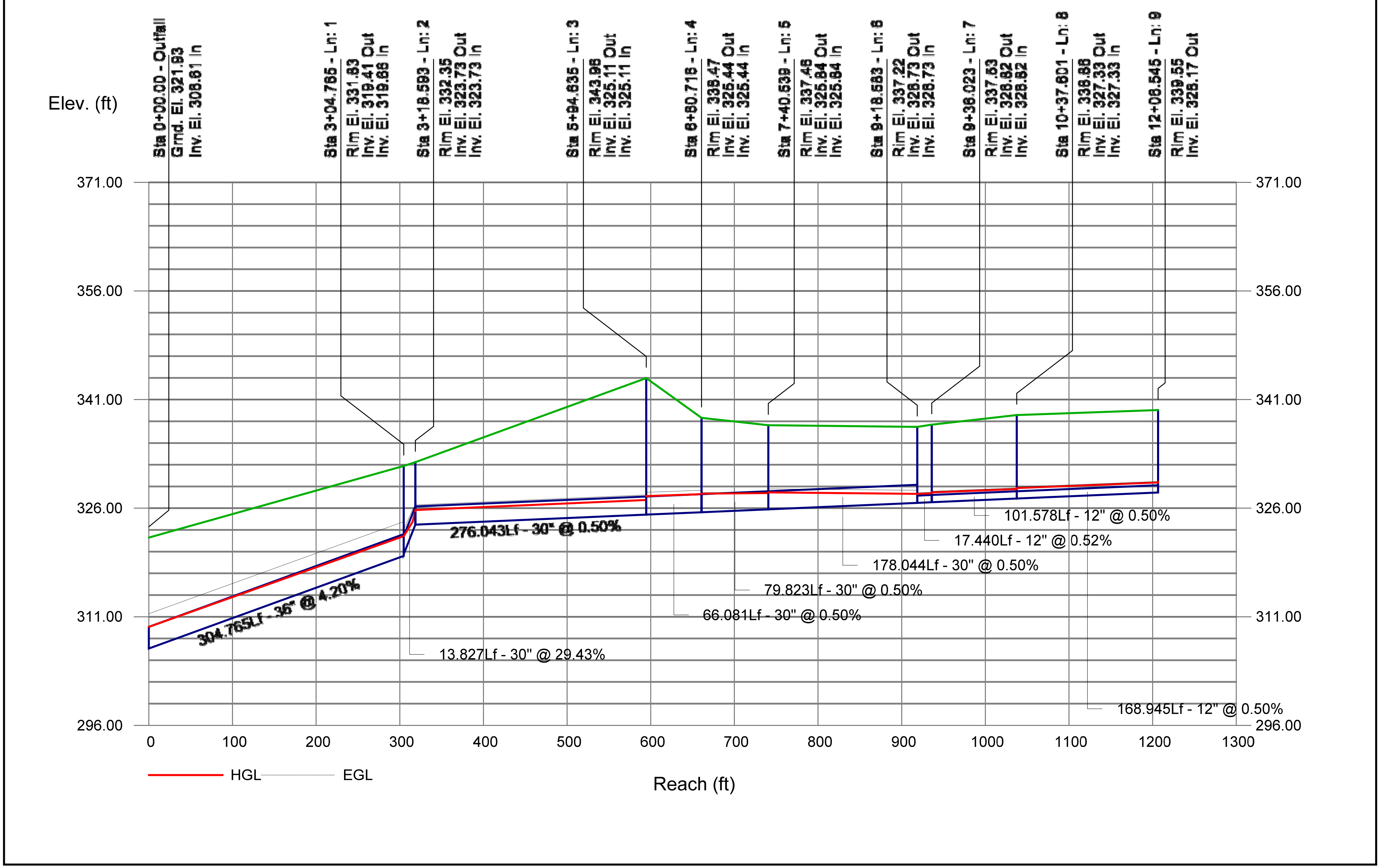
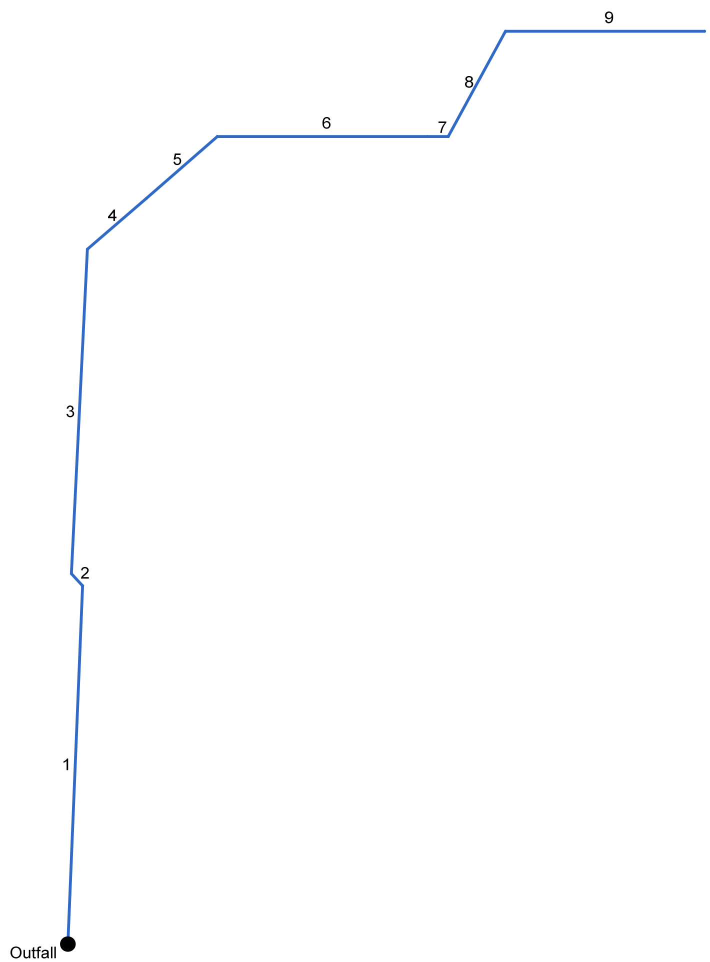
Proj. file: STO 300.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: STO 300.stm	Number of lines: 9	Date: 6/9/2022

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
1	36	85.58	306.61	309.61	3.00	6.89	12.11	2.28	311.89	1.647	304.765	319.41	322.23	2.82**	6.89	12.42	2.40	324.62	1.423	1.535	n/a	0.75	1.80
2	30	28.64	319.66	322.23	2.50	3.83	5.84	0.53	322.76	0.488	13.827	323.73	325.55 j	1.82**	3.83	7.47	0.87	326.42	0.627	0.558	n/a	0.76	n/a
3	30	28.64	323.73	325.75	2.02*	4.25	6.73	0.70	326.46	0.500	276.043	325.11	327.13	2.02	4.25	6.73	0.70	327.84	0.500	0.500	1.379	0.76	0.54
4	30	28.64	325.11	327.67	2.50	4.91	5.84	0.53	328.20	0.488	66.081	325.44	327.94	2.50	4.91	5.83	0.53	328.47	0.476	0.482	0.319	0.15	0.08
5	30	13.74	325.44	328.02	2.50	4.91	2.80	0.12	328.14	0.112	79.823	325.84	328.09	2.25	4.65	2.96	0.14	328.22	0.099	0.106	0.084	0.70	0.10
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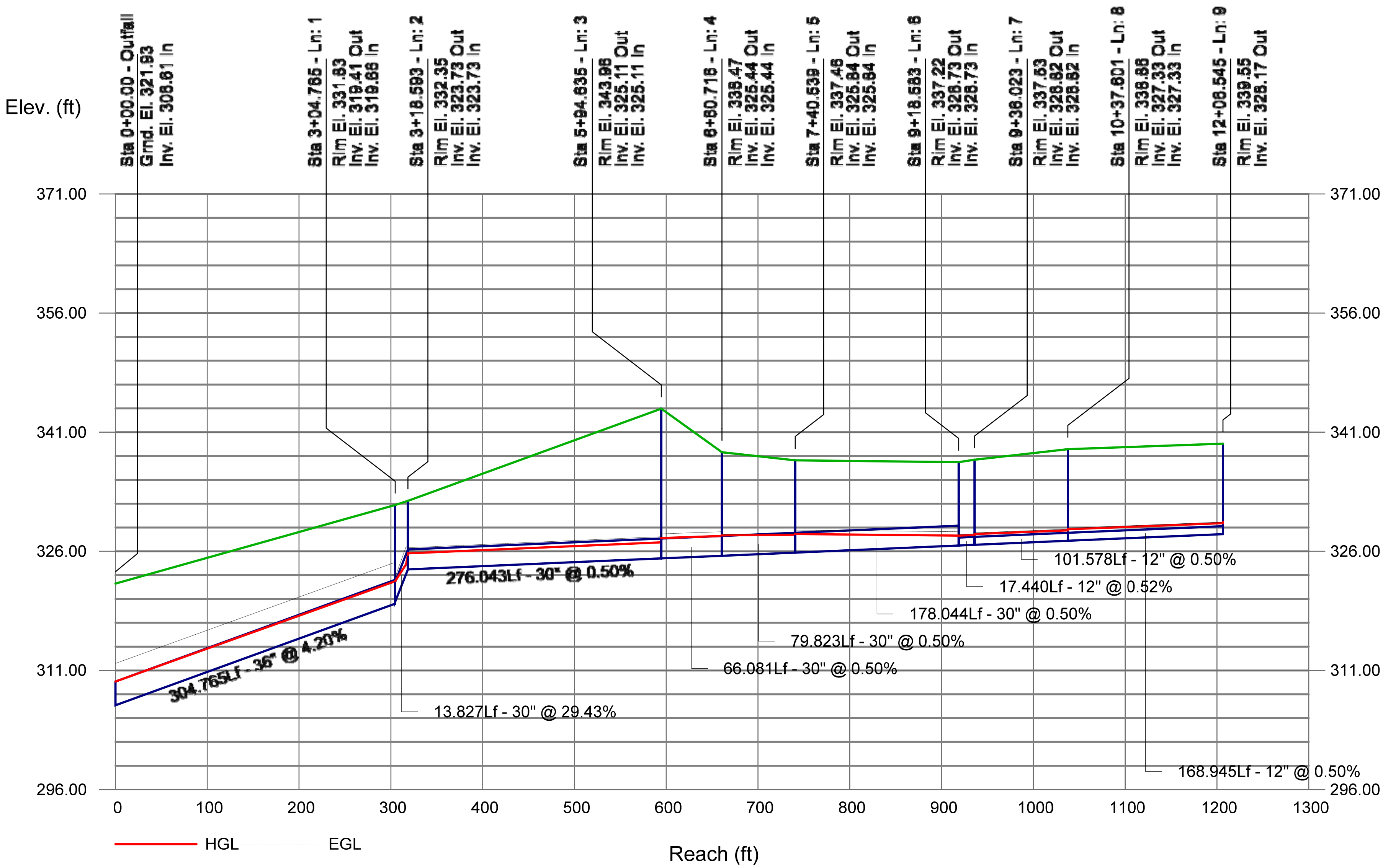

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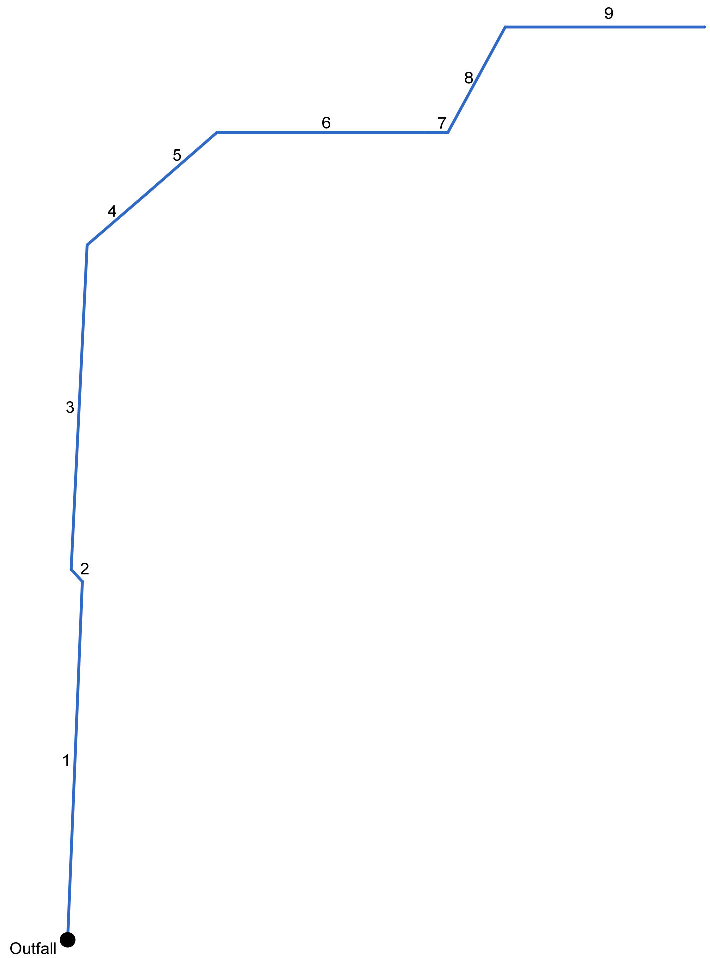

Project File: New.stm	Number of lines: 9	Date: 6/9/2022

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			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
1	36	101.6	306.61	309.61	3.00	7.00	14.37	3.21	312.82	2.321	304.765	319.41	322.31	2.90**	7.00	14.52	3.28	325.59	2.035	2.178	n/a	0.75	2.46
2	30	28.64	319.66	322.31	2.50	3.83	5.84	0.53	322.84	0.488	13.827	323.73	325.55 j	1.82**	3.83	7.47	0.87	326.42	0.627	0.558	n/a	0.76	n/a
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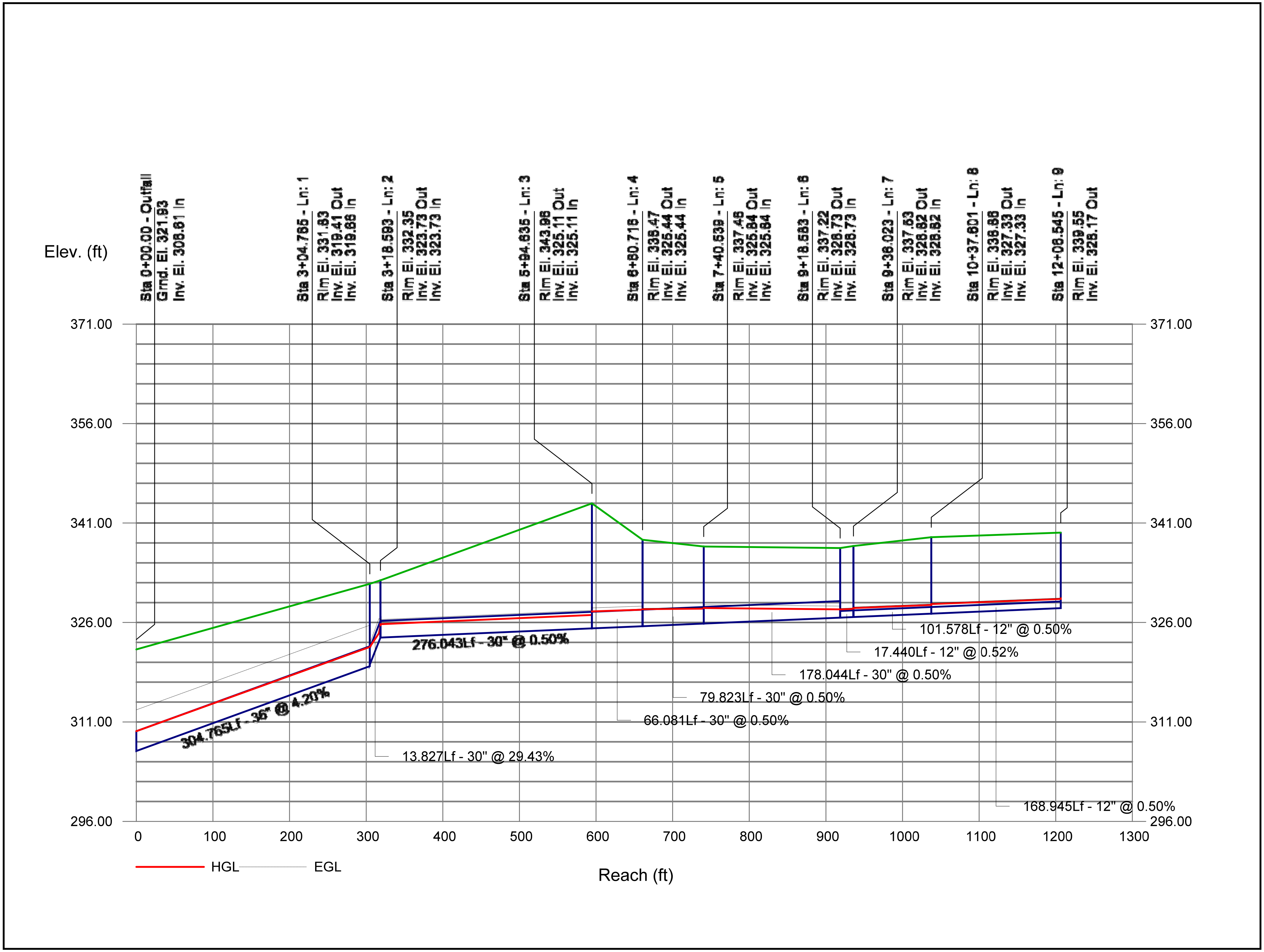


Wastewater Flow Monitoring Services

For

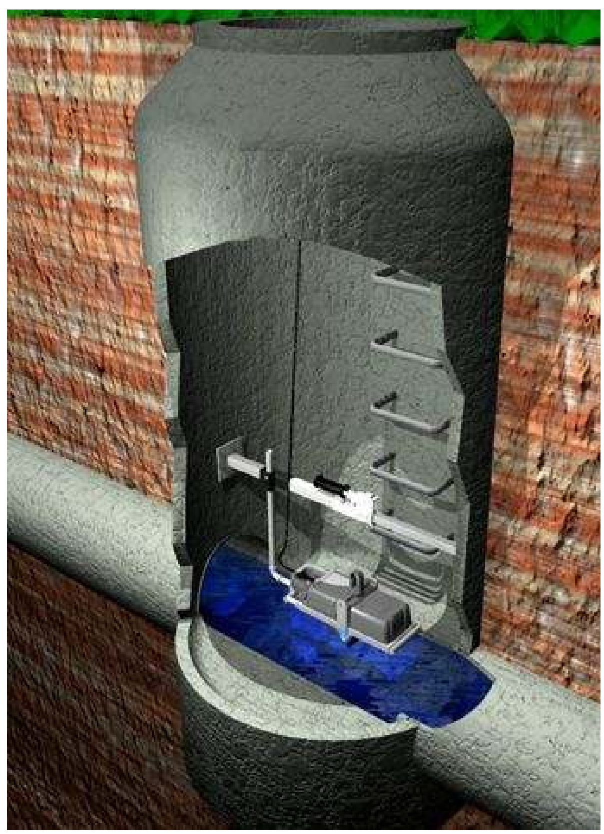
raSmith

Brea Mall Mixed Use Project

1065 Brea Mall

Brea, CA 92821

September 24, 2019 through October 10, 2019



Leaders in Sewer Flow Monitoring Services

601 N. Parkcenter Dr., Suite 209
Santa Ana, CA 92705

Phone: 714-542-1004
Fax: 714-542-1332

www.uscubed.com
www.sewerflow.com

CERTIFICATION PAGE

Brea Mall Mixed Use Project

Sewer Flow Monitoring Study

September 24 - October 10, 2019

"I certify that this document and all of its attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the data submitted. Based on my inquiry of the persons who installed the flow monitoring equipment and those persons directly responsible for gathering the data, the information submitted in this report is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that as a Registered Professional Engineer in the State of California, I am ethically bound to provide services honestly and to protect the public health, safety, and welfare."

Signed on: 11/19/2021

Constance Darlene Szczublewski, RCE 78908
Registration Expires March 31, 2022

Table of Contents

Tab 1: Overview & Site-Specific Information

1.1 Overview

The City of Brea (City) currently serves a population of approximately 41,000 people within a 12 square mile area. The City's wastewater collection system is managed by the City's Street, Sewer, Storm Drain & Sanitation Division. The collection system consists of about 119 miles of gravity sewer lines and three pump (lift) stations. Flows from these local sewers discharge into Orange County Sanitation District facilities for treatment and disposal.

City personnel provide engineering evaluation of proposed and existing sewer facilities, administer the City's sewer service charge ordinance, carry out annexation proceedings for new service areas, form and dissolve service zones, maintain facility record plans and administer preventive maintenance and sewer construction programs. Since the City is responsible for properly managing, operating, and maintaining all portions of their wastewater collection system, as well as providing adequate capacity to carry peak capacity flows, sewer flow monitoring is required as a condition of development whenever a project proposes to construct 10 or more residential dwelling units or add 10,000 square feet (sf) or more of commercial space. This requirement not only helps to ensure adequate capacity, but continually updates their databases with the most current information, allowing the City to improve the condition and performance of its wastewater collection system, reducing the occurrences of SSOs, and ensuring the health and safety of the community.

1.2 Project Description

Utility Systems Science & Software, Inc. (US^3) was contracted by raSmith to perform sewer flow monitoring at five sewer manholes for a period of seven days for their Brea Mall Mixed Use Project. Two sewer monitoring sites within Brea Mall were selected for concurrent monitoring with three downstream manholes. This sewer system assessment was developed under conditions existing between 09/24/2019 and 10/10/2019 to analyze for potential capacity limitations in the monitored lines, which includes the anticipated effects of redeveloping the property at 1065 Brea Mall in Brea.

The Brea Mall encompasses approximately 74 acres in northeast Orange County. The Mall is west of State Route 57 (SR-57) and is generally bounded by State College Boulevard to the east, Imperial Highway (SR 91) to the south, S. Randolph Av to the west, the City of Brea City Hall and Embassy Suites by Hilton to the northwest, and E. Birch St to the north. The project site is generally in the southwest portion of the Brea Mall, in the area formerly occupied by Sears.

US[3] assessed permitting and traffic control requirements for the selected monitoring sites. Site-specific diagrams from the California Work Area Traffic Control Handbook (CA WATCH) were prepared for submittal with the City Encroachment Permit applications, which fully conformed with the California Manual of Uniform Traffic Control Devices. Due to the distance between the monitoring locations, two encroachment permits were approved by the City prior to flow monitoring.

US[3] performed site inspections to evaluate the site hydraulics at the selected monitoring sites as part of the installation process. **Note:** Each wastewater collection system is different, and some of the differences that affect flow monitoring include: slope of sewer line; age, condition and material of sewer line; number and type of connections; and sewer design, specifically the proximity of baffles, drop structures, pumps, siphons, and weirs. Only one of these structures was noted during the initial installations, which was a drop inlet, but since no flow was observed discharging from the drop inlet, it was deemed acceptable for flow monitoring during the inspection. Therefore, the initial installations occurred on 09/24/2019 at the Nordstrom MH and at Sites 1, 2, 3 and 4.

Upon review of the field installation documents and photos, it was determined that what were assumed to be the locations of Sites 3 and 4 were actually Site 3A (most likely a brine line) and Site 3. Therefore, installation at the correct Site 4 MH occurred on 10/02/2019. Monitoring at the Site 4 MH is referred to as the second week of monitoring or secondary monitoring. The monitoring site locations and sewer lines for both the first and second week of monitoring are shown on maps in Section 1.3.

The manholes were equipped with Hach Marsh-McBirney Flo-Dar® AV Sensors and Loggers. With the installation and removal of the equipment, the manholes were opened and confined space entry was limited to crossing the plane with hands and arms, but not actually entering the manholes. Even though US[3] personnel did not enter the manholes during equipment installation or removal, they were fully trained and certified in Confined Space Entry and CPR, and in accordance with safety standards, gas readings were taken and recorded throughout the duration of the installation and removal process.

In summary, US³ performed the following services as part of this project:

- Sewer Flow Monitoring
    - Assessment of permitting and traffic control requirements
    - Installation of Marsh-McBirney Flo-Dar® AV Sensor/s and Logger/s
        - Validation of hydraulic suitability
        - Calibration of flow monitoring equipment
        - Documentation of installation and calibration
    - First week of flow monitoring between 09/24/2019 and 10/02/2019
    - Second week of flow monitoring between 10/02/2019 and 10/10/2019
    - Removal of flow monitoring equipment
    - Validation of flow monitoring data
- Evaluation of the sanitary sewer at the monitored sites
- Development of a report to discuss the flow monitoring data, including system statistics and graphs

1.3 Existing and Proposed Site Maps

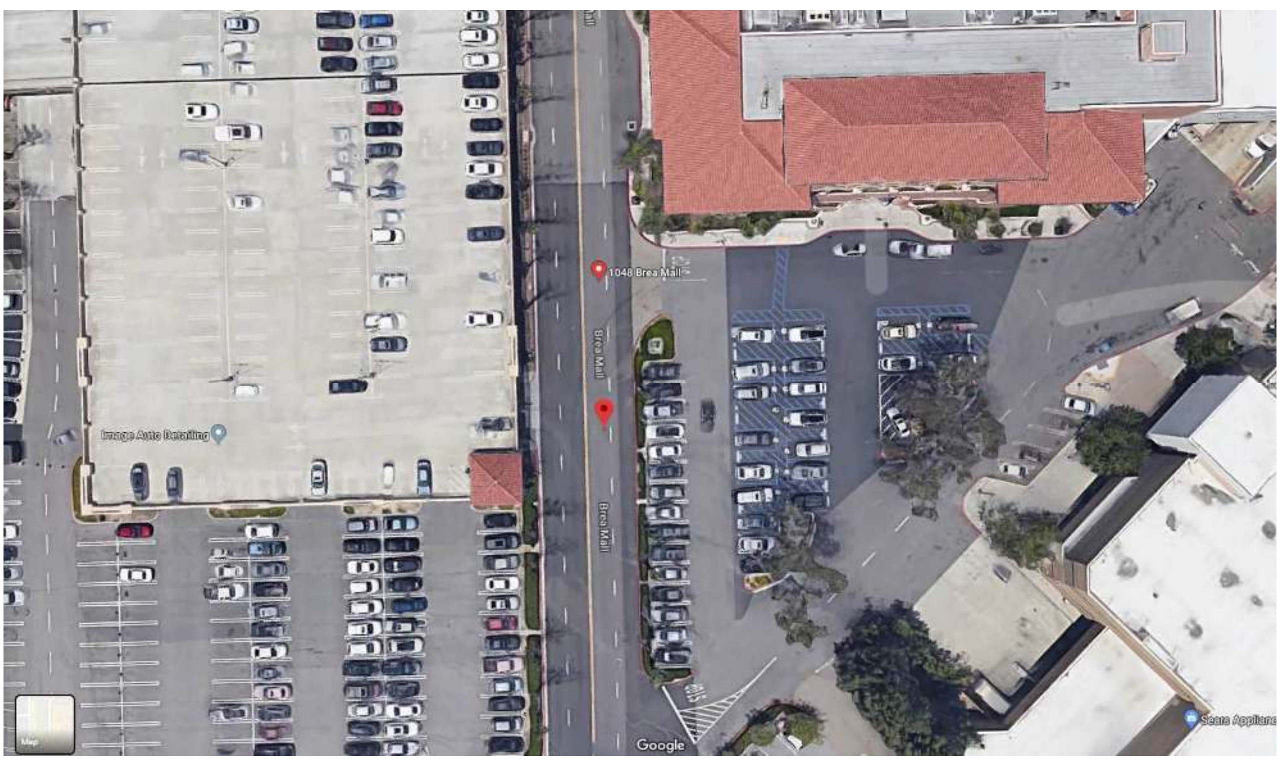
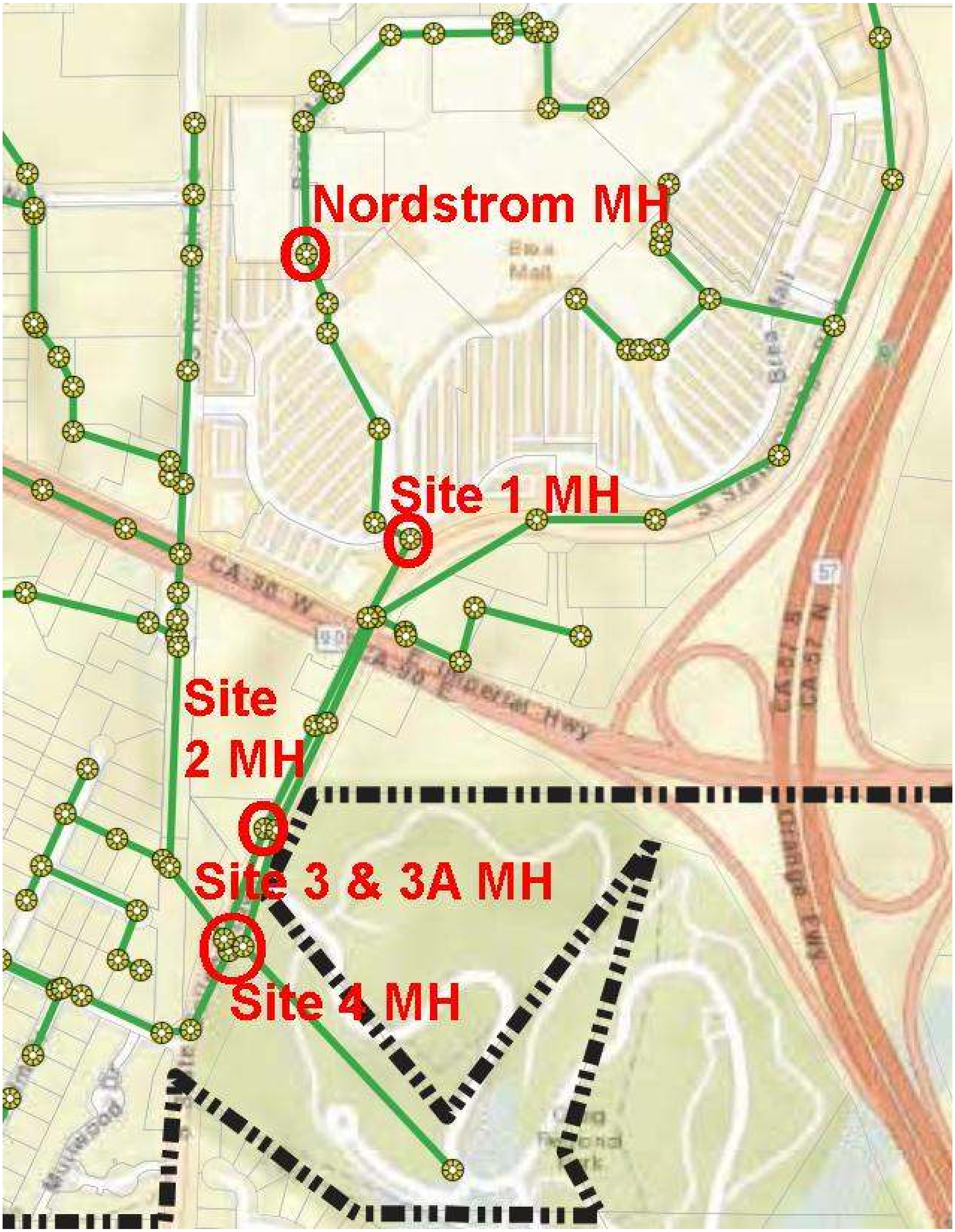
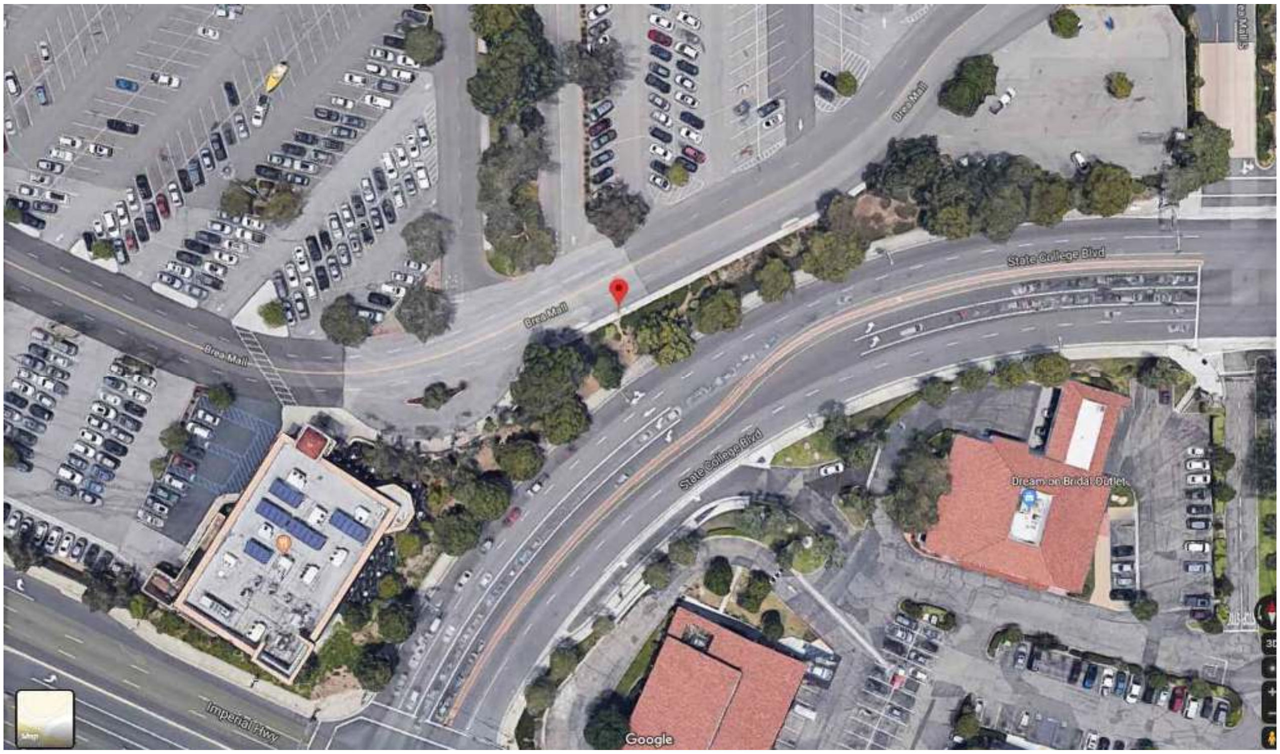


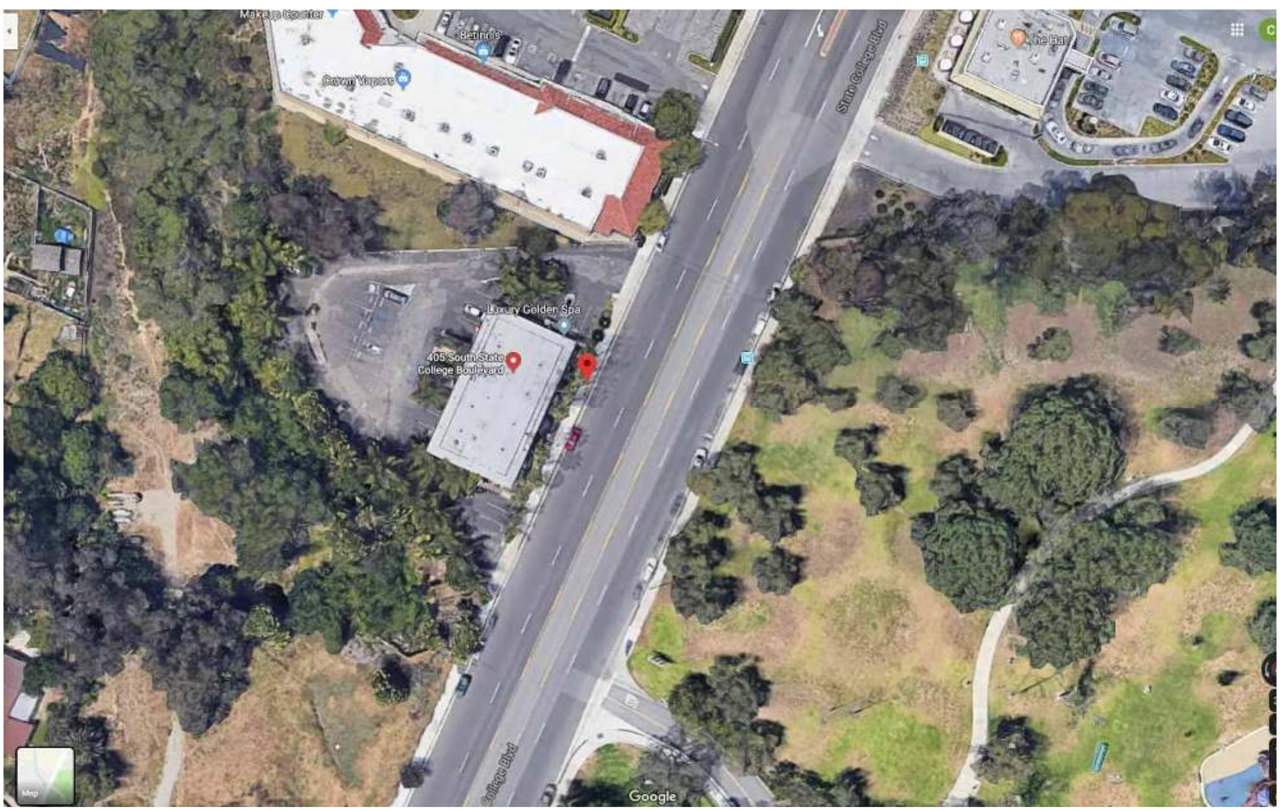
Figure above: The vicinity map shows the temporary wastewater flow monitoring location of the Nordstrom MH. The Nordstrom MH is located at latitude 33.915117 and longitude -117.888619.

Figure below: The sewer map shows the plan view of all seven of the monitored sewer lines.





Figures: The vicinity map (above) shows the temporary wastewater flow monitoring location of the Site 1 MH. The Site 1 MH is located at latitude 33.912802 and longitude -117.887424. The vicinity map (below) shows the temporary wastewater flow monitoring location of the Site 2 MH. The Site 2 MH is located at latitude 33.910330 and longitude -117.888919.



Figures: The vicinity map (above) shows the temporary wastewater flow monitoring locations of the Site 3A MH and the Site 3 MH. Site 3A MH is at latitude 33.909343 and longitude -117.889338 and Site 3 MH is at latitude 33.909322 and longitude -117.889302. The sewer map (below) shows the locations of Sites 3 and 4, which were incorrectly identified during the first week of monitoring.

Figures: The vicinity map (above) shows the temporary wastewater flow monitoring location of the Site 4 MH. The Site 4 MH is located at latitude 33.909049 and longitude -117.889105. The sewer map (below) shows the locations of Sites 3 and 4, which were incorrectly identified during the first week of monitoring; the Site 4 MH being must farther east than show

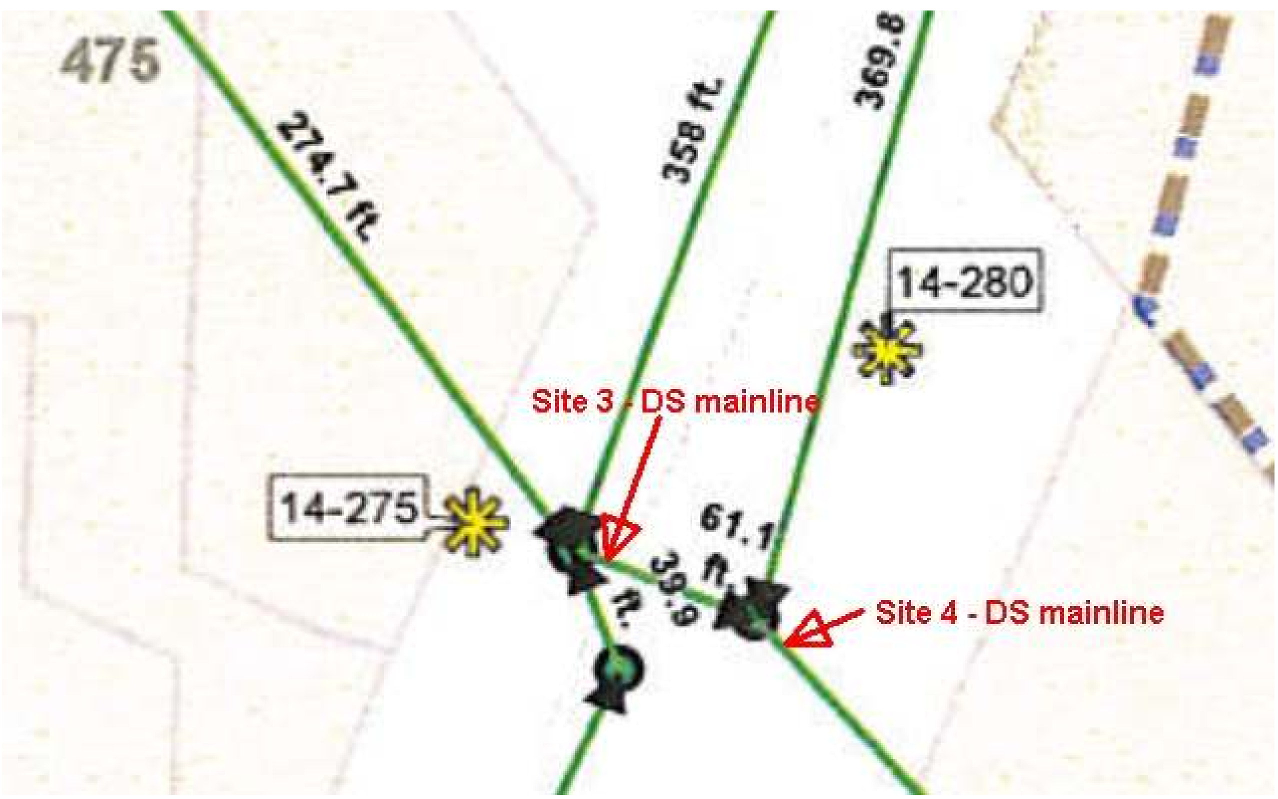
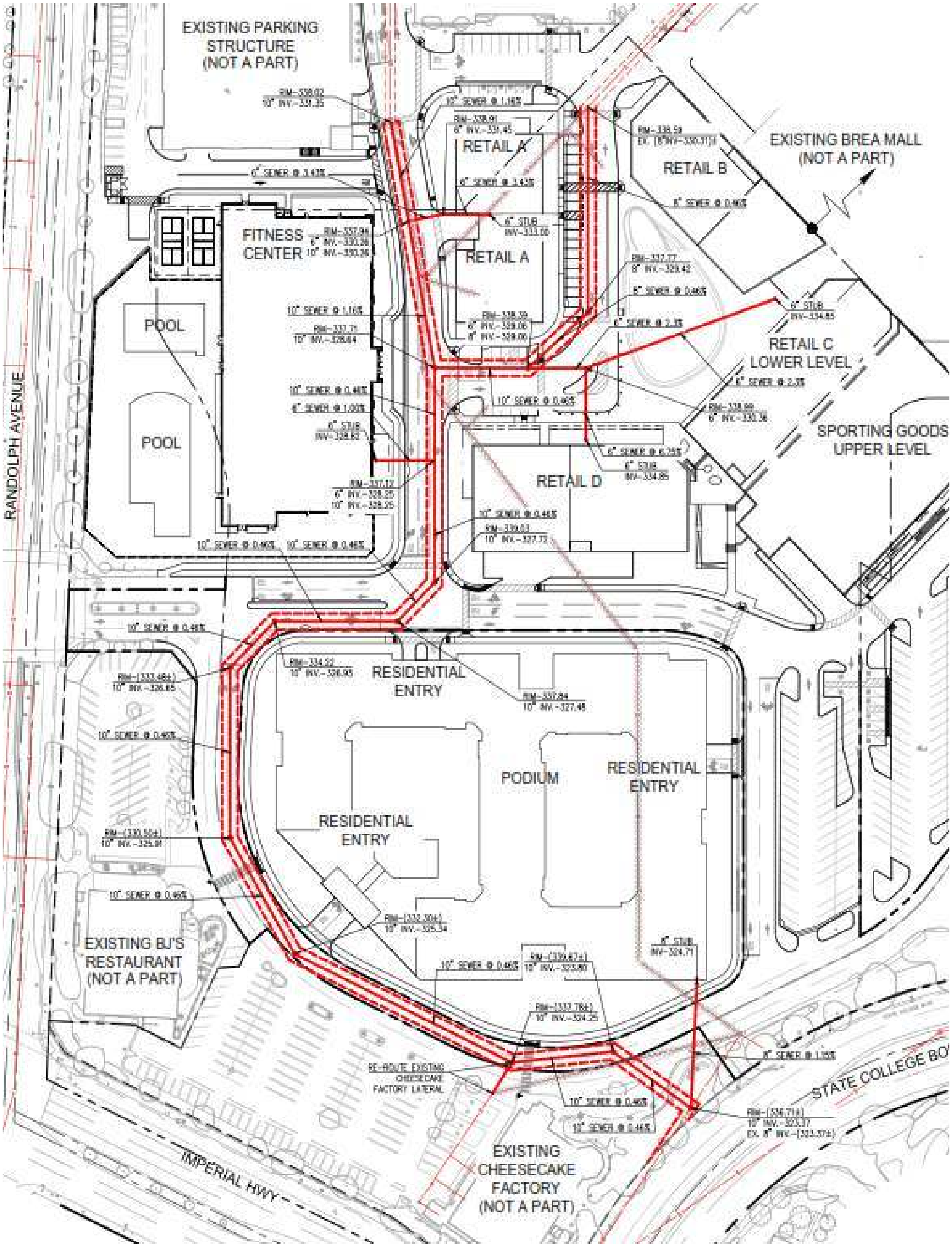


Figure below: Sewer map showing the Brea Mall and Residences at Brea Mall Mixed Use Project.



The project proposes to change the current land use from strictly commercial to a mixed use of commercial and residential. The existing onsite sewer line shown in red and gray will be removed and the new proposed sewer lines shown in bold red will be constructed. The proposed redevelopment consists of a fitness center, sporting goods store, small shops, restaurant and residential dwelling units as shown in Table 1 on page 32 of this report. The proposed 10-inch (in) sewer line will be carrying only the existing and proposed commercial flow. The proposed 10-in sewer line will tie into the existing offsite 8-in sewer line at a new manhole downsteam from the Site 1 MH in order to enter the existing sewer line at a better angle, and thereby improving the hydraulics in the line and in the Site 1 MH.

1.4 Monitoring Site Installations

Figure at left: The photo shows the Nordstrom MH in the left-hand northbound lane at ~1048 Brea Mall. Surface conditions were dry. No issues were encountered during the installation on 9/24/2019 or the removal on 10/02/2019.

Figure at right: This was a commercial access road with a low-speed limit, so the field team used cones, signs and an arrow board in accordance with CA WATCH Diagram 15 during installation and removal of the monitoring equipment.

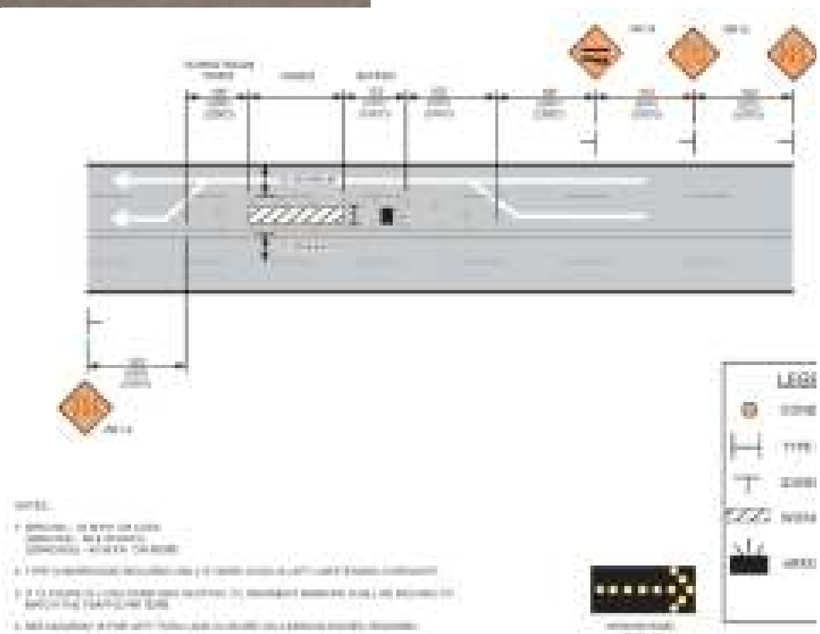


Figure above: The Nordstrom MH provided access to an 8-in sewer line, which entered from the north and discharged to the southeast. Gas levels were good (well within OSHA acceptable limits: O_2=20.9%; LEL, H_2S & CO=0). The flow monitoring equipment was set to monitor the downstream pipe as it provided the best hydraulics. Follow up on this installation confirmed equipment calibration.

