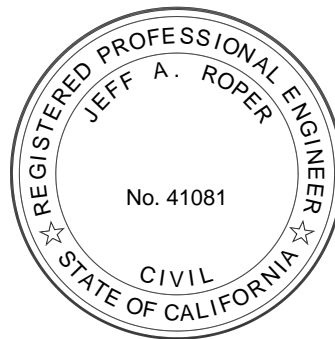


Preliminary Stormwater Control Plan  
for  
Tract No. 1604  
547 Airport Blvd. Townhomes  
547 Airport Blvd.  
Watsonville, CA  
APN 015-321-01

Owner:  
Raoul & Eve Ortiz  
547 Airport Blvd.  
Watsonville, CA 95076

Prepared by:  
Roper Engineering  
64 Penny Lane, Suite A  
Watsonville, CA 95076  
(831) 724-5300



A handwritten signature in black ink that reads "Jeff Roper".

Job No. 16043  
March 2, 2017  
Revised: June 20, 2019

## Project Information

1. Project Location:  
The property is located at 547 Airport Blvd., Watsonville, between Hangar Way and the west end of Aviation Way. APN 015-321-01.
2. Applicant:  
Raoul & Eve Ortiz  
547 Airport Blvd.  
Watsonville, CA 95076
3. Project Phase: N/A
4. Project Type: 21 Unit Residential Townhouse Subdivision
5. Total Project Area: 1.57 ± acres
6. Total new and/or replaced impervious area: 47,975 sf
7. Stormwater Performance Requirements  
This project is subject to performance requirements No.1 Site Design and Runoff Reduction, No. 2 Water Quality Treatment, No. 3 Runoff Retention and No. 4 Peak Management.

**8. Site Design and Runoff Reduction Measures (Performance Requirement No. 1)**

Design Strategies	Y/N	Description
Limit disturbance of creeks and natural drainage features.	N	No creeks or natural drainage features exist on the site.
Minimize compaction of highly permeable soils	Y	Soils under bioretention facilities will not be compacted.
Limit clearing and grading of native vegetation at the site to a minimum area needed to build the project, allow access, and provide fire protection	N	The property has been previously developed. No native vegetation exists at the site.
Minimize impervious surfaces by concentrating improvements on the least-sensitive portions of the site, while leaving the remaining land in a natural undisturbed state.	N	The property has been previously developed. No areas are in their natural undisturbed state.
Minimize stormwater runoff by implementing one or more of the following site design measures: 1. Direct roof runoff into cisterns or rain barrels for reuse 2. Direct roof runoff onto vegetated areas safely away from building foundations and footings, consistent with California building code. 3. Direct runoff from sidewalks, walkways, and/or patios onto vegetated areas safely away from building foundations and footings, consistent with California building code 4. Direct runoff from driveways and/or uncovered parking lots onto vegetated areas safely away from building foundations and footings, consistent with California building code 5. Construct bike lanes, driveways, uncovered parking lots, sidewalks, walkways, and patios with permeable surfaces	Y	The proposed project complies with design measures 2, 3 & 4. All runoff from new impervious surfaces is to be directed to the bioretention facilities.

**9. Water Quality Treatment (Performance Requirement No. 2)**

Performance requirement No. 2 requires the project to treat stormwater runoff to reduce pollutant loads and concentrations using physical, biological, and chemical removal. Runoff from all new impervious surfaces will be directed to the bioretention facilities where water quality treatment will be facilitated. Treatment is flow based using a minimum 4% bioretention ratio to new or replaced impervious area.  $405,584 \text{ sf} \times 0.4 = 1823 \text{ SF}$  required bioretention, 2870 SF provided.

**10. Runoff Retention (Performance Requirement No. 3)**

Performance Requirement No. 3 requires the project to prevent discharge from events up to the 95<sup>th</sup> percentile 24-hour rainfall event (1.3"). Due to the clay soils found at the site, the type D soil percolation rate of 0.25"/hr was utilized in the SCM Sizing Calculator attached. See Section C on Sheet T5 of the tentative map for the Bioretention/Detention Pond Detail.

The SCM Sizing Calculator is an Excel spreadsheet that computes the required SCM sizing and was developed for the Regional Water Quality Control Board, Central Coast Region.

The bioretention area provided is 2953 SF. From the SCM Sizing Calculator, the required storage volume is 2605 CF. Depth of underdrain is 3 feet.

**11. Peak Management (Performance Requirement No. 4)**

Peak management will be provided by the use of the bioretention/detention pond at the northeast corner of the project. See attached detention volume calculations. The project runoff will be metered out into the storm drain pipe in Airport Blvd. with the use of a sized orifice pipe located in the outflow catch basin in the bioretention/detention pond. See Section C on Sheet T5 of the tentative map for the Bioretention/Detention Pond Detail.

Detention pond sizing was determined with the Runoff Detention by Modified Rational Method template developed by the County of Santa Cruz Stormwater Department.

**12. Site Assessment Measures**

Site Assessment Measure	Description
Site topography	The existing site consists of a flat site fronting on Airport Blvd. and surrounded on 2 sides by industrial park lots and one side by a mobile home park.
Hydrologic features including contiguous natural areas, wetlands, watercourses, seeps, or springs	None.
Depth to seasonal high groundwater	Ground water was not encountered.
Locations of groundwater wells used for drinking water	No groundwater wells on site
Depth to an impervious layer such as bedrock	Shallow site soils consist of silty clays. No bedrock was encountered.
Presence of unique geology (e.g., karst)	No unique geology encountered.
Geotechnical hazards	No unique geologic hazards.

Documented soil and/or groundwater contamination	No documented contamination.
Soil types and hydrologic soil groups	Silty Clay, see geotechnical investigation.
Vegetative cover/trees	The existing site was previously developed. No native vegetation exists on the site with the exception of a few trees. New landscaping will be provided per the landscape plan.
Run-on characteristics (source and estimated runoff from offsite which discharges to the project area)	The site receives no run-on from adjacent properties.
Existing drainage infrastructure for the site and nearby areas including the location of municipal storm drains	There are existing storm drain facilities at the intersection of Airport Blvd. and Aviation Way. New site storm drainage will connect to these systems.
Structures including retaining walls	There is an existing residence and office trailer on the site that will be removed. There is also a large concrete slab that will also be removed.
Utilities	New utilities will be provided for sewer, water, storm drainage, electrical, gas and communication. These utilities will connect to existing utility services in Airport Blvd.
Easements	New utility easements will be provided along the south boundary.
Covenants	A home owners association will be formed for this subdivision and will be responsible for maintenance of the stormwater system.
Zoning/Land Use	Current zoning is IP-Industrial Park. Proposed zoning is RM-2 Multiple Residential - Medium Density. Current land use is residential. Proposed land use is a residential.
Setbacks	RM-2 setback requirements
Open space requirements	No open space requirements
Other pertinent overlay(s)	No other pertinent overlays