Figures below: The left photo shows the Site 1 MH on the sidewalk at ~120 Brea Mall. This was adjacent to commercial access road with a low-speed limit, so the field team used cones, signs and an arrow board in accordance with CA WATCH Diagram 2 during installation and removal of the monitoring equipment. Surface conditions were dry. No issues were encountered during installation on 9/24/2019 or removal on 10/02/2019.

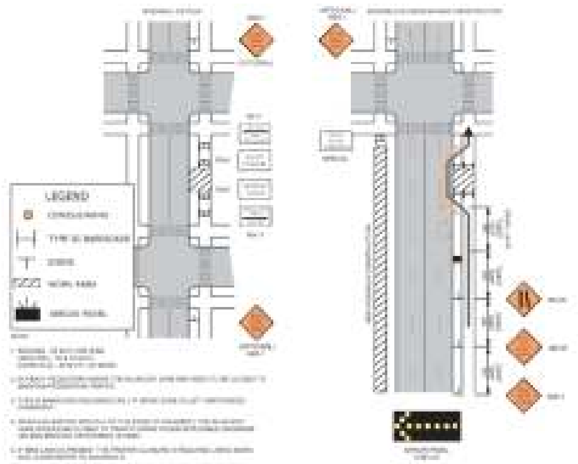


Figure above: The Site 1 MH provided access to an 8-in sewer line, which entered from the northeast and discharged to the southwest. Two laterals entered from the northwest and southeast, but according to the sewer maps, there should only be one upstream line entering from the northwest. Gas levels were good. The flow monitoring equipment was set to monitor the downstream line to get the total flow. Follow up on this installation confirmed equipment calibration.

Figures below: The left photo shows the Site 2 MH on the sidewalk at ~405 S. State College Blvd. This was a commercial area, so the field team used cones and signs in accordance with CA WATCH Diagram 2 during installation and removal of the monitoring equipment, but no arrow board was needed because the parking lane was used. Surface conditions were dry. No issues were encountered during installation on 9/24/2019 or removal on 10/02/2019.

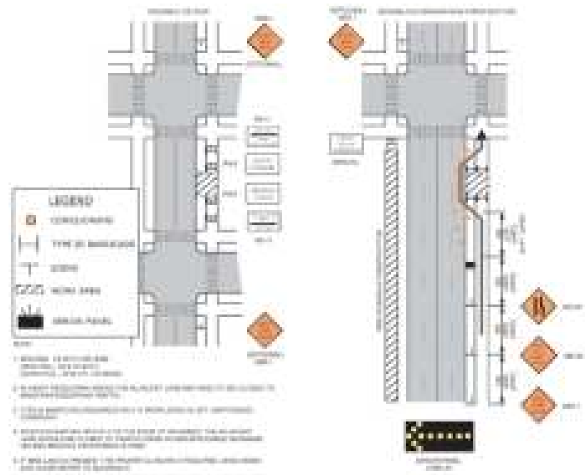


Figure at left: The Site 2 MH provided access to an 8-in sewer line, which entered from the northeast and discharged to the southwest. Gas levels were good. The flow monitoring equipment was set to monitor in the downstream direction in a position within the trough that provided the best hydraulics. Follow up on this installation confirmed equipment calibration.

Figures below: The left photo shows the Site 3A MH in the left-hand southbound lane at ~454 S. State College Blvd. This was a commercial area, so the field team used cones, signs and an arrow board in accordance with CA WATCH Diagram 15 during installation and removal of the monitoring equipment. Surface conditions were dry. No issues were encountered during installation on 9/24/2019 or removal on 10/02/2019.

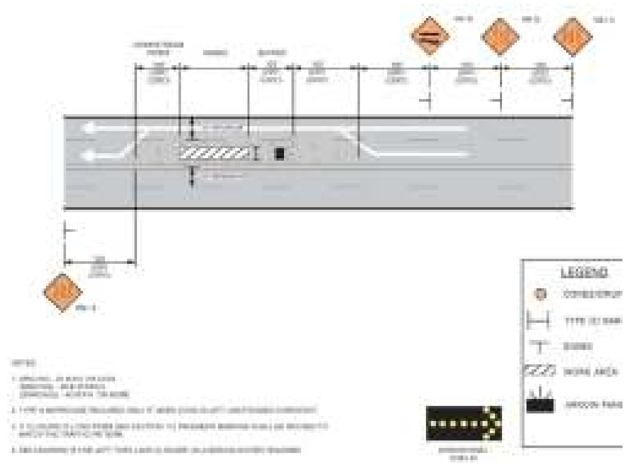


Figure above: This site was originally believed to be the Site 3 MH, but was most likely a brine line since the manhole provided access to a 6-in line, which entered from the southeast and discharged to the northwest. Follow up on this installation determined that the equipment was in the wrong manhole. The next available field crew was dispatched on 10/02/2019 to find the correct manhole in the park.

Figures below: The left photo shows the Site 3 MH in the center of the painted median at ~454 S. State College Blvd. This was a commercial area, so the field team used cones and signs in accordance with CA WATCH Diagram 20 during installation and removal of the monitoring equipment. Surface conditions were dry. No issues were encountered during installation on 9/24/2019 or removal on 10/02/2019.

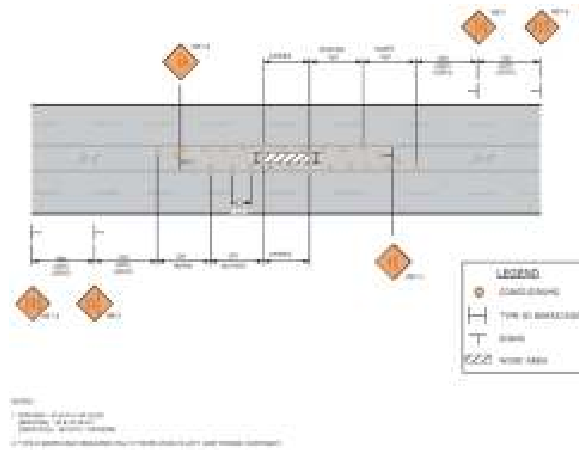


Figure above: This site was originally believed to be the Site 4 MH, but was actually the Site 3 MH. The manhole provided access to an 18-in line, which entered from the northwest and discharged to the southeast. Two laterals entered from the north; one was a drop inlet, but no flow was observed. Follow up on this installation confirmed equipment calibration.

Figures below: The photo shows the Site 4 MH in the park, east of ~471 S. State College Blvd. This was open green space, so the field team used cones to delineate their work zone during installation and removal of the monitoring equipment. Surface conditions were dry. No issues were encountered during installation on 10/02/2019 or removal on 10/10/2019.

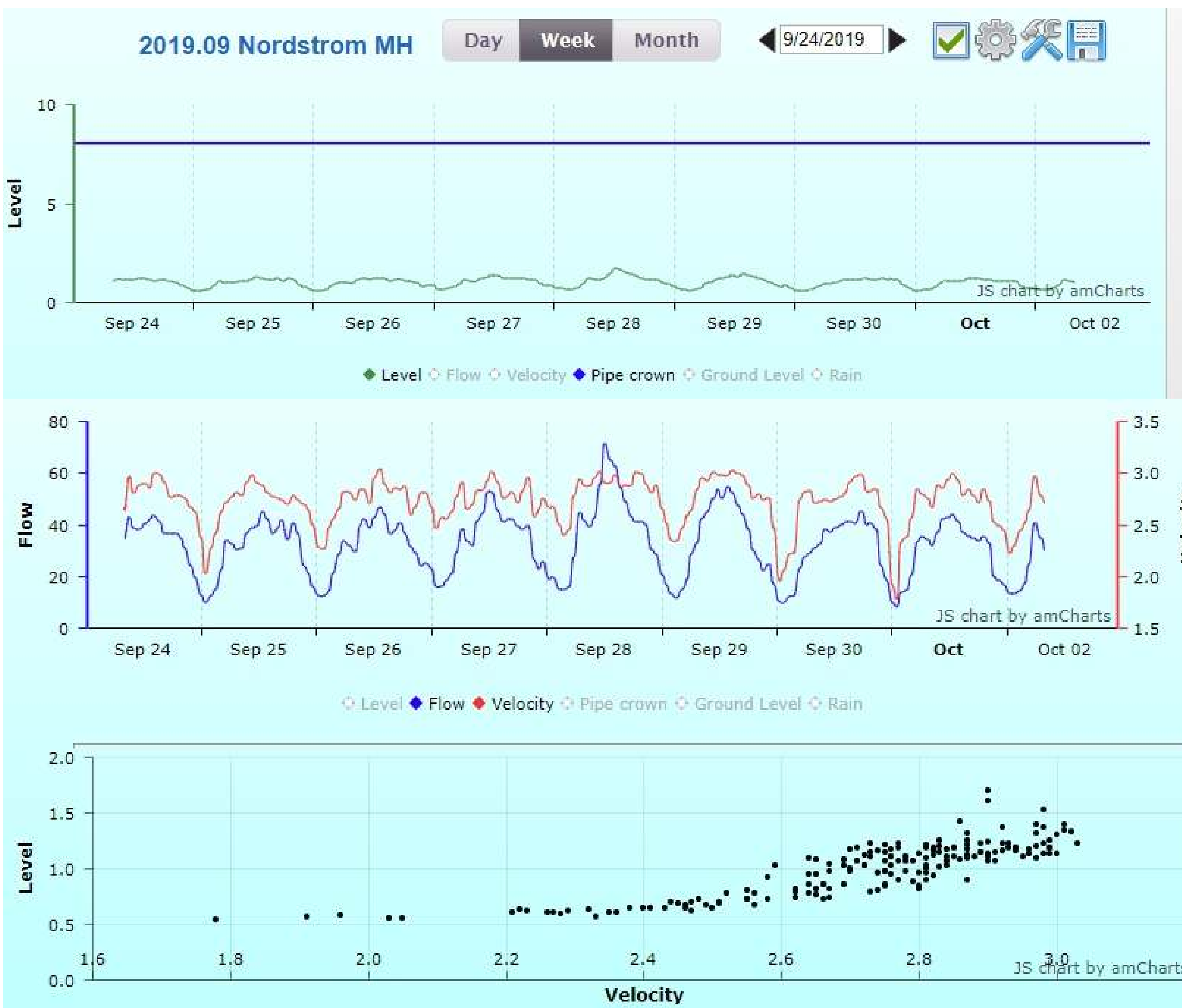
Figure above: The manhole provided access to an 18-in sewer line, which entered from the northwest and discharged to the southeast. One lateral entered from the north. Gas levels were good. The flow monitoring equipment was set to monitor the downstream line to get the total flow. Follow up on this installation confirmed equipment calibration.

1.5 Existing Capacity Analysis

The capacity evaluation method conformed to the following process:

1. Collect 15-minute interval depth and velocity data points at each site over the entire monitoring period and determine the depth versus (vs) velocity relationship or pipe curve based on Manning's equation.
2. Determine statistically the minimum, maximum and average depths and flow rates at each site during the monitoring period.
3. Calculate the maximum theoretical unobstructed flow rate at each site.
4. Determine remaining capacity under peak flow conditions at each site, using the ratios of monitored daily flow depths to pipe diameter.

Figures below: Nordstrom MH graphs of level, flow & velocity, and scatter plot of level in relation to velocity from US[3] Flow Monitoring Website (http://us3.uscubed.com/)



The scatter plot on the previous page shows the depth vs velocity data points for the monitored pipe. The pattern of velocity and depth data points for a sewer operating in free-flow conditions over an extended period of time should conform to the depth-velocity relationship of Manning's Equation, which is the basis for evaluating flow monitoring data. This equation (shown below) defines a commonly used theoretical relationship between depth and velocity in pipes operating under free flow conditions:

$v = 1.486/n \times R^{2/3} \times S^{1/2}$

Where,

v = velocity (fps)

n = pipe roughness, defined as the Manning's Roughness Coefficient

R = hydraulic radius,
defined as wetted area (ft^2) divided by wetted perimeter (ft)

S = hydraulic slope

The scatter plot from the Nordstrom MH shows the depth vs velocity data points for the 8-in downstream pipe, which should resemble a theoretical hydraulic operating curve based on the site-specific characteristics of the pipe. According to the raSmith utility plan (UP-02A), the slope of the line downstream from the Nordstrom MH should be 1.70%.

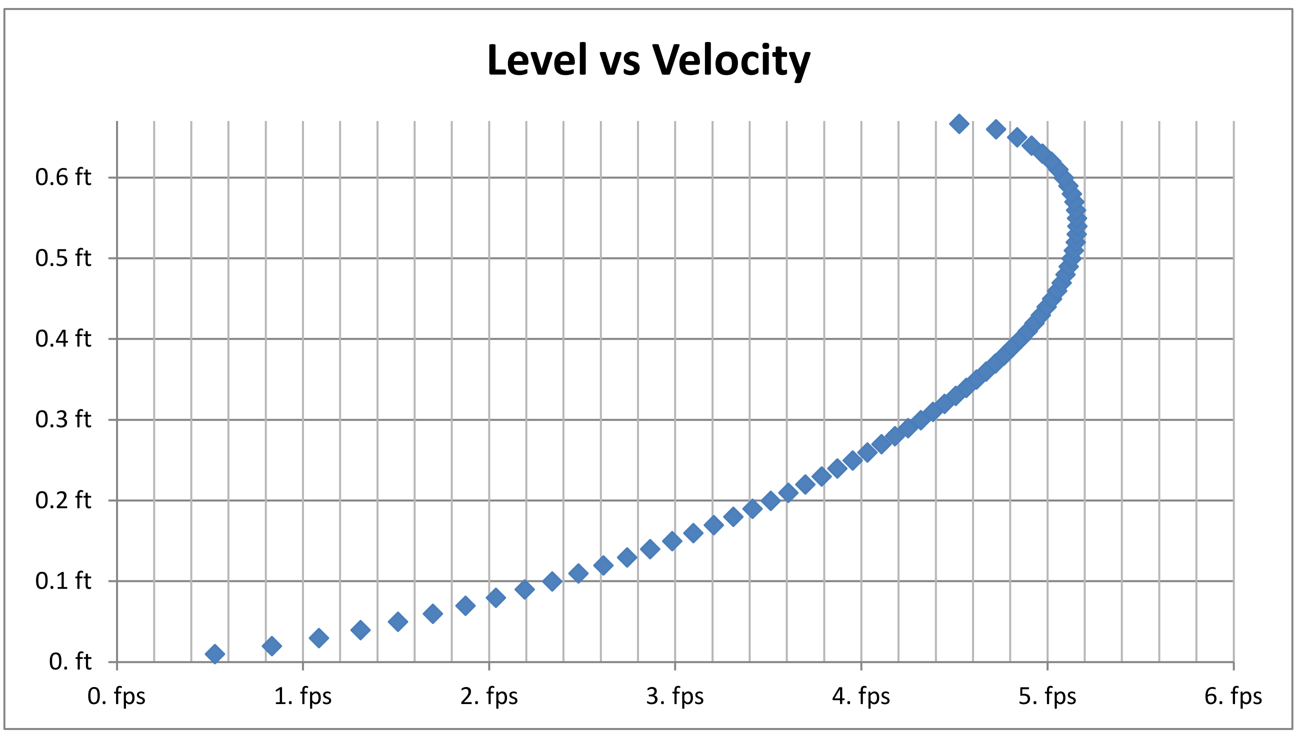


Figure above: This theoretical pipe curve was generated for an 8-in (0.67-ft) pipe with a slope of 1.70%.

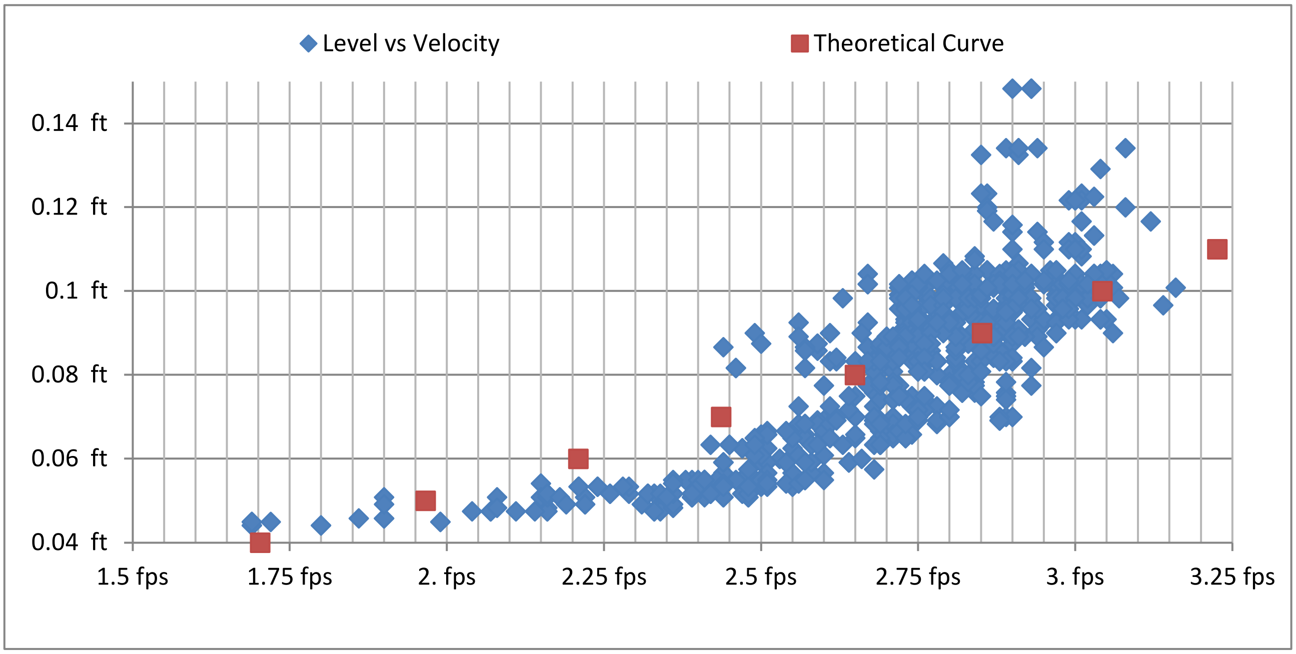


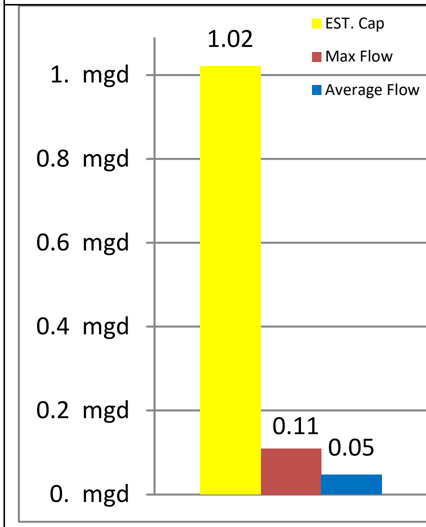
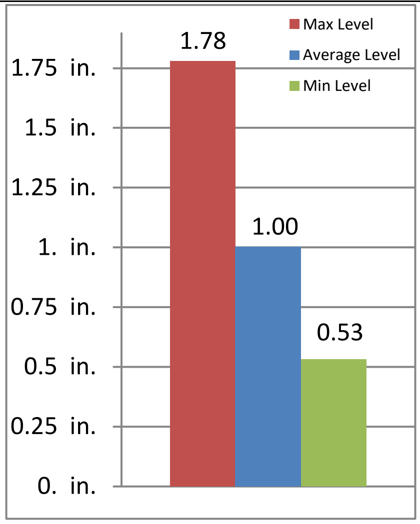
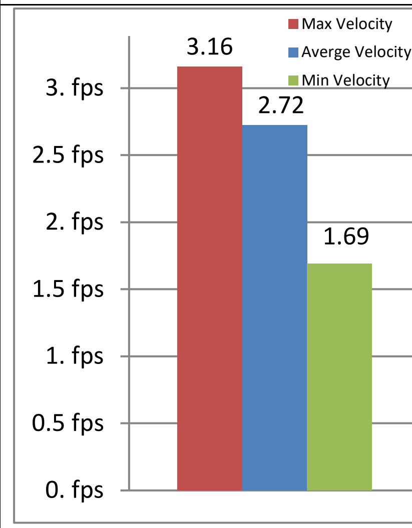
Figure above: Since the flows at the Nordstrom MH utilized ~7% to ~22% of the pipe depth during the study, that portion of its theoretical curve has been overlaid onto its scatter plot.

As shown in the scatter plot above, while a majority of the data falls into an acceptable area along the theoretical curve, there is a curvature to the data that is inconsistent with the theoretical curve. However, the curvature suggests that the data is trending toward higher velocities than expected as the levels increase.

To summarize the site statistics from the data analysis at the Nordstrom MH:

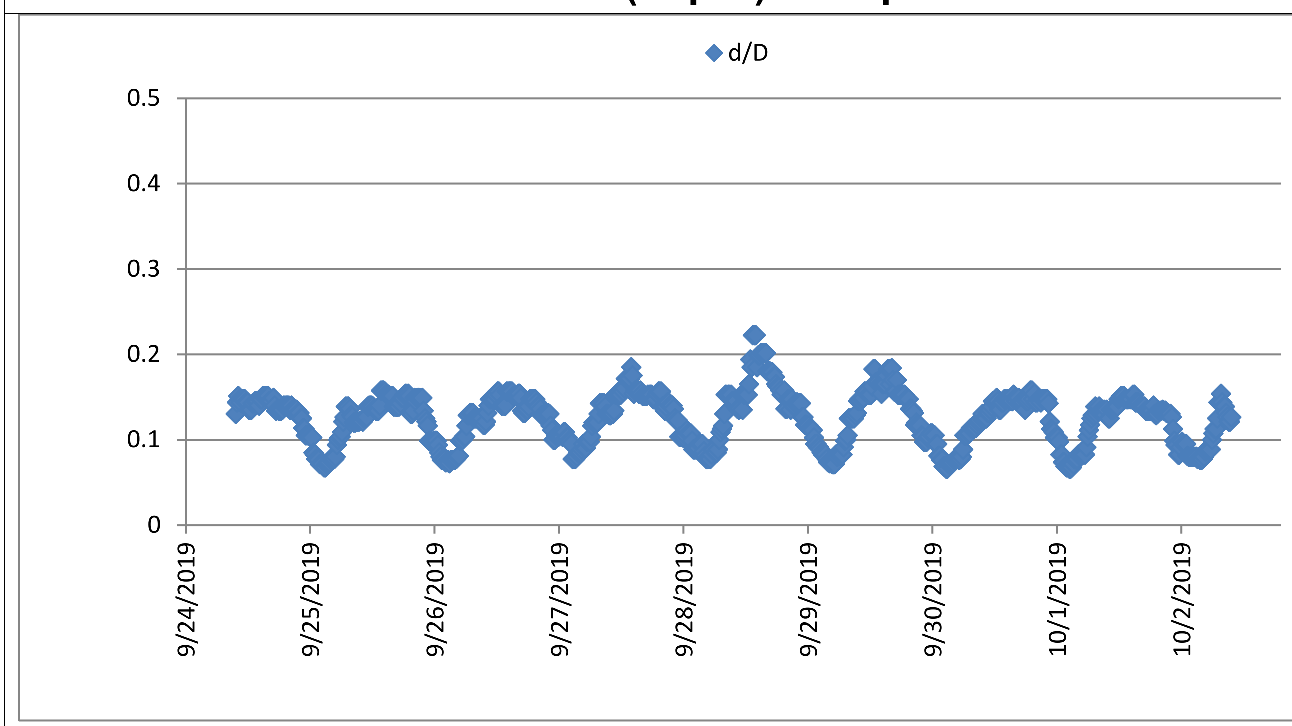
- During peak flows, 0.1090 million gallons per day (mgd) or ~76 gallons per minute (gpm) utilized ~10.7% of the pipe's capacity.
- During average flows, 0.0464 mgd or ~32 gpm utilized ~4.5% of the pipe's capacity.
- According to common practice in sewer system design, velocities need to exceed 2.0 fps a minimum (min) of once per day to provide sufficient scouring action for self-cleaning. The maximum velocity at the Nordstrom MH was 3.16 fps with an average velocity of 2.72 fps. Therefore, this site should have no issues with regard to settlement of normal system solids.
- According to the Brea Sewer System Management Plan, the depth versus diameter (d/D) ratio for existing collection system pipes of 15 inches in diameter or less should be no more than 0.50 during dry weather peak flow conditions. The average d/D ratio from the Nordstrom MH during this study was ~0.13 and the maximum (max) was ~0.22. Therefore, this 8-in pipe had capacity available during the observed dry weather peak flow.

The following is a graphical representation of site statistics (stats) from the data analysis:

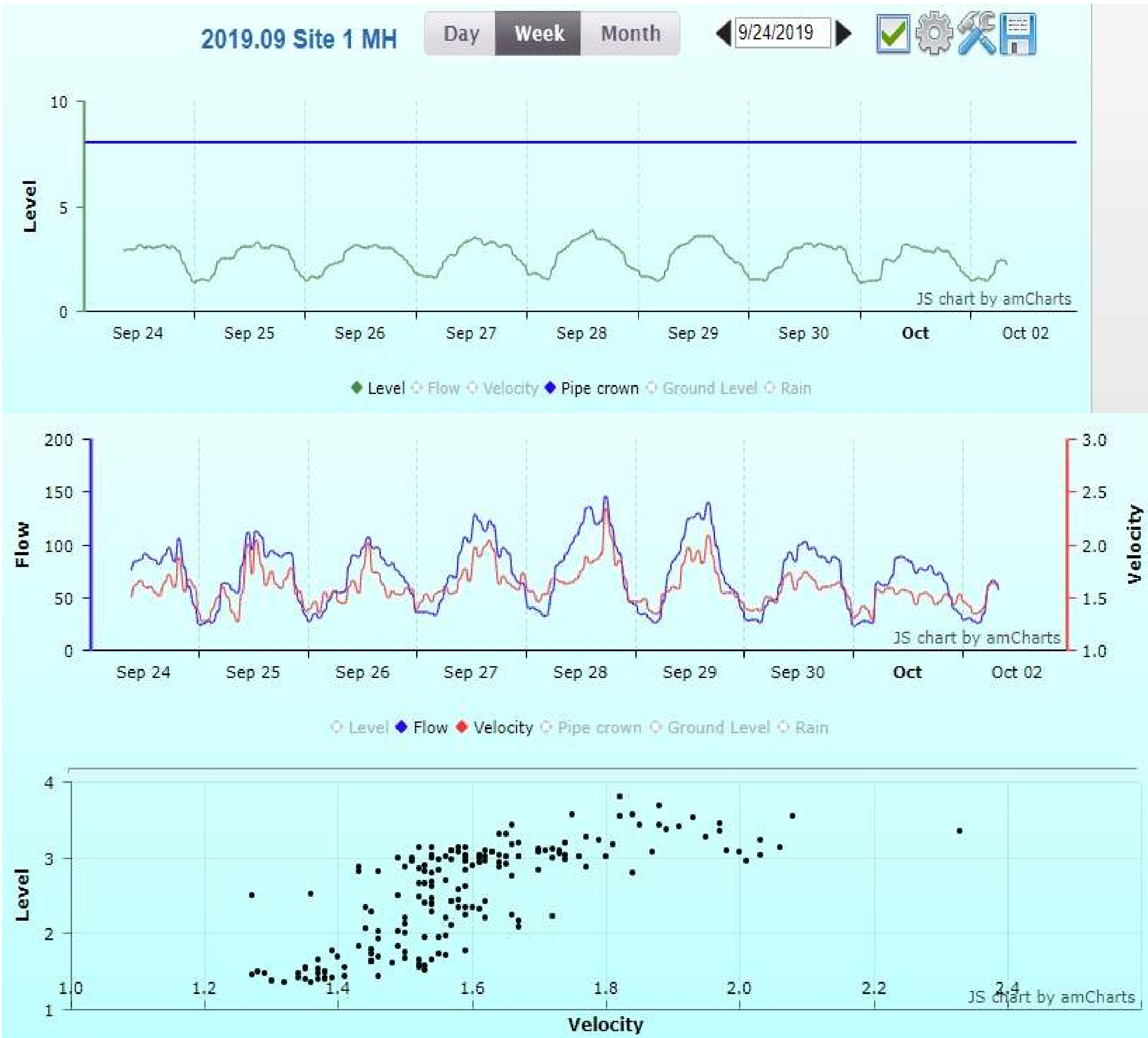
Flow Stats	Level Stats	Velocity Stats
		

The pipe capacity was estimated using a Manning's Circular Pipe Flow Capacity chart, where n=0.013 (in accordance with the minimum value for a vitrified clay sewer pipe (VCP) with manholes, inlets, etc., Chow 1959). From the theoretical hydraulic operating curve for an 8-in pipe with a slope of 1.70%, with the pipe completely full, the velocity is expected to be ~4.5260 fps. When this velocity is input into the Flo-Ware program from the Nordstrom MH, a maximum capacity of ~1.0211 mgd is produced.

Nordstrom MH Level (depth) vs Pipe Diameter



Figures below: Site 1 MH graphs of level, flow & velocity, and scatter plot of level in relation to velocity from US[3] Flow Monitoring Website (http://us3.uscubed.com/)



Site Info			
Description:	MH on sidewalk, NE of address (Cheesecake Factory)	Address:	~120 Brea Mall
Manhole No:	unknown	City:	Brea
Pipe Diameter:	8	Site ID:	3692
Group:	Simon Brea Mall Proj	Device ID:	

The scatter plot above shows the depth vs velocity data points for the 8-in downstream pipe, which should resemble a theoretical hydraulic operating curve based on the site-specific characteristics of the pipe. According to the raSmith utility plan (UP-02A), the slope of the line downstream from the Site 1 MH should be 1.30%.

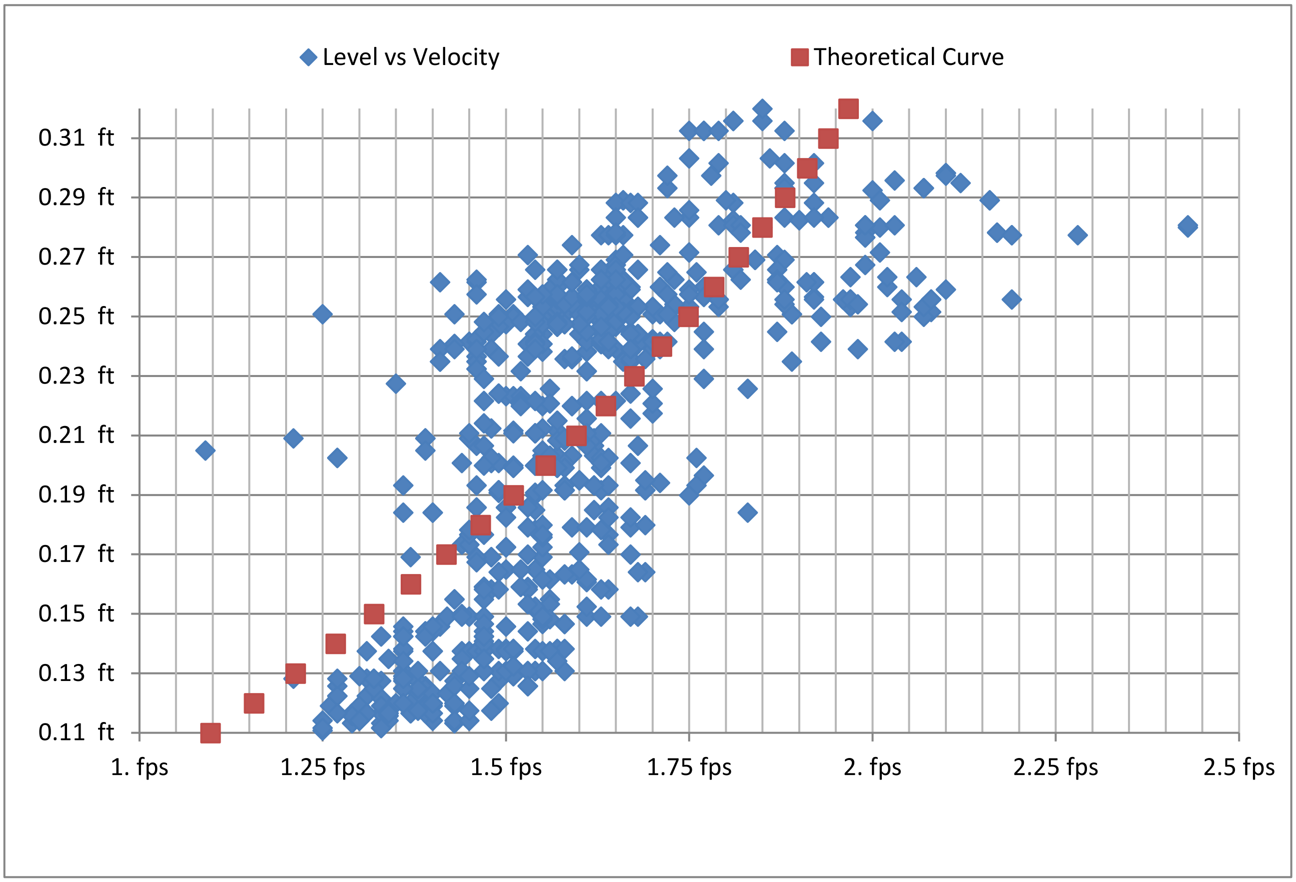


Figure above: Since the flows at the Site 1 MH utilized ~17% to ~48% of the pipe depth during the study, that portion of its theoretical curve has been overlaid onto its scatter plot.

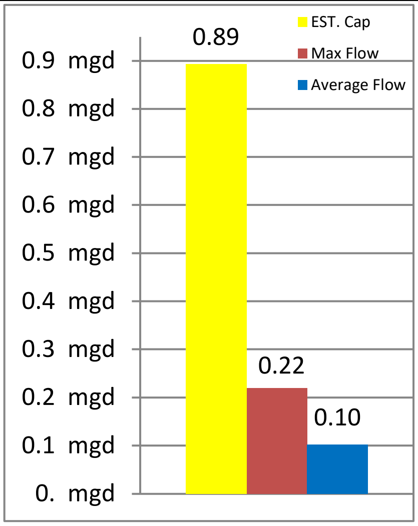
As shown in the scatter plot above, a majority of the data falls into an acceptable area along the theoretical curve, but the distribution of the data is probably due to the hydraulics within the manhole. From the photos, it appears that inflow from the northwest line is causing turbulence, perhaps even a backwater effect in the two other upstream lines.

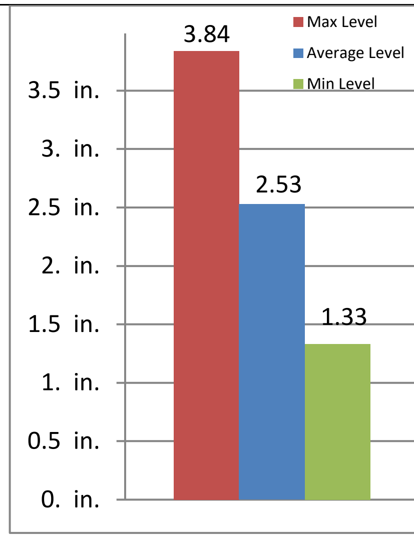
To summarize the site statistics from the data analysis at the Site 1 MH:

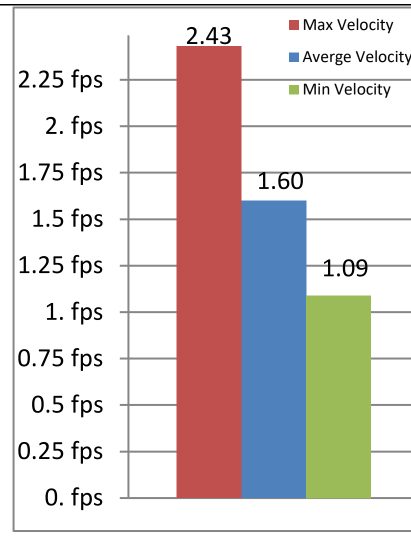
- During peak flows, 0.2194 mgd or ~152 gpm utilized ~24.6% of the pipe's capacity.
- During average flows, 0.1021 mgd or ~71 gpm utilized ~11.4% of the pipe's capacity.
- The maximum velocity at the Site 1 MH was 2.43 fps with an average velocity of 1.60 fps. Since velocities only exceeded 2 fps on five days during this 9-day study, over time, this site is likely to have issues due to settlement of normal system solids.
- The average d/D ratio from the Site 1 MH during this study was ~0.32 and the maximum was ~0.48. Therefore, this 8-in pipe had some capacity available during the observed dry weather peak flow.

The following is a graphical representation of the site statistics from the data analysis:

Flow Stats	Level Stats	Velocity Stats

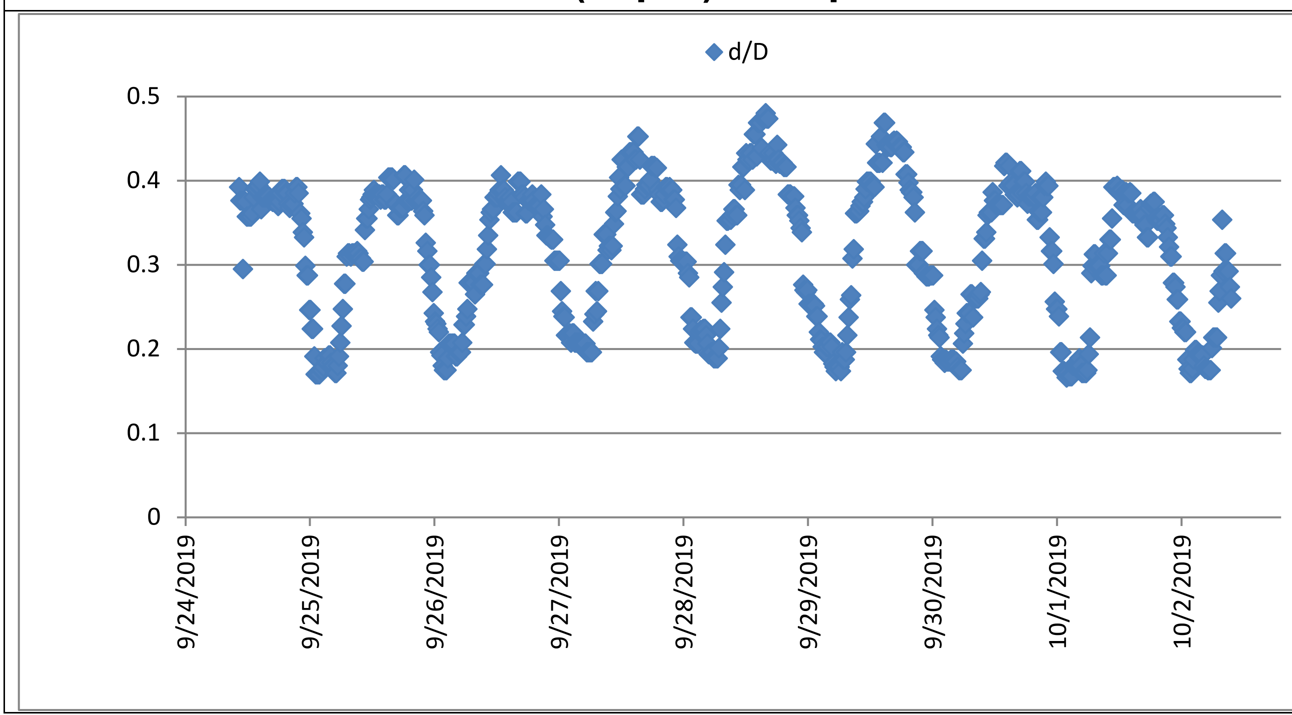




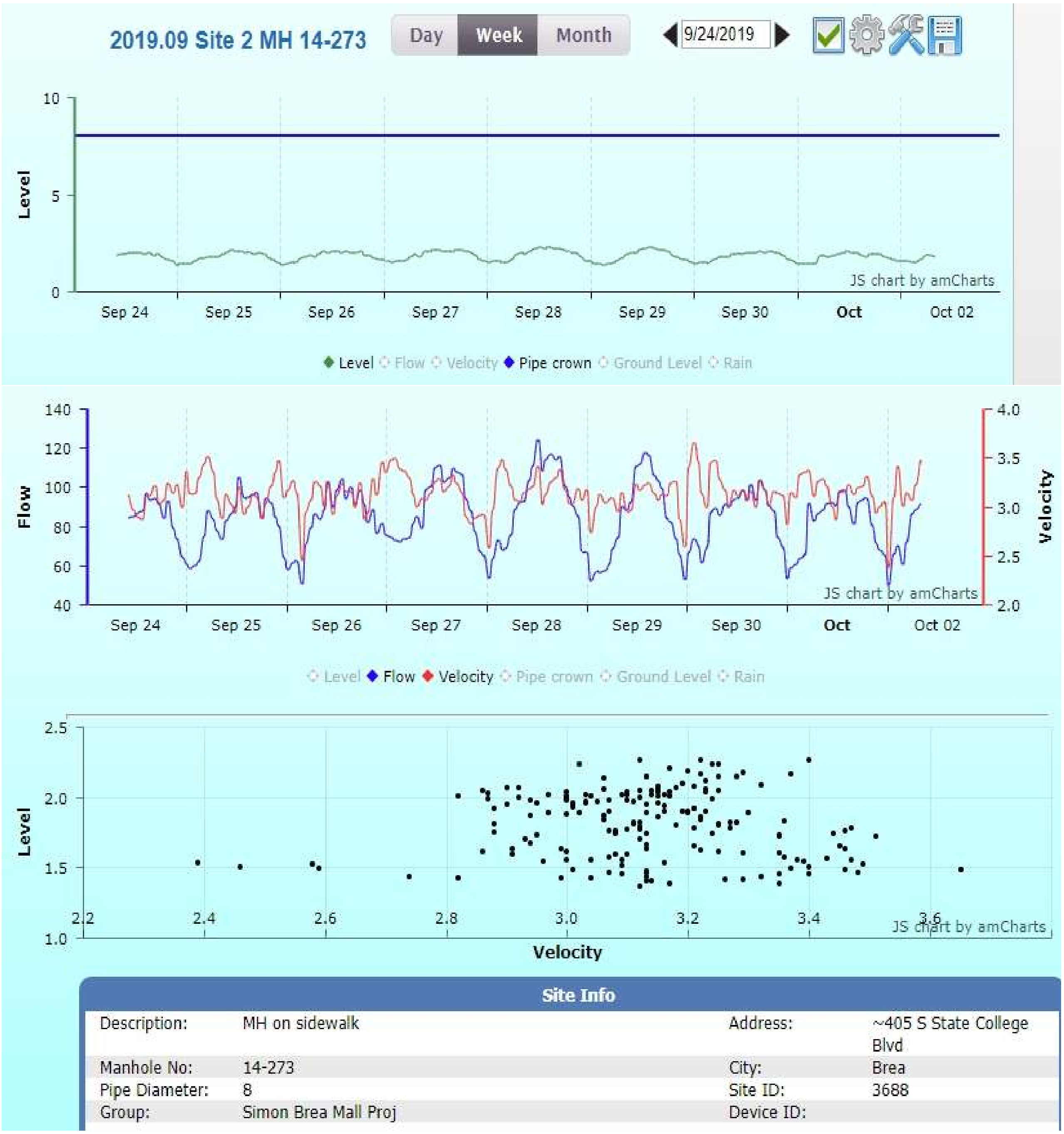


The pipe capacity was estimated using a Manning's Circular Pipe Flow Capacity chart, where n=0.013 (in accordance with the minimum value for a VCP with manholes, inlets, etc., Chow 1959). From the theoretical hydraulic operating curve for an 8-in pipe with a slope of 1.30%, with the pipe completely full, the velocity should be ~3.9579 fps, which when input into the Flo-Ware program from the Site 1 MH produced a maximum capacity of ~0.8929 mgd.

Site 1 MH Level (depth) vs Pipe Diameter



Figures below: Site 2 MH graphs of level, flow & velocity, and scatter plot of level in relation to velocity from US[3] Flow Monitoring Website (http://us3.uscubed.com/)



The scatter plot above shows the depth vs velocity data points for the 8-in downstream pipe, which should resemble a theoretical hydraulic operating curve based on the site-specific characteristics of the pipe. According to the raSmith utility plan (UP-02B), the slope of the line upstream from the Site 2 MH (RB6602-RB6601) should be 3.0%, while the slope of the line downstream from the Site 2 MH (RB6601-RB66) should be 2.16%.

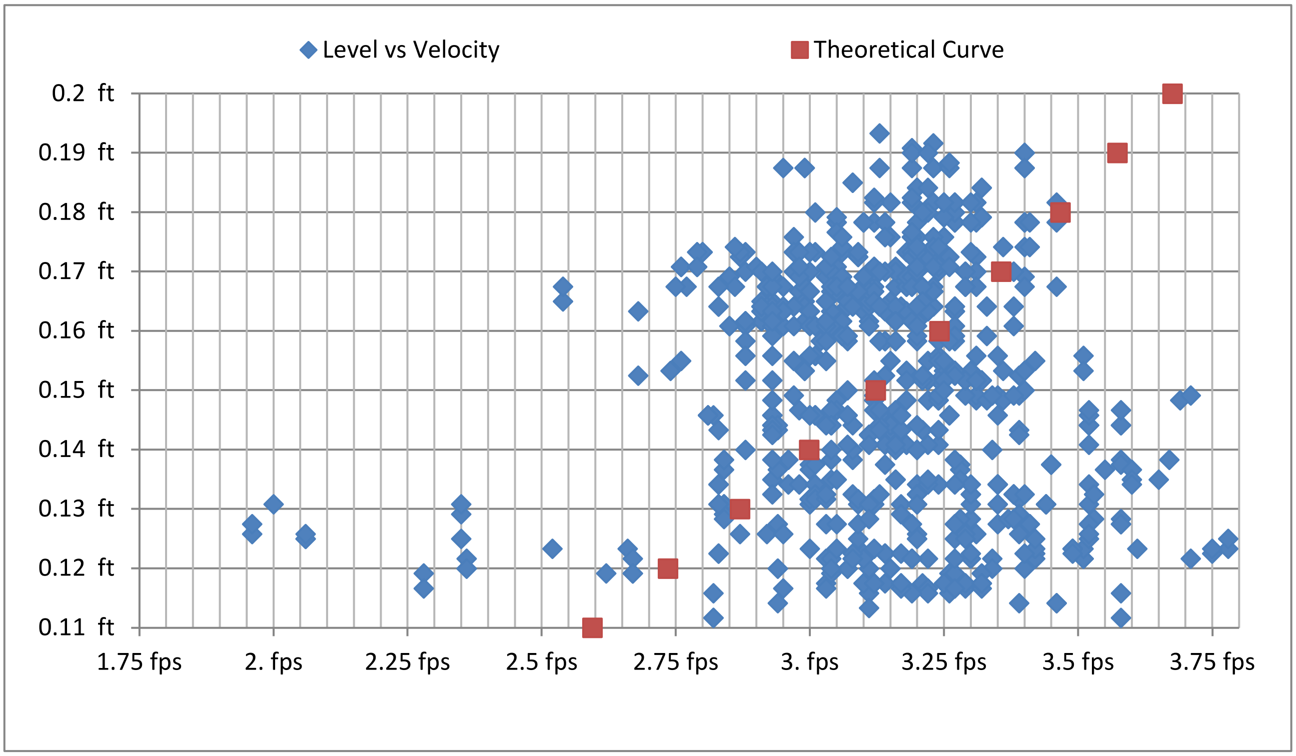


Figure above: Since the flows at the Site 2 MH utilized ~17% to ~29% of the pipe depth during the study, that portion of its theoretical curve has been overlaid onto its scatter plot.

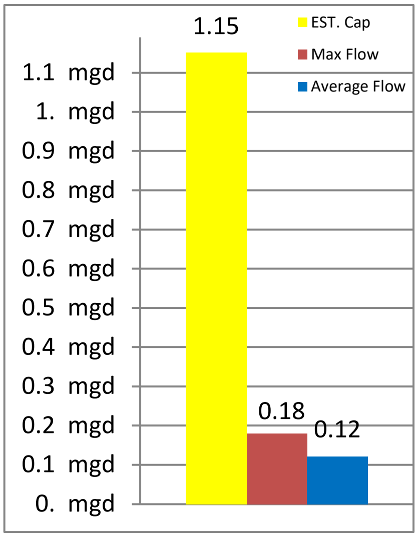
As shown in the scatter plot above, the expected relationship between level and velocity is not prevalent. While some of the data points fall into an acceptable area along the theoretical curve, this data set is more of a cloud formation, which is indicative of processed or non-conforming flow. This is flow that does not conform to the theoretical level-velocity relationship expected under free-flow conditions, such as what occurs during dumping, jetting, pumping, etc. This type of flow is more common in commercial and industrial areas because they are more likely to generate processed flows.

To summarize the site statistics from the data analysis at the Site 2 MH:

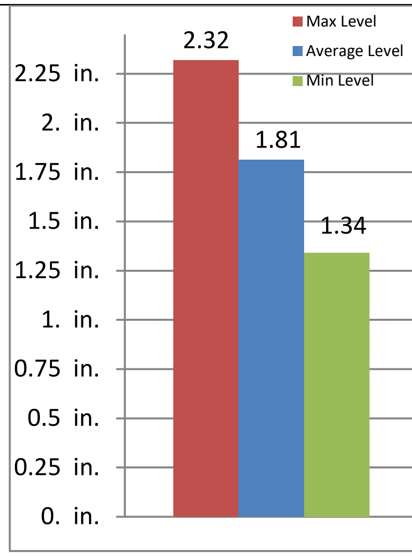
- During peak flows, 0.1798 mgd or ~125 gpm utilized ~15.6% of the pipe's capacity.
- During average flows, 0.1211 mgd or ~84 gpm utilized ~10.5% of the pipe's capacity.
- The maximum velocity at the Site 2 MH was 3.78 fps with an average velocity of 3.14 fps. Therefore, this site should have no issues with regard to blockage due to settlement of normal system solids.
- The average d/D ratio from the Site 2 MH during this study was ~0.23 and the maximum was ~0.29. Therefore, this 8-in pipe had capacity available during the observed dry weather peak flow.

The following is a graphical representation of the site statistics from the data analysis:

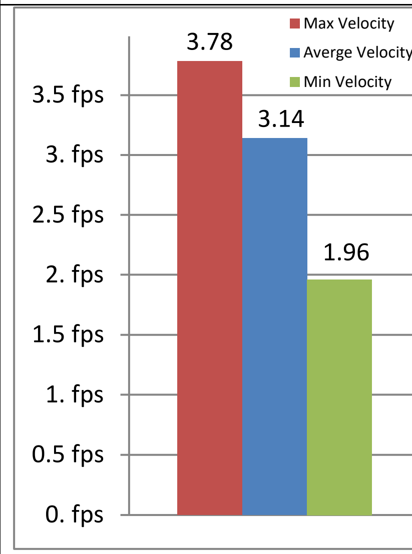
Flow Stats



Level Stats

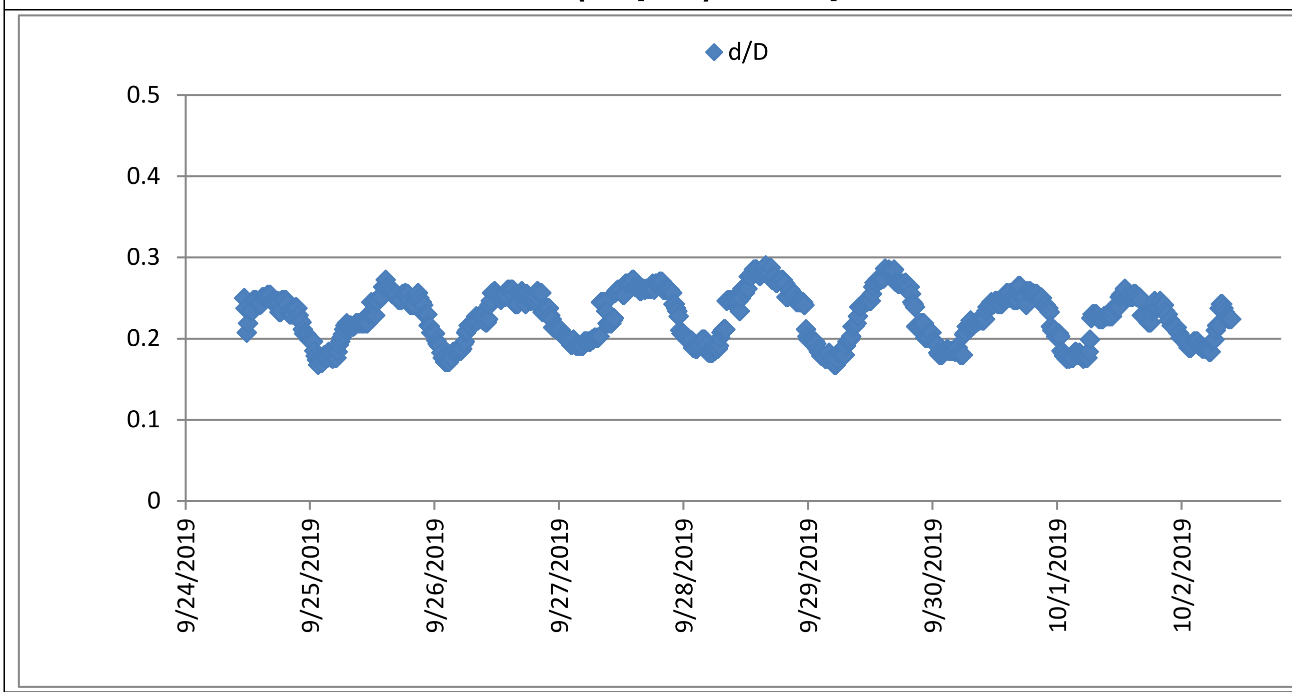


Velocity Stats

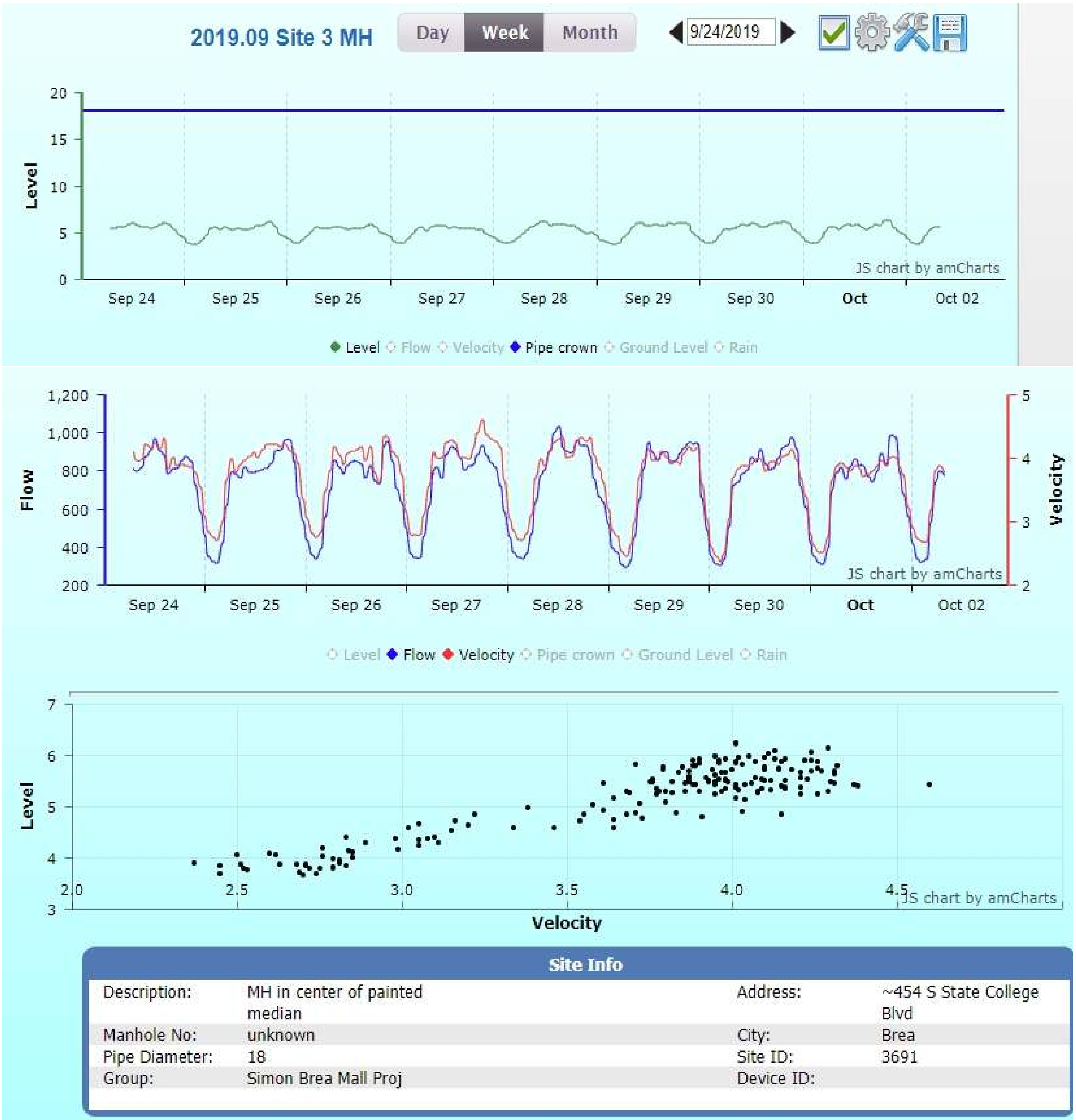


The pipe capacity was estimated using a Manning's Circular Pipe Flow Capacity chart, where n=0.013 (in accordance with the minimum value for a VCP with manholes, inlets, etc., Chow 1959). From the theoretical hydraulic operating curve for an 8-in pipe with a slope of 2.16%, with the pipe completely full, the velocity should be ~5.1037 fps, which when input into the Flo-Ware program from the Site 2 MH produced a maximum capacity of ~1.1514 mgd.

Site 2 MH Level (depth) vs Pipe Diameter



Figures below: Site 3 MH graphs of level, flow & velocity, and scatter plot of level in relation to velocity from US^3 Flow Monitoring Website (http://us3.uscubed.com/)



The scatter plot above shows the depth vs velocity data points for the 18-in downstream pipe, which should resemble a theoretical hydraulic operating curve based on the site-specific characteristics of the pipe. According to the City as-builts, the slope of the 12-in line upstream from the Site 3 MH should be 0.80%, while the slope of the line downstream from the Site 3 MH (RB66-RA43D) should be 0.63%.

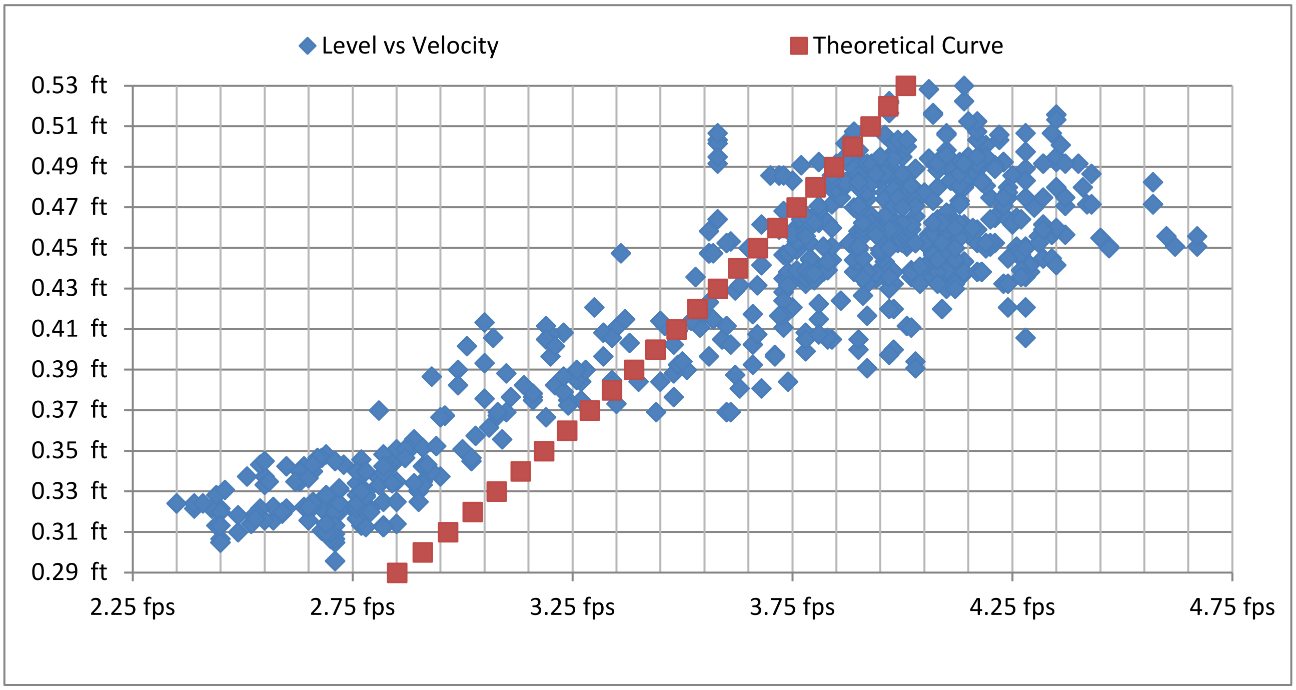


Figure above: Since the flows at the Site 3 MH utilized ~20% to ~36% of the pipe depth during the study, that portion of its theoretical curve has been overlaid onto its scatter plot.

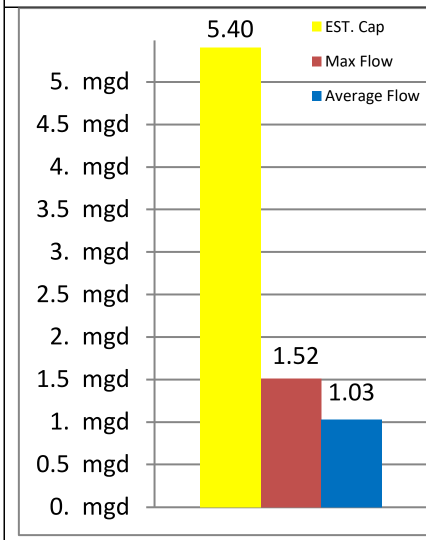
As shown in the scatter plot above, while a majority of the data falls into an acceptable area along the theoretical curve, the level to velocity relationship is slightly skewed at lower levels. This could indicate that some form of blockage is slowing velocities at lower levels, which does not hinder the higher levels. This crossover is between ~4.4 and 5 inches of depth.

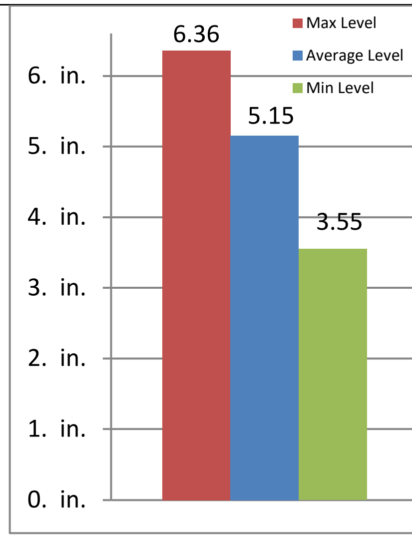
To summarize the site statistics from the data analysis at the Site 3 MH:

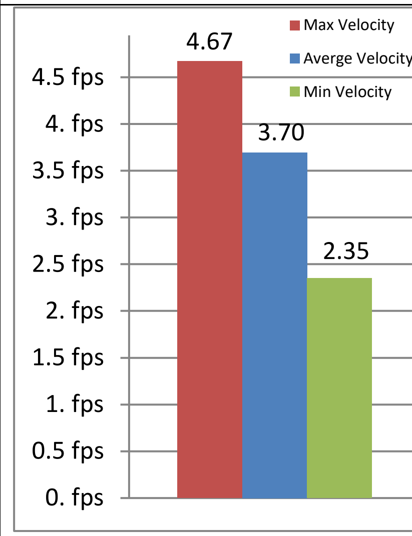
- During peak flows, 1.5150 mgd or ~1052 gpm utilized ~28.0% of the pipe's capacity.
- During average flows, 1.0278 mgd or ~714 gpm utilized ~19.0% of the pipe's capacity.
- The maximum velocity at the Site 3 MH was 4.67 fps with an average velocity of 3.70 fps. Therefore, this site should have no issues with regard to blockage due to settlement of normal system solids.
- According to the Brea Sewer System Management Plan, the depth versus diameter (d/D) ratio for existing collection system pipes of greater than 15 inches in diameter should be no more than 0.64 during dry weather peak flow conditions. The average d/D ratio from the Site 3 MH during this study was ~0.29 and the maximum was ~0.35. Therefore, this 18-in pipe had capacity available during the observed dry weather peak flow.

The following is a graphical representation of the site statistics from the data analysis:

Flow Stats	Level Stats	Velocity Stats

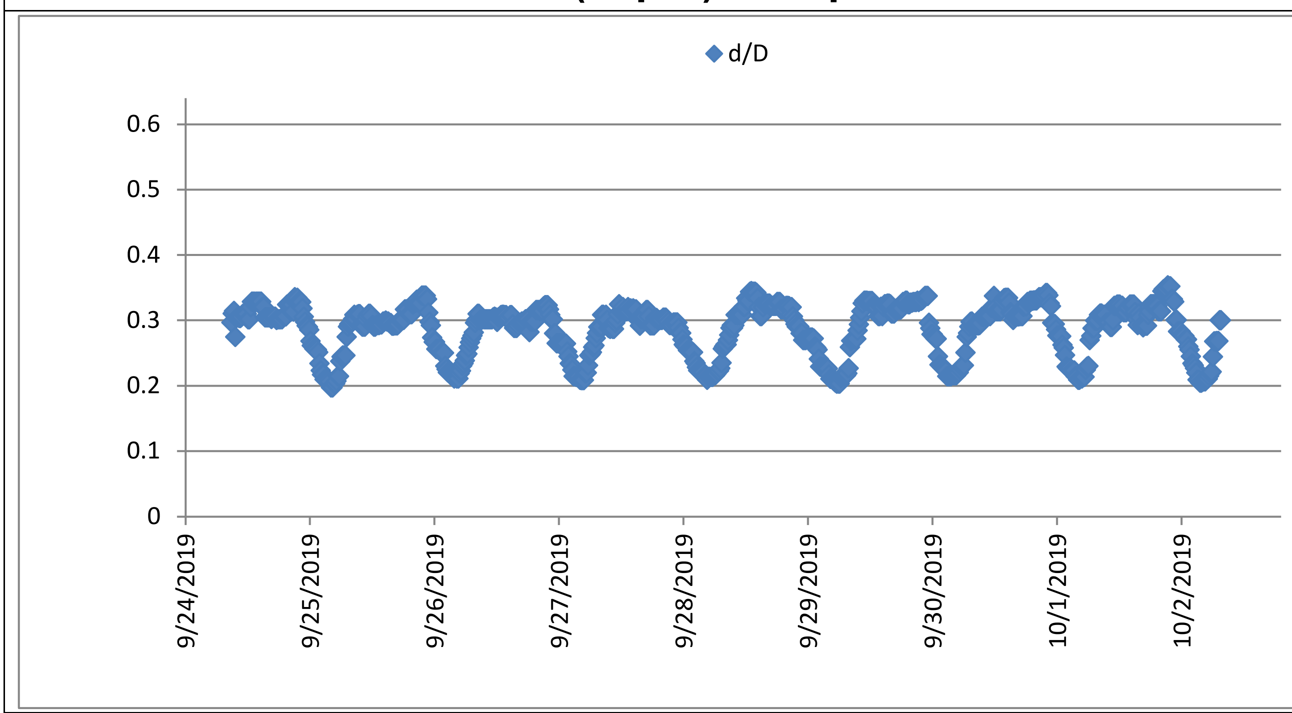




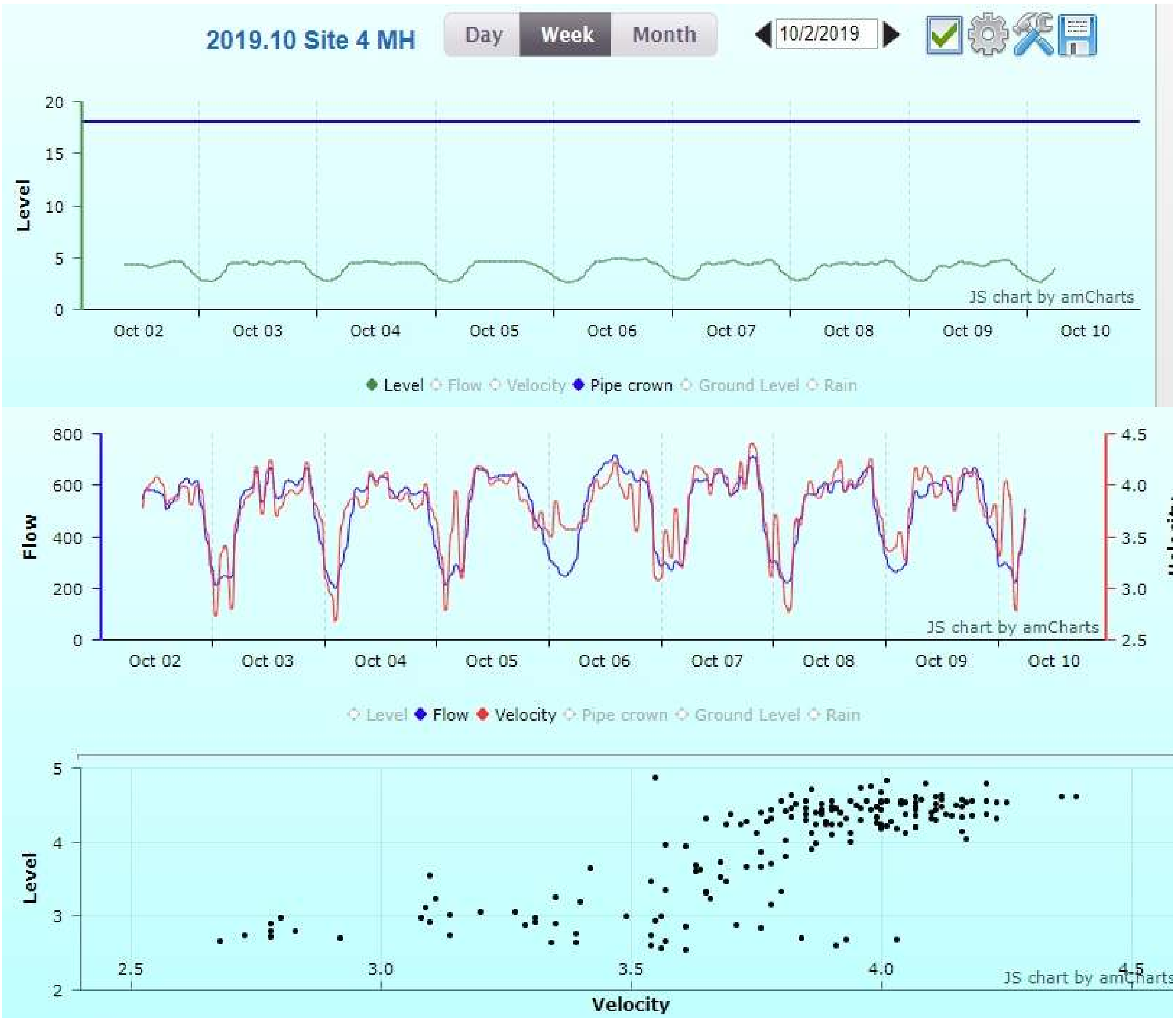


The pipe capacity was estimated using a Manning's Circular Pipe Flow Capacity chart, where n=0.013 (in accordance with the minimum value for a VCP with manholes, inlets, etc., Chow 1959). From the theoretical hydraulic operating curve for an 18-in pipe with a slope of 0.63%, with the pipe completely full, the velocity should be ~4.7308 fps, which when input into the Flo-Ware program from the Site 3 MH produced a maximum capacity of ~5.4032 mgd.

Site 3 MH Level (depth) vs Pipe Diameter



Figures below: Site 4 MH graphs of level, flow & velocity, and scatter plot of level in relation to velocity from US3 Flow Monitoring Website (http://us3.uscubed.com/)



Site Info

Description:	MH in park, E of address	Address:	~471 S State College Blvd
Manhole No:	unknown	City:	Brea
Pipe Diameter:	18	Site ID:	3694
Group:	Simon Brea Mall Proj	Device ID:	

The scatter plot above shows the depth vs velocity data points for the 18-in downstream pipe, which should resemble a theoretical hydraulic operating curve based on the site-specific characteristics of the pipe. According to the Birch & State College Mixed-Use Development Sewer Study Technical Memorandum (Tech Memo), dated 10/30/2017 and accepted by the City, the slope of the line downstream from the MH-R-A-43-Drop, which aligns with the location of the Site 4 MH, should be 0.60%.

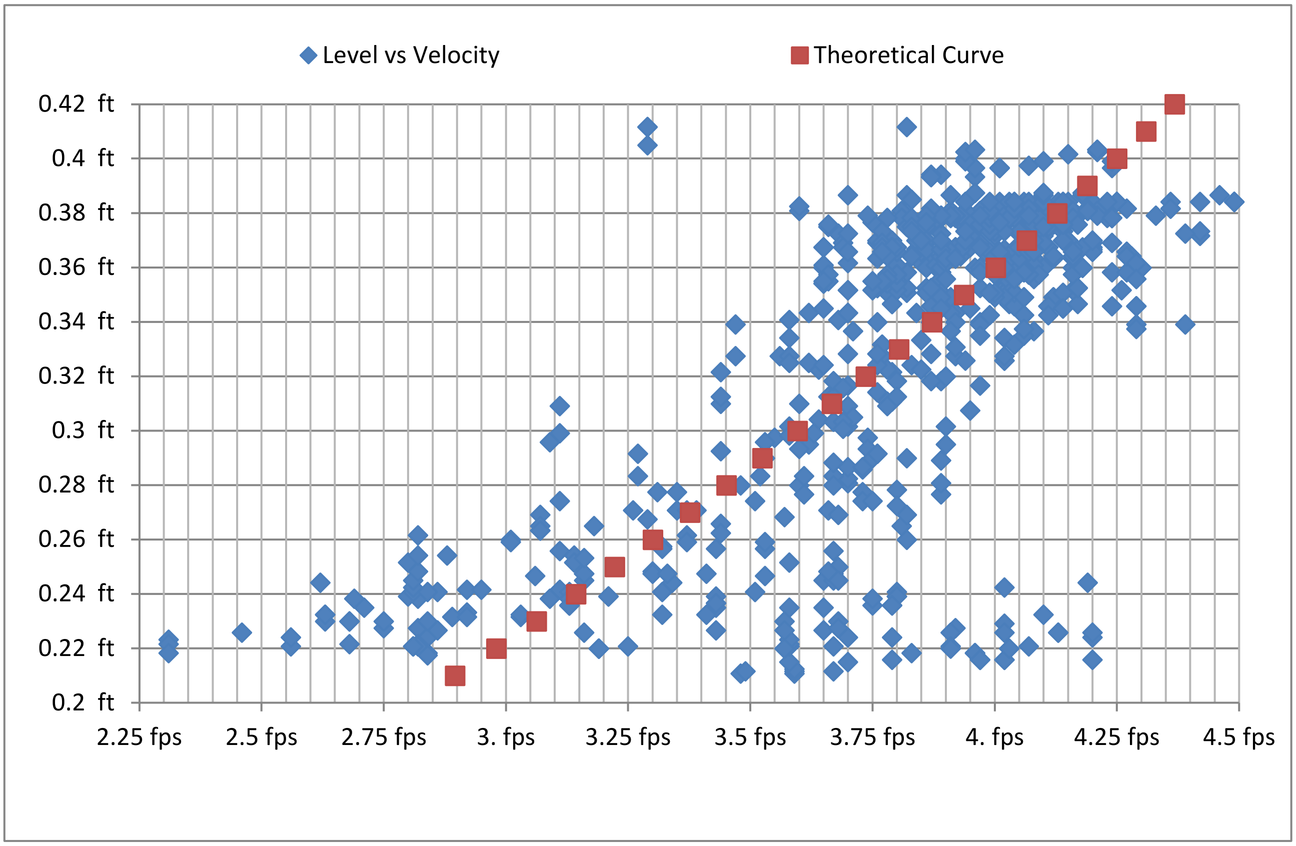


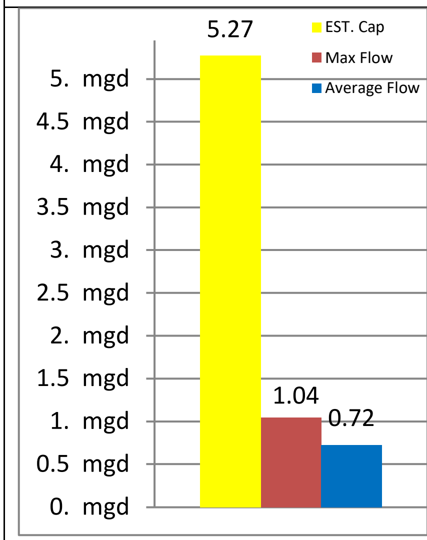
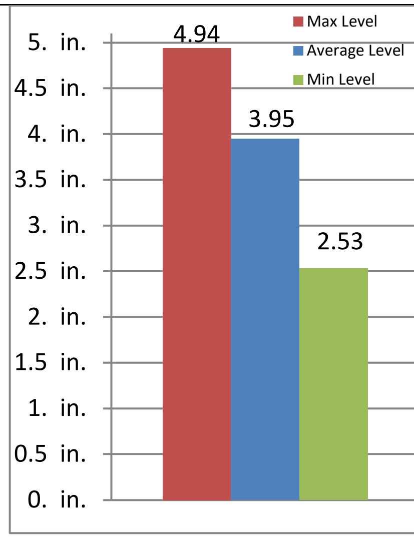
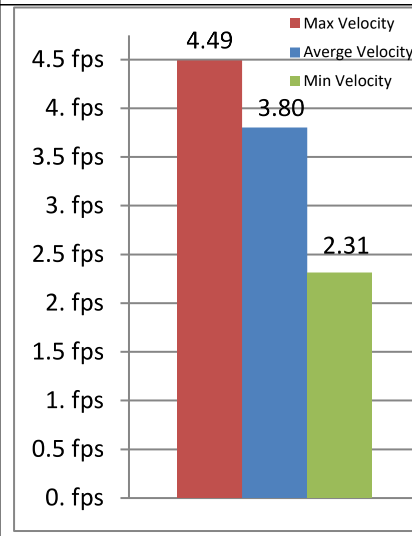
Figure above: Since the flows at the Site 4 MH utilized ~14% to ~27% of the pipe depth during the study, that portion of its theoretical curve has been overlaid onto its scatter plot.

As shown in the scatter plot above, while a majority of the data falls into an acceptable area along the theoretical curve, there are quite a few outliers. In addition, there appears to be a secondary flow pattern at lower levels, which could be flow from the lateral when the mainline flow slows.

To summarize the site statistics from the data analysis at the Site 4 MH:

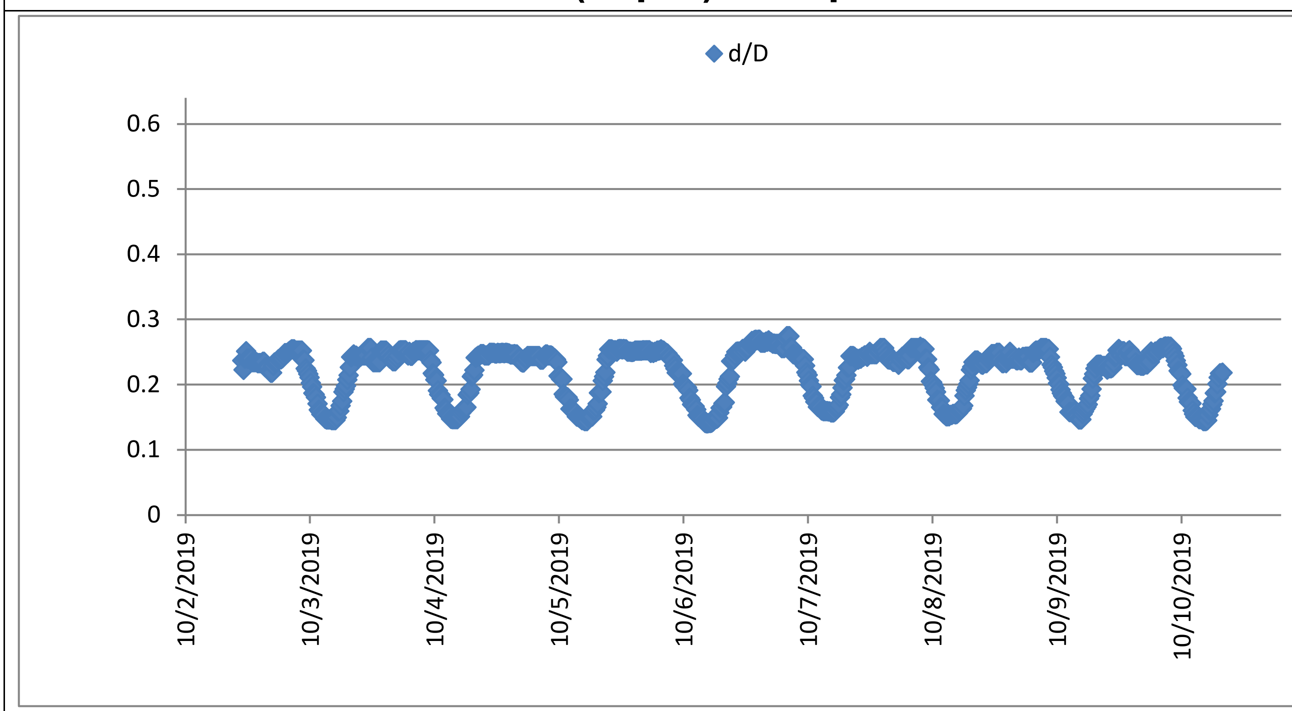
- During peak flows, 1.0417 mgd or ~723 gpm utilized ~19.8% of the pipe's capacity.
- During average flows, 0.7221 mgd or ~501 gpm utilized ~13.7% of the pipe's capacity.
- The maximum velocity at the Site 4 MH was 4.49 fps with an average velocity of 3.80 fps. Therefore, this site should have no issues with regard to blockage due to settlement of normal system solids.
- The average d/D ratio from the Site 4 MH during this study was ~0.22 and the maximum (max) was ~0.27. Therefore, this 18-in pipe had capacity available during the observed dry weather peak flow.

The following is a graphical representation of the site statistics from the data analysis:

Flow Stats	Level Stats	Velocity Stats
		

The pipe capacity was estimated using a Manning's Circular Pipe Flow Capacity chart, where n=0.013 (in accordance with the minimum value for a VCP with manholes, inlets, etc., Chow 1959). From the theoretical hydraulic operating curve for an 18-in pipe with a slope of 0.60%, with the pipe completely full, the velocity should be ~4.6168 fps, which when input into the Flo-Ware program from the Site 4 MH produced a maximum capacity of ~5.2730 mgd.

Site 4 MH Level (depth) vs Pipe Diameter



1.6 Proposed Flow Generation

The Brea Mall currently encompasses approximately 1,291,433 square feet (sf) and consists of a central retail core of major department stores ("anchors"). Sears, which was the anchor on the southwest side of the mall, partially closed in April 2018. Therefore, the Simon Property Group is proposing redevelopment of the 17.5-acre Sears parcel, which includes the adjoining transition areas adjacent to Nordstrom and Macy's. The proposed project involves demolishing the Sears department store and associated auto center (161,990 sf) and 12 acres of surface parking in order to allow a mix of uses.

The project would result in a net increase of commercial space as well as include a residential component. The mean loading used to calculate the proposed average dry weather flow (ADWF) was provided by raSmith, and coordinated with the City of Brea:

- 273.44 gallons per day (gpd) per 1000 sf for the Fitness Center
- 73.5 gpd per 1000 sf for the retail space minus the Sears flow credit
- 210 gpd per dwelling unit for the residential area
- 1575 gpd per 1000 sf for the restaurant

Table 1: Proposed Flow Generation with the Fitness Center

Use Category	Gross Leasable Area/Unit	Mean Loading (gpd/UOU*)	Proposed ADWF (mgd)
Fitness Center	90,000	273.44	0.0246096
Sporting Goods	50,000	73.5	0.0036750
Brea Mall Shops	34,914	73.5	0.0025662
Restaurant	34,501	1,575	0.0543339
-Sears Flow Credit	80,500	73.5	0.0059168
Total Commercial			**0.0792731**
Residential Units	380	210	**0.0798000**
Total proposed flow			**0.1590731**

* Unit of Use

Peak dry weather flow (PDWF) and peak wet weather flow (PWWF) were calculated using the equations from the Brea Sewer System Management Plan:

$$PDWF = 1.777 \times \text{Total ADWF}^{0.92}$$

$$PWWF = 1.25 \times PDWF$$

Total ADWF shown in Table 2 below is the combination of the average monitored flow and the proposed ADWF from Table 1. In addition, the flow in the new 10-in pipe was included with and without the flow from the Cheesecake Factory, based on the water usage during the time of the monitoring.

59,700 cu. ft of water was used from 9/05/19-10/07/19, which averages ~1867 cu. ft/day

1866.67 cu. ft/day = 13,963.66 gpd =0.01396366 mgd

0.1021 mgd – 0.01396366 mgd = 0.088136 mgd

Table 2: Monitored Average Flows and Proposed Flows Combined

Monitored Site & Site Information[1]	Monitored ADWF (mgd)	Proposed ADWF (mgd)	Total ADWF (mgd)	Calculated PDWF (mgd)	Calculated PWWF (mgd)
New 10-in comm pipe @ 0.46%[2]	0.0881	0.079273	0.167373	0.343145	0.428932
New 10-in comm pipe @ 0.46%[3]	0.1021	0.079273	0.181373	0.369466	0.461832
New 8-in res pipe @ 1.15%	0	0.07980	0.0798	0.173592	0.216990
Site 1 MH 8-in D/S @ 1.30%	0.1021	0.159073	0.27157	0.516727	0.645909
Site 2 MH 8-in D/S @ 2.16%	0.1211		0.29057	0.551213	0.689016
Site 3 MH 18-in D/S @ 0.63%	1.0278		1.19727	2.080364	2.600455
MH-R-A-43-Drop 18-in D/S @ 0.60%	1.3730		1.54247	2.631143	3.288929

1. The downstream (D/S) line of each manhole was monitored during this study.
2. Upstream of Cheesecake Factory
3. Downstream of Cheesecake Factory

In Section 1.8 of this report, the d/D values will be presented for all reaches downstream of the proposed development. Since the flows from the Tech Memo for MH-R-A-43-Drop are greater than those monitored during this study, they will be used in place of flows from the Site 4 MH.

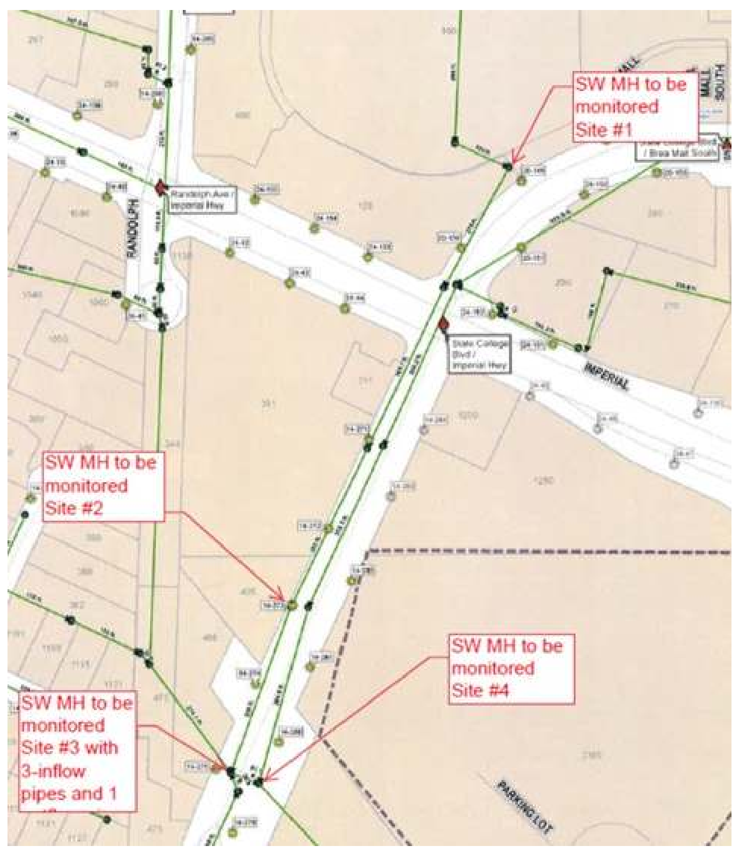
1.7 Flow Monitoring Summary

Calculations in this report are based on steady uniform flow with steady flow defined as the discharge being constant with time, and uniform flow defined as the slope of the water surface and cross-sectional flow area being constant in the length of pipe analyzed. Using velocities from this study in conjunction with the associated cross-sectional areas depicted by the monitored levels, the flow was calculated using the Continuity Equation, and the slope was derived using Manning's Equation.

The flow monitoring equipment at each site was calibrated with regard to site-specific characteristics and manual level and velocity readings for adjustment and verification. Follow-up on the installations confirmed equipment was reading properly at the sites. In addition, all of the equipment went through diagnostic testing before and after the study with less than a 1% deviation between manual and meter level readings and less than a 5% deviation between manual and meter velocity readings. Therefore, equipment calibration was verified in accordance with manufacturer specifications.

Initial flow monitoring for this project began on 09/24/2019 in accord with the supplied sewer map at right. This is also referred to as the first week of monitoring. The Nordstrom MH is not shown but was included in the first week of monitoring.

When the field installation forms and photos were reviewed, it was determined that Site 3 was actually the small line coming up from the southwest and Site 4 was actually Site 3. Therefore, on 10/02/2019, the US^3 field team searched the area and found Site 4 in the park, ~50 ft east of the road. Therefore, flow monitoring began at Site 4 at the same time that monitoring was completed at Sites 1, 2 and 3 and at the Nordstrom MH.



2019.09 Nordstrom MH: The graphs for this 8-in sewer line showed a fairly consistent daily flow pattern. In addition, velocities exceeded the minimum requirements to provide sufficient scouring action for self-cleaning as well as providing good capacity within the line. As previously stated, the utility plans showed the downstream slope for this section of sewer line to be 1.70%.

Therefore, in order to determine the maximum allowable flow within the pipe segment downstream of the Nordstrom MH, the plan slope (1.70%) was used to generate a theoretical hydraulic operating curve for the 8-in pipe. At half pipe (4 inches), the velocity from the theoretical curve was ~4.5258 fps, which when input into the Flo-Ware program from the Nordstrom MH produced an expected capacity of ~0.5105 mgd. Since peak flow was 0.1090 mgd, there should be capacity available for an additional 0.4015 mgd before the pipe exceeds its d/D limit of 0.50 at peak flow.

2019.09 Site 1 MH: The graphs for this site showed a fairly consistent daily flow pattern, but the level to velocity relationship could indicate a hydraulic issue within this confluence. In addition, velocities only met the minimum requirements to provide sufficient scouring action for self-cleaning on five days during this 9-day study. As previously stated, the utility plans showed the downstream slope for this section of sewer line to be 1.30%.

In order to determine the maximum allowable flow within the pipe segment downstream of the Site 1 MH, the plan slope (1.30%) was used to generate a theoretical hydraulic operating curve for the 8-in pipe. At half pipe (4 inches), the velocity from the theoretical curve was ~3.9577 fps, which when input into the Flo-Ware program from the Site 1 MH produced an expected capacity of ~0.4464 mgd. Since peak flow was 0.2194 mgd, there should be capacity available for an additional 0.2270 mgd before the pipe exceeds its d/D limit of 0.50 at peak flow.

2019.09 Site 2 MH: The graphs for this site showed a fairly consistent daily level, but the velocities did not follow any observable pattern. This resulted in a data set resembling a cloud formation, which is indicative of processed or non-conforming flow. However, velocities did exceed the minimum requirements for self-cleaning as well as providing good capacity within the line. As previously stated, the utility plans showed the slope of the line upstream from the Site 2 MH (RB6602-RB6601) to be 3.0%, while the slope of the line downstream from the Site 2 MH (RB6601-RB66) to be 2.16%.

In order to determine the maximum allowable flow within the pipe segment downstream of the Site 2 MH, the plan slope (2.16%) was used to generate a theoretical hydraulic operating curve for the 8-in pipe. At half pipe (4 inches), the velocity from the theoretical curve was ~5.1015 fps, which when input into the Flo-Ware program from the Site 2 MH produced an expected capacity of ~0.5755 mgd. Since peak flow was 0.1798 mgd, there should be capacity available for an additional 0.3957 mgd before the pipe exceeds its d/D limit of 0.50 at peak flow.

2019.09 Site 3 MH: This site was originally believed to be the Site 4 MH, but was actually the Site 3 MH. The graphs for this site showed a fairly consistent daily flow pattern. In addition, velocities exceeded the minimum requirements for self-cleaning as well as providing good capacity within the line. As previously stated, the City as-builts showed the slope of the 12-in line upstream from the Site 3 MH to be 0.80%, while the slope of the 18-in downstream line from the Site 3 MH (RB66-RA43D) to be 0.63%.

In order to determine the maximum allowable flow within the pipe segment downstream of the Site 3 MH, the slope (0.63%) was used to generate a theoretical hydraulic operating curve for the 18-in pipe. At the d/D limit (11.52 inches), the velocity from the theoretical curve was ~5.1775 fps, which when input into the Flo-Ware program from the Site 3 MH produced an expected capacity of ~3.9969 mgd. Since peak flow was 1.5150 mgd, there should be capacity available for an additional 2.4819 mgd before the pipe exceeds its d/D limit of 0.64 at peak flow.

2019.09 Site 3A MH: This site was originally believed to be the Site 3 MH, but was actually determined to be a brine line. Since this was not one of the required monitoring sites, no data analysis was performed on the data.

Second Week of Monitoring

2019.09 Site 4 MH: On 10/02/2019, the US^3 field team searched the area and found this site in the park, ~50 ft east of the road. Therefore, flow monitoring began at the Site 4 MH at the same time that monitoring was completed at the other four sites.

The graphs for the Site 4 MH showed a fairly consistent daily level. The velocity readings were not as consistent as the level readings, but the overall level to velocity relationship was not bad. In addition, velocities exceeded the minimum requirements for self-cleaning as well as providing good capacity within the line. The Tech Memo showed the slope for the MH-R-A-43-Drop downstream line, which aligns with the location of the Site 4 MH, to be 0.60%.

In order to determine the maximum allowable flow within the pipe segment downstream of the Site 4 MH, the Tech Memo slope (0.60%) was used to generate a theoretical hydraulic operating curve for the 18-in pipe. At the d/D limit (11.52 inches), the velocity from the theoretical curve was ~5.0527 fps, which when input into the Flo-Ware program from the Site 4 MH produced an expected capacity of ~3.9006 mgd. Since peak flow was 1.0417 mgd, there should be capacity available for an additional 2.8589 mgd before the pipe exceeds its d/D limit of 0.64 at peak flow.

The first week of flow monitoring at the Nordstrom MH and the Site 1, 2 and 3 MHs was completed on 10/02/2019, which is when the second week of flow monitoring began at the Site 4 MH and was completed on 10/10/2019.

It was noted that the flows decreased at the Site 4 MH during the second week of monitoring when compared to the Site 3 MH during the first week of monitoring. It is not unusual for flows to change from week to week for many different reasons. Unfortunately, no additional information can be provided as to the causes.

1.8 Proposed Mitigation

For the City of Brea's service area, all new pipe 15-in and smaller shall be designed so that the d/D ratio at PDWF shall not exceed 0.5. This ratio shall not exceed 0.64 for 18-in and larger pipes. The PWWF is estimated at 1.25 times the PDWF, and the d/D ratio at PWWF is not to exceed 0.75.