### 13. **Site Design Measures**

Design Measure	Description
Define the development envelope and protected areas, identifying areas that are most suitable for development and areas to be left undisturbed	Project site previously developed. No areas to be left undisturbed.
Conserve natural areas, including existing trees, other vegetation, and soils	Project site previously developed, no native areas exist.
Limit the overall impervious footprint of the project	Overall impervious footprint minimized. 8% bioretention provided.
Construct streets, sidewalks, or parking lot aisles to the minimum widths necessary, provided that public safety or mobility uses are not compromised	Driveways and sidewalks have been proposed to the minimum width necessary.
Set back development from creeks, wetlands, and riparian habitats	No creeks, wetlands or riparian habitats exist in the vicinity of the project.
Conform the site layout along natural landforms	Project layout conforms to the natural landform.
Avoid excessive grading and disturbance of vegetation and soils	Grading has been minimized by utilizing the existing topography as much as possible in the project design.

### 14. **Post-Construction Stormwater Control Measures**

The stormwater control measures proposed for this development are the bioretention facilities for Stormwater Quality and Runoff Retention. The bioretention facility will comply with the City of Watsonville’s Standard Bioretention Facility LID-001. This bioretention facility specification is also the one used by the Regional Water Quality Control Board (RWQCB), Central Coast Region.

Due to the proximity of the SCM to the east property line, an impermeable liner will be placed along the east side of the pond to minimize infiltration onto the neighboring property.

Sizing of the retention/detention pond is represented on the SCM Sizing Calculator and Detention spreadsheet attached to this document. The predevelopment runoff rate is 0.718 CFS as noted on the Detention spreadsheet.

### 15. **Operation and Maintenance Plan**

Homeowners Association of the new subdivision will be required to maintain the post-construction stormwater control measures. See the site map on the following sheet for the Bioretention Facility locations.

The Bioretention Facilities is located at the northeast corner of the project.

**Maintenance:** The primary maintenance requirement for bio retention facilities includes routine inspections targeted at maintaining hydraulic efficiency of the channel, the treatment effectiveness of the bioretention components, and a dense, healthy vegetative cover. Maintenance activities should include periodic mowing (with grass never cut shorter than the design flow depth), clearing of debris and blockages, and sediment removal. Reseed bare areas annually. Inspections should also look for erosion along the bottom of the swale channel.

**Performance and Inspection:** To ensure proper performance, visually inspect that stormwater is infiltrating properly and is being conveyed through the length of the bioswale. Water ponding in a bioswale for more than 48 hours may indicate operational problems. Corrective measures include inspection for and removal of accumulated sediments. Back flushing the under drain is another option. Samples of the bioretention media should be taken in the case of poor infiltration to determine the condition of the media (e.g. clay content). Full or partial replacement of the bioretention media may be required to restore the flow rate through the swale. Alternately, soil amendments can first be applied in an attempt to restore permeability. Perform this inspection annually in spring, and after extreme events (e.g. after heavy rainfall).

**Costs:** We estimate annual inspection and maintenance to cost \$1000 per year. We estimate replacement after the 25 year live expectancy to cost \$25,000.

**Maintenance Agreement and Transfer of Responsibility for SCMs:**

Prior to issuing approval for final occupancy the City will require that projects subject to these Post-Construction Requirements provide verification of ongoing maintenance provisions for Structural Stormwater Control Measures, including but not limited to legal agreements, covenants, CEQA mitigation requirements, and or conditional use permits. Verification shall include, at a minimum:

- a) The project owner's signed statement accepting responsibility for the O&M of the installed onsite and/or offsite structural treatment and flow control SCMs until such responsibility is legally transferred to another entity; and either
  - i) A signed statement from the public entity assuming responsibility for structural treatment and flow control SCM maintenance and stating that the SCM meets all local agency design standards; or
  - ii) Written conditions in the sales or lease agreements or deed for the project that require the buyer or lessee to assume responsibility for the O&M of the onsite and/or offsite structural treatment and flow control SCM until such responsibility is legally transferred to another entity; or
  - iii) Written text in project deeds, or conditions, covenants and restrictions for multi-unit residential projects that require the homeowners association or, if there is no association, each

- individual owner to assume responsibility for the O&M of the onsite and/or offsite structural treatment and flow control SCM until such responsibility is legally transferred to another entity; or
- iv) Any other legally enforceable agreement or mechanism, such as recordation in the property deed, that assigns responsibility for the O&M of the onsite and/or offsite structural treatment and flow control SCM to the project owner(s) or the Permittee

**16. Statement of Compliance:**

The preliminary design of stormwater treatment facilities and other stormwater pollution control measures in this plan are in accordance with the City of Watsonville Stormwater post-Construction Standards (Resolution No. 4-14, Adopted January 14, 2014). The Water Quality Treatment and Peak Management Requirements have been met on the site by the proposed measures.

Bioretention/Detention Pond

Bioretention	Req'd Size 1823 SF	Provided Size 2870 SF
Retention	Req'd Depth 3.2'	Provided Depth 3.2'
Detention	Req'd Volume 1664 CF	Provided Volume 1722 CF

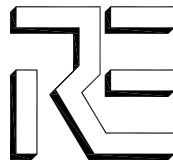




CLIENT: 547 AIRPORT BLVD  
TOWNHOMES

LOCATION:  
AIRPORT BLVD.