The Brea Mall Mixed Use Project proposes to replace the existing onsite 8-in sewer line on the downstream side of the Nordstrom MH. In the proposed redevelopment (Table 1), the new 10-in line will carry existing and proposed commercial flow, which will include a fitness center. This new 10-in sewer line may also pick up the flow from the existing restaurant (Cheesecake Factory) located on the northwest corner of S. State College Blvd and Imperial Hwy prior to discharging to the existing 8-in sewer line at a new manhole, which will be constructed downstream from the Site 1 MH.

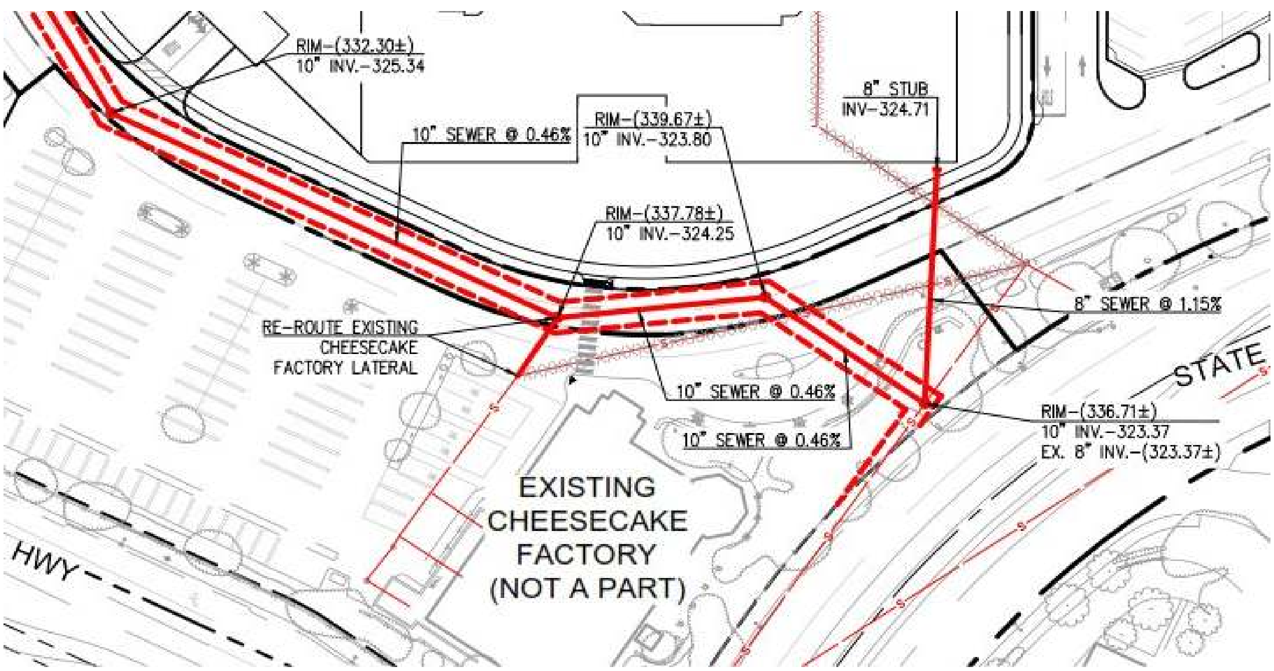


Figure above: Sewer map showing proposed connections of the new onsite sewer lines to the existing offsite sewer line at a new manhole southwest of the Site 1 MH.

The placement of the new manhole will allow the onsite sewer lines to tie into the existing 8-in sewer line at a better angle, thereby improving hydraulics in the line and in the Site 1 MH. A second new onsite 8-in sewer line will be carrying only the proposed flow from the residential area on the south end of the property. This sewer line will also tie into the existing 8-in sewer line at the new manhole downstream from the Site 1 MH.

The total PDWF of the new 10-in line will be 0.369466 mgd and the PWWF will be 0.461832 mgd. If the Cheesecake Factory flow is connected to the existing 8-in sewer line separately, the total PDWF of the new 10-in line will be 0.343145 mgd and the PWWF will be 0.428932 mgd. Both scenarios are shown in Table 2 on page 33 of this report.

The southern residential area will have its own dedicated 8-in sewer line, which will have a slope of 1.15%. The total PDWF of the new 8-in line will be 0.173592 mgd and the PWWF will be 0.21699 mgd as shown in Table 2.

When the new 10-in onsite sewer line ties into the line coming from the Nordstrom MH, the slope will be 1.00%. As it crosses the remainder of the property, the slope of the line will drop. According to the proposed onsite sewer design, the minimum slope of the new 10-in line will be 0.46%. Therefore, this minimum slope was used in the capacity analysis.

In order to evaluate the effect that the proposed development will have on the City's public sewer system, all reaches downstream of the proposed development have been included in Table 3 on page 40 of this report. The City's capacity analysis format has been used to show the d/D design criteria for all existing and proposed pipes in Table 3. This table shows that the existing flow plus the proposed project flow will exceed the City PDWF and PWWF d/D criteria within two sewer line segments within the public right-of-way (MH RB6604 to MH RB6603 and MH RB6603 to MH RB6602). Therefore, as a recommended mitigation measure for these pipe segments, Smart Covers could be installed on MH RB6602 and MH RB6604 in order to notify the City in the case there is a backup within these sewer segments that do not meet the design criteria.

A sewer map has been included on the following page, which references the City MH ID in conjunction with the sewer study monitoring location names as well as the pipe sizes, slopes and pipe lengths for cross-reference.

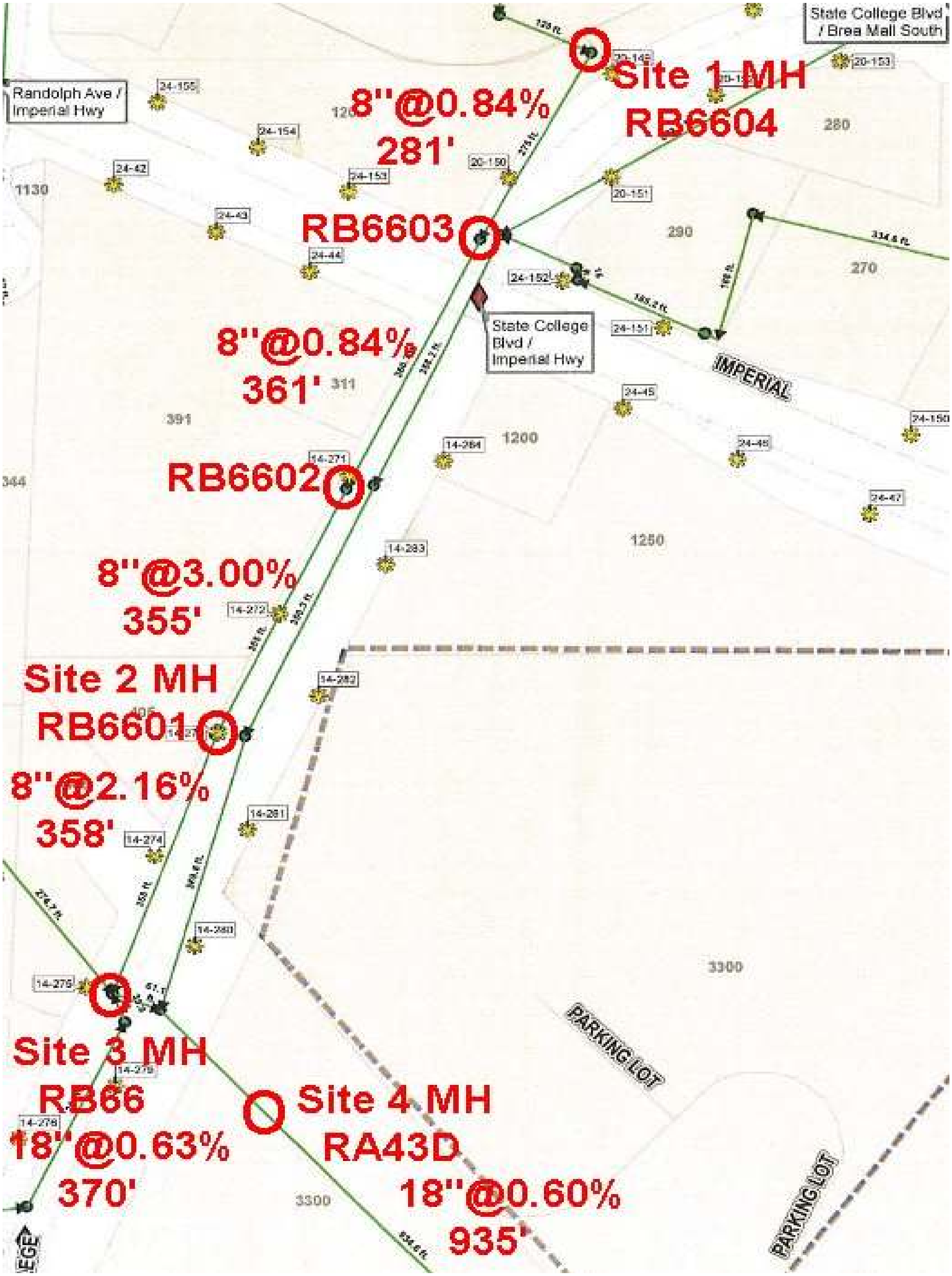

State College Blvd / Brea Mall South
Randolph Ave / Imperial Hwy
Site 1 MH
RB6604
8"@0.84%
281'
RB6603
State College Blvd / Imperial Hwy
IMPERIAL
8"@0.84%
361'
RB6602
8"@3.00%
355'
Site 2 MH
RB6601
8"@2.16%
358'
Site 3 MH
RB66
18"@0.63%
370'
Site 4 MH
RA43D
18"@0.60%
935'
PARKING LOT
PARKING LOT
3300
1200
1250
290
270
280
1130
391
344

Table 3: Capacity Analysis of Proposed Onsite Pipes & Existing Offsite Pipes for the Proposed Brea Mall Mixed Use Project														
General Information						**Hydraulic Analysis Results**								
Pipe	U/S MH ID	D/S MH ID	Dia (in)	Length (ft)	Slope	Total ADWF (mgd)	PDWF (mgd)	PDWF Vel (fps)	PDWF d/D	PDWF Depth (ft)	PWWF (mgd)	PWWF Vel (fps)	PWWF d/D	PWWF Depth (ft)
Proposed Onsite Line[1]			10	1375	0.0046	0.167373	0.343145	2.5018	0.41	0.343699	0.428932	2.6529	0.47	0.389594
Proposed Onsite Line[2]			10	1375	0.0046	0.181373	0.369466	2.5515	0.43	0.358074	0.461832	2.7034	0.49	0.406602
Proposed Onsite Line[3]			8	360	0.0115	0.079800	0.173592	2.9336	0.31	0.205674	0.216990	3.1227	0.35	0.231181
DS of Site 1	RB6604	RB6603	8	281	0.0084	0.261173	0.516727	3.4625	0.63	0.418827	0.645909	3.6003	0.74	0.511068
DS of MH[4]	RB6603	RB6602	8	361	0.0084	0.261173	0.516727	3.4625	0.63	0.418827	0.645909	3.6003	0.74	0.510087
US of Site 2	RB6602	RB6601	8	355	0.0300	0.280173	0.551213	5.6897	0.44	0.296297	0.689016	6.0238	0.51	0.343781
DS of Site 2	RB6601	RB66	8	358	0.0216	0.280173	0.551213	5.0466	0.49	0.325026	0.689016	5.3295	0.56	0.379553
DS of Site 3	RB66	RA43D	18	370	0.0063	1.186873	2.080364	4.4226	0.43	0.645815	2.600455	4.6856	0.49	0.736852
DS of Site 4	RA43D	Outletr	18	935	0.0060	1.532073	2.631143	4.6144	0.50	0.749101	3.288929	4.8692	0.57	0.861438

1. New 10-in sewer pipe with existing & proposed commercial flows using the minimum design slope without the Cheesecake Factory flow
2. New 10-in sewer pipe with existing & proposed commercial flows using the minimum design slope with the Cheesecake Factory flow
3. New onsite 8-in sewer pipe with only proposed residential flow
4. First MH on State College Blvd, south of Imperial Hwy

Tab : Calibration Site Sheets & Flo-Ware raphs

Site Report

10/14/2019

Confidential Proprietary Information

raSmith

MH at ~1048 Brea Mall
Brea, CA 92821
MH # unknown

2019.09 Nordstrom MH

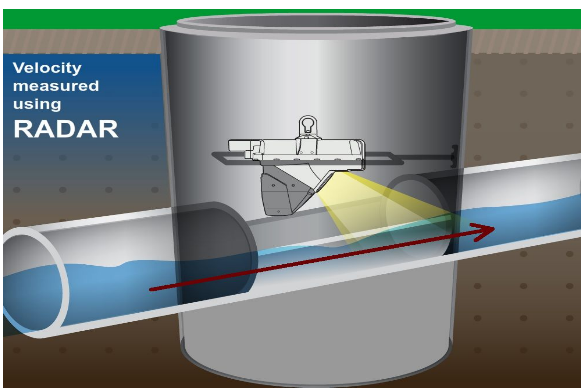
Access:
MH in left-hand NB lane, E of parking structure

System Type:
Sanitary [X] Storm [ ]

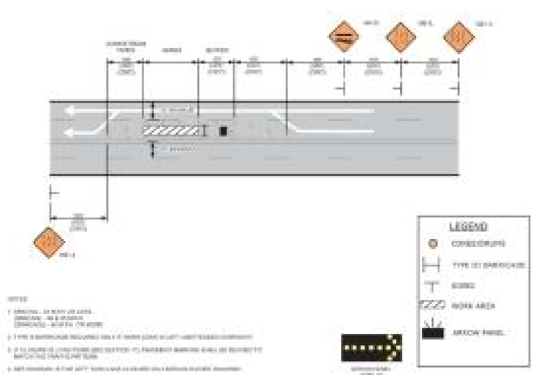
Install Date: 9/24/2019

Map

Technology



Traffic Plan



Flow Meter			
Meter Depth: 67"			
MH Coordinates: 33.915117, -117.888619			
Moderate open channel hydraulics			
Avg Velocity	Avg Measured Level		Multiplier
2.75 fps	1.0"		1.0

Gas			
O2	H2S	CO	LEL
20.9	0	0	0

Notes

No laterals; monitored the downstream line as it provided the best hydraulics.

Traffic Safety

No formal TCP required; used cones & signs per WATCH Diagram 15 requirements.

Land Use			
Residential	Commercial	Industrial	Trunk
	X		

Manhole Depth	81"
Monitored Pipe Size	8"
Inner Pipe Size (In/Out)	8"/8"
Pipe Shape	Round
Pipe Condition	Fair
Manhole Material	Concrete
Silt	0
Velocity Profile Data	*
Velocity Profile Taken	0.4 2-D
Sensor Offset	14.09"
Sensor Dist. to Crown	6.09"
Sensor Direction	Downstream
Flow Heading	South

Meter Site Document

2019.09 Nordstrom MH

MH at ~1048 Brea Mall

Brea, CA 92821

Site

Manhole Before Install

Installation Process

Installed

D□□ □stream□□□□□□□

Downstream

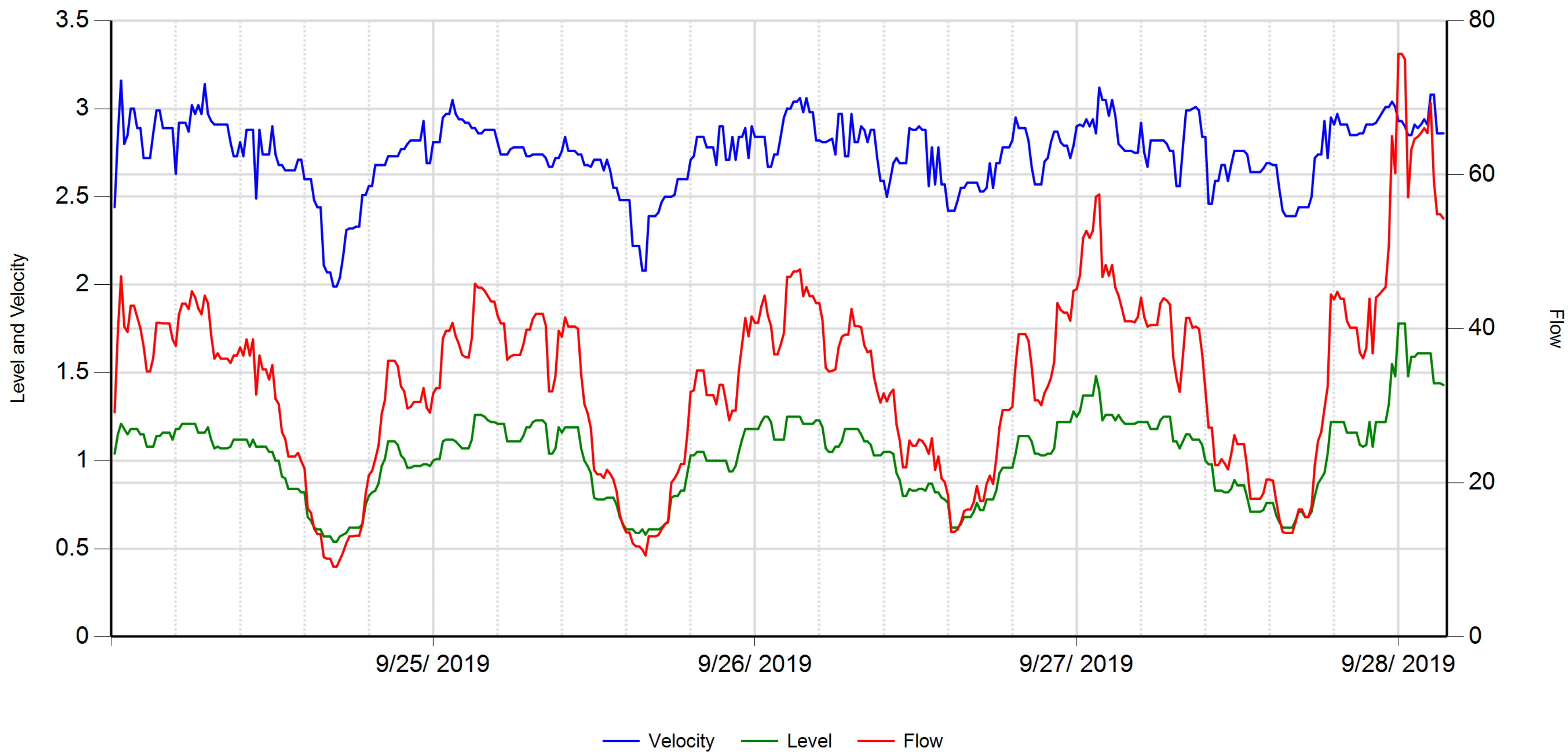
Utility Systems Science and Software

Report Date: 10/14/2019
Customer: raSmith
Group: Simon Brea Mall Proj
Site: 2019.09 Nordstrom MH

Statistics for 2019.09 Nordstrom MH: 09/24/2019 thru 10/02/2019

	Flow (GPM)			Flow (MGD)			Velocity (FPS)			Level (inches)				
Date	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Total Gal	Rain
9/24/19	37.04	46.81	23.40	0.05	0.07	0.03	2.84	3.16	2.44	1.10	1.21	0.84	53,339	
9/25/19	30.35	45.83	9.10	0.04	0.07	0.01	2.68	3.05	1.99	0.98	1.26	0.54	43,698	
9/26/19	31.04	47.71	10.56	0.04	0.07	0.02	2.72	3.06	2.08	0.98	1.25	0.58	44,703	
9/27/19	33.99	57.43	13.61	0.05	0.08	0.02	2.75	3.12	2.42	1.04	1.48	0.62	48,948	
9/28/19	38.40	75.69	13.47	0.06	0.11	0.02	2.81	3.08	2.39	1.11	1.78	0.62	55,298	
9/29/19	33.35	59.79	11.46	0.05	0.09	0.02	2.78	3.03	2.33	1.01	1.47	0.57	48,024	
Week:	**34.03**	**75.69**	**9.10**	**0.05**	**0.11**	**0.01**	**2.77**	**3.16**	**1.99**	**1.04**	**1.78**	**0.54**	**294,010**	
9/30/19	30.13	47.01	7.92	0.04	0.07	0.01	2.66	3.07	1.80	0.97	1.26	0.53	43,384	
10/1/19	29.31	45.07	7.43	0.04	0.06	0.01	2.65	3.00	1.69	0.95	1.22	0.53	42,205	
10/2/19	22.45	45.83	12.78	0.03	0.07	0.02	2.56	2.99	2.21	0.82	1.23	0.61	32,323	
Week:	**27.29**	**47.01**	**7.43**	**0.04**	**0.07**	**0.01**	**2.62**	**3.07**	**1.69**	**0.91**	**1.26**	**0.53**	**117,912**	
Totals:	**31.78**	**75.69**	**7.43**	**0.05**	**0.11**	**0.01**	**2.72**	**3.16**	**1.69**	**0.99**	**1.78**	**0.53**	**411,922**	

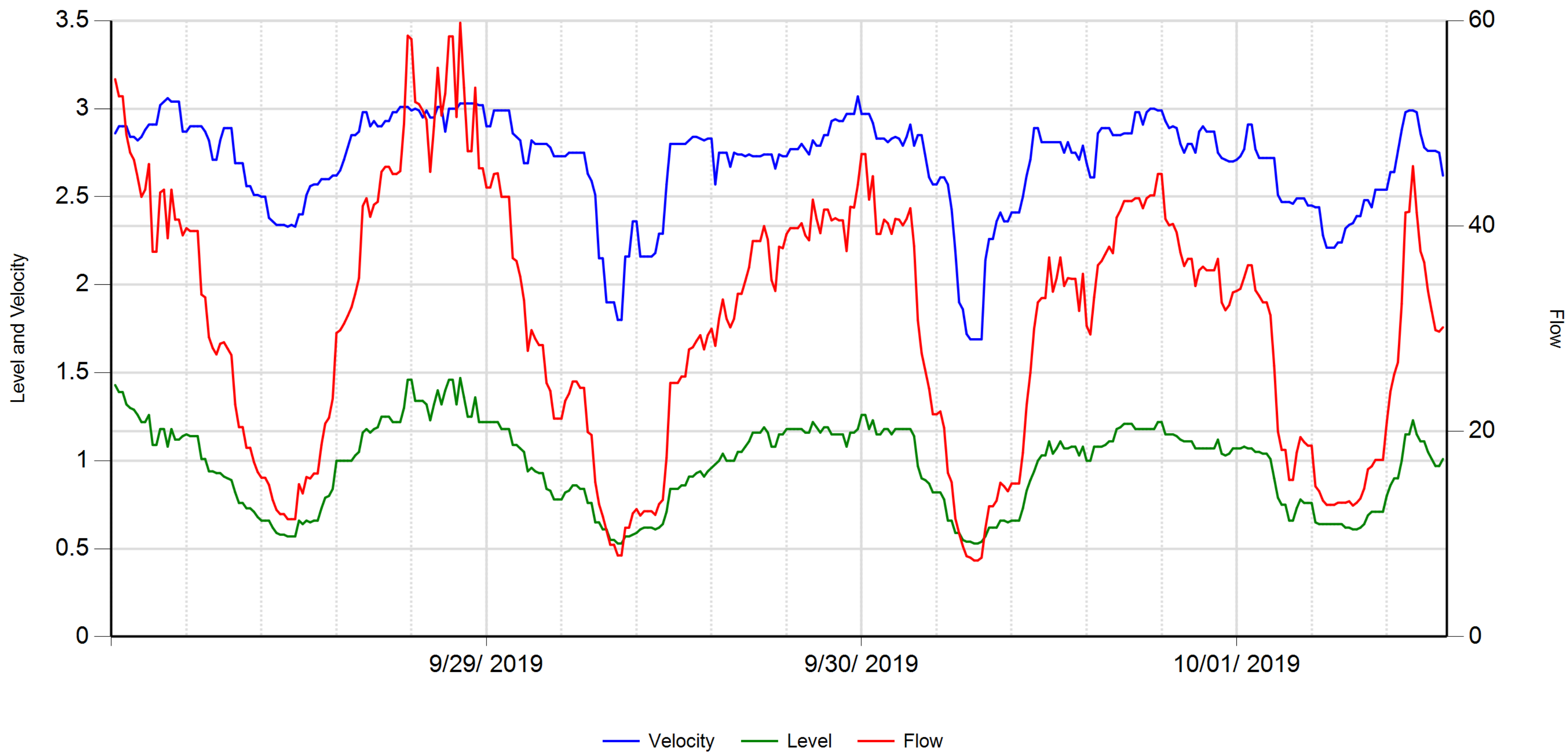
2019.09 Nordstrom MH



	Velocity (fps)	Level (in)	Flow (gpm)		
Average	2.745	1.028	33.426	**RainFall**	Inches
Maximum	3.160	1.780	75.694		
Minimum	1.990	0.540	9.097		

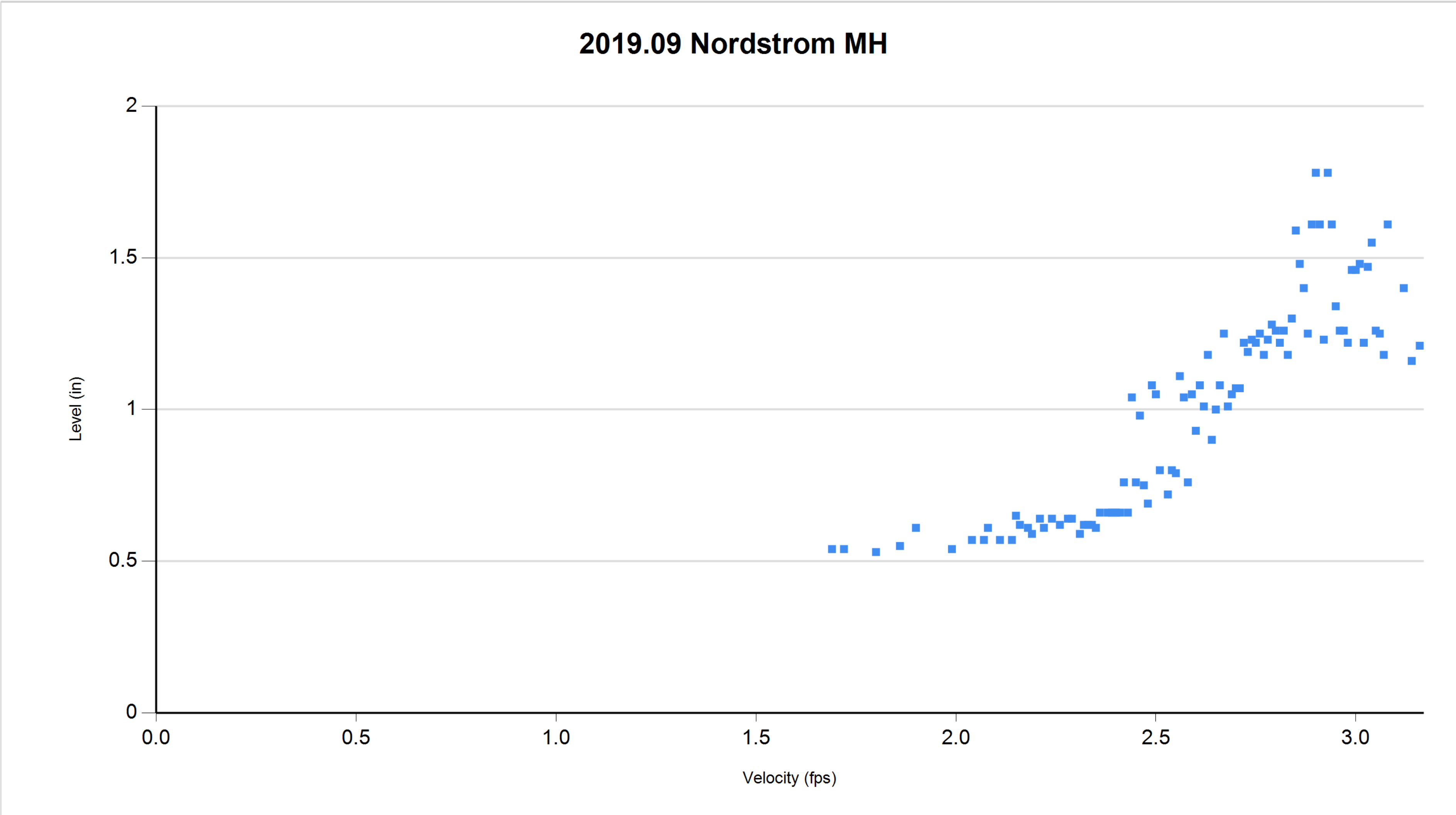
10/14/2019

2019.09 Nordstrom MH



	Velocity (fps)	Level (in)	Flow (gpm)		
Average	2.698	0.974	30.806	**RainFall**	Inches
Maximum	3.070	1.470	59.791		
Minimum	1.690	0.530	7.431		

10/14/2019



09/24/2019 thru 10/02/2019

10/14/2019 11:06:49 AM

Site Report 10/14/2019

Confidential Proprietary Information

raSmith

MH at ~120 Brea Mall
Brea, CA 92821
MH # unknown

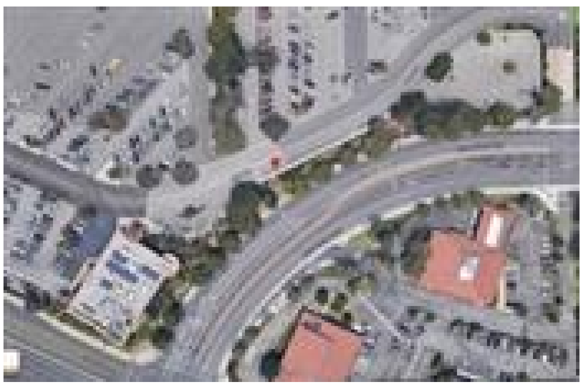
2019.09 Site 1 MH

Access:
MH on sidewalk, NE of Cheesecake Factory

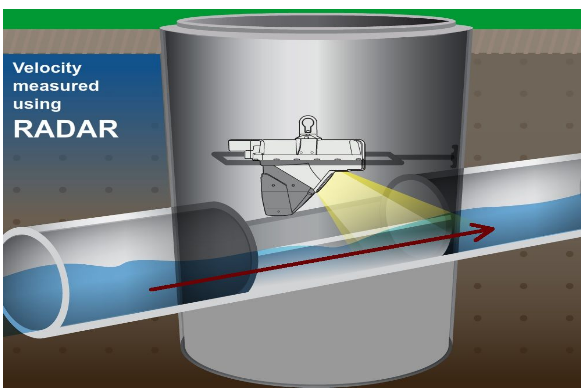
System Type:
Sanitary [X] Storm [ ]

Install Date: 9/24/2019

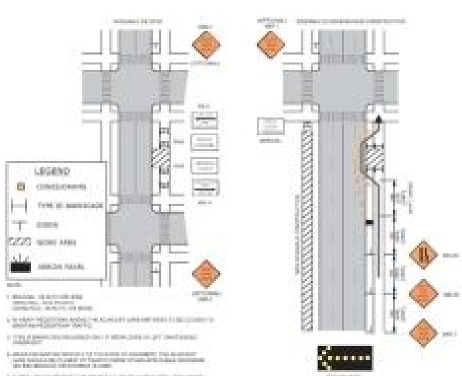
Map



Technology



Traffic Plan



Flow Meter		
Meter Depth: 188"		
MH Coordinates: 33.912802, -117.887424		
Moderate open channel hydraulics with turbulence due to inflow from lateral		
Avg Velocity	Avg Measured Level	Multiplier
1.66 fps	2.5"	1.0

Gas			
O2	H2S	CO	LEL
20.9	0	0	0

Notes

Two inlets from west & north, eastern line plugged; monitored downstream line to get total flow.

Traffic Safety

No formal TCP required; used cones & signs per WATCH Diagram 2 requirements.

Land Use			
Residential	Commercial	Industrial	Trunk
	X		

Manhole Depth	202"
Monitored Pipe Size	8"
Inner Pipe Size (In/Out)	8"/8"
Pipe Shape	Round
Pipe Condition	Fair
Manhole Material	Concrete
Silt	0
Velocity Profile Data	*
Velocity Profile Taken	0.4 2-D
Sensor Offset	13.90"
Sensor Dist. to Crown	5.90"
Sensor Direction	Downstream
Flow Heading	South

Meter Site Document

2019.09 Site 1 MH

MH at ~120 Brea Mall

Brea, CA 92821

Site

Manhole Before Install

Installation Process

□□□□□r□□ □□□□□□□□□□d

D□□ □stream□□□□□□□□□

Downstream

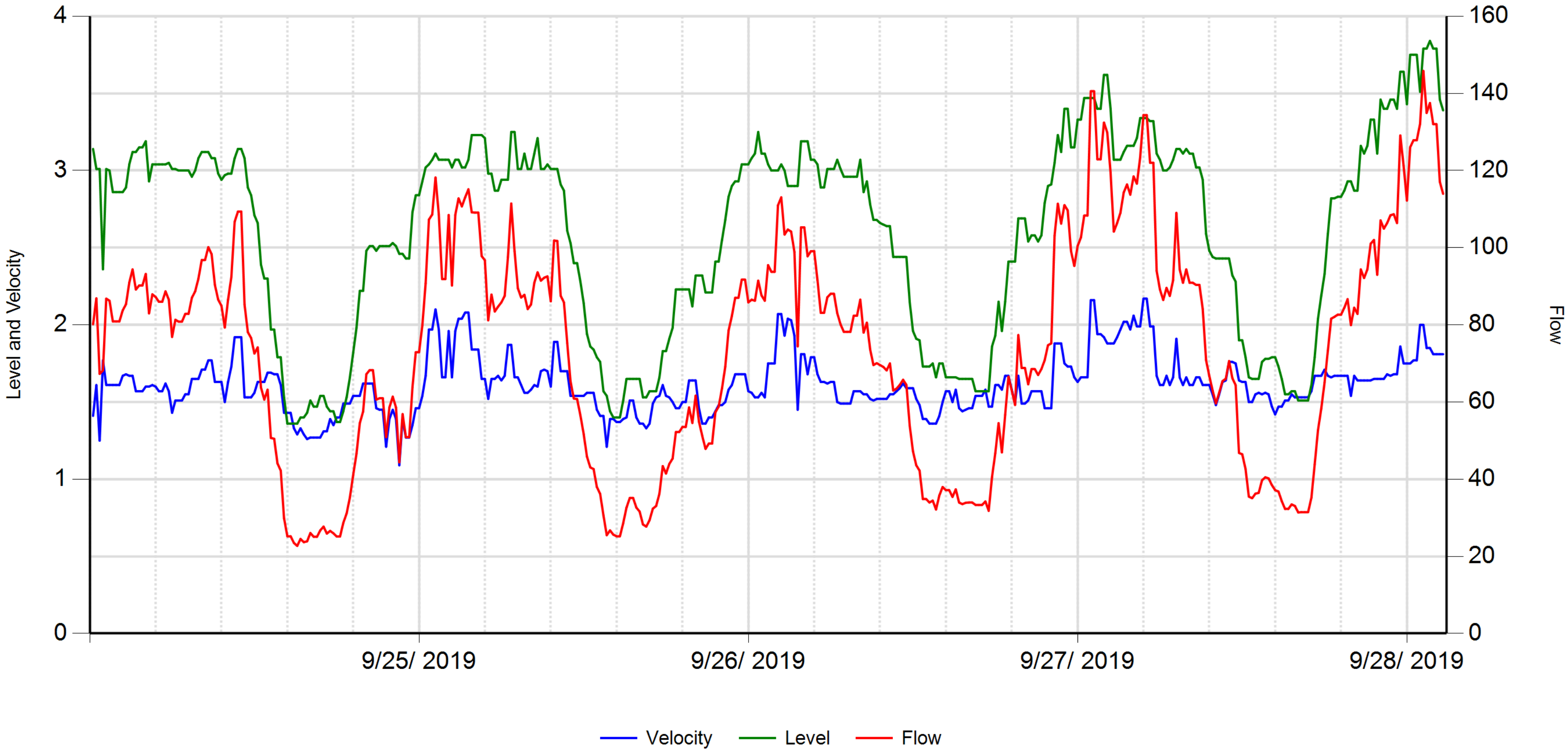
Utility Systems Science and Software

Report Date: 10/14/2019
Customer: raSmith
Group: Simon Brea Mall Proj
Site: 2019.09 Site 1 MH

Statistics for 2019.09 Site 1 MH: 09/24/2019 thru 10/02/2019

	Flow (GPM)			Flow (MGD)			Velocity (FPS)			Level (inches)				
Date	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Total Gal	Rain
9/24/19	84.67	109.37	50.69	0.12	0.16	0.07	1.62	1.92	1.25	2.94	3.19	1.97	121,920	
9/25/19	68.63	118.19	22.71	0.10	0.17	0.03	1.58	2.10	1.09	2.48	3.25	1.36	98,828	
9/26/19	66.46	113.06	25.21	0.10	0.16	0.04	1.56	2.07	1.21	2.47	3.25	1.40	95,706	
9/27/19	77.93	140.56	31.81	0.11	0.20	0.05	1.67	2.17	1.36	2.63	3.62	1.57	112,215	
9/28/19	85.40	152.36	31.39	0.12	0.22	0.05	1.74	2.43	1.42	2.74	3.84	1.51	122,980	
9/29/19	76.35	142.36	23.47	0.11	0.21	0.03	1.63	2.12	1.29	2.59	3.75	1.39	109,941	
Week:	**76.57**	**152.36**	**22.71**	**0.11**	**0.22**	**0.03**	**1.63**	**2.43**	**1.09**	**2.64**	**3.84**	**1.36**	**661,590**	
9/30/19	67.24	114.10	24.17	0.10	0.16	0.03	1.56	1.82	1.31	2.48	3.37	1.40	96,823	
10/1/19	59.54	90.42	21.39	0.09	0.13	0.03	1.48	1.68	1.25	2.37	3.15	1.33	85,743	
10/2/19	39.28	83.61	24.58	0.06	0.12	0.04	1.48	1.69	1.32	1.77	2.83	1.37	56,561	
Week:	**55.35**	**114.10**	**21.39**	**0.08**	**0.16**	**0.03**	**1.51**	**1.82**	**1.25**	**2.21**	**3.37**	**1.33**	**239,127**	
Totals:	**69.50**	**152.36**	**21.39**	**0.10**	**0.22**	**0.03**	**1.59**	**2.43**	**1.09**	**2.50**	**3.84**	**1.33**	**900,717**	

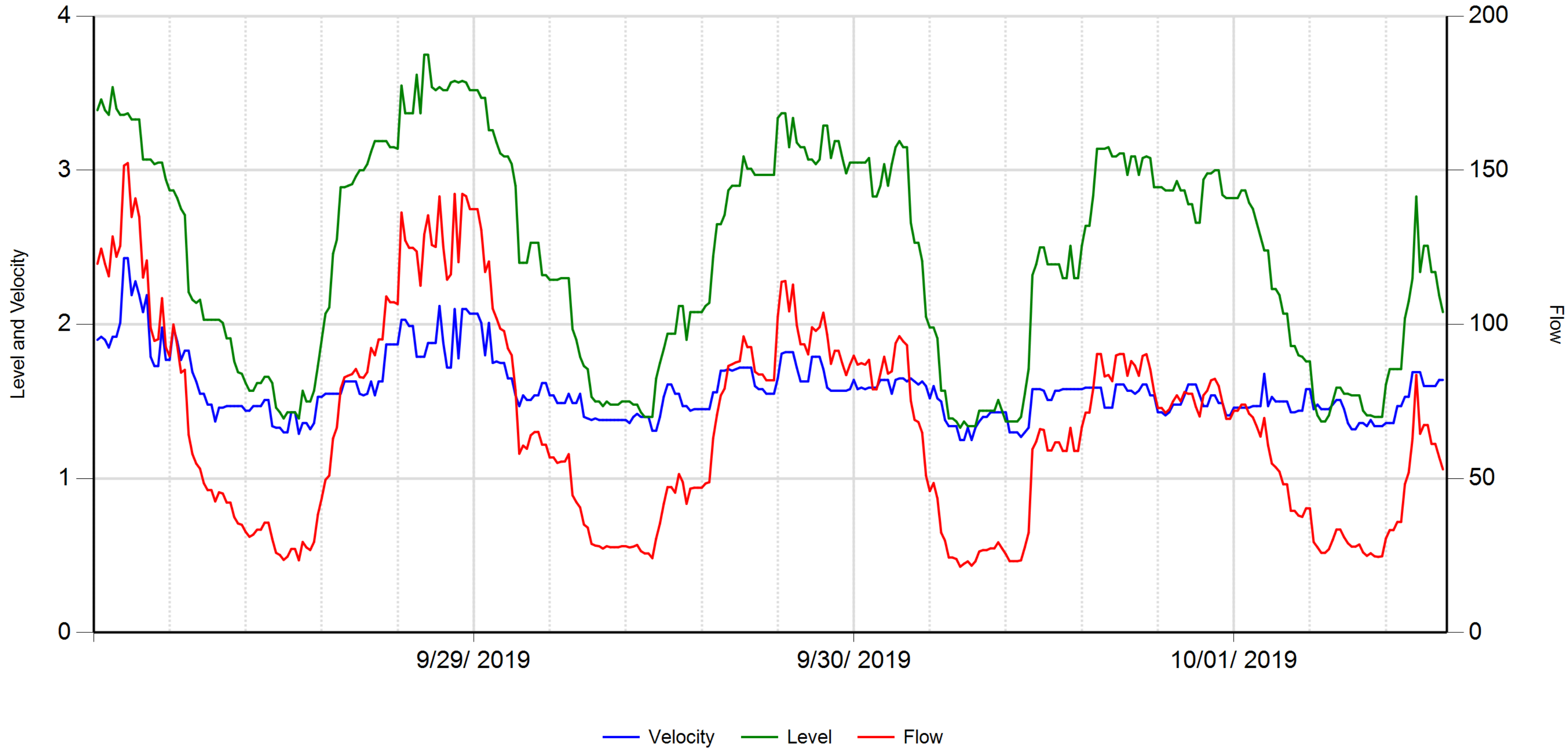
2019.09 Site 1 MH



	Velocity (fps)	Level (in)	Flow (gpm)		
Average	1.615	2.598	73.788	**RainFall**	Inches
Maximum	2.170	3.840	145.833		
Minimum	1.090	1.360	22.708		

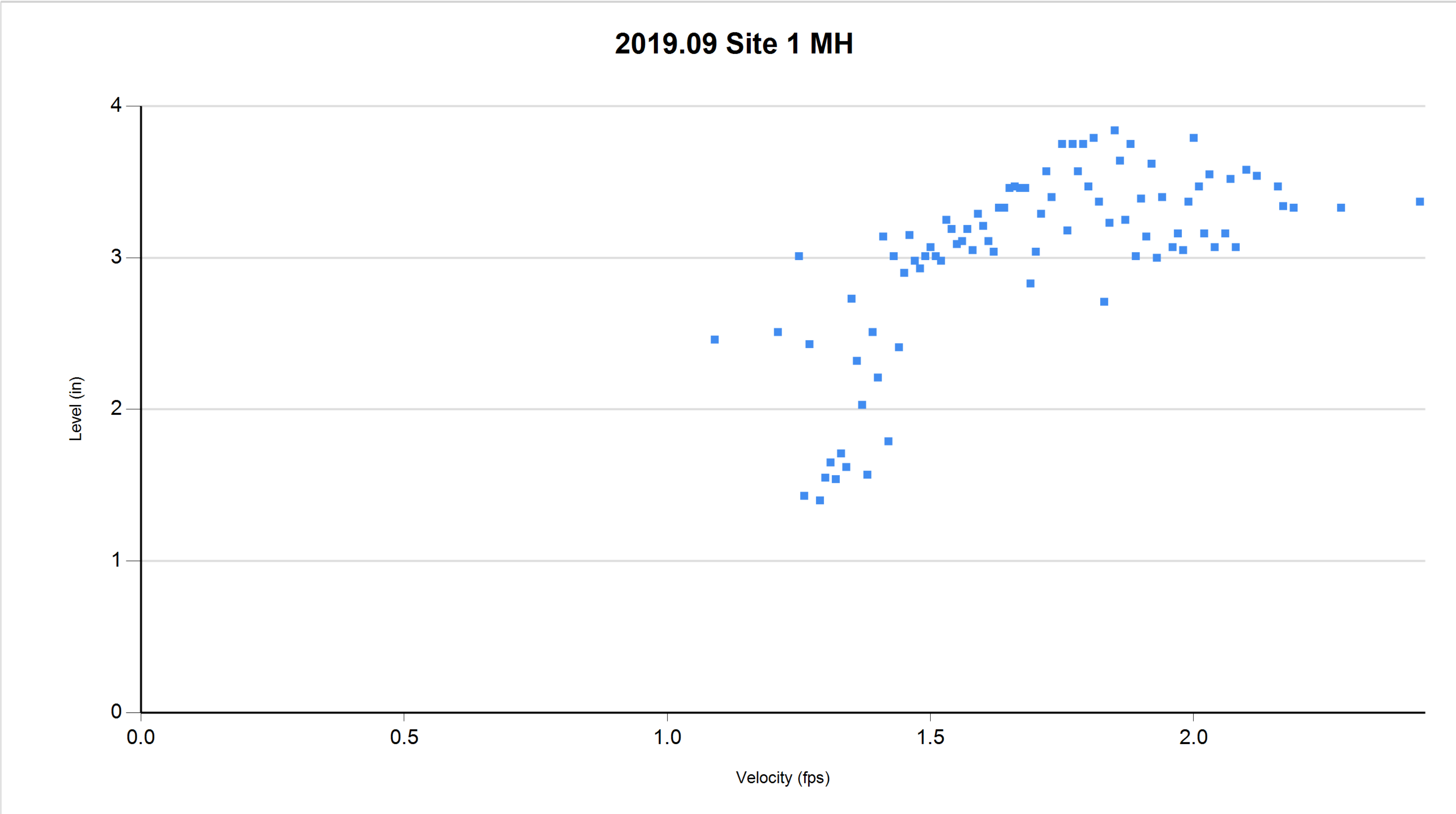
10/14/2019

2019.09 Site 1 MH



	Velocity (fps)	Level (in)	Flow (gpm)		
Average	1.580	2.447	67.636	**RainFall**	Inches
Maximum	2.430	3.750	152.361		
Minimum	1.250	1.330	21.389		

10/14/2019



09/24/2019 thru 10/02/2019

10/14/2019 11:08:05 AM

Site Report 10/14/2019

Confidential Proprietary Information

raSmith

2019.09 Site 2 MH 14-273

MH at ~405 S State College Blvd
Brea, CA 92821
MH # 14-273

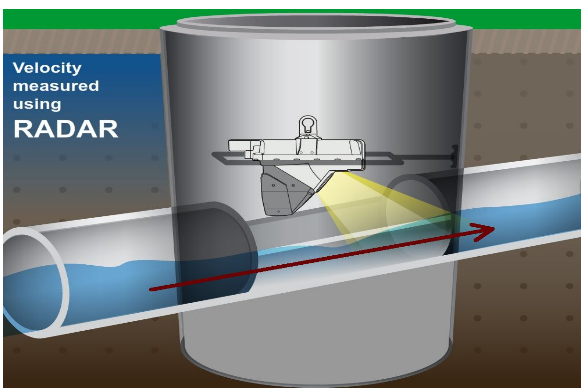
Access:
MH on sidewalk

System Type:
Sanitary [X] Storm [ ]

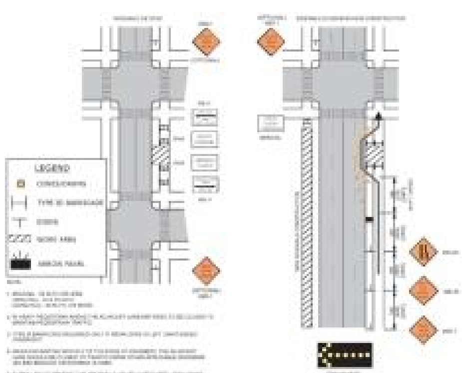
Install Date: 9/24/2019

Map

Technology



Traffic Plan



Flow Meter			
Meter Depth: 95"			
MH Coordinates: 33.910330, -117.888919			
Moderate open channel hydraulics			
Avg Velocity	Avg Measured Level		Multiplier
3.25 fps	1.75"		1.75

Gas			
O2	H2S	CO	LEL
20.9	0	0	0

Notes

No laterals; monitored the downstream line as it provided the best hydraulics.

Traffic Safety

No formal TCP required; used cones & signs per WATCH Diagram 2 requirements.

Land Use			
Residential	Commercial	Industrial	Trunk
	X		

Manhole Depth	110"
Monitored Pipe Size	8"
Inner Pipe Size (In/Out)	8"/8"
Pipe Shape	Round
Pipe Condition	Fair
Manhole Material	Concrete
Silt	0
Velocity Profile Data	*
Velocity Profile Taken	0.4 2-D
Sensor Offset	14.53"
Sensor Dist. to Crown	6.53"
Sensor Direction	Downstream
Flow Heading	South

Meter Site Document

2019.09 Site 2 MH 14-273

MH at ~405 S State College Blvd

Brea, CA 92821

Site

Manhole Before Install

Installation Process

Installed

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Downstream

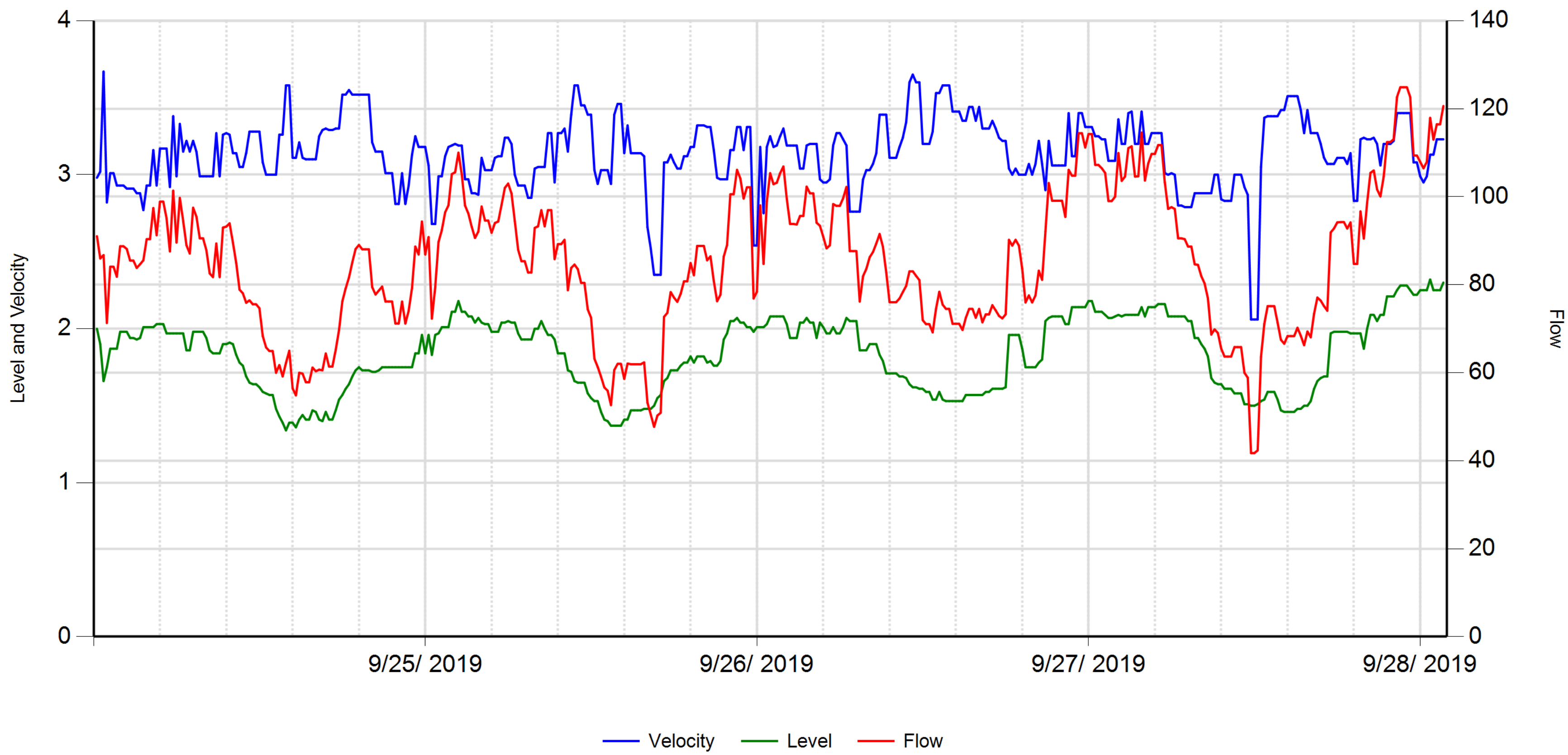
Utility Systems Science and Software

Report Date: 10/14/2019
Customer: raSmith
Group: Simon Brea Mall Proj
Site: 2019.09 Site 2 MH 14-273

Statistics for 2019.09 Site 2 MH 14-273: 09/24/2019 thru 10/02/2019

	Flow (GPM)			Flow (MGD)			Velocity (FPS)			Level (inches)				
Date	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Total Gal**	**Rain**
9/24/19	87.10	101.39	68.33	0.13	0.15	0.10	3.08	3.67	2.77	1.89	2.03	1.59	125,425	
9/25/19	81.91	110.00	54.86	0.12	0.16	0.08	3.15	3.58	2.68	1.78	2.18	1.34	117,953	
9/26/19	82.46	106.87	47.71	0.12	0.15	0.07	3.10	3.46	2.35	1.81	2.08	1.37	118,745	
9/27/19	89.30	114.58	68.68	0.13	0.17	0.10	3.20	3.65	2.79	1.87	2.18	1.53	128,592	
9/28/19	90.88	124.86	41.74	0.13	0.18	0.06	3.15	3.51	2.06	1.91	2.32	1.46	130,861	
9/29/19	83.02	118.61	41.94	0.12	0.17	0.06	3.10	3.35	2.28	1.81	2.29	1.34	119,555	
Week:	**85.78**	**124.86**	**41.74**	**0.12**	**0.18**	**0.06**	**3.13**	**3.67**	**2.06**	**1.84**	**2.32**	**1.34**	**741,132**	
9/30/19	83.98	106.25	45.28	0.12	0.15	0.07	3.17	3.78	2.36	1.80	2.12	1.44	120,932	
10/1/19	80.81	103.61	50.56	0.12	0.15	0.07	3.15	3.51	2.67	1.76	2.09	1.40	116,369	
10/2/19	70.66	97.15	40.28	0.10	0.14	0.06	3.06	3.71	1.96	1.63	1.94	1.47	101,746	
Week:	**78.48**	**106.25**	**40.28**	**0.11**	**0.15**	**0.06**	**3.13**	**3.78**	**1.96**	**1.73**	**2.12**	**1.40**	**339,047**	
Totals:	**83.35**	**124.86**	**40.28**	**0.12**	**0.18**	**0.06**	**3.13**	**3.78**	**1.96**	**1.81**	**2.32**	**1.34**	**1,080,179**	

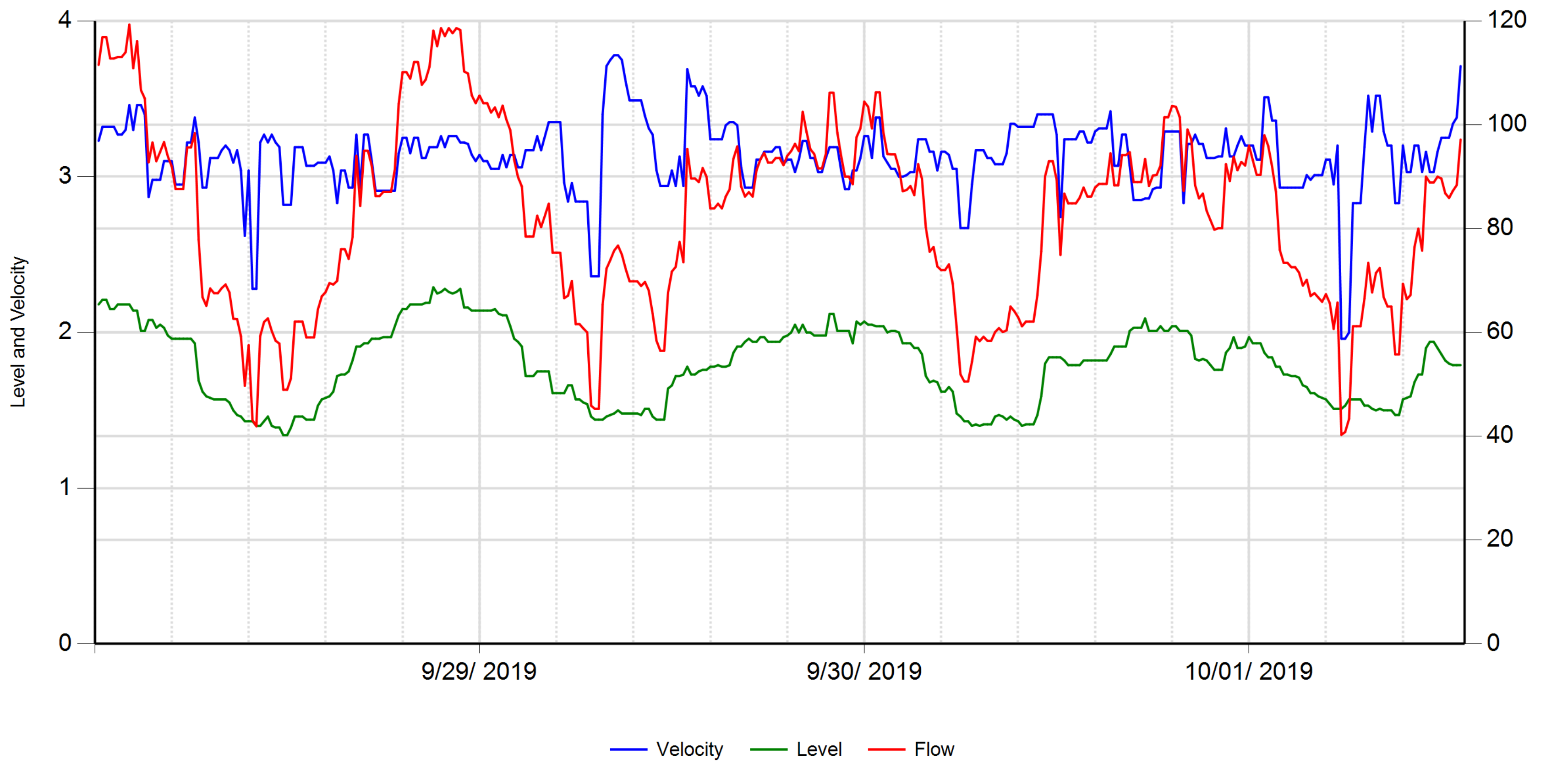
2019.09 Site 2 MH 14-273



	Velocity (fps)	Level (in)	Flow (gpm)		
Average	3.139	1.834	85.241	**RainFall**	Inches
Maximum	3.670	2.320	124.861		
Minimum	2.060	1.340	41.736		

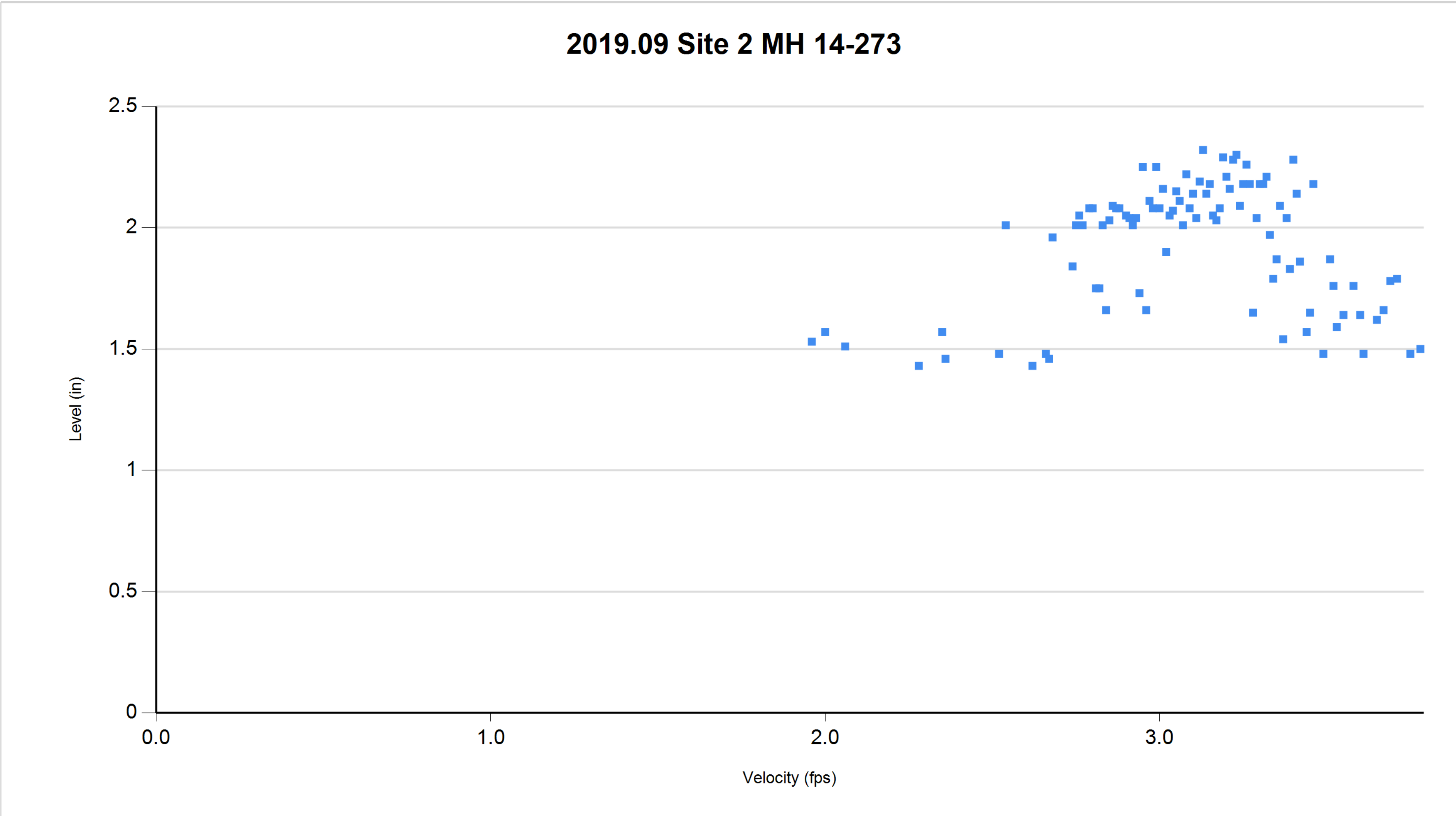
10/14/2019

2019.09 Site 2 MH 14-273



	Velocity (fps)	Level (in)	Flow (gpm)		
Average	3.135	1.792	82.738	**RainFall**	Inches
Maximum	3.780	2.290	119.305		
Minimum	1.960	1.340	40.278		

10/14/2019



09/24/2019 thru 10/02/2019

10/14/2019 11:08:46 AM

Site Report 10/14/2019

Confidential Proprietary Information

raSmith

MH at ~454 S State College Blvd
Brea, CA 92821
MH # unknown

2019.09 Site 3 MH

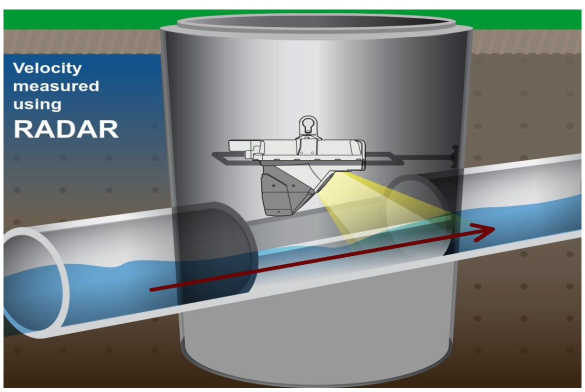
Access:
MH in center of painted median

System Type:
Sanitary [X] Storm [ ]

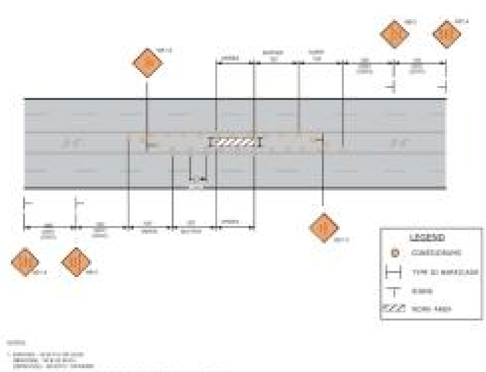
Install Date: 9/24/2019

Map

Technology



Traffic Plan



Flow Meter			
Meter Depth: 281"			
MH Coordinates: 33.909322, -117.889302			
Poor open channel hydraulics due to inflow from multiple drop inlets			
Avg Velocity	Avg Measured Level		Multiplier
3.75 fps	5.25"		1.0
Gas			
O2	H2S	CO	LEL
20.9	0	0	0
Notes			
Three inlets, one from west & two from north; monitored downstream line to get total flow.			
Traffic Safety			
No formal TCP required; used cones & signs per WATCH Diagram 20 requirements.			
Land Use			
Residential	Commercial	Industrial	Trunk
	X		

Manhole Depth	306"
Monitored Pipe Size	18"
Inner Pipe Size (In/Out)	12"/18"
Pipe Shape	Round
Pipe Condition	Fair
Manhole Material	Lined
Silt	0
Velocity Profile Data	*
Velocity Profile Taken	0.4 2-D
Sensor Offset	24.73"
Sensor Dist. to Crown	6.73"
Sensor Direction	Downstream
Flow Heading	East

Meter Site Document

2019.09 Site 3 MH

MH at ~454 S State College Blvd

Brea, CA 92821

Site

Manhole Before Install

Installation Process

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Downstream

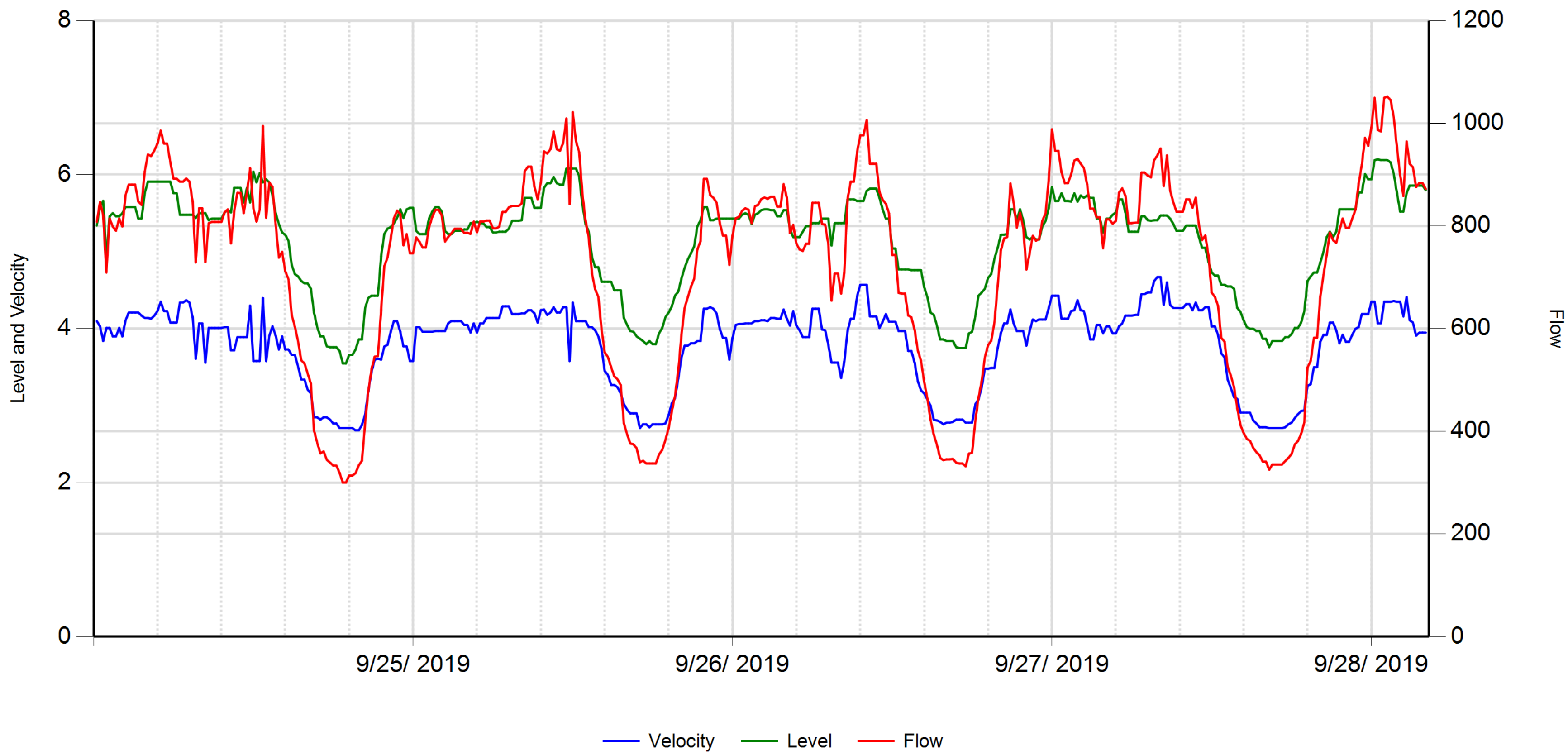
Utility Systems Science and Software

Report Date: 10/14/2019
Customer: raSmith
Group: Simon Brea Mall Proj
Site: 2019.09 Site 3 MH

Statistics for 2019.09 Site 3 MH: 09/24/2019 thru 10/02/2019

	Flow (GPM)			Flow (MGD)			Velocity (FPS)			Level (inches)				
Date	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Total Gal**	**Rain**
9/24/19	845.91	994.79	696.32	1.22	1.43	1.00	4.01	4.40	3.56	5.61	6.04	4.94	1,218,118	
9/25/19	709.73	1022.01	300.49	1.02	1.47	0.43	3.76	4.34	2.68	5.07	6.08	3.55	1,022,010	
9/26/19	706.71	1006.39	337.43	1.02	1.45	0.49	3.77	4.57	2.71	5.07	5.82	3.80	1,017,664	
9/27/19	726.74	988.40	331.87	1.05	1.42	0.48	3.87	4.67	2.76	5.07	5.84	3.75	1,046,502	
9/28/19	721.10	1052.08	325.42	1.04	1.52	0.47	3.76	4.41	2.71	5.12	6.20	3.76	1,038,385	
9/29/19	705.81	992.29	284.17	1.02	1.43	0.41	3.60	4.28	2.45	5.17	6.07	3.66	1,016,368	
Week:	**736.00**	**1052.08**	**284.17**	**1.06**	**1.52**	**0.41**	**3.79**	**4.67**	**2.45**	**5.19**	**6.20**	**3.55**	**6,359,046**	
9/30/19	711.71	998.19	296.32	1.03	1.44	0.43	3.57	4.17	2.35	5.26	6.15	3.86	1,024,869	
10/1/19	705.50	1036.18	292.92	1.02	1.49	0.42	3.56	4.14	2.44	5.25	6.36	3.76	1,015,916	
10/2/19	537.75	817.22	314.10	0.77	1.18	0.45	3.22	3.97	2.65	4.63	5.54	3.68	774,354	
Week:	**651.65**	**1036.18**	**292.92**	**0.94**	**1.49**	**0.42**	**3.45**	**4.17**	**2.35**	**5.04**	**6.36**	**3.68**	**2,815,138**	
Totals:	**707.88**	**1052.08**	**284.17**	**1.02**	**1.52**	**0.41**	**3.68**	**4.67**	**2.35**	**5.14**	**6.36**	**3.55**	**9,174,184**	

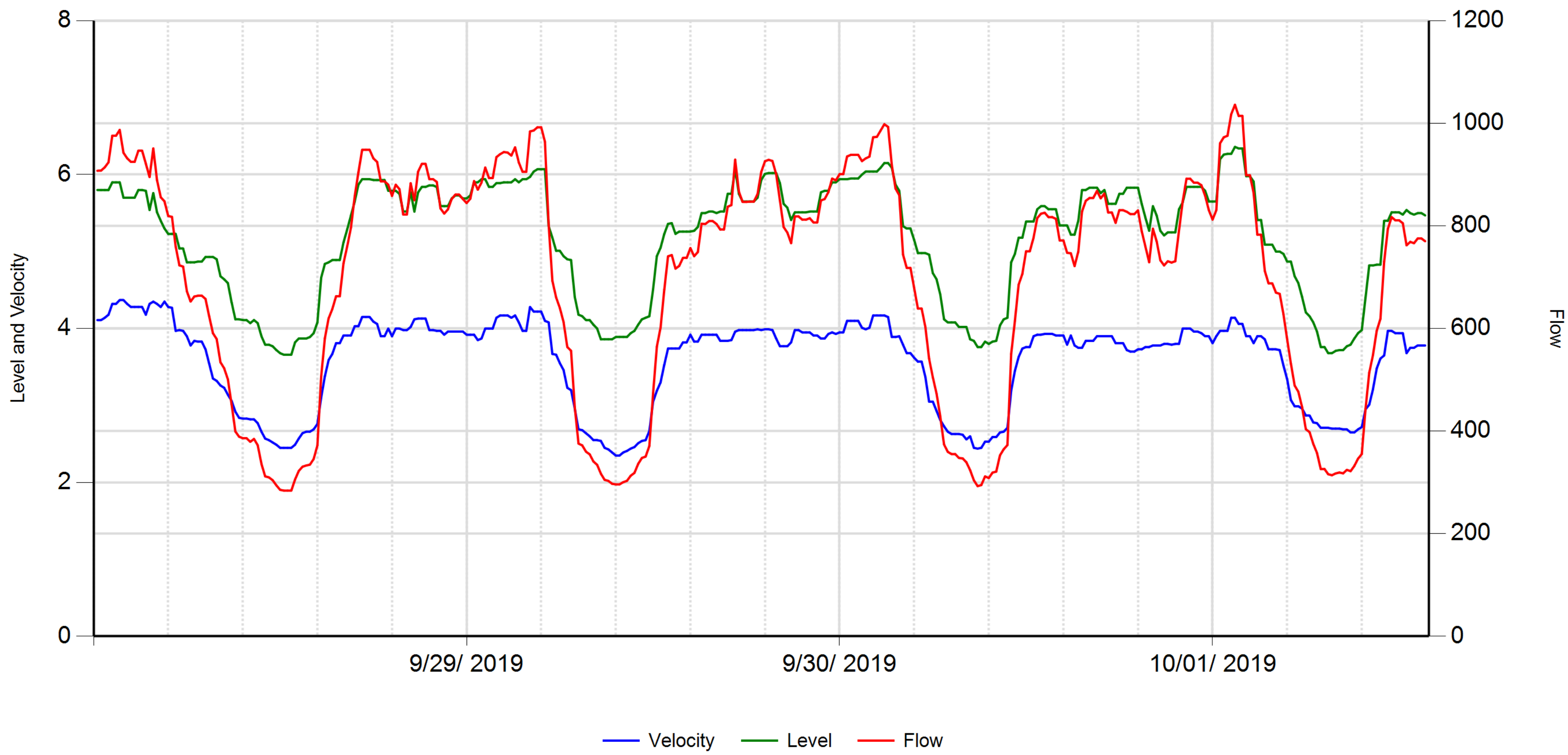
2019.09 Site 3 MH



	Velocity (fps)	Level (in)	Flow (gpm)		
Average	3.793	5.134	725.440	**RainFall**	Inches
Maximum	4.670	6.200	1052.080		
Minimum	2.680	3.550	300.485		

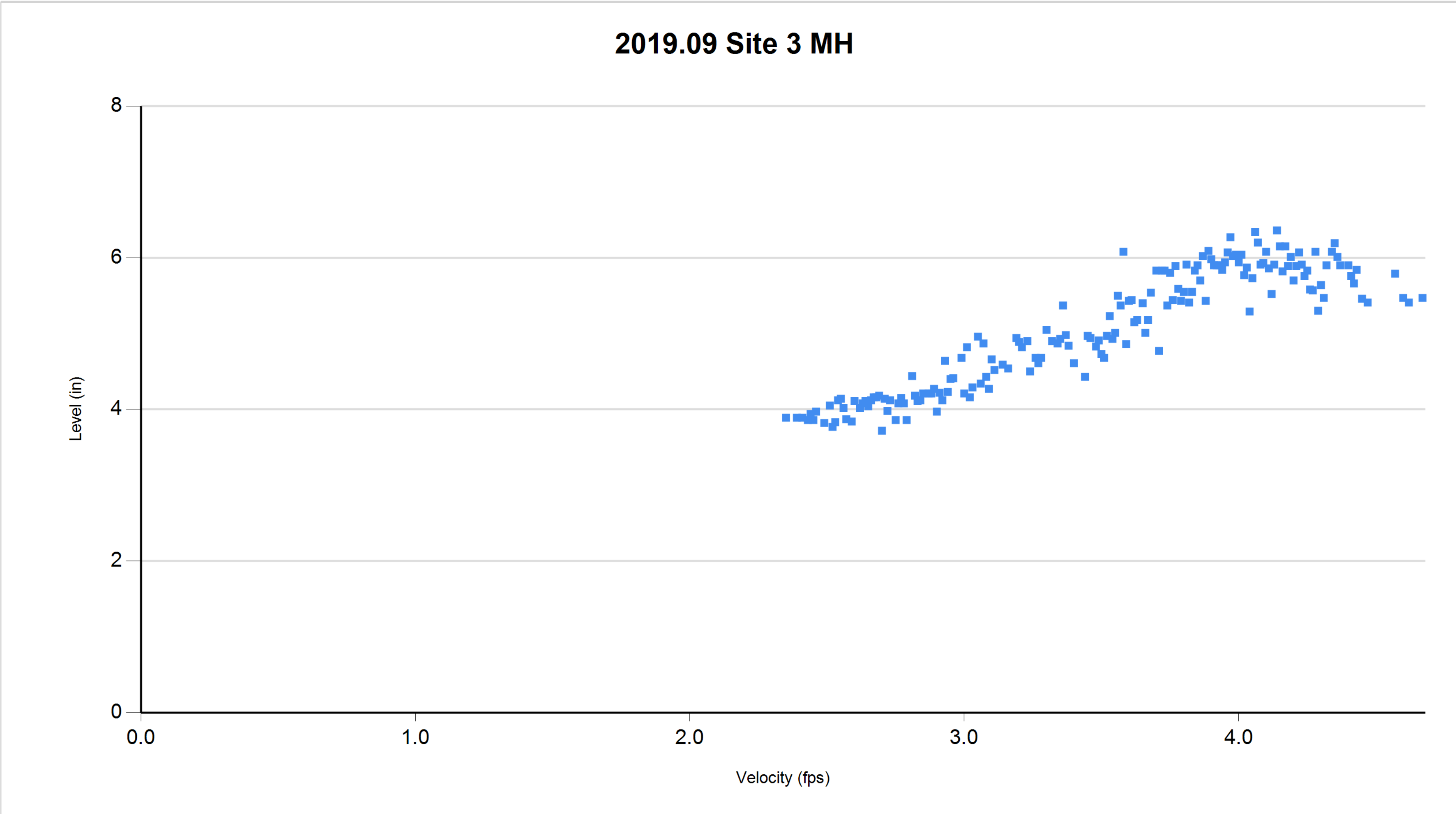
10/14/2019

2019.09 Site 3 MH



	Velocity (fps)	Level (in)	Flow (gpm)		
Average	3.584	5.177	700.058	**RainFall**	Inches
Maximum	4.370	6.360	1036.177		
Minimum	2.350	3.660	284.166		

10/14/2019



09/24/2019 thru 10/02/2019

10/14/2019 11:09:15 AM

Site Report 10/14/2019

Confidential Proprietary Information

raSmith

2019.10 Site 4 MH

MH at ~471 S State College Blvd
Brea, CA 92821
MH # unknown

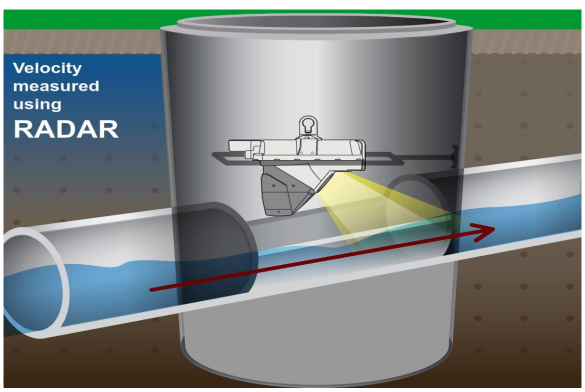
Access:
MH in park, E of address

System Type:
Sanitary [X] Storm [ ]

Install Date: 10/02/2018

Map

Technology



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Flow Meter			
Meter Depth: 85"			
MH Coordinates: 33.909049, -117.889105			
Moderate open channel hydraulics			
Avg Velocity	Avg Measured Level		Multiplier
3.75 fps	4.0"		1.4

Gas			
O2	H2S	CO	LEL
20.9	0	0	0

Notes

Three inlets, one from west, one from north & one from south; monitored downstream line to get total flow.

Traffic Safety

MH in open space, no traffic control required.

Land Use			
Residential	Commercial	Industrial	Trunk
X	X		X

Manhole Depth	110"
Monitored Pipe Size	18"
Inner Pipe Size (In/Out)	18"/18"
Pipe Shape	Round
Pipe Condition	Poor
Manhole Material	Concrete
Silt	0
Velocity Profile Data	*
Velocity Profile Taken	0.4 2-D
Sensor Offset	24.87"
Sensor Dist. to Crown	6.87"
Sensor Direction	Downstream
Flow Heading	East

Meter Site Document

2019.10 Site 4 MH

MH at ~471 S State College Blvd

Brea, CA 92821

Site

Manhole Before Install

Installation Process

Installed

Upstream

Downstream

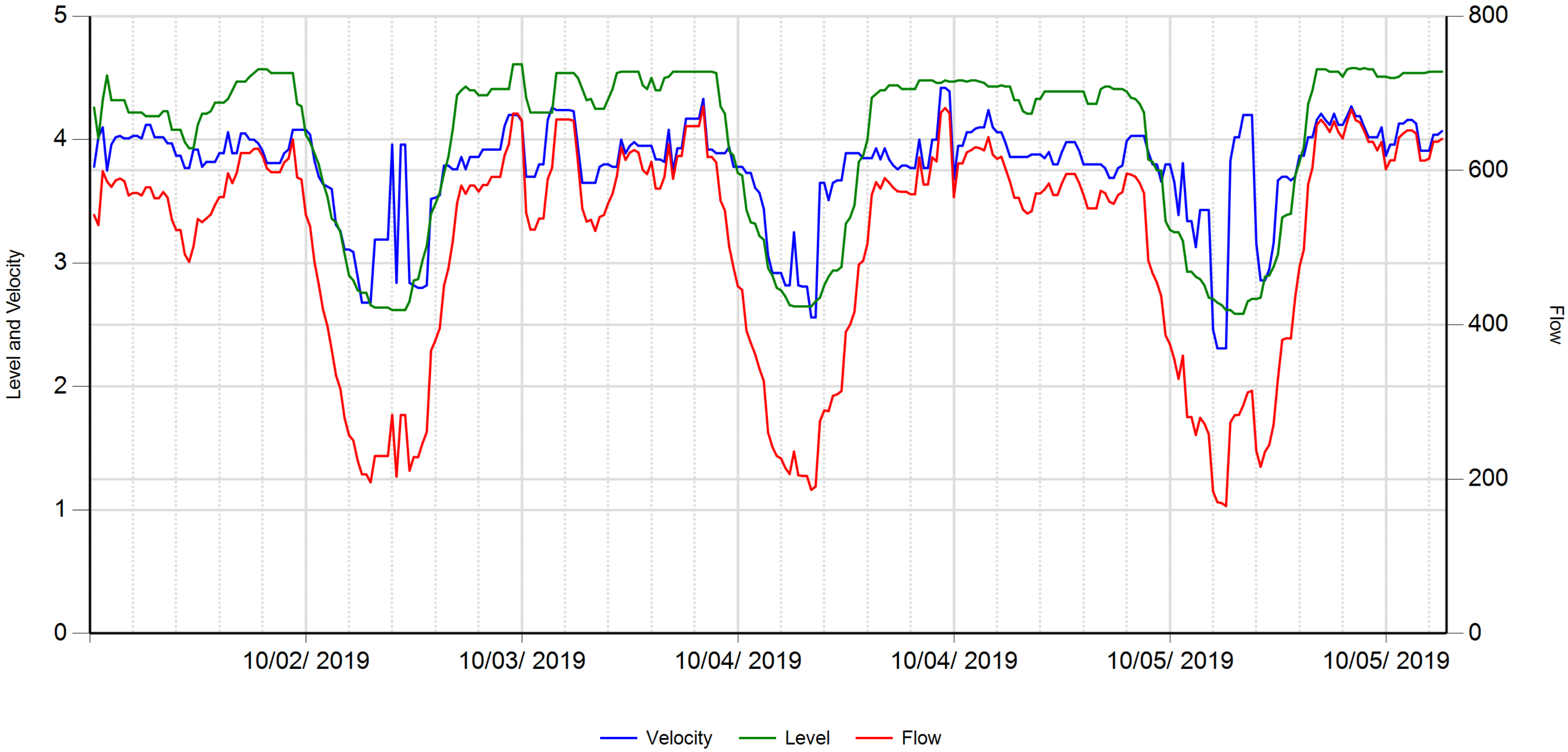
Utility Systems Science and Software

Report Date: 10/14/2019
Customer: US3
Group: Simon Brea Mall Proj
Site: 2019.10 Site 4 MH

Statistics for 2019.10 Site 4 MH: 10/02/2019 thru 10/10/2019

	Flow (GPM)			Flow (MGD)			Velocity (FPS)			Level (inches)				
Date	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Total Gal	Rain
10/2/19	569.03	640.35	452.36	0.82	0.92	0.65	3.94	4.12	3.70	4.28	4.57	3.80	819,407	
10/3/19	499.41	683.19	195.83	0.72	0.98	0.28	3.72	4.33	2.68	3.98	4.61	2.62	719,146	
10/4/19	499.45	681.04	186.11	0.72	0.98	0.27	3.75	4.42	2.56	3.97	4.48	2.65	719,208	
10/5/19	495.97	679.23	165.14	0.71	0.98	0.24	3.78	4.27	2.31	3.92	4.58	2.59	714,196	
10/6/19	512.46	723.40	235.83	0.74	1.04	0.34	3.83	4.25	3.14	3.99	4.94	2.53	737,948	
Week:	**515.26**	**723.40**	**165.14**	**0.74**	**1.04**	**0.24**	**3.81**	**4.42**	**2.31**	**4.03**	**4.94**	**2.53**	**3,709,904**	
10/7/19	517.15	721.94	253.26	0.75	1.04	0.36	3.86	4.49	3.01	3.99	4.64	2.83	744,694	
10/8/19	498.44	699.72	202.85	0.72	1.01	0.29	3.77	4.36	2.63	3.94	4.61	2.73	717,759	
10/9/19	505.47	678.47	217.57	0.73	0.98	0.31	3.84	4.39	2.69	3.95	4.65	2.64	727,870	
10/10/19	335.23	513.82	201.60	0.48	0.74	0.29	3.63	4.13	2.62	3.11	3.93	2.59	482,733	
Week:	**464.07**	**721.94**	**201.60**	**0.67**	**1.04**	**0.29**	**3.78**	**4.49**	**2.62**	**3.75**	**4.65**	**2.59**	**2,673,055**	
Totals:	**492.51**	**723.40**	**165.14**	**0.71**	**1.04**	**0.24**	**3.79**	**4.49**	**2.31**	**3.90**	**4.94**	**2.53**	**6,382,959**	

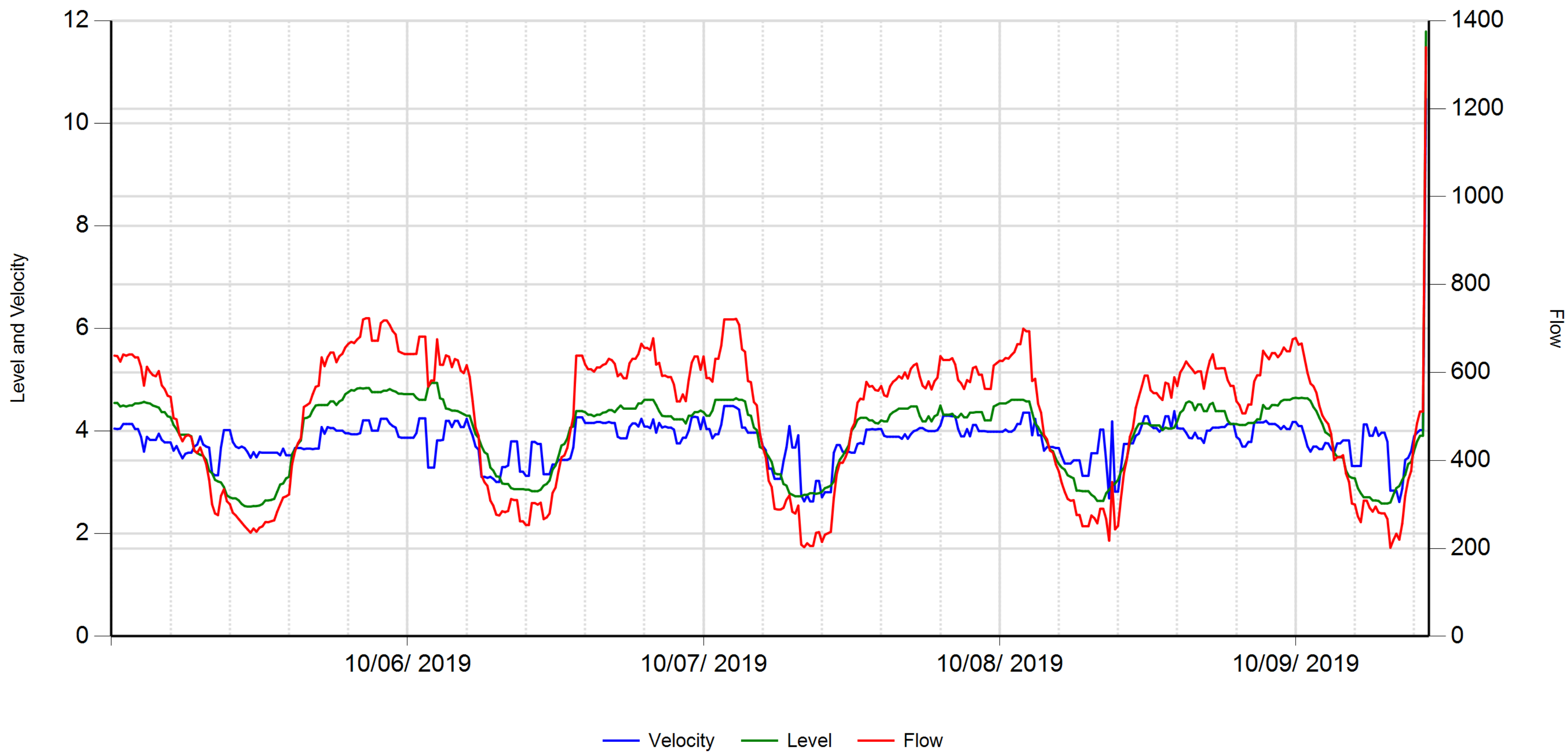
2019.10 Site 4 MH



	Velocity (fps)	Level (in)	Flow (gpm)		
Average	3.776	3.977	504.282	**RainFall**	Inches
Maximum	4.420	4.610	683.192		
Minimum	2.310	2.590	165.138		

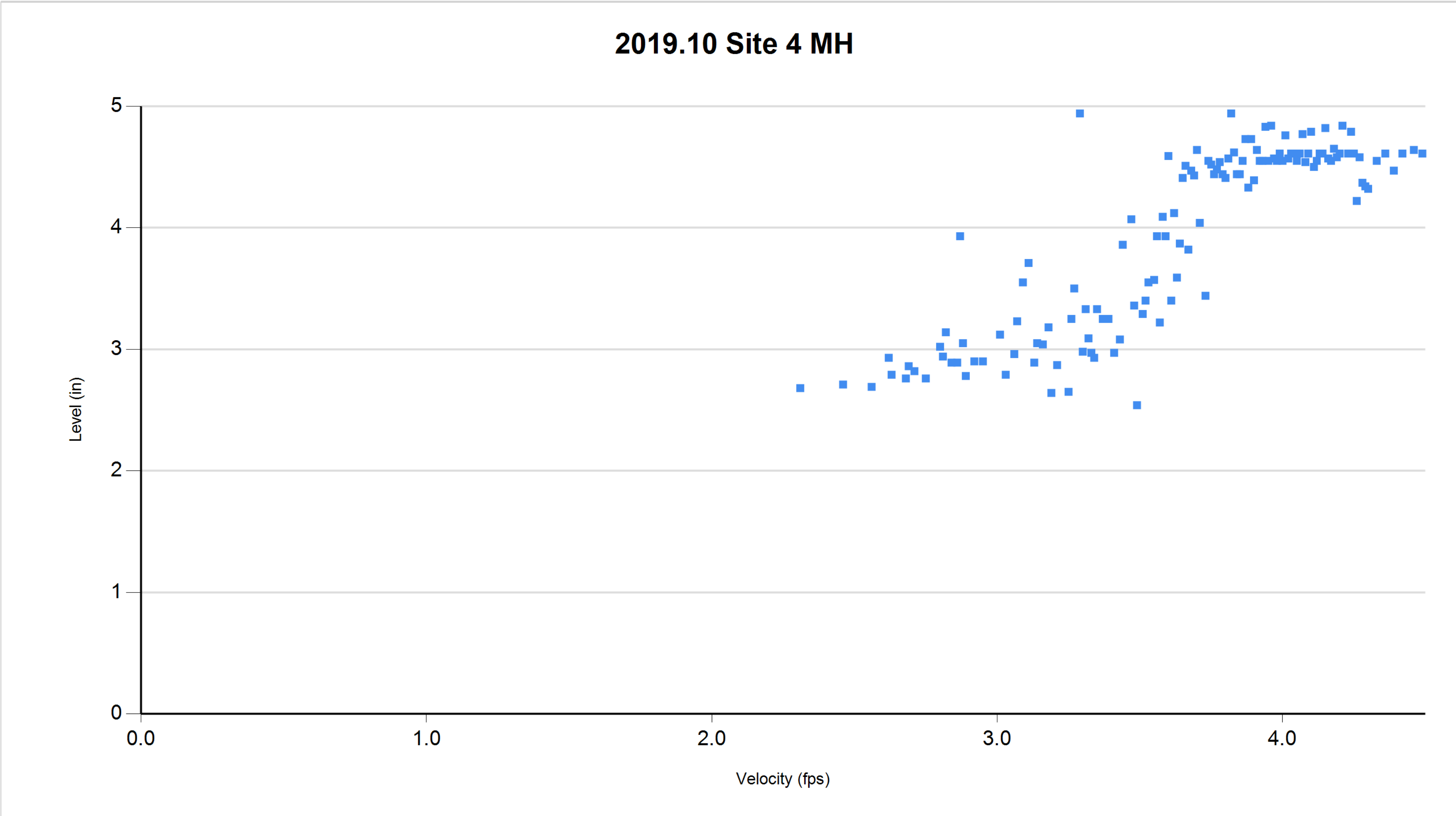
10/14/2019

2019.10 Site 4 MH



	Velocity (fps)	Level (in)	Flow (gpm)		
Average	3.811	3.928	499.087	**RainFall**	Inches
Maximum	4.490	4.940	723.401		
Minimum	2.620	2.530	201.597		

10/14/2019



10/02/2019 thru 10/10/2019

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Site Report 10/14/2019

Confidential Proprietary Information

raSmith

MH at ~120 Brea Mall
Brea, CA 92821
MH # unknown

2019.□0 Site 1 MH US

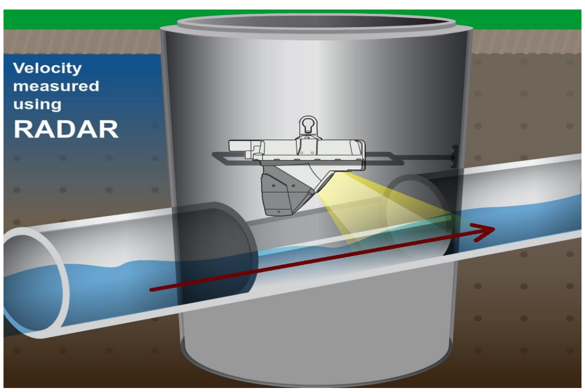
Access:
MH on CL of parking lot access road, NE of address

System Type:
Sanitary [X] Storm [ ]

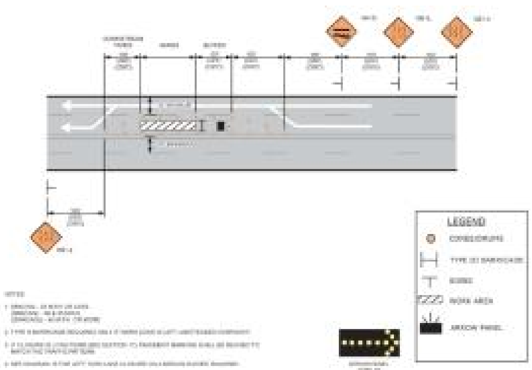
Install Date: 10/04/2019

Map

Technology



Traffic Plan



Flow Meter		
Meter Depth: 153"		
MH Coordinates: 33.915117, -117.888619		
Moderate open channel hydraulics		
Avg Velocity	Avg Measured Level	Multiplier
2.0 fps	2.66"	1.0

Gas			
O2	H2S	CO	LEL
20.9	0	0	0

Notes

Two inlets from west & north; monitored downstream line to get total flow.