DRAINAGE CALCS



**ROPER ENGINEERING**

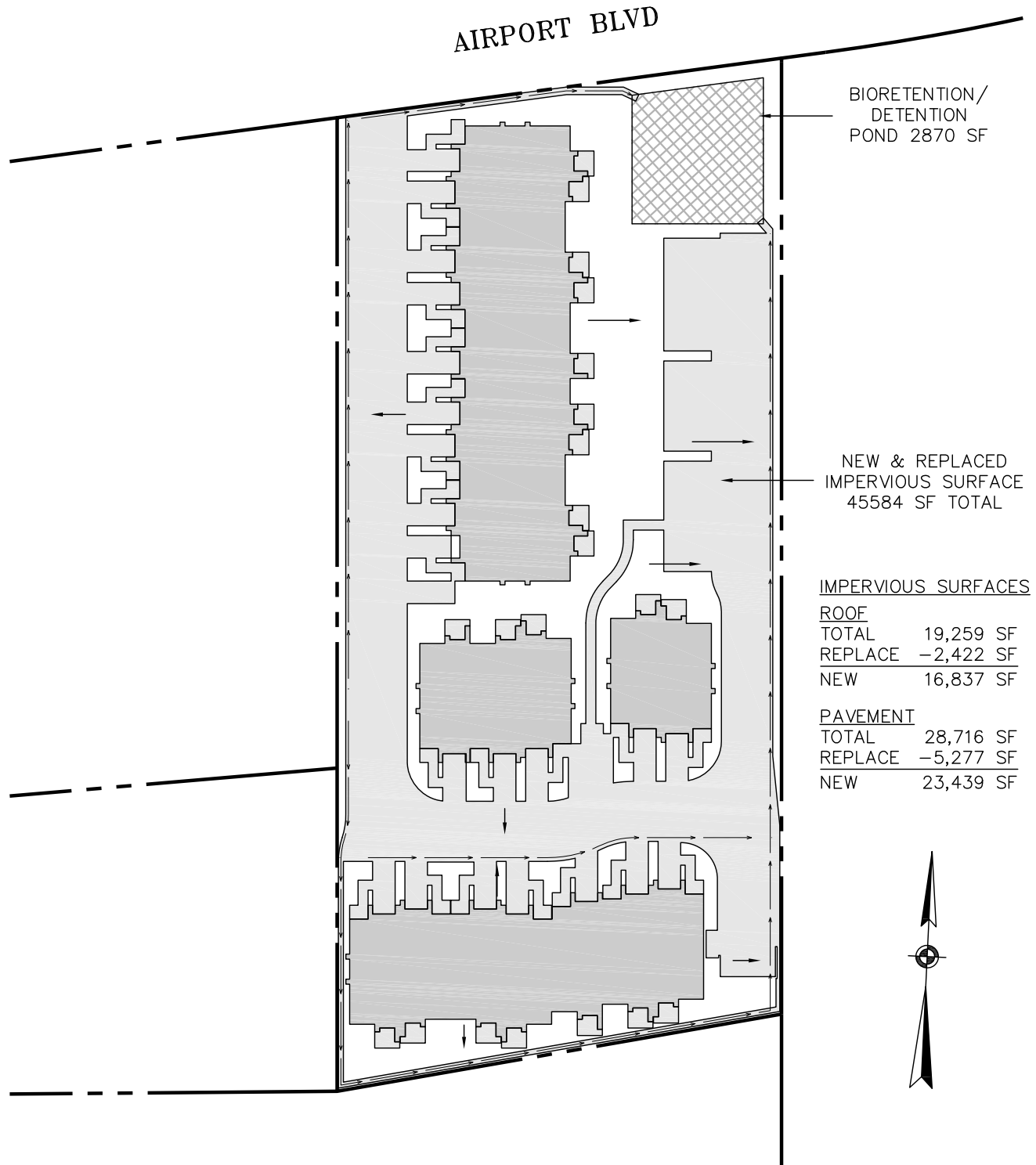
CIVIL ENGINEERING & LAND SURVEYING  
64 PENNY LANE, SUITE A  
WATSONVILLE, CA 95076  
(831) 724-5300

JOB NO.: 16043

DATE:  
JUNE 20, 2019

SHEET:  
2 OF 2

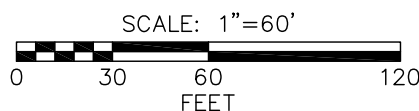
### DRAINAGE MANAGEMENT AREAS



IMPERVIOUS SURFACES

<u>ROOF</u>	
TOTAL	19,259 SF
REPLACE	-2,422 SF
NEW	16,837 SF

<u>PAVEMENT</u>	
TOTAL	28,716 SF
REPLACE	-5,277 SF
NEW	23,439 SF



# Central Coast Region Stormwater Control Measure Sizing Calculator

Version: 2/26/2014

## 1. Project Information

Project name:	547 Airport Blvd Townhomes 12-29-17
Project location:	547 Airport Blvd., Watsonville
Tier 2/Tier 3:	Tier 3 - Retention
Design rainfall depth (in):	1.3
<b>Total project area (ft2):</b>	<b>68279</b>
Total new impervious area (ft2):	40277
Total replaced impervious in a USA (ft2):	0
Total replaced impervious not in a USA (ft2):	7699
Total pervious/landscape area (ft2):	20933

## 2. DMA Characterization

Name	DMA Type	Area (ft2)	Surface Type	New, Replaced?	Connection
New Roof	Drains to SCM	16837	Roof	New	Bioretention Area
Replaced Roof	Drains to SCM	2422	Roof	Replaced	Bioretention Area
New Pavement	Drains to SCM	23439	Concrete or asphalt	New	Bioretention Area
Replaced Pavement	Drains to SCM	5277	Concrete or asphalt	Replaced	Bioretention Area
Landscape	Self-Treating	20933			

### DMA Summary Area

Total project impervious area (ft2):	47975
New impervious area (ft2):	40276
Replaced impervious within a USA (ft2):	0
Replaced impervious not in a USA (ft2):	7699
Total pervious/landscape area (ft2):	0

## 3. SCM Characterization

Name	SCM Type	Safety Factor	SCM Soil Type	Infiltr. Rate (in/hr)	Area (ft2)
Bioretention Area	Bioretention	1	HSG C/D	0.25	2870

## 4. Run SBUH Model

## 5. SCM Minimum Sizing Requirements

SCM Name	Min. Required Storage Vol. (ft3)	Depth Below Underdrain (ft)	Drain Time (hours)
Bioretention Area	3636	3.17	50.7

## 6. Self-Retaining Area Sizing Checks

Self-Retaining DMA Name	Self-Retaining DMA Area (ft2)	Tributary DMA Name	Tributary DMA Area (ft2)	Tributary / SRA Area Ratio

**RUNOFF DETENTION BY THE MODIFIED RATIONAL METHOD**

Data Entry: **PRESS TAB & ENTER DESIGN VALUES** SS Ver: 1.0

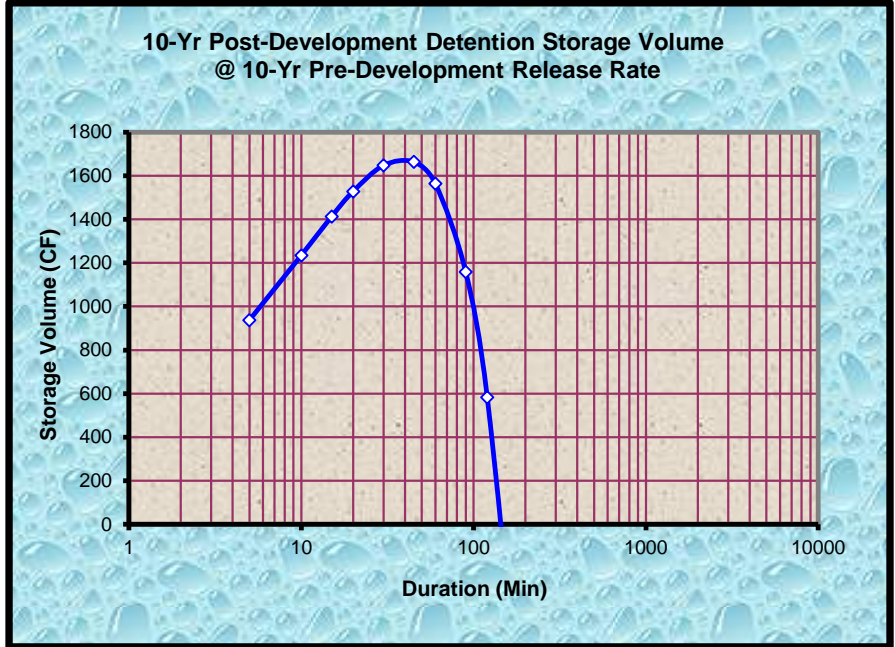
Site Location P60 Isoleth: **1.30** Fig. SWM-2 in County Design Criteria  
 Rational Coefficients Cpre: **0.28** See note # 2  
 Cpost: **0.77** See note # 2  
 Impervious Area: **68279** ft<sup>2</sup> See note # 2 and # 4

**STRUCTURE DIMENSIONS FOR DETENTION**

1664 ft<sup>3</sup> storage volume calculated  
**40** % void space assumed  
 4159 ft<sup>3</sup> excavated volume needed

Structure Ratios	Length	Width*	Depth*	*For pipe, use the square root of the sectional area
	<b>52.40</b>	<b>54.80</b>	<b>1.50</b>	
<b>Dimen. (ft)</b>	<b>51.79</b>	<b>54.16</b>	<b>1.48</b>	

10 - YEAR DESIGN STORM				DETENTION @ 15 MIN.	
Storm Duration (min)	10 - Year Intensity (in/hr)	10 - Yr. Release Qpre (cfs)	10 - Year Qpost (cfs)	Detention Rate To Storage (cfs)	Specified Storage Volume (cf)
1440	0.21	0.094	0.259	-0.459	-49538
1200	0.23	0.102	0.281	-0.437	-39311
960	0.25	0.113	0.310	-0.407	-29338
720	0.29	0.128	0.353	-0.365	-19716
480	0.35	0.154	0.422	-0.295	-10635
360	0.39	0.175	0.480	-0.238	-6419
240	0.47	0.209	0.575	-0.143	-2572
180	0.54	0.238	0.653	-0.064	-869
120	0.64	0.285	0.782	0.065	583
90	0.73	0.323	0.889	0.172	1159
60	0.88	0.387	1.065	0.347	1564
45	0.99	0.440	1.211	0.493	<b>1664</b>
30	1.19	0.527	1.450	0.732	1647
20	1.43	0.631	1.737	1.019	1528
15	1.62	<b>0.718</b>	1.974	1.256	1413
10	1.94	0.860	2.364	1.646	1235
5	2.64	1.170	<b>3.218</b>	2.500	938



**Notes & Limitations on Use:**

- 1) The modified rational method, and therefore the standard calculations are applicable in watersheds up to 20 acres in size.
- 2) Required detention volume determinations shall be based on all net new impervious area both on and off-site, resulting from the proposed project. Pervious areas shall not be included in detention volume sizing; an exception may be made for incidental pervious areas less than 10% of the total area.
- 3) Gravel packed detention chambers shall specify on the plans, aggregate that is washed, angular, and uniformly graded (of single size), assuring void space not less than 35%.
- 4) A map showing boundaries of both regulated impervious areas and actual drainage areas routed to the hydraulic control structure of the detention facility is to be provided, clearly distinguishing between the two areas, and noting the square footage.
- 5) The EPA defines a class V injection well as any bored, drilled, or driven shaft, or dug hole that is deeper than its widest surface dimension, or an improved sinkhole, or a subsurface fluid distribution system. Such storm water drainage wells are "authorized by rule". For more information on these rules, contact the EPA. A web site link is provided from the County DPW Stormwater Management web page.
- 6) Refer to the County of Santa Cruz Design Criteria, for complete methodology.



# **BOWMAN & WILLIAMS**

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## **Off-site Storm Water Analysis**

**For**

**Tract No. 1604  
547 Airport Blvd  
Townhouse Project**

**Prepared At the Request of  
Raoul Ortiz**

**February 2021**

**B&W Job No. 28191**

## **1. Introduction**

The purpose of this report is to analyze the hydrologic and hydraulic impacts of the development of Tract No. 1604, a 21 unit townhouse development at 547 Airport Blvd to the existing 27" diameter storm drain pipe at the North side of Airport Blvd. The analysis shall determine if the existing system in Airport Blvd is capable of conveying the flow from the site and the pipe's other tributary areas.

The analysis utilizes surveyed stormdrain information from the Airport Boulevard Widening City Project No. ST 91-03 prepared by Bowman and Williams. The new stormwater infrastructure was taken from the plans for Tract No. 1604 547 Airport Blvd. Townhomes, prepared by Roper Engineering dated June 20, 2019 (datum NAV 1988). There was a difference in datums for the surveyed data and the plans, so the surveyed data was converted to NAV 1988 datum.

In accordance with the City's guidance a preliminary limited analysis was performed to focus on the impact from the site. The existing 27" RC pipe adjacent to the site was analyzed to determine if it can convey runoff from the upstream tributary area as well as the mitigated flow from the site. To acknowledge that the system downstream of the adjacent 27" pipe experiences flooding (but not mitigate for existing flooding issues), the model included a tailwater depth equal to full-pipe conditions.

The analysis showed that the 27" pipe would surcharge and flooding would overflow from surface grates for the 25 year storm event. For this reason we are recommending modifications to the Roper plans to increase the detention pond to mitigate for both the 10 year storm and 25 year storm, and elimination of the proposed catch basin in Airport Blvd which would overload the site's proposed discharge pipe.

## **2. Drainage Conditions**

The tributary areas and infrastructure which discharges to the 27" RCP drainage system was assumed from the County of Santa Cruz GIS system, the City of Watsonville Sanitary Sewer and Stormdrain Map Book and the Watsonville Municipal Airport Drainage and Utility Master Plan dated April 2010, prepared by Reinard W. Brandley Consulting Airport Engineers.

The total pre-development tributary drainage area was determined to be 24.41 acres which was divided into 3 subbasins for analysis purposes. The existing portion of the site contribution to Airport Blvd was 0.78 acres. Post development the site contribution to Airport Blvd was 1.51 acres, bringing the total tributary drainage area to 25.14 acres.

## **3. Hydrology & Hydraulics**

Autodesk Storm and Sanitary Analysis 2017 (SSA) was used to model the drainage infrastructure and tributary areas contributing to the adjacent 27" RCP drainage system. The County of Santa Cruz Rainfall Intensity Duration curve data for a P-60 value of 1.3 was used to create an IDF curve in the model. The rational method was selected for the hydrology method and hydrodynamic was selected as the link routing methodology due to the connections to existing systems which have the potential to reverse flow. Estimated were the slopes, flow path lengths, and runoff coefficients for each subbasin, utilizing the rational method (FAA) to determine the time of concentration within the model.