Traffic Safety

No formal TCP required; used cones & signs per WATCH Diagram 15 requirements.

Land Use			
Residential	Commercial	Industrial	Trunk
	X		

Manhole Depth	172"
Monitored Pipe Size	8"
Inner Pipe Size (In/Out)	8"/8"
Pipe Shape	Round
Pipe Condition	Fair
Manhole Material	Concrete
Silt	0
Velocity Profile Data	*
Velocity Profile Taken	0.4 2-D
Sensor Offset	18.96"
Sensor Dist. to Crown	10.96"
Sensor Direction	Downstream
Flow Heading	East

Meter Site Document

2019.□0 Site 1 MH US

MH at ~120 Brea Mall

Brea, CA 92821

Site

Manhole Before Install

Installation Process

Installed

D□□ □stream□□□□□□□□

Downstream

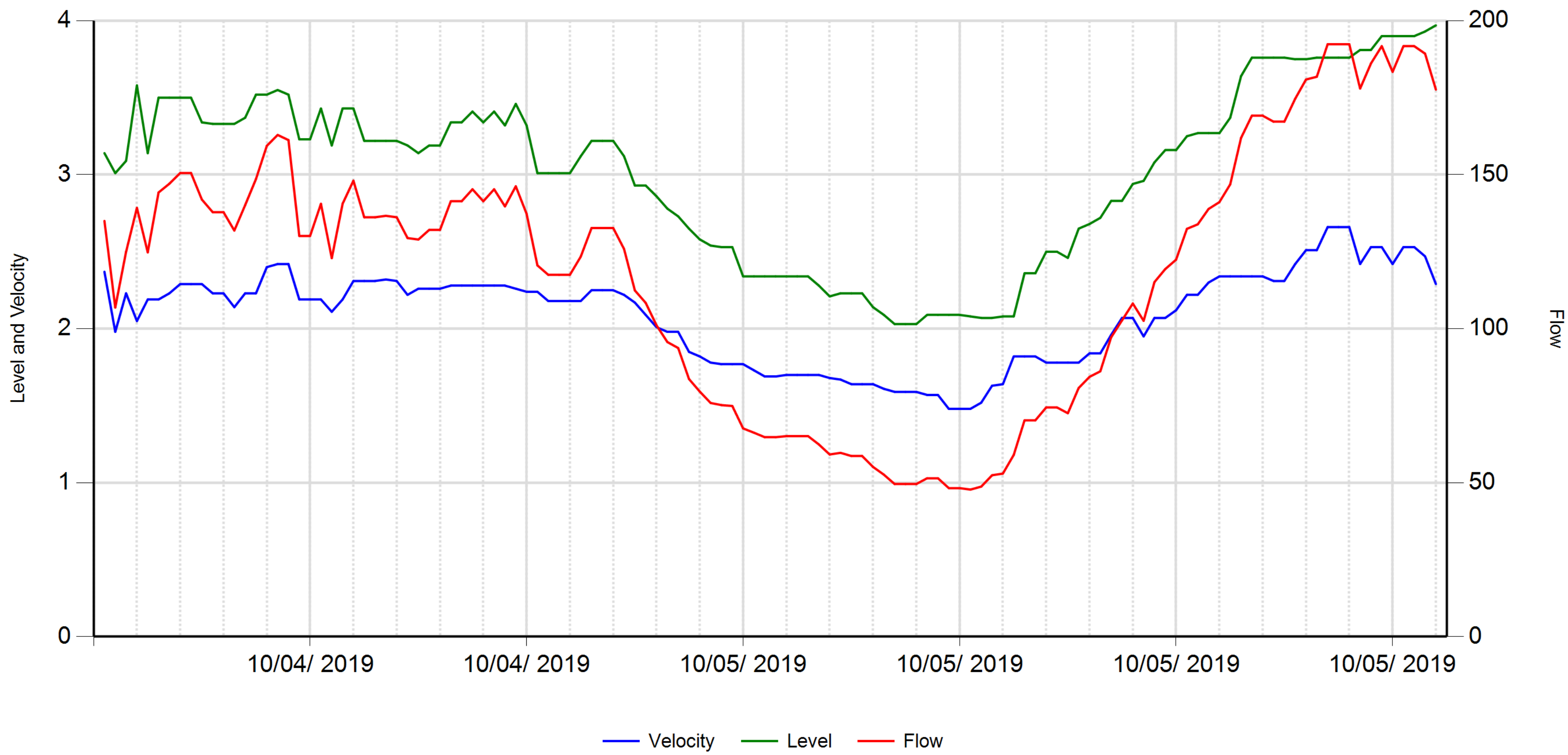
Utility Systems Science and Software

Report Date: 10/14/2019
Customer: US3
Group: Simon Brea Mall Proj
Site: 2019.10 Site 1 MH US

Statistics for 2019.10 Site 1 MH US: 10/04/2019 thru 10/10/2019

	Flow (GPM)			Flow (MGD)			Velocity (FPS)			Level (inches)				
Date	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Total Gal	Rain
10/4/19	131.40	162.92	79.58	0.19	0.23	0.11	2.21	2.42	1.82	3.23	3.58	2.58	189,215	
10/5/19	113.06	192.36	47.78	0.16	0.28	0.07	2.04	2.66	1.48	2.96	3.97	2.03	162,803	
10/6/19	101.65	176.11	44.72	0.15	0.25	0.06	1.96	2.44	1.51	2.81	3.83	1.94	146,383	
Week:	**115.37**	**192.36**	**44.72**	**0.17**	**0.28**	**0.06**	**2.07**	**2.66**	**1.48**	**3.00**	**3.97**	**1.94**	**498,401**	
10/7/19	83.33	129.17	41.60	0.12	0.19	0.06	1.86	2.34	1.45	2.56	3.12	1.86	119,991	
10/8/19	78.92	137.22	22.29	0.11	0.20	0.03	1.82	2.35	1.22	2.45	3.19	1.36	113,639	
10/9/19	83.07	127.43	38.06	0.12	0.18	0.05	1.87	2.26	1.44	2.53	3.14	1.80	119,618	
10/10/19	45.36	70.97	37.43	0.07	0.10	0.05	1.54	1.81	1.44	1.93	2.46	1.78	65,319	
Week:	**72.67**	**137.22**	**22.29**	**0.10**	**0.20**	**0.03**	**1.77**	**2.35**	**1.22**	**2.37**	**3.19**	**1.36**	**418,568**	
Totals:	**90.97**	**192.36**	**22.29**	**0.13**	**0.28**	**0.03**	**1.90**	**2.66**	**1.22**	**2.64**	**3.97**	**1.36**	**916,969**	

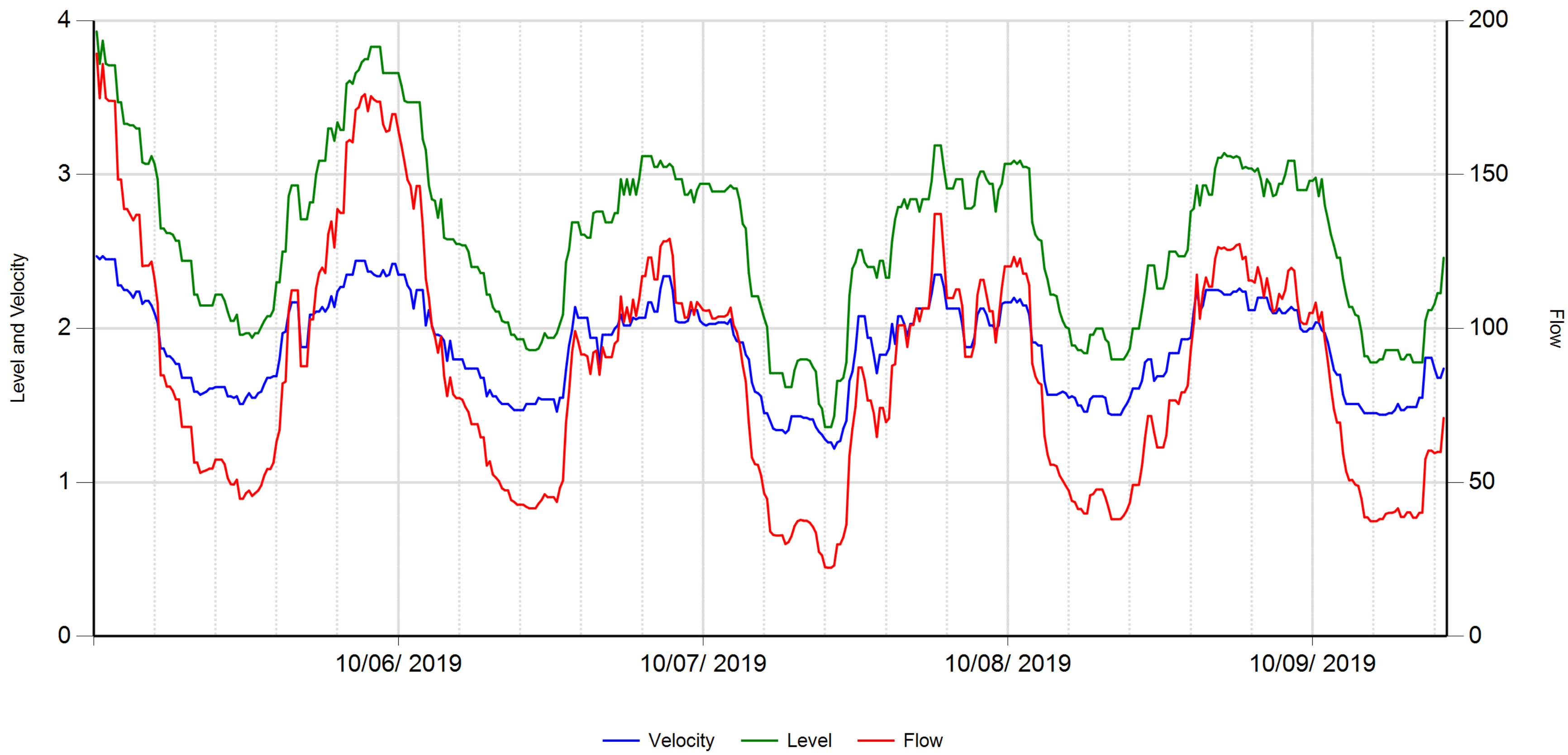
2019.10 Site 1 MH US



	Velocity (fps)	Level (in)	Flow (gpm)		
Average	2.086	3.023	117.515	**RainFall**	Inches
Maximum	2.660	3.970	192.361		
Minimum	1.480	2.030	47.778		

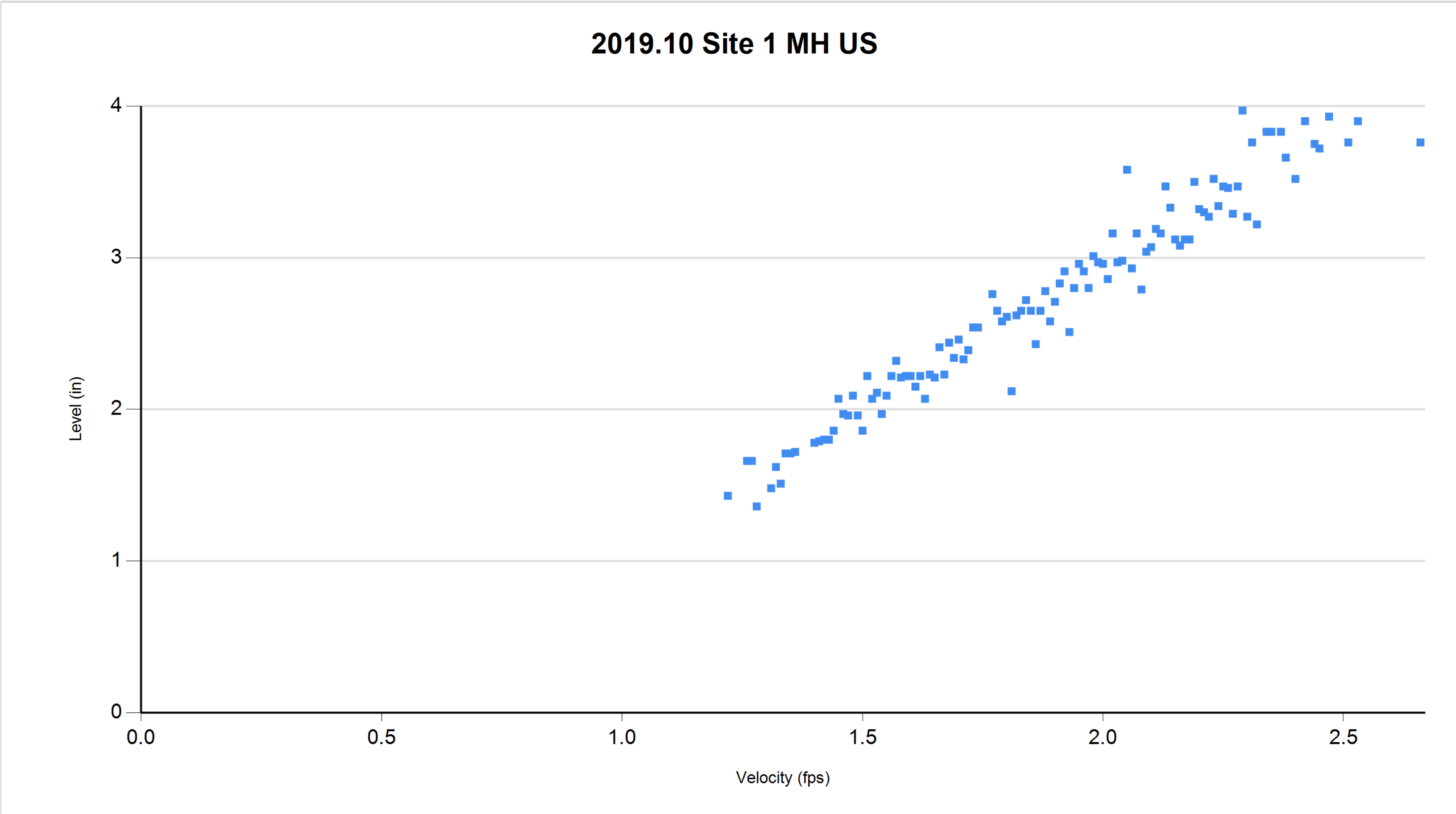
10/14/2019

2019.10 Site 1 MH US



	Velocity (fps)	Level (in)	Flow (gpm)		
Average	1.874	2.583	86.580	RainFall	Inches
Maximum	2.470	3.930	189.305		
Minimum	1.220	1.360	22.292		

10/14/2019



10/04/2019 thru 10/10/2019

10/14/2019 1:29:42 PM

Tab 3: Methods & Procedures & Equipment

3.1 Methods and Procedures

[illegible]

- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]

3.2 Equipment

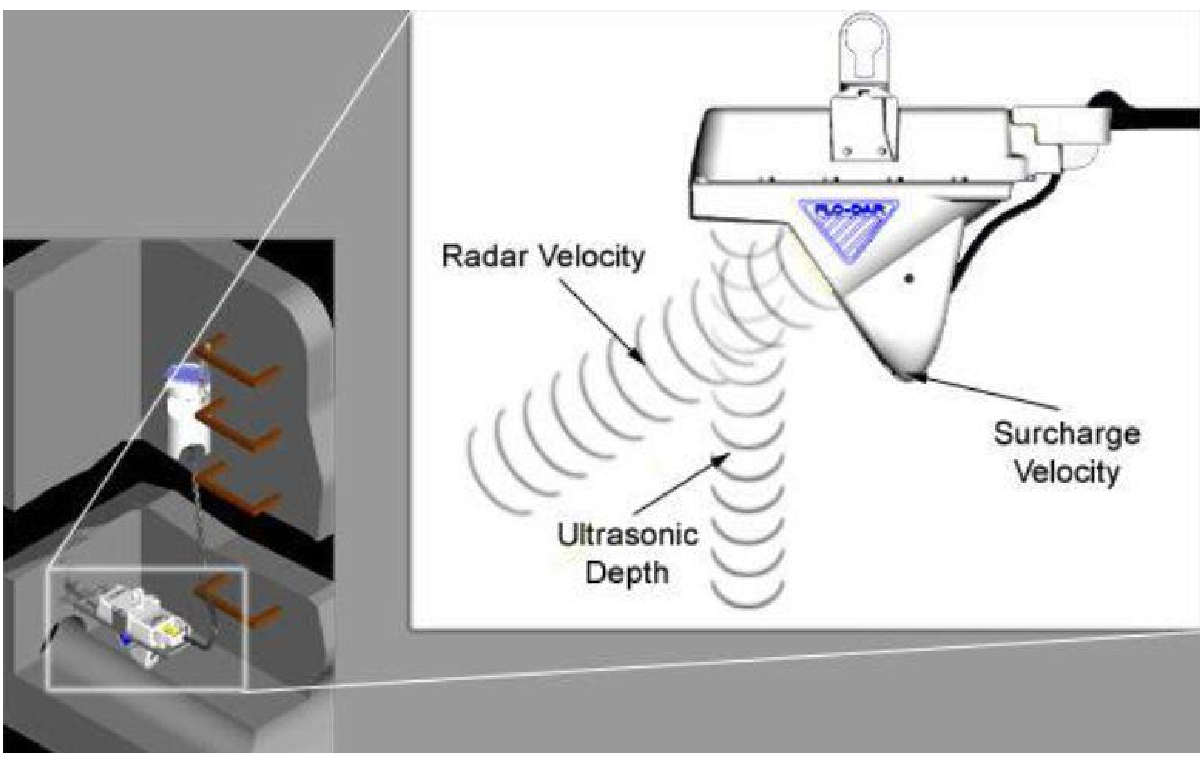


Figure: [illegible]

Figure: [illegible]

3.2.1 SPECIFICATIONS

- **Enclosure**
    - [illegible]
- **Dimensions**
    - [illegible]
    - [illegible]
- **Weight**
    - [illegible]
- **Operating Temperature**
    - [illegible]
- **Storage Temperature**
    - [illegible]
- **Power Requirements**
    - [illegible]

- **Interconnecting Cable**
  - [illegible]
  - [illegible]
  - [illegible]
- **Cables – available in two styles:**
  - [illegible]
  - [illegible]
- **Certification**
  - [illegible]
  - [illegible]

[illegible]

  - [illegible]
- **Method**
  - [illegible]
- **Range**
  - [illegible]

[illegible]

- **Method**
  - [illegible]
- **Range**
  - [illegible]
- **Frequency Range**
  - [illegible]
- **Accuracy**
  - [illegible]

[illegible]

- **Method**
  - [illegible]
- **Standard Operating Range from Flo-Dar® Housing to Liquid**
  - [illegible]
- **Optional Extended Level Operating Range from Transducer Face to Liquid**
  - [illegible]
- **Accuracy**
  - [illegible]

[illegible]

- **Method**
  - [illegible]
- **Accuracy**
  - [illegible]

[illegible]

- **Surcharge depth supplied by Flo-Dar® sensor.**

[illegible]

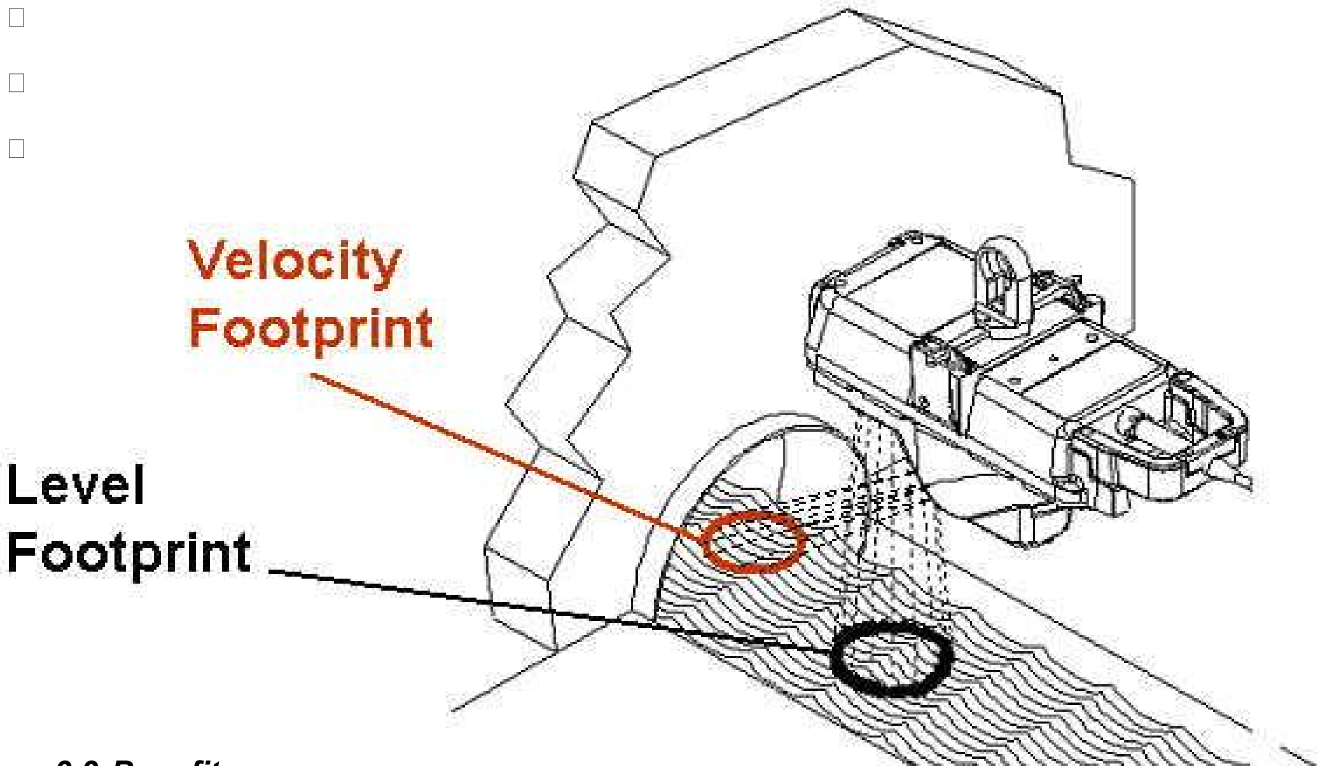
- **Method**
  - [illegible]
- **Range**
  - [illegible]
- **Accuracy**
  - [illegible]
- **Zero Stability**
  - [illegible]

[illegible]

3.2.2 Perfect Solution for Difficult Flow Conditions:

- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]

- [illegible]
- [illegible]
- [illegible]



3.3 Benefits

3.3.1 [illegible]

3.3.2 [illegible]

3.3.3 [illegible]

3.4 How It Works

[illegible]

Q = V x A, Where Q = Flow, V = Average Velocity and A = Area

3.5 Accurate Flow Measurements

[illegible]

MARSH McBIRNEY
A Higher Level of Flow Measurement

Understanding the Flo-Dar™ Flow Measuring System

Independent tests verify non-contact flowmeter is highly accurate under both open channel and surcharge conditions

Flo-Dar is the only non-contact open channel velocity/area type flow meter available for measurement of flows in municipal wastewater and storm water sewers. Flo-Dar consists of a radar-based velocity measurement system and an ultrasonic-based pulse echo depth measurement system.

Flo-Dar has an optional surcharge velocity sensor (electromagnetic type) and depth sensor (pressure transducer) that provides the continuation of accurate flow data where intermittent, surcharged flow conditions are experienced.

Flo-Dar combines the information from the velocity and depth systems along with site specific data (pipe size, pipe shape, velocity profile) and provides the user with highly accurate, reliable flow data under a wide range of flow velocities and depths. Since the radar velocity sensor and the ultrasonic depth sensor cease to provide useful data when submerged, Flo-Dar has an optional surcharge velocity sensor (electromagnetic type) and depth sensor (pressure transducer) that provides for the continuous measurement of accurate flow data where intermittent, surcharged flow conditions are experienced.

The data system merges the data from these two independent flow systems and provides the user with a single flow signal that accurately represents flow over a range from a dry pipe to extreme surcharge conditions. Accuracy tests performed at Alden Research Labs have shown that the Flo-Dar is highly accurate under both open channel and surcharge (submerged) conditions.

Accuracy tests performed at Alden Research Labs have shown that the Flo-Dar is highly accurate under both open channel and surcharge (submerged) conditions.

Measurement of Flow Under Free Flow, Non-submerged Conditions

Open Channel Velocity

Open channel flow is any flow in a channel that has a free surface. Flo-Dar measures open channel flow as depicted in Figure 1. The radar velocity sensor measures flow in a manner similar to how radar guns measure the velocity of a baseball or an automobile.

Marsh-McBirney has developed and patented a process that yields an accurate determination of the average velocity from the measurement of the surface velocity at a known point on the flow surface.

A radar "horn" contained inside of the watertight housing transmits a microwave beam through the housing at a defined angle to the flow surface. Disturbances on the surface reflect some of the microwaves back to the horn. The frequency of these returning microwave signals have been shifted (the Doppler effect) by an amount directly proportional to the speed of the moving surface. This frequency shift is detected and measured by the Flo-Dar flow meter and the data is stored as a measure of the surface velocity.

Since the accurate measurement of open channel flow requires the accurate determination of the average velocity of the flow stream, the measured surface velocity must be dynamically modified to obtain an accurate average velocity for use in the Continuity Equation, Q= Vav x A). Marsh-McBirney has developed and patented a process that yields an accurate determination of the average velocity from the measurement of the surface velocity at a known point on the flow surface.

Factors that influence the accuracy and stability of the measured surface velocity signal:

1. *Transmitted Frequency*
2. *Speed of Microwaves in Air*
3. *Angle of Microwave Beam*
4. *Calculation of Mean Velocity*

If one analyzes each of the four factors that influence the accuracy and stability of the measured surface velocity signal, it becomes obvious that a Doppler Radar based velocity sensor is very accurate and stable:

1. Transmitted Frequency - The transmitted frequency of 24.175 GHz is controlled to an accuracy of +/- 0.065%
2. Speed of Microwaves in Air - Essentially constant at the speed of light
3. Angle of Microwave Beam - The sensor is placed in a rigid mount that is positioned parallel to the water surface (i.e. nearly level). The sensor can be removed from the mount and reinstalled while easily maintaining its original mounting location.
4. Calculation of Average Velocity—The relationship between the sensed (surface) velocity and the average velocity varies with pipe size and water depth.

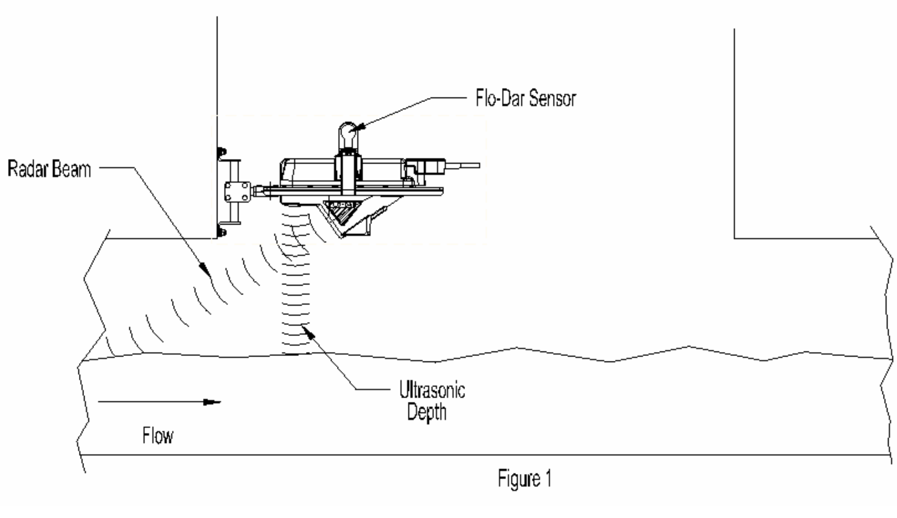


Figure 1

By applying algorithms developed through basic hydraulic principles and from actual flow data taken at Alden Labs and at various customer sites, the surface velocity is transformed into an accurate representation of the mean velocity.

Since the location of the sensing region on the flow surface is known, the repeatability of the surface velocity measurement is excellent and its relationship to the mean velocity is very predictable.

Since the location of the sensing region on the flow surface is known, the repeatability of the surface velocity measurement is excellent and its relationship to the mean velocity is predictable.

Figures 2a, 2b, 2c and 2d depict the relationship that exists between various velocity contours and the mean velocity at different **d**epth/**D**iameter ratios. Note that the velocity gradients that exist throughout the flow cross section are generally represented at the flow's surface - essentially creating a "finger-print" of the velocity contours that exist beneath the surface.

As one might expect, the velocities near the wall are less than the mean velocity and those near the surface are greater than the mean velocity. Since a) the radar sensor measures surface velocity at a know location on the flow surface, and b) these various surface velocities have known relationships to the mean velocity, then the mean velocity can be reliably and accurately calculated.

The accuracy of the calculated average velocity, after correction, is typically between 2% to 5%.

Note that the velocities present on the surface are typically within 10% of the average velocity. The accuracy of the calculated mean velocity, after correction, is typically between 2% to 5%. (See Note 1.)

Ultrasonic Pulse Echo Depth Measurement

Ultrasonic pulse echo depth sensors operate by energizing a piezoelectric transducer with an electronic pulse. This pulse creates an ultrasonic pulse of energy that travels to the flow surface where a portion of the energy returns to the transducer.

The transit time to the flow surface and back is recorded and the distance calculated by knowing the speed of sound at the site which has been corrected by an embedded temperature sensor. The accuracy of the depth measurement is 1%, +/- 0.1 inch .

Measurement of Flow Under Submerged Conditions

Electromagnetic (EM) Surcharge Velocity Sensor

As stated previously, the radar based velocity sensor measures the surface velocity of the flowing stream by detecting the average speed of the surface irregularities. When the radar sensor becomes totally submerged, it becomes "blind" and is no longer capable of measuring the fluid velocity.

*Figures 2a, 2b, 2c and 2d depict the relationship that exists between various velocity contours and the mean velocity at different **d**epth/**D**iameter ratios. Note that the velocity gradients that exist throughout the flow cross section are generally represented at the flow's surface—essentially creating a "finger-print" of the velocity contours that exist beneath the surface.*

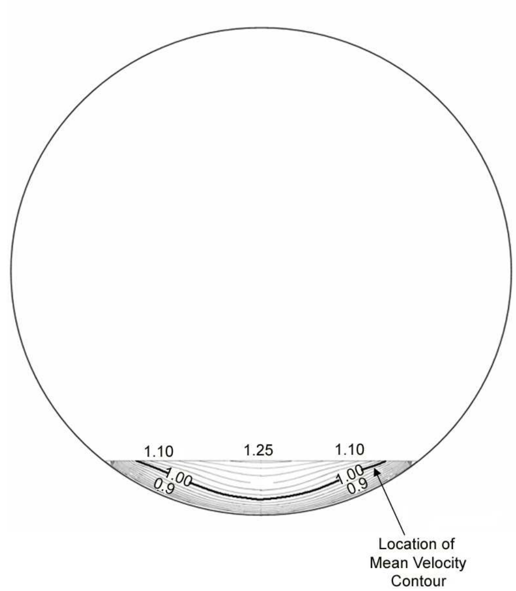


Figure 2a:
d/D= 0.10

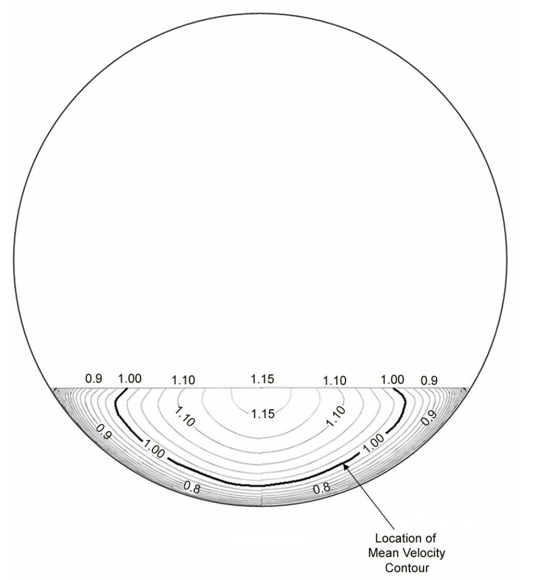


Figure 2b:
d/D= 0.25

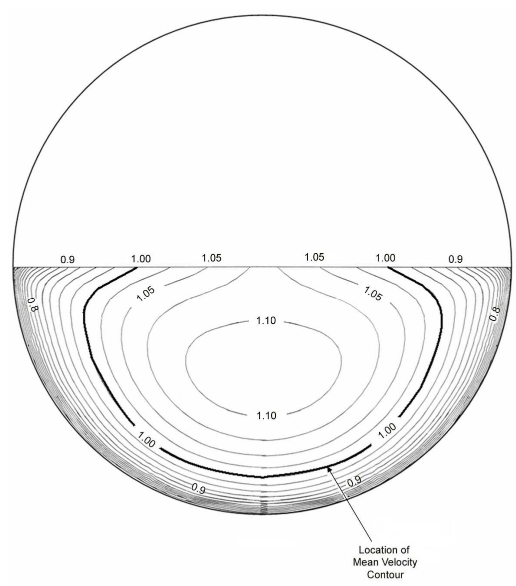


Figure 2c:
d/D= 0.50

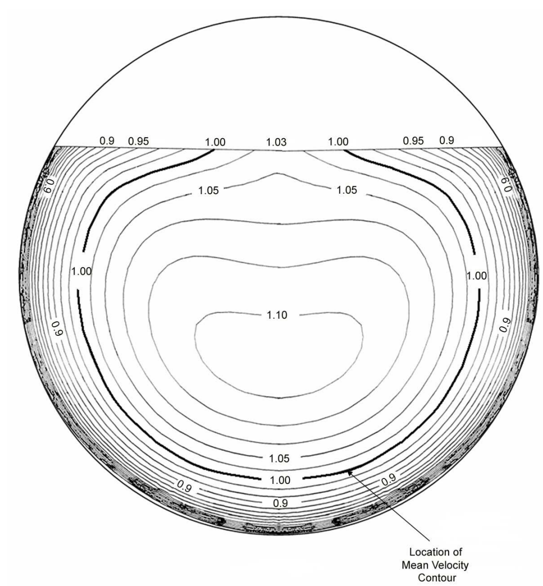


Figure 2d:
d/D= 0.75

To allow for the uninterrupted measurement of flow under conditions that change from open channel flow to submerged flow as experienced in sewers that surcharge, Marsh-McBirney has added an additional surcharge velocity sensor. Placed on the underside of the standard Flo-Dar sensor, this electromagnetic sensor becomes active when the flow level rises to within four inches of the Radar horn and remains activated until the flow once again falls beneath that depth.

To allow for the uninterrupted measurement of flow under conditions that change from open channel flow to submerged flow as experienced in sewers that surcharge, Marsh-McBirney has added an additional surcharge velocity sensor.

Placed on the underside of the standard Flo-Dar sensor, this electromagnetic sensor becomes active when the flow level rises to within 4 inches of the Radar horn and remains activated until the flow once again falls beneath that depth.

The optional surcharge velocity sensor is based on the Faraday Principle of Electromagnetic Induction. This is the same well-proven principle that "full bore" or "spool-piece" magmeters utilize, the most widely used method of measuring wastewater flow in full pipes.

In the Marsh-McBirney design, an electromagnet embedded within the streamlined sensor generates a magnetic field in the flowing stream. The flow of the water passing through this magnetic field generates voltages in the water that are directly proportional to the speed of the water passing the sensor. Marsh-McBirney uses an in-house 120 foot long towing basin for calibration of electromagnetic sensors. Tow carriage accuracy is better than +/- 0.5%.

Surcharge Depth Sensor

Once submerged conditions exist, the ultrasonic depth sensor ceases to provide useful depth information. To measure depth of the flow during surcharge conditions, a pressure transducer embedded in the Flo-Dar sensor is used in the system.

The location of the surcharge velocity sensor relative to the crown of the pipe is shown in Figure 3. This location provides sensing of the velocity stream just below the crown of the pipe where the flow exits the upstream piping. Empirical data, verified by independent tests at Alden Labs in Holden, Massachusetts indicate that the velocity measured at this location, when multiplied by 0.9, is typically equal to the average velocity.

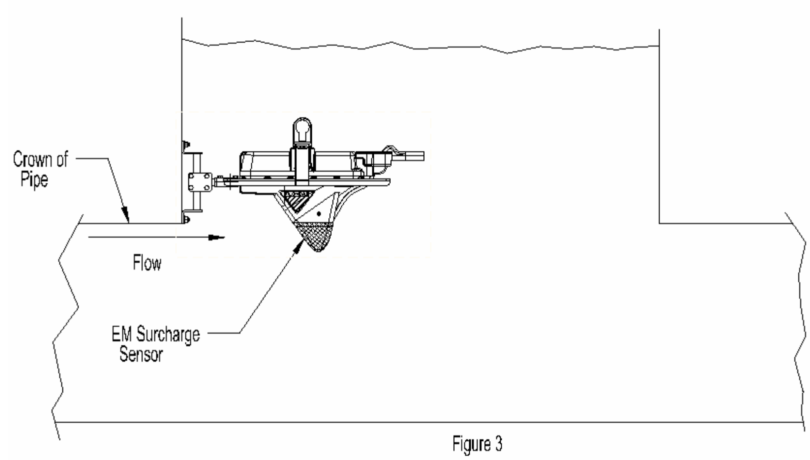


Figure 3

Laboratory Tests

In September 2002 Marsh-McBirney contracted Alden Research Labs of Holden, Massachusetts to perform flow accuracy tests on the Flo-Dar sensor with an electromagnetic surcharge sensor. The Flo-Dar was subjected to a flow range of 400 gpm to over 9000 gpm in a pipe size of 23.5 inches. The pipe had a slope of approximately zero. The test results are shown in Figure 4, Figure 5, Figure 6 and Figure 7.

The flow tests showed that the Flo-Dar compared very favorably with the Alden flow standard (weigh tank) over a wide range of flows where the open channel flow ranged from 400 gpm to 6000 gpm, and the surcharge (submerged) flow ranged from 6000 gpm to 9000 gpm.

The flow tests showed that the Flo-Dar compared very favorably with the Alden flow standard (weigh tank) over a wide range of flows where the open channel flow ranged from 400 gpm to 6000 gpm, and the surcharge (submerged) flow ranged from 6000 gpm to 9000 gpm.

Tests were also run to depict how Flo-Dar performs under transition conditions where the flow goes from an open channel condition to a surcharge (submerged) condition.

Test results show that the data from the open channel radar sensor and surcharge electromagnetic sensor overlay each other and the Alden Standard. Tests were run under both free flow conditions as well as where the pipe outlet was partially blocked so as to create an entirely different velocity/depth relationship.

Additional flow accuracy tests were run on a 36" pipe at Alden on July 17, 2003. All of the data points were shown to be within 3.5% of the Alden Standard.

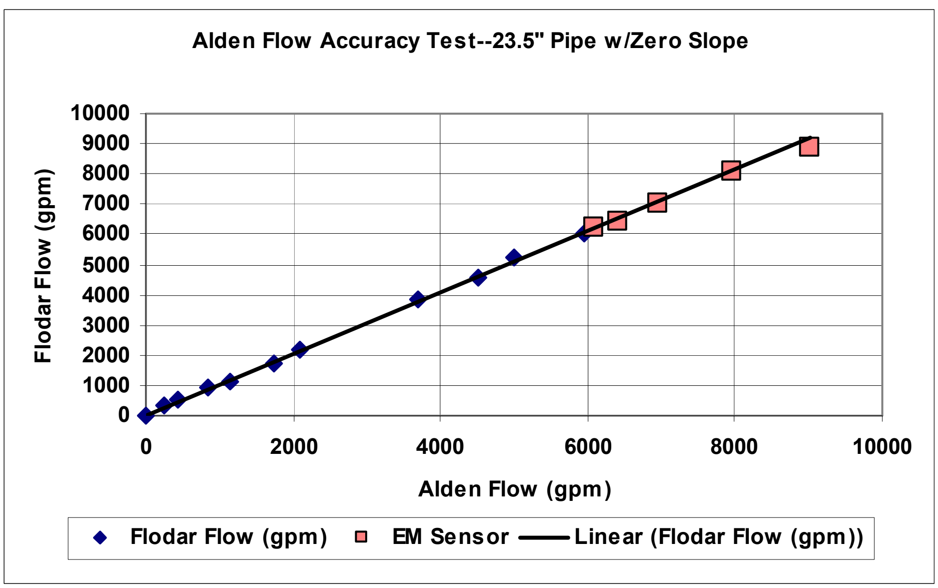
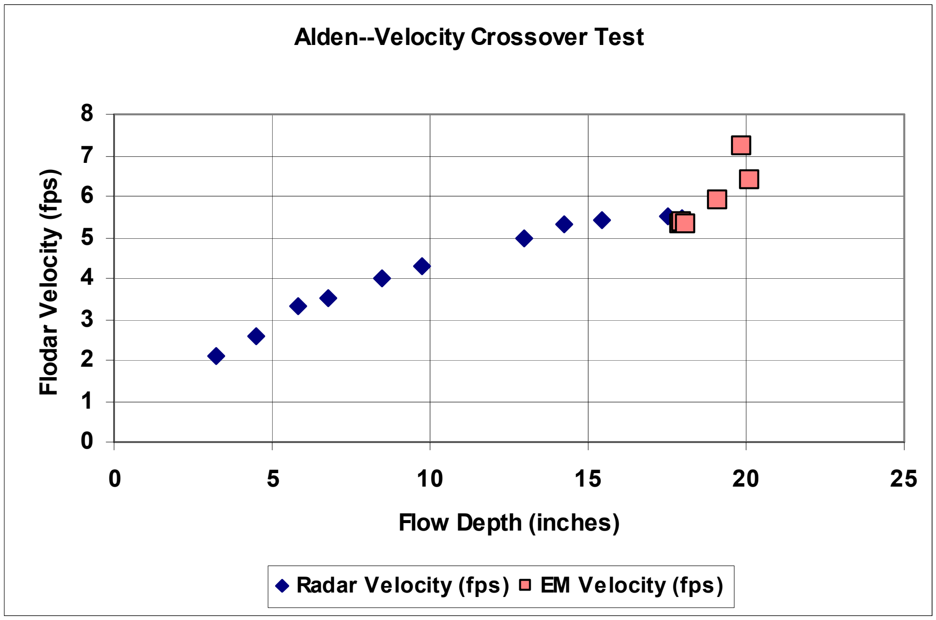


Figure 4 compares the Flo-Dar flow vs. the Alden Standard (weigh tank). The flow condition for this test was both open channel flow and surcharge (submerged) flow.



Test results show that the data from the open channel radar sensor and surcharge electromagnetic sensor overlay each other and the Alden Standard.

Figure 5 compares the velocity measured by the Radar sensor plotted against flow depth. Note that when the depth reaches approximately 18 inches the EM surcharge sensor has been activated. There is one data point where both sensors are active and then the EM surcharge sensor continues to measure after the radar sensor has become submerged and inoperative.

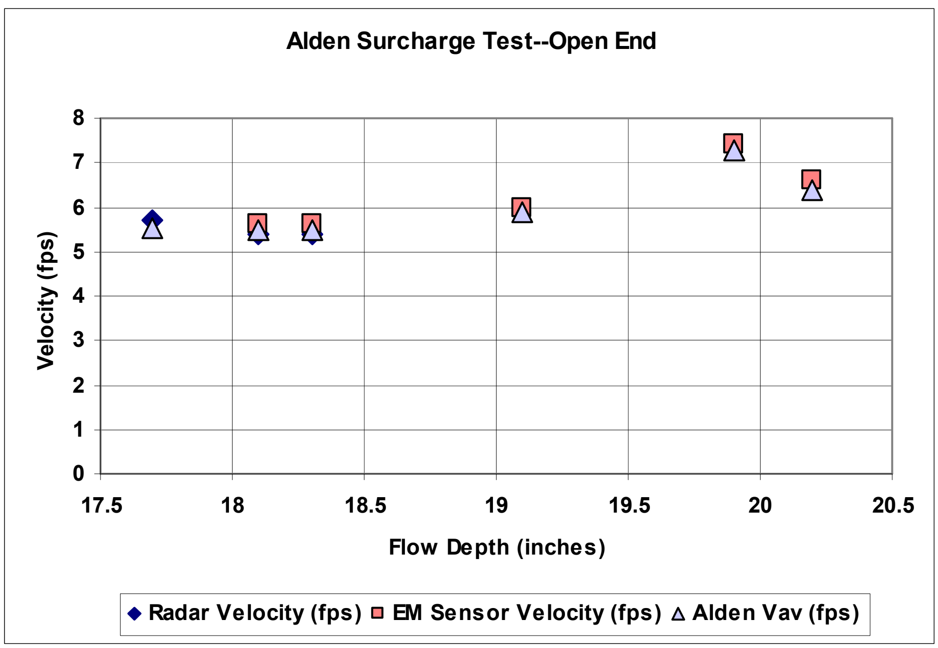


Figure 6 depicts a second surcharge test where the flow was incremented more slowly in order to achieve additional data points in the area where both the Radar sensor and the EM surcharge sensors are active simultaneously. Note that both the Radar sensor and the EM sensor are active between flow depths of 18 inches and 18.5 inches. Also, note how both the Radar and EM data points overlay each other and the Alden standard.

The accuracy of Flo-Dar under both open channel conditions as well as surcharge (submerged) conditions is more than adequate for the most demanding of metering applications including open channel billing applications.

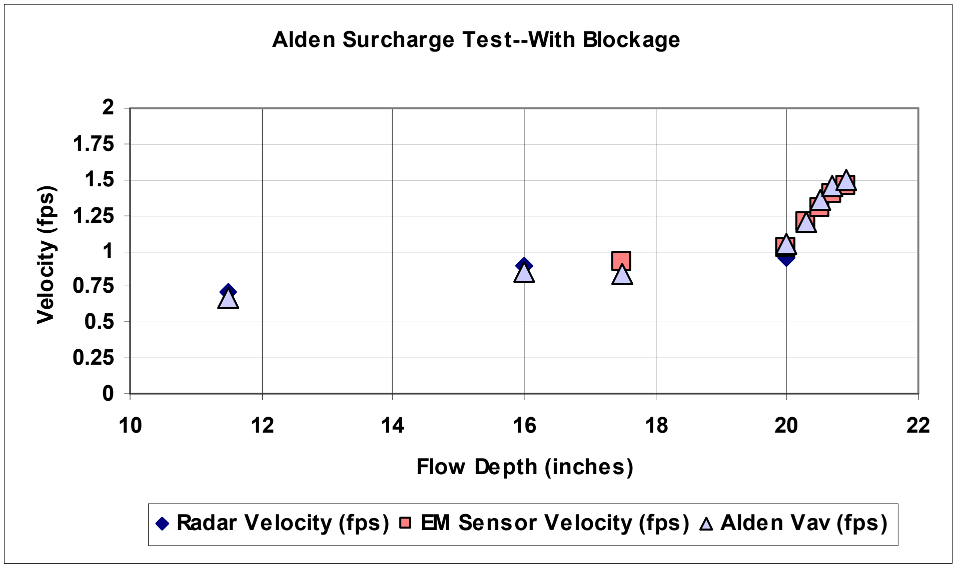


Figure 7 depicts the result of a surcharge test at a lower flow rate. In this test, a round plate with multiple holes was placed at the outlet of the test pipe so as to achieve submerged flow at a lower velocity. Note the consistency of both the Radar velocity data and the EM velocity data as compared to the Alden standard.