Each of the 3 subbasins were routed to the drainage infrastructure shown on the GIS system. Rim and invert elevations were from the Airport Boulevard Widening City Project No. ST 91-03. The existing and proposed drainage infrastructure were evaluated using the 25 year storm events.

Three scenarios were modeled:

1. The existing system without the project
2. The system with the improvements (designed by Roper)
3. The system with modifications to the improvements

#### 4. Modeling Results

For each of the scenarios run there is some flooding at the intersection of Airport Blvd and Aviation Way for the 25 year storm events. The intersection is a low point, so the water will pond in that location. The Santa Cruz County GIS contour data indicates that the ponding water would overflow to the neighboring drainage system in the Colonial Manor mobile home park. The flooding and surcharged conditions are likely due to undersized pipes and shallow slopes. The 25 year storm analysis maps, reports and profiles for the existing condition are included in the appendix.

##### Existing Conditions

The existing condition has a portion of the site from draining away from Airport Blvd. Therefore the Tributary area draining to the 27" system is less than post development. The existing system layout can be shown on the map in Appendix C. The 25 year storm event flow results are as follows:

Tributary Area (ac)	Link (See Map in Appendix C Section 1)	Peak Flow (cfs)	Capacity (cfs)	Flow/Capacity	Condition
1.31	PIPE0A	1.27	10.66	0.12	SURCHARGED
1.31	PIPE0B	4.31	17.51	0.25	SURCHARGED
24.41	PIPE1C	22.96	1.29	17.74	SURCHARGED
24.41	PIPE2A	22.96	17.47	1.31	SURCHARGED
24.41	PIPE2B	22.96	20.79	1.10	SURCHARGED

The existing system has flooding issues.

##### Roper Proposed Development

The proposed development provides detention to release the 10 year predevelopment flow rate (assuming the whole site drained to Airport Blvd pre-development). The Roper system layout can be shown on the map in Appendix C The 25 year storm event flow results are as follows:

Tributary Area (ac)	Link(See Map in Appendix C Section 2)	Peak Flow (cfs)	Capacity (cfs)	Flow/Capacity	Condition
1.51	PIPE1A	1.07	14.46	0.07	SURCHARGED
2.04	PIPE1B	1.15	8.46	0.14	SURCHARGED
25.14	PIPE1C	25.36	1.29	19.59	SURCHARGED
25.14	PIPE2A	24.65	17.47	1.41	SURCHARGED
25.14	PIPE2B	24.65	20.79	1.19	SURCHARGED

The proposed Roper development would increase the peak flow to the already flooded system.

*Modified Proposed Development*

The modified proposed development would provide detention for the 25 year storm event with a release of the 10 year predevelopment flow rate (assuming a portion of the site drained to the rear of the site pre-development). The Modified system layout can be shown on the map in Appendix C The 25 year storm event flow results are as follows:

Tributary Area (ac)	Link (See Map in Appendix C Section 3)	Peak Flow (cfs)	Capacity (cfs)	Flow/Capacity	Condition
0.53	PIPE0A	0.92	10.42	0.09	SURCHARGED
0.53	PIPE0B	4.10	17.51	0.23	SURCHARGED
23.63	PIPE1C	23.17	1.29	17.90	SURCHARGED
1.51	PIPE1D	1.43	4.26	0.34	SURCHARGED
25.14	PIPE2A	22.91	17.47	1.31	SURCHARGED
25.14	PIPE2B	22.91	20.79	1.10	SURCHARGED

The modified design would prevent any additional flooding to the existing system for the 25 year storm event.

**5. Preliminary and Modified Design**

The current Roper plans are designed to meet the City’s standard Stormwater requirements, but do not address the re-direction of runoff from 0.73 acres. The current design has a 2,870 sf bioretention area with 1.5 ft of gravel to provide 1,722 cf of detention.

Due to the existing overloading of the drainage system in Airport Boulevard, there is currently no capacity to handle the increased storm water runoff from the 25 year storm event. For that reason we are proposing to modify the project design to detain the increase in stormwater runoff from the project’s 25 year storm event instead of just detaining the increase in runoff from added impervious for the 10 year storm event.

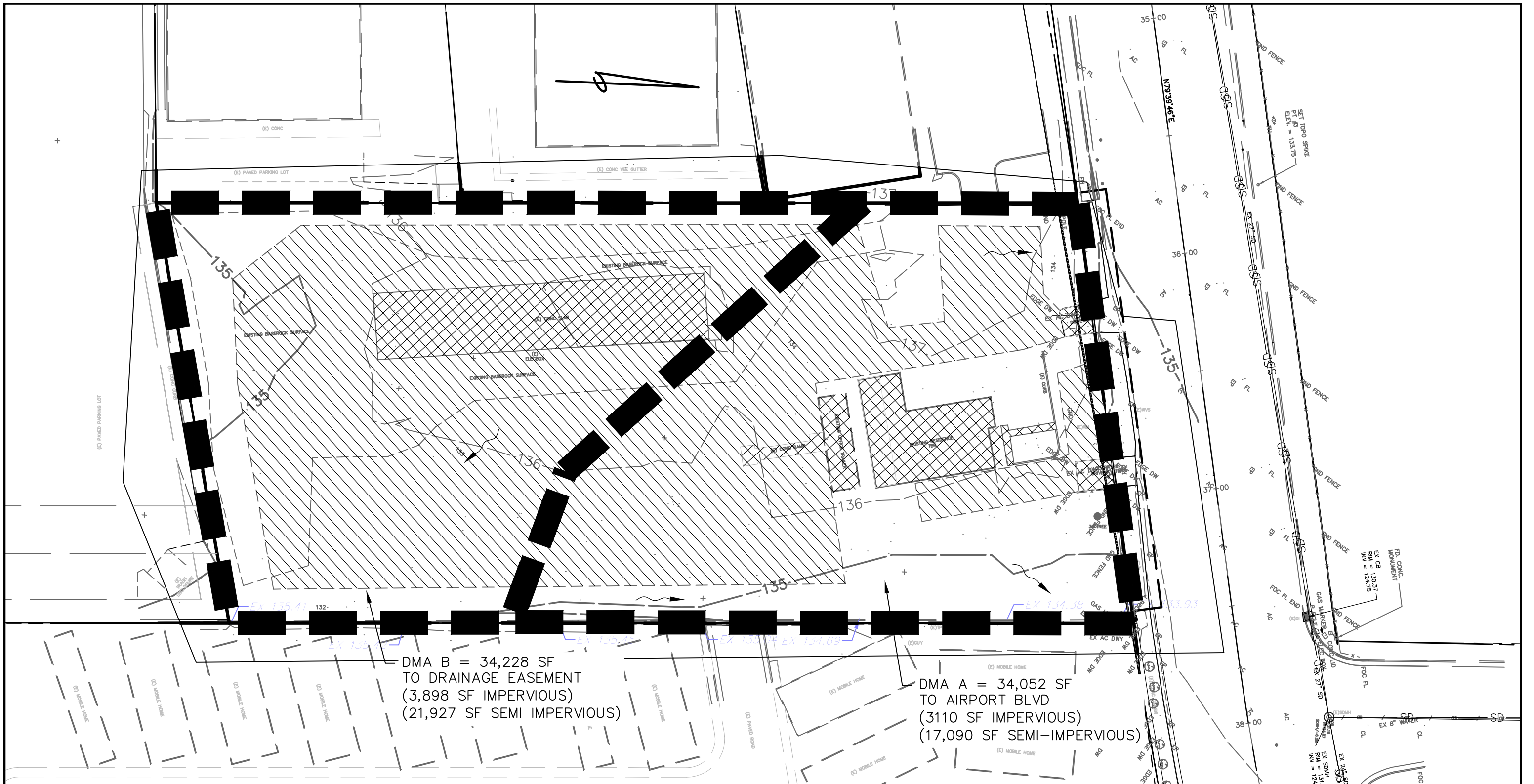
The modified detention volume for the site was determined using the County of Santa Cruz detention methodology for the 25- year 15 min storm event. To account for the redirection of flow the allowable pre-development flow is only for the existing 0.78 acres.

The resulting detention volume would need to be 3539 cf. Therefore we proposed to modify the existing bioretention design to provide storage in a gravel depth to 1.25 ft, include 2 ft of storage in the bioretention media, and provide 0.5 ft of ponding above the bioretention, resulting in 3750 cf of detention.



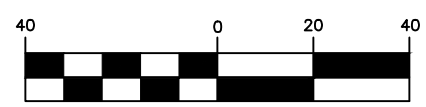
# APPENDIX A

## SITE MAPS



**PRE-DEVELOPMENT MAP**

**GRAPHIC SCALE**



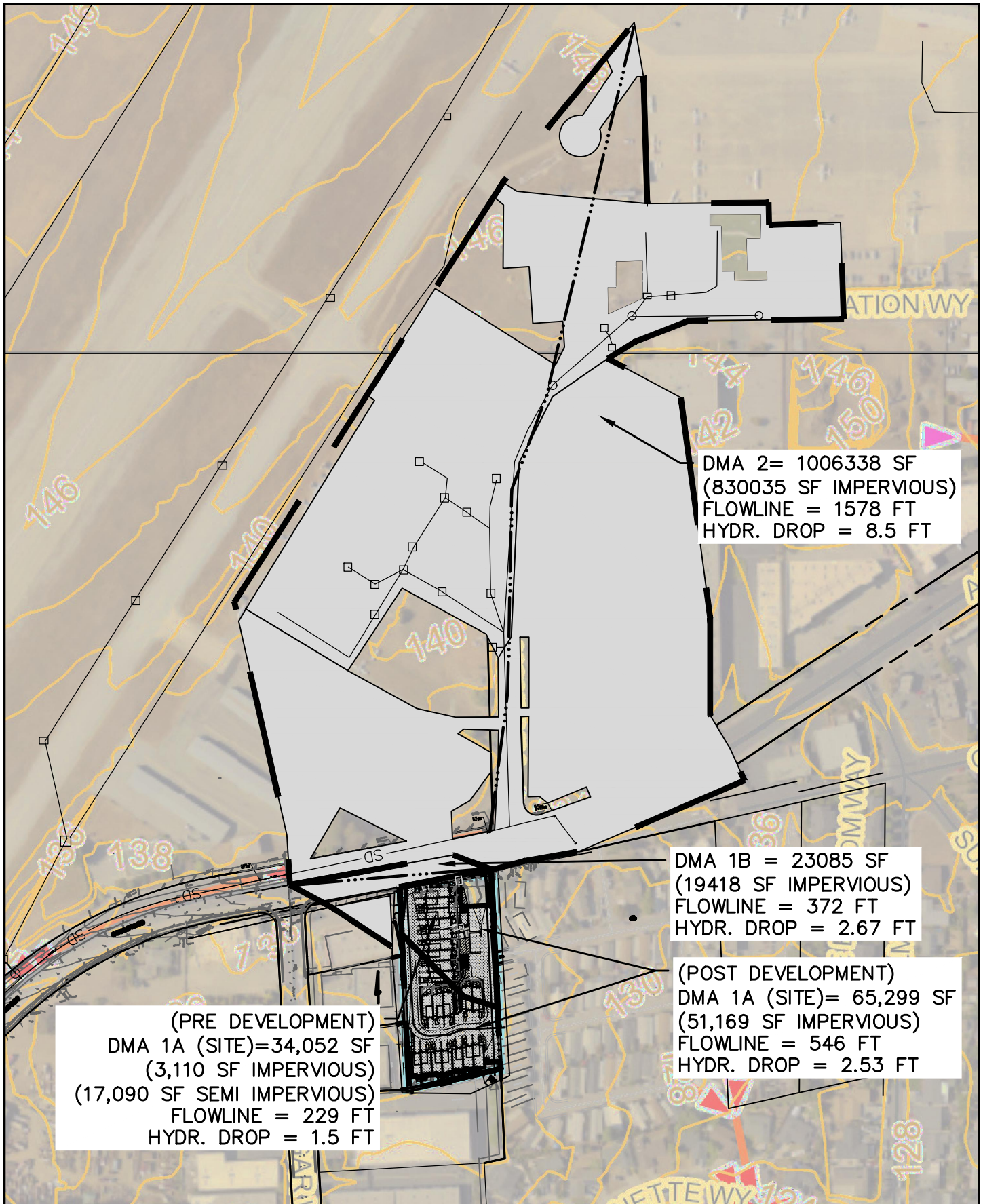
( IN FEET )  
1 inch = 40 ft.

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 AND LAND SURVEYORS  
 3949 RESEARCH PARK CT., STE. 100, SOQUEL, CA 95073  
 (831) 426-3560

SCALE 1" = 40'	JOB NO.
DATE	DWG NAME
DRAWN	FILE NO.







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3949 RESEARCH PARK CT., STE. 100, SOQUEL, CA 95073  
 (831) 426-3560

SCALE 1" = 250'

DATE FEB 2021

DRAWN KAB

JOB NO. 28191

DWG NAME 28191-DRN

FILE NO.