Additional tests performed at Alden in 2003 on a 36" pipe again validated Flo-Dar's accuracy under open channel and surcharge flow.

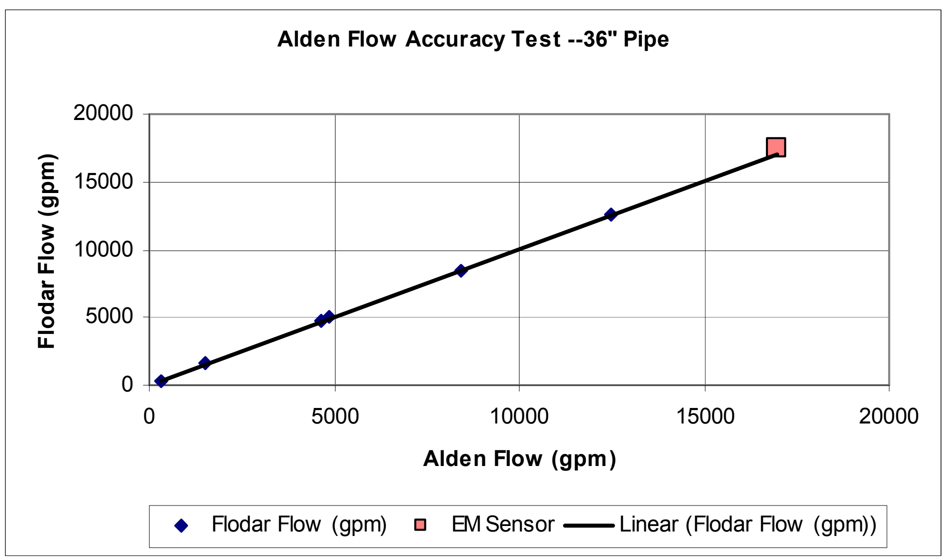


Figure 8 compares the Flo-Dar flow vs. the Alden Standard (weigh tank) for flow accuracy tests in a 36" pipe. These tests were performed on July 17, 2003. Note that at 17,000 gpm the sensor was under surcharge conditions. All of the data points were shown to be within 3.5% of the Alden Standard.

The Flo-Dar data logger records all four of the flow parameters - open channel surface velocity and depth, and surcharged velocity and depth. When the water depth is below the bottom of the Flo-Dar sensor, only the surface velocity and the flow depth of the open channel flow are used in the flow calculation.

Flo-Dar measures open channel velocity and depth by non-contact means virtually eliminating the need to periodically clean the sensors as required by all submerged type sensors.

Once the flow depth is such that both the surcharge depth sensor is activated and a conductivity switch is activated, then flow is calculated using the full pipe dimensions for area and the surcharge velocity sensor for velocity.

Conclusions

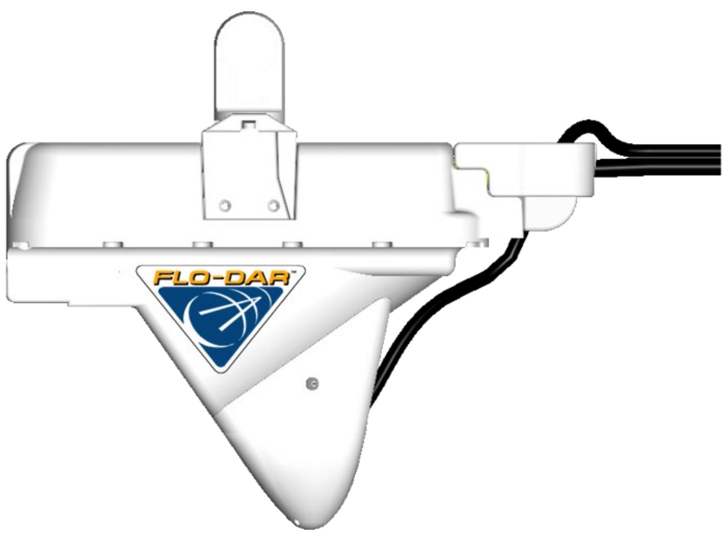
Flo-Dar is a rugged, general purpose flow meter for use in most open channels such as sanitary sewers, storm water sewers and other man-made channels such as aqueducts as well as certain natural channels such as small streams. Flo-Dar measures open channel velocity and depth by non-contact means virtually eliminating the need to periodically clean the sensors as required by all submerged type sensors. Data recovery from Flo-Dar deployments ranges between 98% to 100% even under site conditions that render most submerged sensors inoperable.

Data recovery from Flo-Dar deployments ranges between 98% to 100% even under site conditions that render most submerged sensors inoperable.

The accuracy of Flo-Dar under both open channel conditions as well as surcharge (submerged) conditions is more than adequate for the most demanding of metering applications including open channel billing applications.

Note 1. The accuracy of open channel flow meters can be affected by adverse conditions present at any metering site. The accuracy specifications of most manufacturers are generally stated under ideal conditions.

Open Channel Flow Monitoring Study



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P/N 105006001

Index

1) Locate the following parts (See Figure 1):

1) Flo-Dar Sensor
2) Flo-Dar Logger
3) Flo-Dar Communication Cable
4) Flo-Ware Software CD
5) Sensor Mounting Frame
6) Jack-Bar Assembly
7) Extension Pipe, Tee Fitting, and Bushing
8) Clamp Set with qty. (8) ¼-20 Bolts
9) Desiccant Capsule
10) Laser-Alignment Tool
11) Installation & Operations Manual
12) Start-Up Guide (not pictured)

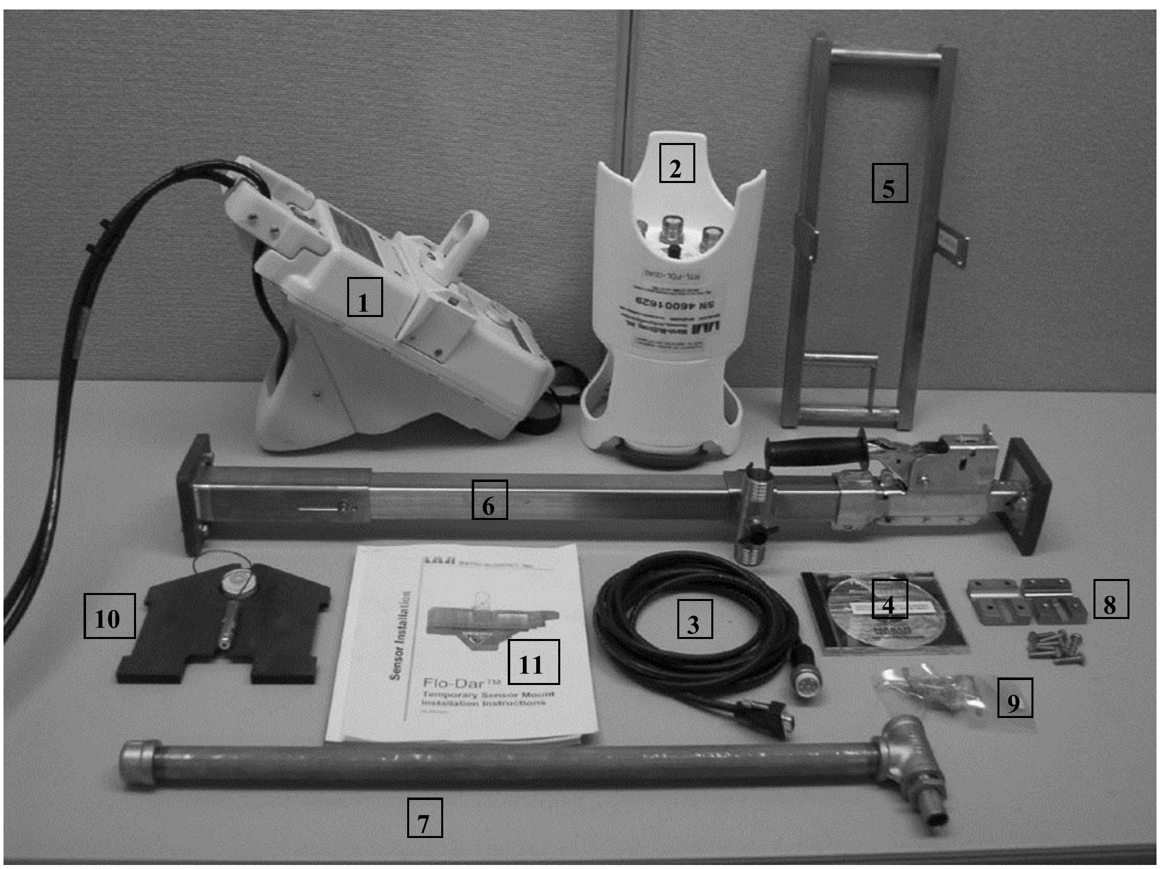


Figure 1

Methods & Procedures

2) Flo-Ware Software Configuration.

1. Insert the "Flo-Ware For Windows Resources CD" into your drive.
2. Select (single-click) "floware4.exe" from the "Software" box on your screen.
3. Select "Save" from the "File Download—Security Warning" screen.
4. Select "Save" from the "Save As" screen.
5. Select "Run" from the "Download Complete" screen.
6. Select "Run" from the "Internet Explorer—Security Warning" screen.
7. An installation wizard will initiate and load the files onto your hard drive.
8. Select the language you want to use from the "Select Language" screen.
9. Select "Next" from the "Welcome" screen.
10. Select "Next" from the "Choose Destination Location" screen.
11. Select "Next" from the "Select Components" screen.
12. Select "Next" from the "Start Installation" screen.
13. Select "Finish" from the "Installation Complete" screen.
14. Scroll down the screen and find "Flo-Dar / SVS" on the left side of the screen. Select (single-click) "flodar.exe" from that box on your screen
15. Select "Run" from the "File Download—Security Warning" screen.
16. Select "Run" from the "Internet Explorer—Security Warning" screen.
17. An installation wizard will initiate and install the files onto your hard drive.
18. Select "Finish" from the "Flo-Dar / SVS File Driver Installation" screen.

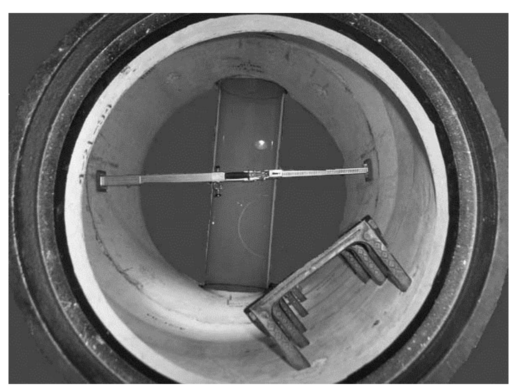
NOTE: There are ample help files on the "Flo-Ware for Windows Resources CD"

3) Set up the mounting frame and jack-bar assembly.

A) Install the jack-bar assembly in the manhole. As a general rule, the jack-bar should be approximately 20" to 24" above the crown (top) of the pipe. In order to reduce movement of the jack-bar due to the cantilever action of the sensor, the jack-bar should be located as parallel to the pipe and invert of the manhole as possible.

MOST Desirable Jack-Bar Mount

LEAST Desirable Jack-Bar Mount



B) Assemble the frame, clamp-set, bushing, tee, and extension as shown in figure 2. Position the frame as close as possible to the lip of the pipe by sliding the assembly along the jack-bar with the slide. Be sure to secure the set-screw.

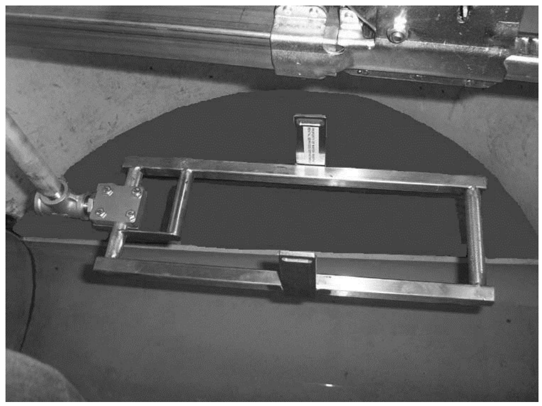


Figure 2

C) Set the elevation of the frame (measured to the top of the frame tubes) to be 6" above the inside crown of the pipe (for pipe I.D. under 25") or 5" above the inside crown of the pipe (for pipe I.D. of 25" and greater). An easy way to set the frame elevation is to measure the distance from the bottom of the manhole invert to the top of the mounting frame tubes. (This assumes that there is no drop or hydraulic jump from the lip of the pipe to the invert) Set the dimension to equal the pipe I.D. plus 6" (for pipe I.D. under 25") or the pipe I.D. plus 5" (for pipe I.D. of 25" or greater).

Figure 3

D) If you are not interested in measuring flow under surcharge conditions, or if you are sure the site will not surcharge, you can mount the sensor at any elevation above the surface of the water as long as the frame is within 60" of the water surface. When the sensor is mounted at higher elevations than those shown in Figure 3, it will still read normal velocity and level readings. Surcharge level will still be recorded properly, but surcharge velocity readings will not be possible. If you are mounting the sensor at higher elevations, it is still necessary to confirm the location of the velocity radar beam as described on pages 5 & 6 of this guide.

E) Align and level the frame by placing the laser alignment tool in the frame as shown in figure 4. Utilize the bubble-level on the tool to level the frame.

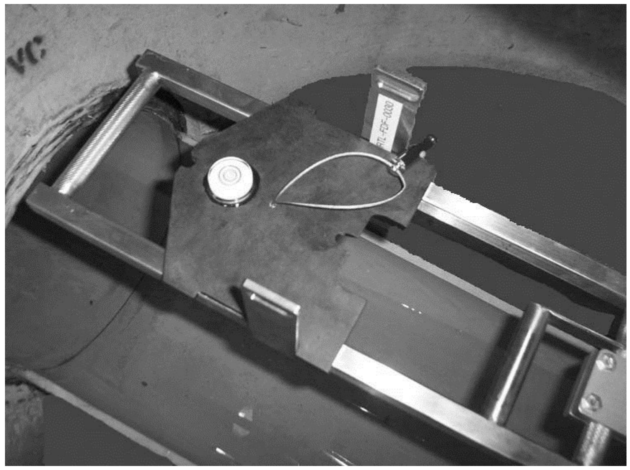


Figure 4

F) Snap the laser-pointer into the laser alignment tool as shown below in figure 5. It is a tight fit. Make sure the pointer is firmly and evenly seated in its slot as shown.

Figure 5

G) With the laser-pointer snapped into the tool, as shown, place the alignment tool back into the frame. The laser is now set up to duplicate the velocity radar beam angle. Use the laser-pointer to shine the beam onto the surface of the water. Ideally, the beam should be aligned so that it lands in the middle of the surface of the water inside the pipe.

NOTE: There are numerous adjustment points on the frame and jack-bar assembly.

H) Remove the laser-pointer from the tool and re-install it into the tool as shown below in figure 6. With the laser-pointer in the position shown, it is now set up to duplicate the ultra-sonic level transducer beam location.

I) Align the beam so that it lands in the middle of the channel you are measuring.

NOTE: You may have to check level, velocity laser alignment, and level laser alignment several times to ensure all three are correct. Adjusting one or more of the alignments will often affect one or more of the other adjustments! It is critical to remember to tighten all bolts on the jack-bar and clamp set to assure that the sensor frame does not move, once positioned correctly.

Figure 6

4) Install the Sensor.

A) Gently lower the sensor into the mounting frame and lock it in place by rotating the bail assembly (located on top of the sensor) 90 degrees. The two locking arms will extend out to engage the slots in the vertical side webs of the frame ensuring that the sensor will not dislodge from the frame, particularly if the manhole surcharges.

NOTE: Make sure the sensor is placed in the frame so that the cables are exiting the sensor on the downstream (manhole effluent) side. (see Figure 7 below)

5) Connect the Data Logger.

A) Connect the sensor cables to the data logger. Make sure the grey cable-end connects to the connector marked grey. Connect the yellow cable-end to the connector marked yellow. Tighten the threaded cable connector-ends securely to the data logger connectors.

B) Remove the desiccant capsule from the vacuum-sealed bag and plug it onto the brass A.P.R. fitting (located next to the yellow cable connector) on the data logger. See Figure 8 below.

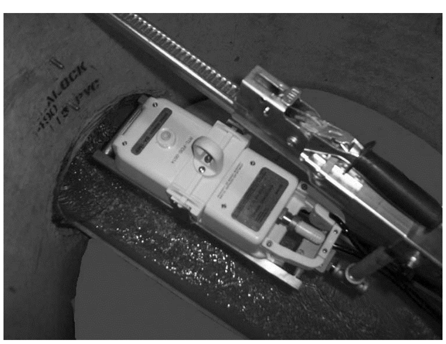


Figure 7

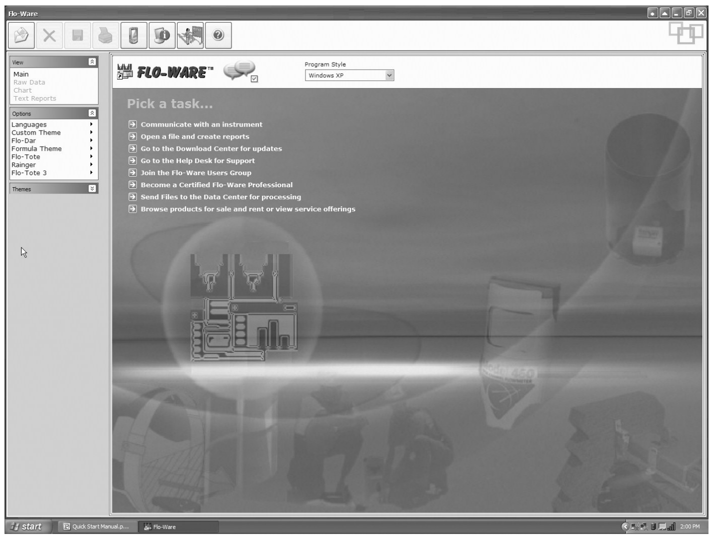
Figure 8

6) Configure the Data Logger using Flo-Ware Software.

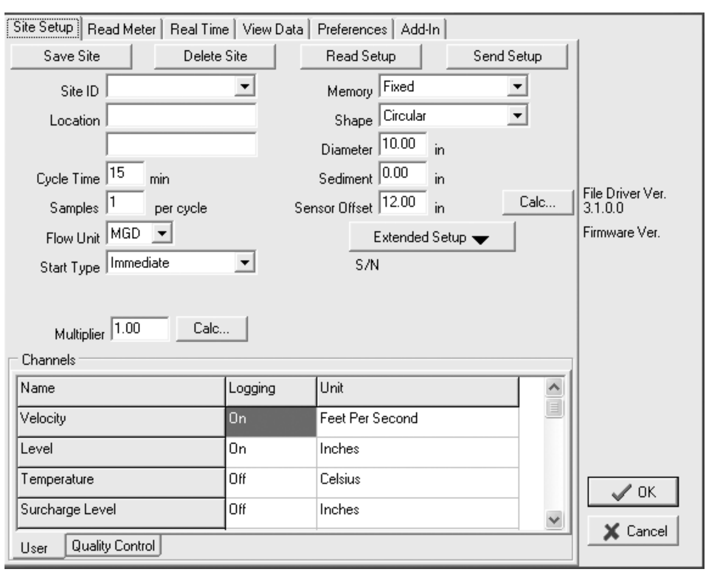
A) Connect the interface cable from the data logger to the laptop’s 9-pin serial port.

NOTE: If your laptop does not have a 9-pin serial port, you will have to use a USB port with a USB-to-serial port adapter (not provided by Marsh-McBirney).

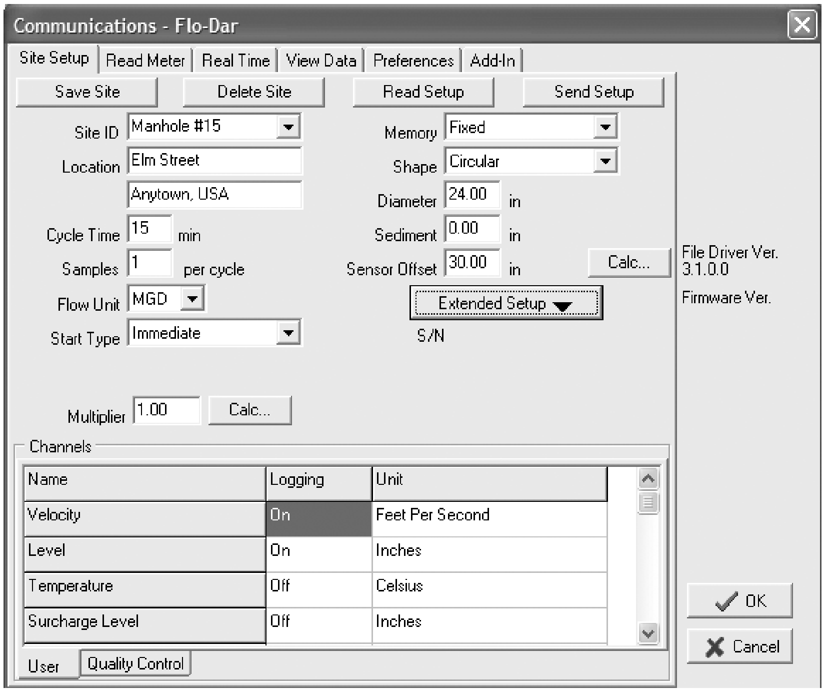
B) Double-click the “Flo-Ware” icon on your computer’s desktop.
C) When Flo-Ware opens, you will see the screen shown below.



D) Place your cursor on the line that says “Communicate with an instrument” and single-click. A small pop-up window will open. Place your cursor over the “Flo-Dar” line and single-click. A second pop-up window will appear. Single-click on the word “communications”. The site set-up screen will appear as shown below.

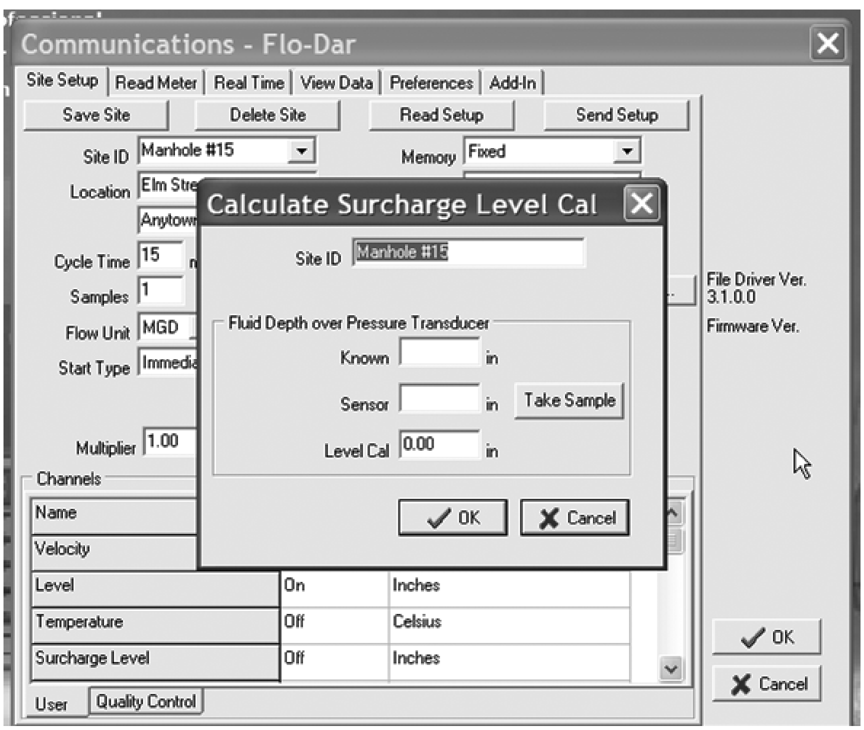


E) Proceed to enter your specific site information into the appropriate boxes in the site set-up screen. An example of a typical set-up is shown below, along with explanations-actions of the input required from the user.



- Site I.D. and Location are self-explanatory. You MUST enter something in the site I.D. box in order for the program to work.
- Cycle time is the time interval between the start of each sample.
- Number of samples is the number of 1-minute samples that the instrument will take at the beginning of each cycle.
- Flow Units can be selected by using the pull-down arrow to view the available choices.
- Start Type is either immediate or delayed. If you choose a delayed start, you can use the pull -down arrow to reveal a calendar box and time box. You can use the pull down arrow on the calendar box to view convenient calendars which allow you to click on the date you desire. When using a delayed start, the instrument will “sleep” until the desired start-up date and time are reached. It will then “wake up” and start sampling.
- Multiplier should be left at 1.00 for most applications in round pipes. If you have a round pipe greater than 54” in diameter, or you are using the instrument in a square/rectangular channel, or an odd-shaped channel, contact the Customer Support Department at 714-542-1004 for instructions about the multiplier.
- Memory can be either “Fixed” or “Wrapped”. If you choose “Fixed”, the instrument will stop collecting data once the memory is full. In ‘Wrapped” mode, when the memory becomes full, the instrument will continue collecting data and will over-write the first data point, then the second, etc., with new data. This will continue indefinitely until a new set-up is downloaded to the instrument.

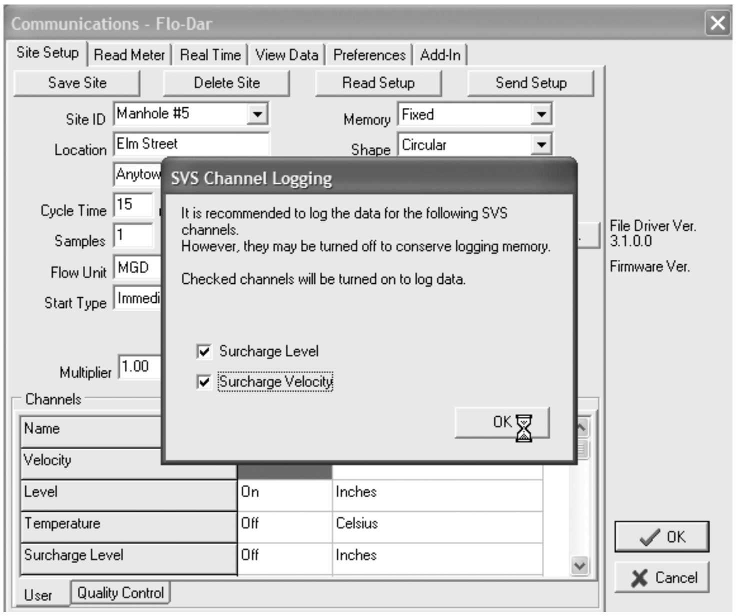
- Shape is self-explanatory. If you are measuring flow in an odd-shaped conduit, please call the US3 at 714-542-1004 for detailed instructions.
- Diameter is the INSIDE diameter of the pipe. This dimension should be measured in the field. Often, the pipe diameter is not what one assumes from the specs on a given pipe. Always measure the inside diameter to be sure of the dimension.
- Sediment is the amount of non-flowing sediment that may be in the bottom of the pipe. The software will take sediment into account when calculating cross-sectional area for the flow calculation. If there is no sediment, leave the number at 0.00.
- Sensor offset is the dimension from the top surface of the horizontal sensor mounting frame tubing, to the bottom of the invert or cannel. (see Figure 3, page 4) If you want to measure flow in a surcharge condition, or if you want to set the instrument up to measure flow in case the manhole surcharges, then the mounting frame should be located so that the sensor offset dimension is equal to the pipe diameter plus 6 inches for pipe diameters up to 24", or equal to the pipe diameter plus 5 inches for pipe diameters greater than 24".
- Single-click on the "Extended Setup" button.
- Single-click on "Surcharge Level Cal"
- A window marked "Calculate Surcharge Level Cal will appear as shown below.



- Type 0.00 in the box marked "known".
- Single-click on the "Take Sample" box.
- Allow the unit to perform a real time sample of the surcharge pressure transducer. This will take approx. 45 seconds. The software will fill in the box marked "Sensor" and the box marked "Level Cal" with the proper values automatically.

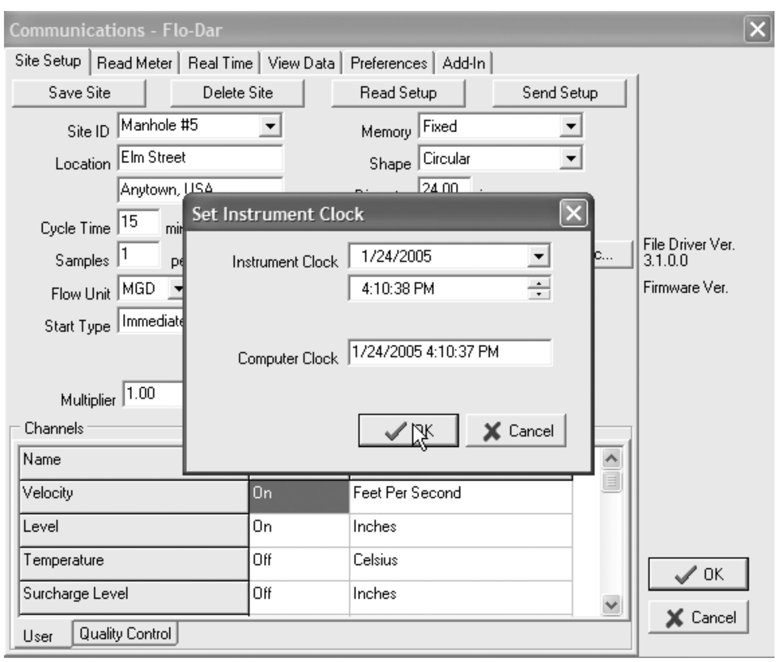
7)Save the site information to your hard drive by clicking on the "Save Site" button near the upper left-hand corner of the set-up screen.

8) Download the site information to the data logger by clicking on the "Send Setup" button near the upper right-hand corner of the site set-up screen.

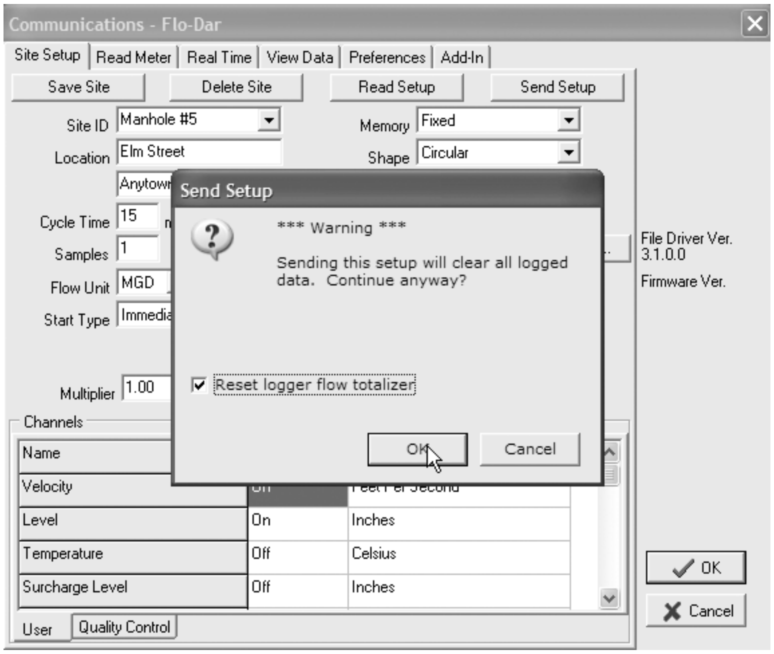


9) Turn on (check the boxes) both of the SVS channels as shown above.

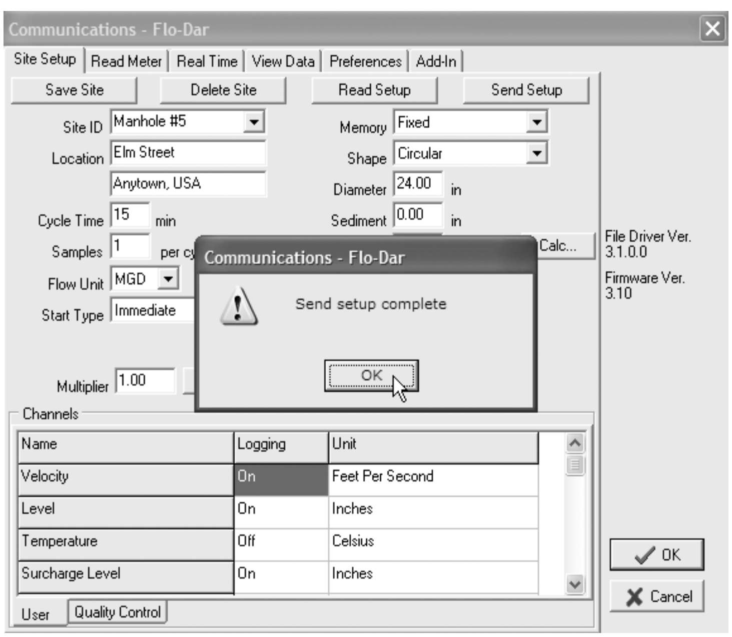
10) Adjust the instrument clock to match your laptop computer clock as shown below. Use the pull-downs next to the date and time to help you set the instrument clock time. Click OK.



11) A warning screen will appear as shown below. Select whether or not you want to reset the logger flow totalizer, then click OK.

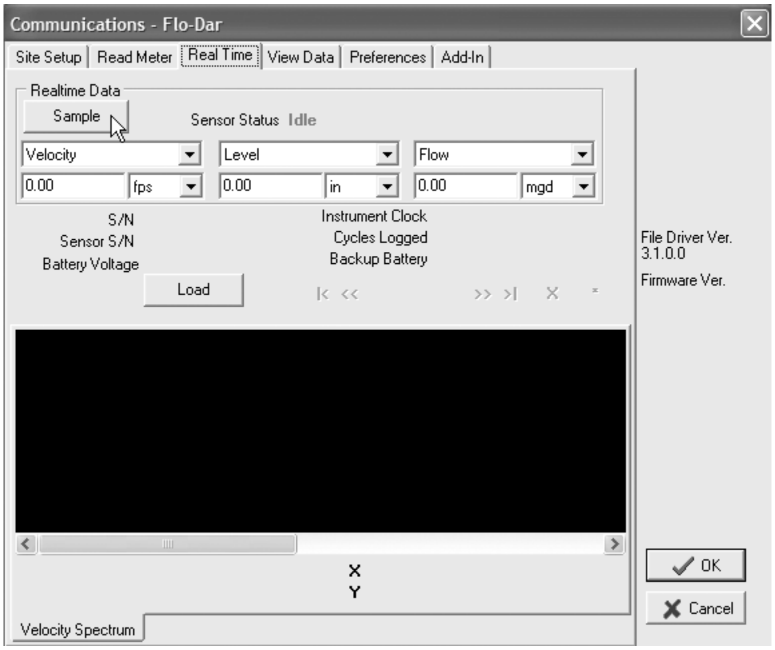


12) The "Send setup complete" screen (shown below) will appear, indicating that you have successfully sent the setup data to the instrument. The instrument will now begin collecting data.

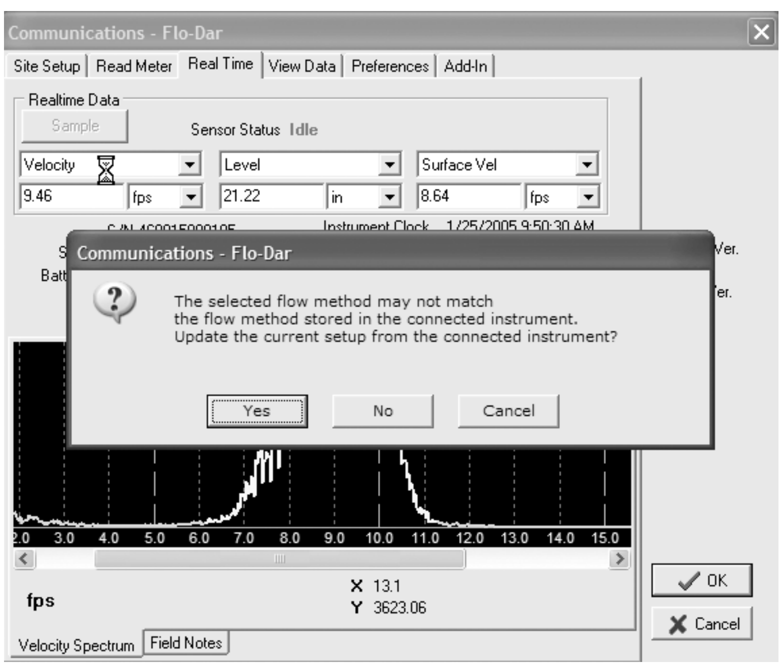


13) Collect real-time readings to confirm proper operation of the instrument before leaving the metering site.

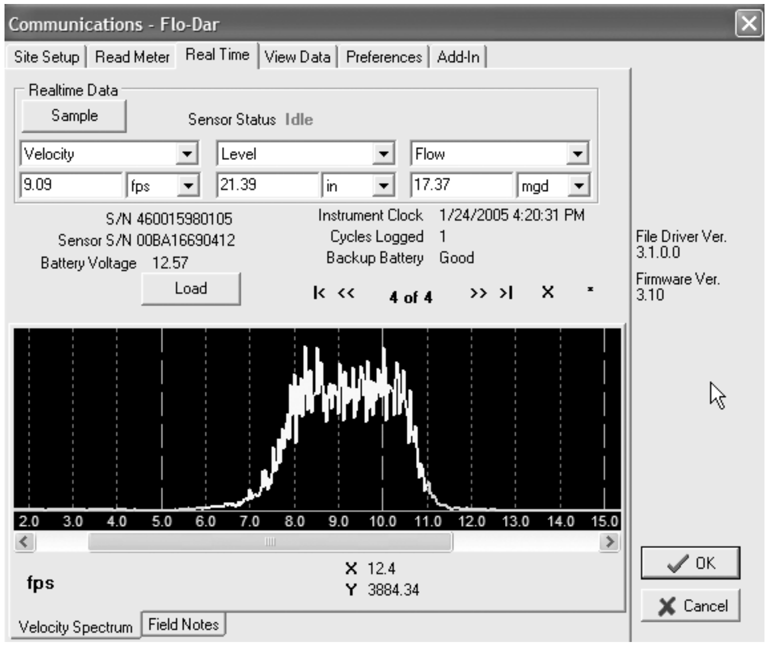
A) Single-click on the “Real Time” tab on the Communications Screen. The real time screen will appear as shown below.



B) Single-click on the “Sample” button. You may or may not see the following pop up window appear.



C) Single-click the “Sample” button. It will take about 45 to 60 seconds for the meter to sample velocity, level, and send the data packet to the data logger. It will then display the real time sample on the screen (see below).



D) Confirm the level reading on the screen matches the actual water level in the pipe. Confirm that the velocity reading on the screen matches the velocity you approximate in the pipe.

14) Close the real time window and Flo-Ware main screen.

15) Disconnect the communications cable from your laptop to the data logger.

16) Screw the protective metal cap onto the communications port connector. in order to protect the connector from damage due to water or dirt.

17) Coil the sensor cables and secure them to the top ladder rung. Hang the data logger from the top ladder rung. (See Figure 9 next page.)

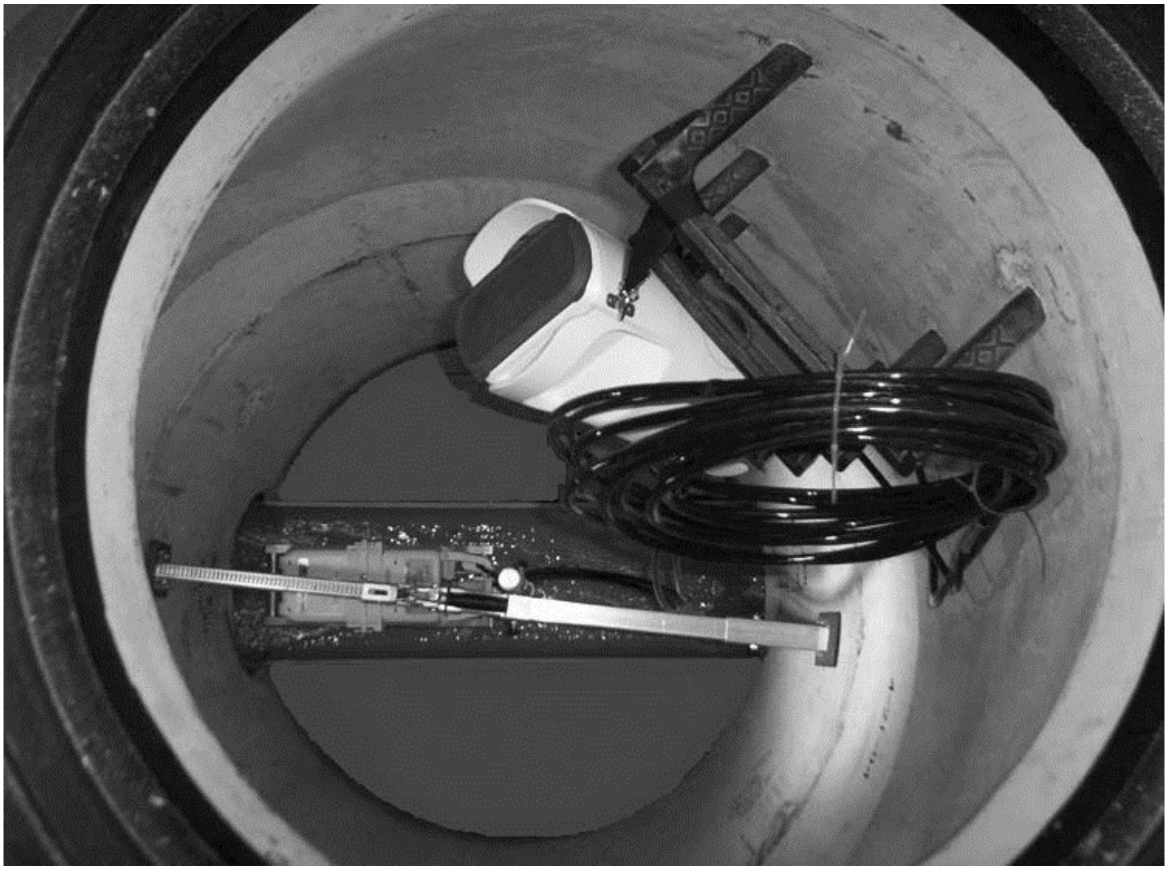
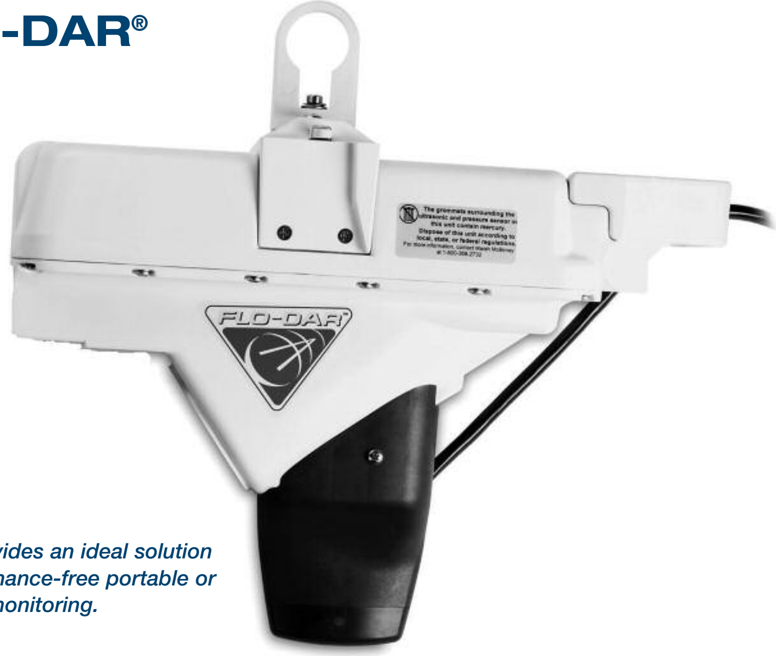


Figure 9

You have successfully installed the Flo-Dar Flowmeter. Please remember to secure the manhole lid prior to leaving the site.

If you have any questions regarding this flowmeter, please contact US3. Please note that telephone support is available Monday through Friday between 9:00 AM and 5:00 PM U.S. Pacific Standard Time.

Marsh-McBirney FLO-DAR® Area/Velocity Radar Flow Meter Sensor



The Flo-Dar Sensor provides an ideal solution for non-contact, maintenance-free portable or permanent sewer flow monitoring.

Features and Benefits

The Flo-Dar Area/Velocity Radar Flow Meter provides a revolutionary approach to open channel flow monitoring. The sensor combines advanced Digital Doppler Radar velocity sensing technology with ultrasonic pulse echo depth sensing to remotely measure open channel flow. Use with FL900 Series Flow Logger or Flo-Logger/Logger XT for portable monitoring; for permanent monitoring sites, the Flo-Dar can be connected to the Flo-Station which displays flow rate, velocity, and level. (See Lit. No. 2709 [standard] or Lit. No. 2711 [wireless] for Flow Logger product information, or Lit. No. 2616 for Flo-Station product information). Intrinsically safe models available.

Accurate Flow Measurement

Flo-Dar provides the user with highly accurate flow measurements under a wide range of flows and site conditions. By measuring the velocity of the fluid from above, Flo-Dar eliminates accuracy problems inherent with submerged sensors including sensor disturbances, high solids content and distribution of reflectors.

Non-Contact Sensor Eliminates Lost Data

No lost data with non-contact, above the flow sensor that is unaffected by fouling due to debris and grease.

Easy Installation and Maintenance

As the sensor is mounted above the flow, personnel have little or no contact with the flow during installation. Future sensor removal can be done without the need for confined space entry.

Independent Accuracy / Long-Term Stability Verification

Flo-Dar sensor accuracy and long-term stability (up to 3 years without need for site calibration) from low flow depths up to surcharge conditions has been independently verified many times over the years including a formal evaluation by the Alden Research Laboratory, Inc. and recent field evaluations done by municipalities and consulting engineering firms.

Perfect Solution for Difficult Flow Conditions

Operates in the most difficult conditions including flows with high solids content, high temperature, shallow and caustic flows, large man-made channels, and high velocities up to 20 ft/s.

Optional Surcharge Velocity Sensor

During surcharge events Flo-Dar's optional electromagnetic sensor will continue to provide uninterrupted and accurate flow monitoring through dry and wet weather flows without the need for routine sensor cleaning or maintenance.

Applications

Municipal

- *Sanitary Sewer Evaluation Studies*
- *Collection Systems*
- *Capacity Studies*
- *Combined Sewer Overflows*
- *Inflow and Infiltration (I&I) Studies*
- *Billing / Custody Transfer*
- *Plant Influent and Effluent*

Industrial

- *Process Waste*
- *Plant Influent*
- *Plant Effluent*
- *Non-contact Cooling Water*
- *Stormwater Monitoring and Compliance*

WW IW C

DW = drinking water WW = wastewater municipal PW = pure water / power
IW = industrial water E = environmental C = collections FB = food and beverage

HACH® Be Right™

Specifications*

FLO-DAR SENSOR

Enclosure
IP68 Waterproof rating, Polystyrene

Dimensions
160.5 W x 432.2 L x 297 D mm (6.32 x 16.66 x 11.7 in.), with SVS, D = 387 mm (15.2 in.)

Weight
4.8 kg (10.5 lbs.)

Operating Temperature
-10 to 50°C (14 to 122°F)

Storage Temperature
-40 to 60°C (-40 to 140°F)

Power Requirements
Suppied by FL900 Flow Logger, Flo-Logger, or Flo-Station

Interconnecting Cable
–Disconnectable at both sensor and logger or Flo-Station
Polyurethane, 0.400 (±0.015) in. diameter; IP68
Standard length 9M (30 ft), maximum 305 m (1000 ft)

Cables are available in two styles:
–connectors both ends
–connector from sensor with open leads to desiccant hub, desiccant hub with connector to logger. A potting/sealant kit will be included. This can be used to run the cable through conduit.

Important Note: The sensor cable assembly with desiccant hub is compatible with either the Marsh-McBirney Flo-Logger/Logger XT or the Hach FL900 Series Flow Loggers. When using this cable assembly with the Marsh-McBirney Flo-Logger, do not disconnect the desiccant cartridge that is attached to the Flo-Logger itself. It is important to keep the air tube plugged.

If using Flo-Dar cable with Flo-Station, the cable will have bare leads to the Flo-Station (30 to 1000 ft. lengths) and there will be no desiccant hub, as the air tube terminates inside of the Flo-Station housing.