APPENDIX B  
CALCULATIONS

<u>TYPE OF AREA</u>	<u>10- YEAR RUNOFF COEFFICIENTS</u>
Rural, park, forested; agricultural	0.10 - 0.30
Low residential (Single family dwellings)	0.45 - 0.60
High residential (Multiple family dwellings)	0.65 - 0.75
Business and commercial	0.80
Industrial	0.70
Impervious	0.90

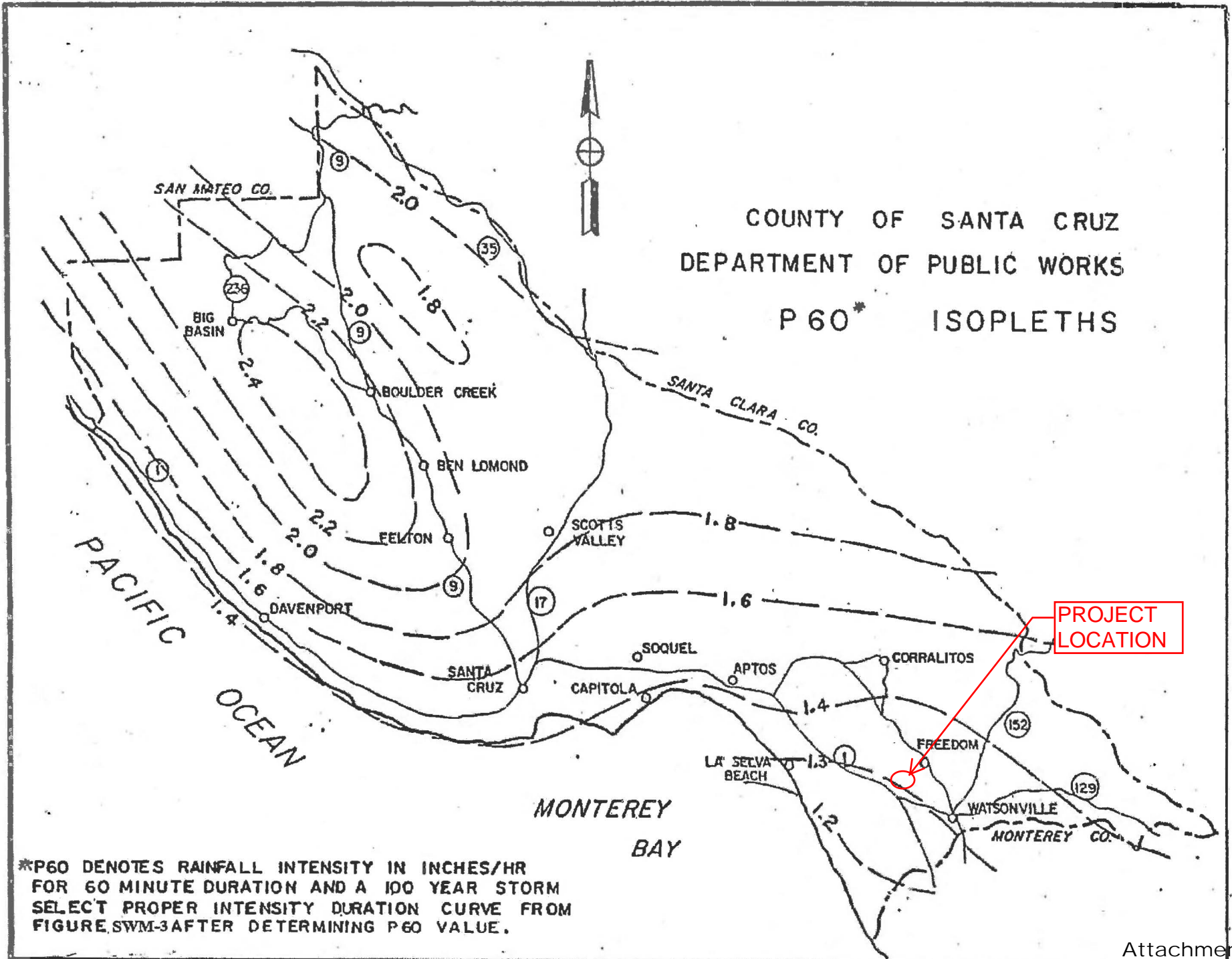
  

**REQUIRED ANTECEDENT MOISTURE FACTORS (Ca) FOR THE RATIONAL METHOD\***

Recurrence Interval (Years)	Ca
2 to 10	1.0
25	1.1
50	1.2
100	1.25

Note: Application of antecedent moisture factors (Ca) should not result in an adjusted runoff coefficient (C) exceeding a value of 1.00

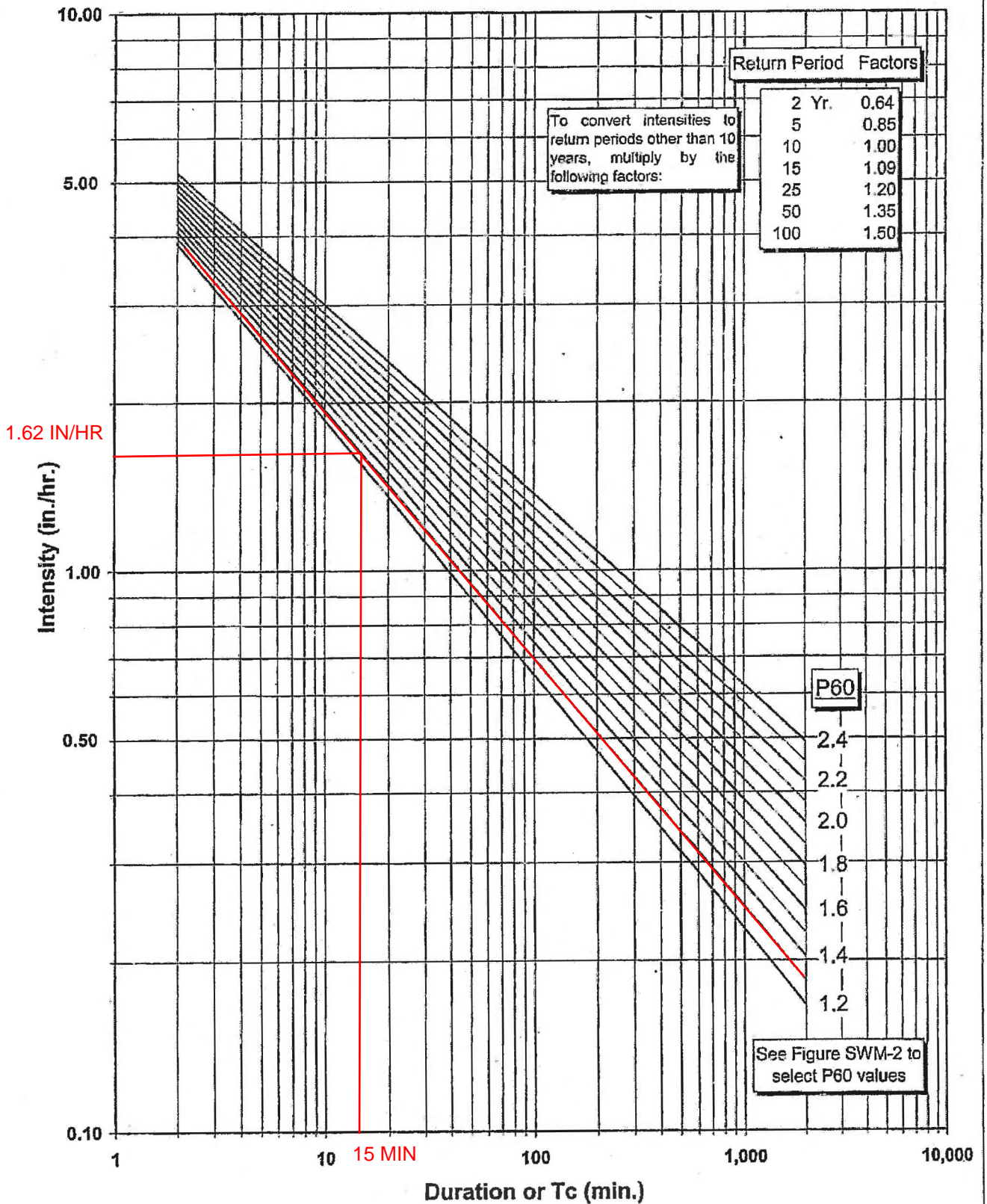
\*APWA Publication "Practices in Detention of Stormwater Runoff"