Warranty
1 year

Set-up/Data Retrieval
Flo-Ware for Windows software is the user on-site set-up, data management, and report generation software. It is compatible with desktop/laptop computers utilizing Windows operating system.

Certification
The Flo-Dar Transmitter is certified to the following requirements:
- Transmitter type: Field Disturbance Sensor
- Frequency: 24.125 GHz - Doppler pulse
- Maximum rated power output: 128 dbuV (ave) @ 3 meters

Certified to: FCC Part 15.245: FCC ID: VIC-FLODAR24
Industry Canada Spec. RSS210. v7: IC No.: 6149A-FLODAR24

Use of this device is subject to the following conditions:
1. There are no used serviceable items inside this device.
2. The user must install this device in accordance with the supplied installation instructions and must not modify the device in any manner whatsoever.
3. Any service involving the transmitter must only be performed by Hach Company.
4. The user must ensure that no one is within 20 cm of the face of the transmitter when operating.

SURCHARGE DEPTH MEASUREMENT

Auto zero function maintains zero error below 0.5 cm (0.2 in.)

Method
Piezo-resistive pressure transducer with stainless steel diaphragm

Range
3.5 m (138 in.), overpressure rating 2.5 x full scale

VELOCITY MEASUREMENT

Method
Radar

Range
0.23 to 6.10 m/s (0.75 to 20 ft/s)

Frequency Range
24.075 to 24.175 G-Hz, 15.2mW (max.)

Accuracy
±0.5%; ±0.03 m/s (±0.1 ft/s)

DEPTH MEASUREMENT

Method
Ultrasonic

Standard Operating Range from Flo-Dar Housing to Liquid
0 to 152.4 cm (0 to 60 in.)

Optional Extended Level Operating Range from Transducer Face to Liquid
0 to 6.1 m (0 to 20 ft.) with 43.18 cm (17 in.) dead band, temperature compensated.

Accuracy
±1%; ±0.25 cm (±0.1 in.)

FLOW MEASUREMENT

Method
Based on Continuity Equation

Accuracy
±5% of reading typical where flow is in a channel with uniform flow conditions and is not surcharged, ±1% full scale max.

SURCHARGE CONDITIONS DEPTH/VELOCITY

DEPTH (Std with Flo-Dar Sensor)
Surcharge depth supplied by Flo-Dar sensor.

VELOCITY (Optional Surcharge Velocity Sensor)

Method
Electromagnetic

Range
±4.8 m/s (±16 ft/s)

Accuracy
±0.15 ft/s or 4% of reading, whichever is greater.

Zero Stability
> ±0.05 ft/s

CERTIFICATION INTRINSICALLY SAFE

The Flo-Dar and Surcharge Velocity Sensors are certified to Class I, Zone 1 Standards. They conform to ANSI/UL 60079-11 and are certified to CAN/CSA E60079-11 and EN 60079-11 standards.

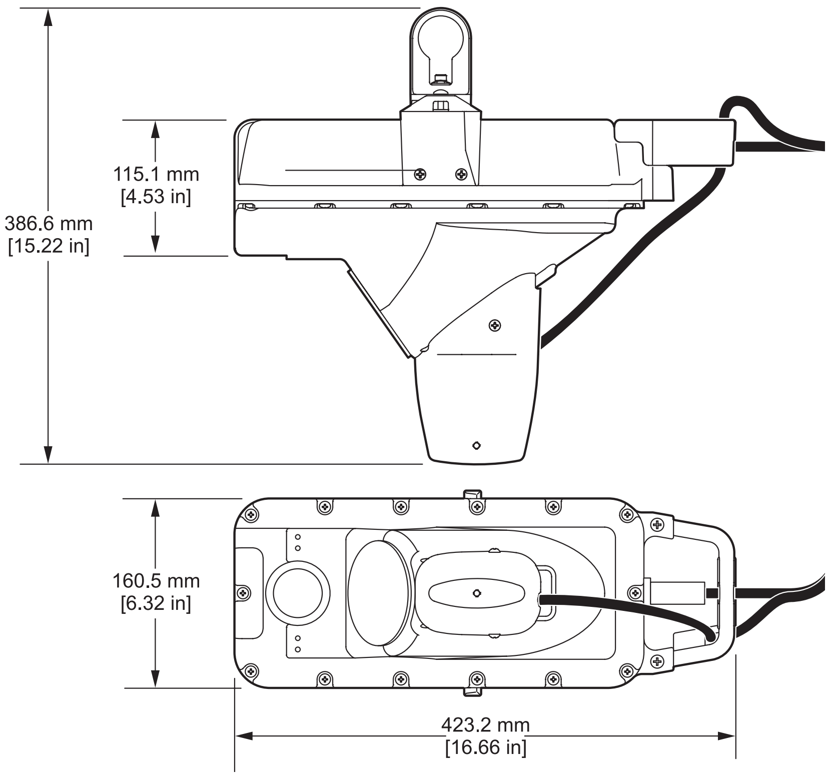
CE The Flo-Dar sensor meets CE requirements.

**Specifications subject to change without notice.*

Engineering Specifications

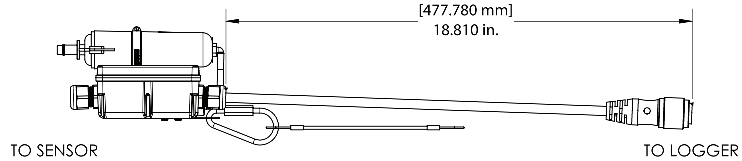
1. The flow meter shall be capable of measuring level, average velocity and surcharge depth.
2. The method of velocity measurement shall be Doppler radar.
3. The sensor shall combine advanced Doppler Radar velocity sensing technology with ultrasonic pulse echo depth sensing to remotely measure open channel flow.
4. Flow shall be calculated based on the Continuity Equation (Q=V x A), where Q=Flow, V=Average Velocity and A=Area.
5. The range of velocity measurement shall be 0.23 to 6.10 m/s (0.75 to 20 ft/s).
6. The method of depth measurement shall be ultrasonic.
7. The standard operating range for depth measurement shall be 0 to 152.4 cm (0 to 60 in.) with an optional operating range of 0 to 6.1 m (0 to 20 ft.) with 43.18 cm (17 in.) deadband, temperature compensated.
8. The flow meter shall have a surcharge condition velocity sensor option.
9. Exterior dimensions of the sensor shall not exceed 160.5 W x 432.2 L x 297 D mm (6.32 W x 16.66 L x 11.7 D in.) or 160.5 W x 432.2 L x 387 D mm (6.32 W x 16.66 L x 15.2 D in.) with Surcharge Velocity option.
10. The sensor shall be able to measure bi-directional surcharge flow.
11. Optional Intrinsically Safe models available for flow monitoring in hazardous locations.
12. The model shall be the Marsh-McBirney Flo-Dar Open Channel Flow Meter Sensor.

Dimensions

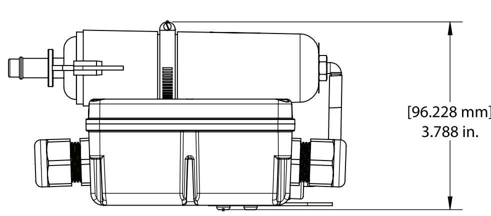


Flo-Dar Area/Velocity Radar Flow Meter

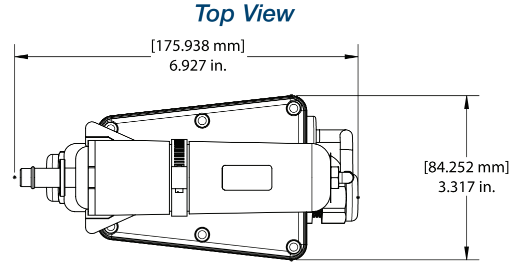
The desiccant hub assembly includes a junction box to connect sensor cable to the desiccant and subsequently to the FL900 Logger. The desiccant can easily be replaced without need to purchase a separate desiccant module.



Side View



Top View



Desiccant Hub Assemblies for use with portable FL900 Series Loggers and Flo-Logger.
(Sensor cable for use with Flo-Station will not contain a desiccant hub and will have bare wires on cable end.)

Ordering Information

Configure FLO-DAR Sensor to Logger (Portable)

Flo-Dar Sensor	Model 4000	–	4	X	X
Flo-Dar Sensor with specified cable length (need to add cable as separate line item)			4		
Non Intrinsically Safe				0	
Surcharge Velocity Sensor Option (IMPORTANT NOTE: SVS cable length MUST MATCH FloDar Sensor Cable length)				3	
Non Extended Range					0
Extended Range Option–Allows use in flow depths up to 18 feet. Allow for 18" deadband. Standard unit max depth is 60". SVS Option requires Remote Extended Range below.					1
Remote Extended Range Option with 6' sensor cable–Flow depths up to 18 feet. Allow for 18" deadband. Standard unit max depth is 60".					2

Configure FLO-DAR Sensor to Flo-Station (Permanent)

Flo-Dar Sensor	Model 4000	–	9	X	X
Flo-Dar Sensor with specified cable length (need to add cable as separate line item)			9		
Non Intrinsically Safe				0	
Surcharge Velocity Sensor Option (IMPORTANT NOTE: SVS cable length MUST MATCH Flo-Dar Sensor Cable length)				3	
Non Extended Range					0
Extended Range Option–Allows use in flow depths up to 18 feet. Allow for 18" deadband. Standard unit max depth is 60". SVS Option requires Remote Extended Range below.					1
Remote Extended Range Option with 6' sensor cable–Flow depths up to 18 feet. Allow for 18" deadband. Standard unit max depth is 60".					2

Cables

FD9000CBL-XXX* FL900 Series Logger to Flo-Dar sensor. Cable w/two connectors.

FDJCTBOXCBL-XXX* FL900 Series Logger to Flo-Dar sensor. Cable with connector to sensor, open end to desiccant hub, desiccant hub with connector to sensor. Includes finishing kit for potting/sealing desiccant hub. For use with conduit.

6000062XX* SVS Sensor with connector for use with FL900 Series Logger.

570011800-XXX* Model 4000-9 Flo-Station to Flo-Dar sensor Cable with one connector and bare leads.

6000059XX* SVS Sensor with bare leads for use with Flo-Station.

**Contact customer service for product numbers.*

Available Cable Lengths (in feet)

30	125	225	400	700
60	150	250	450	800
75	175	300	500	900
100	200	350	600	1000

See Lit. No. 2709 (standard models) and Lit. No. 2711 (wireless models) for FL900 Series Flow Logger ordering information. See Lit. No. 2616 for Flo-Station ordering information.

Mounting Hardware

800016701 Permanent Sensor Mount-Includes sensor frame & all mounting hardware. Portable Sensor Mounts Available (Sizes 34-107") Contact Sales.

Accessories & Spares

245000501 Sensor Retrieval Pole - Used to place and retrieve sensor from mounting bracket. Pole extends to 7.3 m (21 ft.)

510012701 Sensor Retrieval Hook - Used with Sensor Retrieval Pole

570011401 Grounding Strap (required with Retrieval Pole and Hook when used with IS units

8755500 Bulk desiccant beads (1.5 pounds)

Lit. No. 2708 Rev 2
K11 Printed in U.S.A.

At Hach, it's about learning from our customers and providing the right answers. It's more than ensuring the quality of water—it's about ensuring the quality of life. When it comes to the things that touch our lives...

Keep it pure.

Make it simple.

Be right.

For current price information, technical support, and ordering assistance, contact the Hach office or distributor serving your area.

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Telephone: 800-368-2723
Fax: 301-874-8459
E-mail: hachflowsales@hach.com
www.hachflow.com

In Europe contact:

Flow-Tronic
Rue J.H. Cool 19a
B-4840 Welkenraedt Belgium
Telephone: +32-87-899799
Fax: +32-87-899790
E-mail: site@flow-tronic.com
www.flow-tronic.com

Be Right™

Hach FL900 Series Cellular Wireless Flow Logger

NEW!

When combined with the Flo-Dar or Flo-Tote 3 sensor, the Hach FL900 Series Wireless Flow Logger takes flow monitoring to a whole new level. With features that reduce site time and increase crew safety, the wireless flow monitoring system allows you to easily manage your flow data 24/7, as well as your budget.

Features and Benefits

The FL900 Wireless Flow Logger provides users with a reliable, budget saving open channel wireless flow monitoring solution for open portable flow monitoring applications. Flow data is accessible 24/7 with Hach FSDATA web-based software. When combined with the Flo-Dar or Flo-Tote 3 sensor, the system will drastically reduce site time and increase safety for monitoring crews.

Increase Monitoring Crew Safety

With the time saving features designed into the FL900 Wireless Flow Loggers, crews spend less time in the manhole and less time on site to decrease monitoring costs while increasing the safety of flow monitoring crews.

Plug and Play Sensor Ports

The FL900 Series Flow Logger is available with 1, 2 or 4 sensor ports. The sensor ports are "plug and play"; the logger auto-detects the type of sensor connected (Flo-Dar, Surcharge Velocity Sensor or Flo-Tote 3) to allow customers maximum flexibility for their Hach flow sensor inventories.

Flow Monitoring Data at Your Fingertips with FSDATA™ Web-Based Software

Hach FSDATA web-based flow meter software is the ideal time-saving and economical solution for the management of your Hach wireless flow meters and data 24/7. With FSDATA routine site visits to collect flow data are eliminated keeping flow monitoring crews safe. (See Lit. No. 2707 for additional information on FSDATA.)

Easy Installation/Versatile Mounting Options

The logger can be quickly attached to a wall, pole or manhole ladder in minutes. Users can choose to hang logger from standard carabiner or optional 4-bolt wall mount for pole, horizontal or vertical wall mount or ladder rung mount.

LED Gives Quick Confirmation of Logger Status

Get peace of mind the logger is ready to capture the next flow event, before you leave the site. The rugged FL900 Wireless Flow Logger includes a status LED panel. The indicator light on the top of the logger shows the status of the instrument and modem (if equipped with wireless option). The user can manually send a call to the server to make sure the network connection is good by simply swiping the magnet over the call initiation target.

Specifications*

FL900 SERIES FLOW LOGGER PORTABLE DC POWERED ELECTRONICS (Includes Models FL901, FL902 & FL904)

Dimensions (W x D x H)
25.4 x 22 x 40 cm (10.0 x 8.7 x 16.0 in.)

Enclosure
PC/ABS structural foam

Environmental Rating
NEMA 6P (IP68)

Weight (Using Model FL900)
4.5 kg (10 lb)—no batteries; 6.3 kg (14 lb)—2 batteries;
8.2 kg (18 lb)—4 batteries

Operating Temperature
–18 to 60°C (0 to 140°F) at 95% RH

Storage Temperature
–40 to 60°C (–40 to 140°F)

Power Requirements
8 to18 Vdc from batteries or external power source, 2.5W max.

Battery Life at 15 minute logging intervals (at room temperature)
185 days with 4 lantern batteries and a Flo-Dar sensor,
306 days with 4 lantern batteries and a Flo-Tote sensor

The optional long life alkaline battery pack can be used to extend battery life, if the Flow Logger is ordered with the external power option connector.

LED Status Indicator
– Green Flashes every 3 seconds during normal operation. Flashes every 15 seconds during sleep mode.

– Red Flashes when an attached sensor does not agree with the logger program, when an expected sensor is not found or the sensor is not working properly.

LED Modem Indicator
– Stays green during a call to the server. Goes blank after the call is successfully completed and terminated.

– Flashes red if the call to the server failed.

Sensor Ports
1, 2 or 4 ports

Connectors
Stainless steel connectors

Datalog Channels
16 maximum

Alarms
Maximum of 16 channel alarms including high/high, high, low, low/low and system alarms including low battery, low RTC battery, low slate memory, slate memory full.

Alarm Actions
Trigger sampler, change logging interval, change call interval, send an e-mail, or send text message (SMS).

Logging Intervals
1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 or 60 minutes
Primary and secondary intervals for dynamic logging.

Data Storage
Event Log: 1,000 events maximum in non-volatile flash memory
Sample History: 2,000 sample events maximum in non-volatile flash memory
Datalog: 325,000 data points; 1128 days for 3 channels at 15-minute log intervals

Local Communication
USB
RS232 (Baud rates: 9600, 19200, 38400, 57600, 115200)

Remote Communication (optional)
Wireless modem; CDMA or GPRS technology with a mobile provider, CDMA2000 1xRTT or GPRS.

Protocols
Modbus RTU; Modbus ASCII; Mobile-Terminated SMS; Mobile-Originated SMS; TCP/IP

Timebase Accuracy
±0.002%, synchronized every 24 hours with server software and modem

Supported Sensors
Flo-Tote 3, Flo-Dar, Flo-Dar with SVS, Rain Gauge

Sampler Interface
Compatible with Sigma 900 Standard, Sigma 900 Max, Hach SD900 to support set-point sampling,flow- pacing, and logging sample history.

Desktop Software
Flo-Ware for Windows software is required for programming the logger, data management, and report generation software. It is compatible with desktop/lap top computers utilizing Windows operating system. Minimum resolution needed is 1024x768.

Internet Application Software
FSDATA web-based software for flow meter data management and report generation for wireless flow meters and data access 24/7.

Certifications
Logger: CE; optional AC power supply: UL/CSA/CE

Warranty
1 year

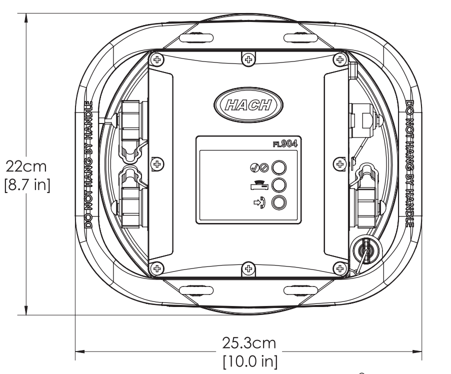
CE The FL900 Series Loggers meet CE requirements.

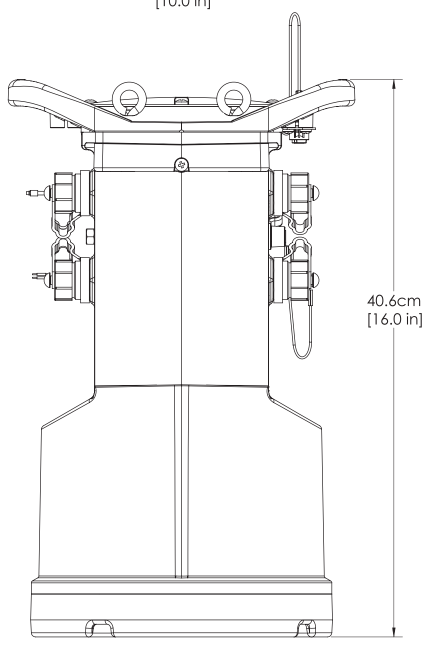
**Specifications subject to change without notice.*

Engineering Specifications

1. Exterior dimensions of the Flow Logger shall be 25.4 W x 22 D x 40 cm H (10.0 W x 8.7 D x 16.0 in. H)
2. The Flow Logger enclosure material shall be PC/ABS structural foam with NEMA 6P (IP68) rating.
3. The operating temperature for the Flow Logger shall be –18 to 60ºC (0 to 140ºF) at 95% relative humidity and storage temperature of –40 to 60ºC (–40 to 140ºF).
4. Power requirements of the Flow Logger shall be 8 to18 Vdc from batteries or external power source, 2.5W max.
5. When used with a Flo-Dar sensor, the Flow Logger shall have a battery life of 185 days utilizing 4 6v alkaline batteries at a 15 minute logging interval (at room temp.). When used with a Flo-Tote sensor, the Flow Logger shall have a battery life of 306 days utilizing 4 6v alkaline batteries at a 15 minute logging interval (at room temperature). A long-life battery for longer deployments shall be available option.
6. The Flow Logger shall have 1, 2 or 4 sensor ports with stainless steel connector, 1 communications port and 1 auxiliary port.
7. The Flow Logger shall have primary logging intervals of 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 or 60 minutes.
8. The Flow Logger shall have secondary logging intervals available to modify the logging rate based on a defined channel alarm condition or trigger.
9. Optional remote communication shall be available on the FL900 Series Loggers via Wireless modem; CDMA2000 1xRTT or GPRS.
10. The Flow Logger data storage event log shall be 1,000 events maximum in non-volatile flash memory.
11. Timebase Accuracy of the Flow Logger shall be 0.002% synchronized every 24 hours with server software and modem.
12. The Flow Logger shall support the Flo-Dar, Flo-Dar with SVS, Flo-Tote 3 Sensors and Rain Gauge.
13. The Flow Logger shall be compatible with Sigma 900 Standard, Sigma 900 Max and Hach SD900 to support set point sampling, flow-pacing and sample history logging.
14. The Flow Logger shall be able to connect to a lap top or desk top PC using either USB or RS232 serial connection.
15. The Flow Logger shall have an LED indicator for operating /programming status visible on the topmost horizontal surface of the logger.
16. The internet data management software shall indicate sites in alarm condition in either a map view or list view.
17. When connected to an external power source, the FL900 series logger shall be capable of power switching, i.e. drawing power from the external source and conserving the alkaline batteries inside the logger base. At the time the external power source reaches a low alarm condition, it will then switch the power draw to the alkaline batteries mounted inside the base of the logger.
18. The internet software for flow data management shall be Hach FSDATA.
19. The logger will be a Hach FL901, FL902, or FL904 Flow Logger.

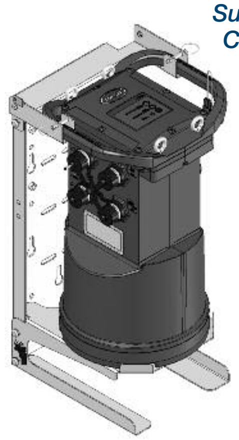
Dimensions



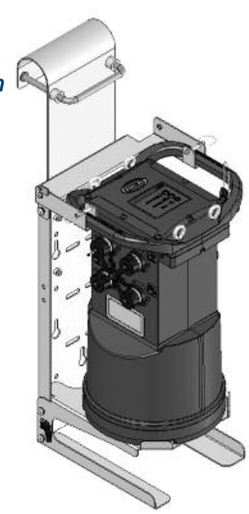


Installation/Mounting Options

Flow Logger Suspension Cable with Carabiner (Standard)



Flow Logger Wall Mount Prod. No. 8542700 (Optional)



Flow Logger Ladder Rung Mount Prod. No. 854450 (Optional)

Ordering Information

		Sensor Connector(s)	Country Code	Modem	Rain Gauge
FL90X Electronics (Flow Logger)	Model FL90	___	97	___	___
1 Sensor Connector		1			
2 Sensor Connectors		2			
4 Sensor Connectors		4			
None				X	
AT&T (Activated)				A	
GPRS no SIM				G	
Sprint (Inactive)				R	
Sprint (Activated)				S	
No Rain Gauge Connector					X
With Rain Gauge Connector					R

Cables

8528700 Cable, External power, 2 wire, 9 ft.
8528200 Cable, Communication, RS232
8528300 Cable, Communication, USB
8528400 Cable, Aux, 7pin MIL 5015 (Connect to Sigma Sampler), 9 ft.
8528401 Cable, Aux, 7pin MIL 5015 (Connect to Sigma Sampler), 25 ft

Antennas

5228400 Antenna, Half Wave (824-894, 1850-1990 MHz)
—US for Verizon, Sprint, AT&T, T-Mobile (Is attached to Logger)
6241804 Antenna, Mini-Wing, Quad (824-960, 1710-2170 MHz)
—US for Verizon, Sprint, AT&T, T-Mobile (Customer to Mount)
6683000 Antenna, Traffic Rated In Road/Burial (1850-1990 MHz)
—US for use with Sprint only wireless service
6246200 Antenna, Traffic Rated In Road/Burial (824-896 MHz)
—US for use with Verizon only wireless service
5255400 Antenna, Traffic Rated Manhole Lid (824-896, 1850-1990 MHz)
—US for Verizon, Sprint, AT&T, T-Mobile

Software

Model T200-200 Flo-Ware Desktop Software
FS-HOSTING Monthly data hosting service for FSDATA
FS-DATAXFR Monthly wireless service

Mounting Hardware

8543800 Wall mount bracket (304 Stainless)
8545600 Wall mount bracket with ladder hanger (304 Stainless)
8542700 Wall mount bracket with AC Power Supply shelf (304 Stainless)
8544500 Wall mount bracket with AC Power Supply Shelf with ladder hanger (304 Stainless)

Replacement Parts

8755500 Desiccant refill beads, Bulk 1.5 lb
11013M Battery, 6V lantern
8542900 Battery, long-life alkaline
8543000 Battery pack top cap adaptor and cable
(for long-life alkaline battery pack 800017701)
8542800 Rain Gauge with 100 ft. cable

Lit. No. 2711
G101.5 Printed in U.S.A.

At Hach, it's about learning from our customers and providing the right answers. It's more than ensuring the quality of water—it's about ensuring the quality of life. When it comes to the things that touch our lives...

Keep it pure.

Make it simple.

Be right.

For current price information, technical support, and ordering assistance, contact the Hach office or distributor serving your area.

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HACH COMPANY
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Frederick, MD 21704-9452, U.S.A.
Telephone: 800-368-2723
Fax: 301-874-8459
E-mail: hachflowsales@hach.com
www.hachflow.com

In Europe contact:

Flow-Tronic
Rue J.H. Cool 19a
B-4840 Welkenraedt Belgium
Telephone: +32-87-899799
Fax: +32-87-899790
E-mail: site@flow-tronic.com
www.flow-tronic.com

Be Right™

User Instructions

Antennas for flow products

Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed.

	Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August of 2005. In conformity with European local and national regulations (EU Directive 2002/98/EC), European electrical equipment users must now return old or end-of-life equipment to the Producer for disposal at no charge to the user. ***Note:** For return for recycling, please contact the equipment producer or supplier for instructions on how to return end-of-life equipment, producer-supplied electrical accessories, and all auxillary items for proper disposal.*

Product components

Make sure that all components have been received. If any items are missing or damaged, contact the manufacturer or a sales representative immediately.

Required equipment/software

Make sure that the following requirements are available:

- FL900 Series flow logger with modem option or Sigma 930T
- Remote host computer operating FSDATA or Telogers for Windows server software
- Portable computer operating FSDATA, FloWare or Telogers for Windows
- Activated wireless account

FL900 Series Flow Logger

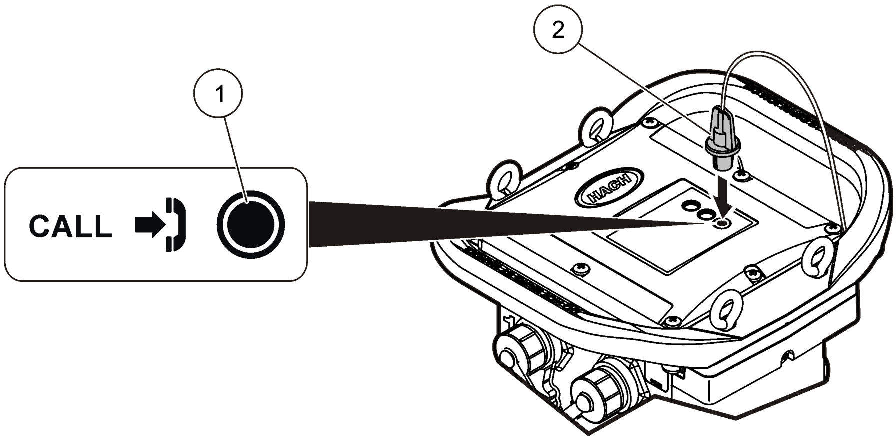
Verify the telemetry (wireless option)

The user can manually send a call to the server to make sure that the network communication is good.

1. Temporarily attach the antenna to the logger to test the antenna and the cell coverage at the site location before installation.
2. Touch the magnet to the call initiation target (Figure 1). The modem LED indicator changes to green.
3. Look at the modem LED indicator during the call (45 to 90 seconds) and wait for a change:
   - LED goes off—the connection to the server is good.
   - LED flashes red—the connection to the server failed.

   ***Note:** If the connection failed, refer to the instrument user manual for more information.*

Figure 1 Call the server



1 Call initiation target	**2** Magnet

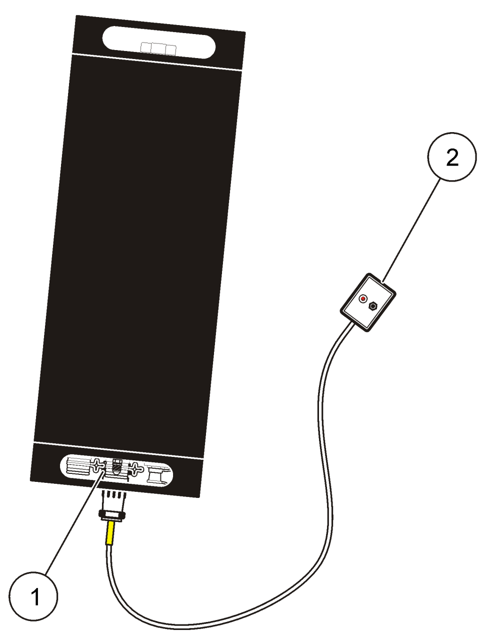
930T Flow meter

Verify the wireless connection

The tamper button is used to examine if the wireless connection is working.

1. Temporarily attach the antenna to the logger to test the antenna and the cell coverage at the site location before installation.
2. Attach the tamper module to the RS232 connector on the flow meter (Figure 2).
3. Push the tamper button to start a cellular call from the flow meter to the remote host computer.
4. Go to the event log in Telogers for Windows to make sure that the data was successfully downloaded from the flow meter to the remote host computer. Refer to the 930T documentation for further information about telemetry troubleshooting.

Figure 2 Tamper module connected to the 930T Flow meter



1 RS232 connector	**2** Tamper module

Installation

⚠ WARNING

Electromagnetic radiation hazard. To meet the requirements of the FCC Grant, CE Mark and other regulatory bodies, do not use or install the device with an antenna that is not supplied by the manufacturer. Make sure that all antennas are kept at a minimum distance of 20 cm (7.9 in.) from all personnel in normal use.

NOTICE

Test the antenna and cell coverage at the site location before installation.

NOTICE

Make sure that the flow meter is programmed to call the host PC before installation.

Half wave antenna

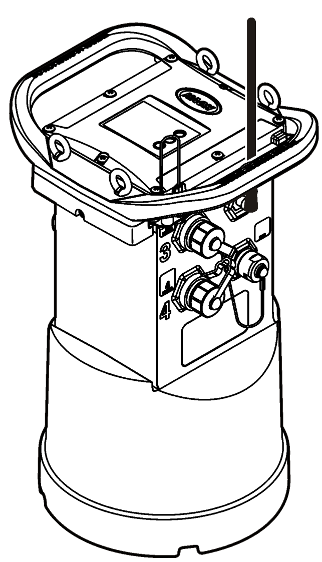
NOTICE

The half wave antenna is intended for above-ground use.

1. Unpack the antenna (Figure 3).
2. Bend the antenna at the joint to a 90 degree angle between the antenna and the swivel fitting.
3. Put the antenna extension inside of the logger handle (Figure 4).
4. Align the threads from the antenna fitting to the antenna receptacle on the logger. Hand-tighten by turning the swivel end.

Figure 3 Half wave antenna

Figure 4 Half wave antenna attached



Traffic rated manhole lid antenna

Required tools:

- 31.75 mm (1¼ in.) open-end wrench
- Large nylon Ty-wrap cable ties

1. Unpack the antenna (Figure 5) or disassemble the antenna from the instrument.
2. Make sure that the manhole lid has a 25.4 mm (1 in.) hole for the antenna neck to fit into.
   ***Note:** Do not use the pick hole. Use a drill, motor oil for lubrication and increasing size drill bits to drill the 25.4 mm (1 in.) hole if needed. Make sure that the location of the hole does not coincide with the ribs on the underside of the manhole lid.*
3. Remove the manhole lid and put the lid in a stable position where the lid top and bottom are accessible.
4. Remove the nut and washers from the threaded neck on the base of the antenna (Figure 6).
5. Put the antenna cable and neck through a hole on the manhole lid until the base of the antenna is against the top of the manhole lid.
6. Install the flat washer, then the lock washer and then the nut on to the threaded neck of the antenna.
7. Tighten the nut with the open-end wrench until both washers are flush against the base of the manhole lid and the antenna is tight (Figure 6).
8. Connect the antenna cable to the instrument connector labeled "Antenna". To make sure proper transmission, hand-tighten the connections.
9. Attach any excess cable to the access ladder or another non-obstructing location with Ty-wrap cable ties.
10. Replace the manhole lid.

Figure 5 Traffic rated manhole lid antenna

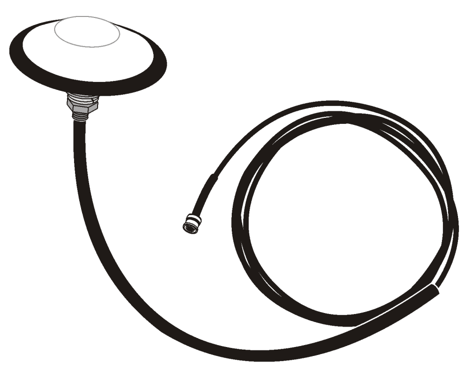
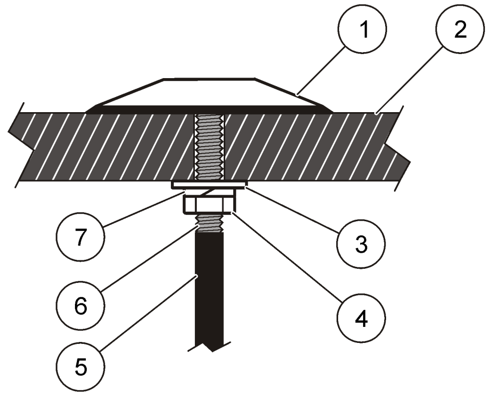


Figure 6 Manhole lid installation



1	Antenna top	**5**	Antenna cable
2	Manhole lid	**6**	Antenna threaded neck
3	Flat washer	**7**	Lock washer
4	31.75 mm (1¼ in.) nut		

Wing Quad antenna

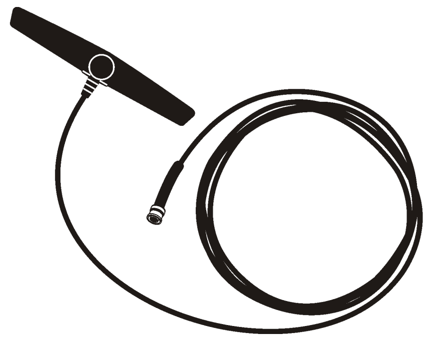
The Wing Quad antenna can be attached to an interior wall or to a window for a longer term deployment or the antenna can be attached to a manhole lid for a short term deployment.

Required tools:

- Large nylon Ty-wrap cable ties

1. Unpack the antenna (Figure 7).
2. To attach the antenna to a window or a wall, remove the adhesive backing and push the antenna to a clean surface.
3. To attach the antenna to a manhole, make sure that the manhole lid has a hole large enough for the antenna connector to fit into.
__Note:__ Do not use the pick hole. Use a drill, motor oil for lubrication and increasing size drill bits to drill the 1" hole if needed. Make sure that the location of the hole does not coincide with the ribs on the underside of the manhole lid.
4. Remove the manhole lid and put the lid in a stable position where the lid top and bottom are accessible.
5. Put the antenna cable and neck through a hole on the manhole lid until the base of the antenna is against the top of the manhole lid.
6. Attach the antenna to the manhole lid with heavy tape or tar tape.
7. Connect the antenna cable to the instrument connector labeled "Antenna". To make sure proper transmission, hand-tighten the connections.
8. Attach any excess cable to the access ladder or another non-obstructing location with Ty-wrap cable ties.
9. Replace the manhole lid.

Figure 7 Wing Quad antenna



Traffic rated in-road/burial antenna

Required tools:

- Asphalt saw or auger: saw capable of cutting 127 mm (5 in.) in diameter and 76.2 mm (3 in.) deep into a road surface or ground
- Asphalt chisel
- Hammer drill with 19.1 to 25.4 mm (¾ to 1 in.) asphalt drill bit (for antenna cable installation)
- Sakrete asphalt mix (Asphalt patch)
- Bondo; Mar-Hyde P606 Traffic Detector Wire Loop Sealer or equal
- Shovel, if placing in the ground

The traffic rated in-road/burial antenna is intended for burial beneath the road surface or ground adjacent to a manhole or vault that is being monitored (Figure 9).

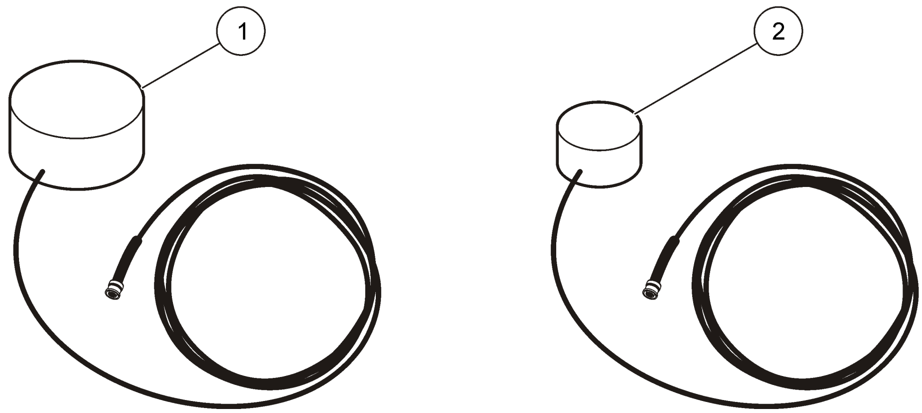
NOTICE

The antenna should be installed in the road approximately 152.4 to 203.2 mm (6 to 8 in.) inches from the manhole or vault containing the flow meter.

1. Unpack the antenna (Figure 8) or disassemble the antenna from the instrument.
2. Excavate a hole or trench in the road surface or ground approximately 127 mm (5 in.) in diameter (or square) and 76.2 mm (3 in.) deep.
3. Select the closest position from the excavated hole to the manhole. Drill a 19.1 to 25.4 mm (¾ to 1 in.) hole from the selected position to the manhole. Make sure to drill the hole below the steel manhole cover support ring (Figure 9, List item. on page 7).
4. Put the antenna cable through the drill hole into the manhole or vault.
5. Install the antenna in the excavated hole. Pull the antenna cable taut. Locate the antenna so that the ceramic side of the antenna is approximately 6.4 (¼ in.) to 12.7 mm (½ in.) maximum below the road or ground surface. Make sure the antenna sits safely in the hole.
6. Attach the antenna cable to the antenna connector.
7. Make sure that the antenna is working by placing a call from the instrument (refer to Verify the wireless connection on page 2).
8. When the operation of the antenna is confirmed, permanently bury the antenna.
    a. Insert asphalt mix around the antenna and pack it in place. Make sure the antenna is sitting firmly on a solid base and cannot be rocked back and forth.
    b. Install the asphalt mix around the antenna. The mix should be level with the road surface but not over the antenna surface.
    c. Pour the Bondo sealer on and over the asphalt mix and over the top of the antenna. There should be no more than 6.4 mm (¼ in.) of Bondo sealer over the top of the antenna.

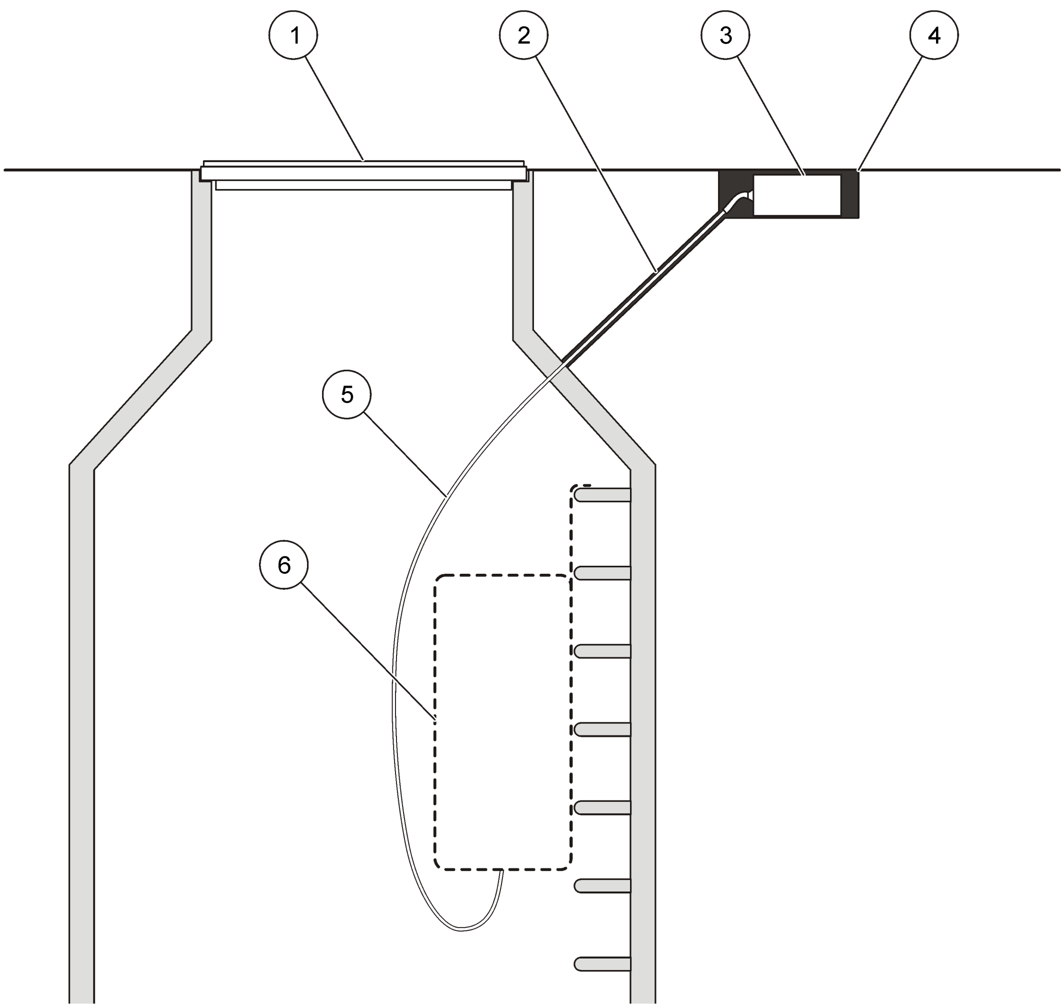
d. Connect the desired sensors and options to the flow meter. Calibrate the sensors and install the flow meter in the manhole.

Figure 8 Burial antennas



1	Traffic rated in-road/burial antenna (Verizon)	**2**	Traffic rated in-road/burial antenna (Sprint)

Figure 9 Burial antenna assembly



1	Manhole cover	**4**	Trench or hole for antenna
2	19.1 to 25.4 mm (¾ to 1 in.) hole	**5**	Antenna cable
3	Antenna	**6**	Flow meter

Replacement Parts

Note: *Product and Article numbers may vary for some selling regions. Contact the appropriate distributor or refer to the company website for contact information.*

Description	Item no.
Half wave, 824-894 & 1850-1990 MHz, 3 dBi	5228400
Half wave European, 870-960 & 1710-1880 MHz, 3dBi	5255300
Traffic rated manhole lid quad, 824-896 & 1850-1990 MHz, 3 dBi	5255400
Wing Quad, 824-960 & 1710-2170 MHz, 2.15 dBi	6241804
Traffic rated in-road/burial antenna (Verizon), 824-896 MHz, 3 dBi	6246200
Traffic rated in-road/burial antenna (Sprint), 1850-1990 MHz, 3 dBi	6683000

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Tab 4: US^3 Company Information

US^3 is a California Corporation **Federal ID No. 33-0729605** and qualifies as a Minority Business Enterprise. US^3 has certified as an MBE with the California Public Utility Commission's authorized clearinghouse, **Verification Number: 97ES0008.**

US^3 is a specialty service company for the Water & Waste Water industry, providing monitoring and control for Utilities since 1996. US^3 is in the forefront of this industry by taking the proven technological approaches developed in other high-tech industries and applying them to protect one of our most precious natural resources - our water.

US^3 engineers and technical personnel have applied advanced instrumentation system technology to water/wastewater open channel flow monitoring, pipeline evaluation, engineering, and data analysis, all coupled to the power of the Internet. This unique integrated systems approach allows the company to bring greater insight and intelligence to gathering information about water/wastewater system performance of our clients, and in turn, to support the fulfillment of their commitments to manage and cost effectively design, operate, and maintain these systems.

Moreover, ***US^3*** supports Municipalities, Consulting Engineering firms and other water/waste water systems integrators by providing temporary technical services for engineering, software programming and technical site maintenance and calibration site support work, primarily in the Water and Waste Water industries.

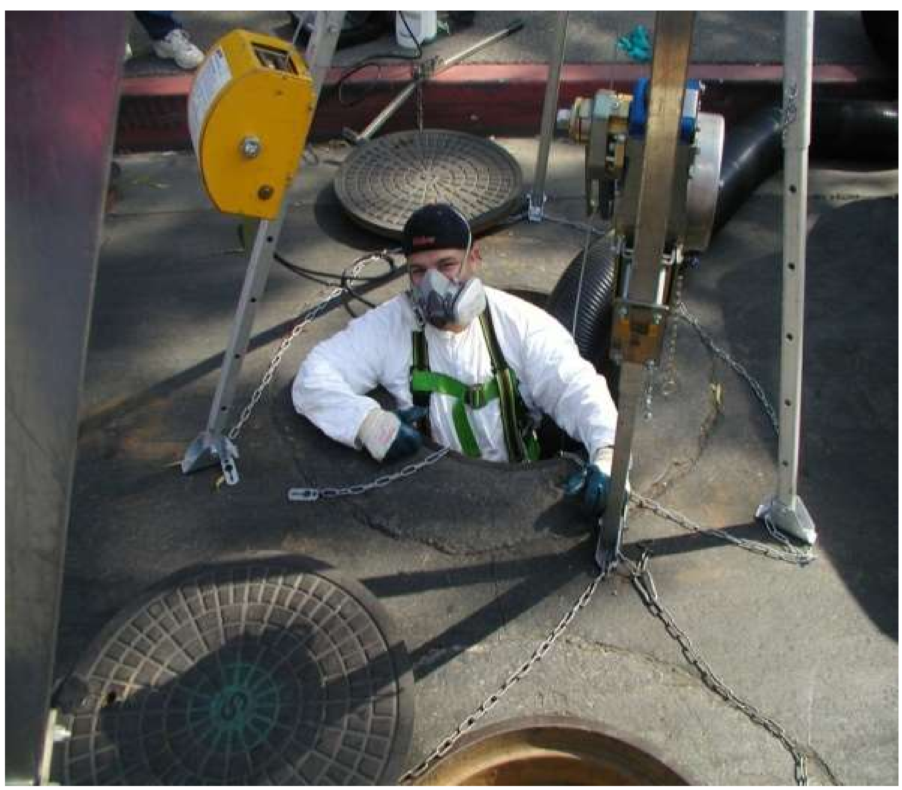

Figure at right: All US^3 technicians are certified for Confined Space Entry.

Key Personnel Assigned

US³ provided the necessary resources to fully implement this project. Primary in support of this effort were the following personnel:

Mr. Mark Serres: Mr. Serres is a degreed electrical engineer with over 25 years of experience with fresh/wastewater systems, project management, and systems integration in relation to complex industrial systems. This includes experience in industrial automation and water/wastewater industries. Mr. Serres is responsible for assuring client satisfaction and marshalling the required resources to meet the project requirements.

Mr. Thomas Williams: Mr. Williams is an Engineering Manager with over 20 years of experience in complex systems development for wastewater monitoring. This experience includes hydraulic compatibility, instrumentation, communications and analysis. Mr. Williams is responsible for assuring that the required equipment is designed and calibrated to meet the project requirements.

Darlene Szczublewski, PE: Mrs. Szczublewski is a licensed Civil Engineer in multiple states. She has over 15 years of engineering experience with stormwater/wastewater related projects. She assisted in the completion of several Sanitary Sewer Evaluation Surveys and Capacity Analysis projects to meet Consent Decrees as well as completing numerous Infiltration and Inflow (I&I) studies for other clients. Mrs. Szczublewski has developed numerous flow data analysis techniques to present a clear informative picture of flow in a monitored system. Her work also includes the development of training programs for clients describing I&I and capacity analysis methodologies. Mrs. Szczublewski is responsible for analyzing the data as well as the data collection process and assuring that the reports meet the project requirements.

Name, title, address and telephone number of persons to contact regarding this US³ project.

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