# Rainfall Intensity - Duration Curves 10 Yr. Return Period

$$((4.29112) * (1.1952)^{P60\_VALUE}) / (DURATION^{(0.60924)} * (0.78522)^{P60\_VALUE})$$



Rev. 11-05

FIG. SWM-3



**DRAINAGE CALCULATIONS FOR :**  
**547 Airport Blvd**  
**Watsonville, CA**  
**BOWMAN & WILLIAMS FILE: 28191**  
**February 19, 2021**

**Flow Rate Calculations**  
**DMAS**

**Intensity for Storm: 10 Yr**

Return Period =  Years  
P60 Isopleth =  (Based on Location - See County Map)  
I<sub>a</sub> =  (Based on Return Period - See Above Right)

Return Period	I <sub>a</sub>
2	0.64
5	0.85
10	1.00
15	1.09
25	1.20
50	1.35
100	1.50

**Pre-development**

Area Description	Total Area (ft <sup>2</sup> )	Semi			Area (AC)	C	A*C	C <sub>a</sub>	Tc (min)	I (in/hr)	Q (cfs)
		Impervious Area (sf)	Impervious Area (sf)	Pervious Area (sf)							
1A. Site	34,052	3,110	17,090	13,852	0.78	0.46	0.36	1.25	15	1.622	<b>0.33</b>
1B. Offsite	23,085	19,418	0	3,667	0.53	0.80	0.43	1.25	15	1.622	<b>0.70</b>
2. Aviation to Airport Blvd	1,006,338	830,035	0	176,303	23.10	0.79	18.36	1.25	15	1.622	<b>29.59</b>
<b>Total</b>	<b>1,063,475</b>				<b>24.41</b>		<b>19.15</b>				<b>30.61</b>

**Post-development**

Area Description	Total Area (ft <sup>2</sup> )	Semi			Area (AC)	C	A*C	C <sub>a</sub>	Tc (min)	I (in/hr)	Q (cfs)
		Impervious Area (sf)	Impervious Area (sf)	Pervious Area (sf)							
1A. Site	65,764	51,634	0	14,130	1.51	0.77	1.16	1.25	15	1.622	<b>1.82</b>
1B. Offsite	23,085	19,418	0	3,667	0.53	0.80	0.43	1.25	15	1.622	<b>0.70</b>
2. Aviation to Airport Blvd	1,006,338	830,035	0	176,303	23.10	0.79	18.36	1.25	15	1.622	<b>29.59</b>
<b>Total</b>	<b>1,095,187</b>				<b>25.14</b>		<b>19.95</b>				<b>32.11</b>

**DRAINAGE CALCULATIONS FOR :**  
**Tract 1604, 547 Airport Blvd**  
**Watsonville, CA**  
**BOWMAN & WILLIAMS FILE: 28191**  
**February 19, 2021**

**Detention Calculations**

**1. Basis of Calculation Based on County of Santa Cruz Design Criteria 2014, Page 85**

A = Area in acres  
 Ia = Return Period Factor  
 Ca = Antecedent Moisture Factor  
 Cpre = Pre-developed runoff coefficient  
 Cpost = Post-developed runoff coefficient  
 tc = Time of Concentration in minutes

Intensity (I) =  $((4.29112)^{(1.1952P60)}) / (tc^{((0.60924)^{(0.78522P60))})$  \* Ia  
 Pre Development Runoff (Qpre) = Ca \* Cpre \* Ia \* I \* A / 43200  
 Post Development Runoff (Qpost) = Ca \* Cpost \* Ia \* I \* A / 43200  
 Required Storage Volume = (Qpost-Qpre) \* Rainfall Duration \* 60  
 Note: Maximum volume produced from a storm duration during a 24 hour event is selected for design.

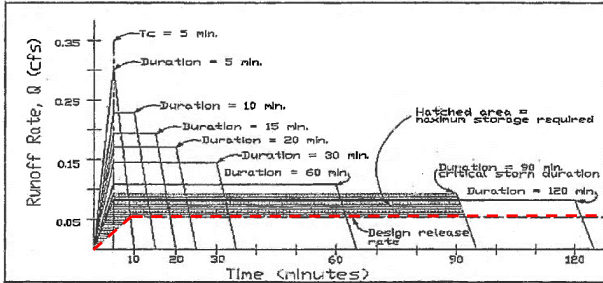


Figure 1: Sample Detention Hydrographs

**2. Data**

Design Rainfall Frequency = 25 Year  
 Pre-developed Runoff Coefficient (Cpre) = 0.35 (Fig. SWM-1 or from site estimate)  
 Post-developed Runoff Coefficient (Cpost) = 0.77 (Fig. SWM-1 or from site estimate)  
 Antecedent Moisture Content Ca = 1.1 (for 25 year storm per Fig. SWM-1)  
 P60 Isopleth = 1.3 (Fig. SWM-2 & SWM-3 of Design Criteria)  
 Detention Storm Ia = 1.2 (Fig. SWM-3)  
 Pre-developed Time of Concentration = 15 minutes  
 Post-developed Time of Concentration = 15 minutes  
 Pre Development Total area = 34,052 sf  
 Post Development Total area = 65,299 sf  
 Factor of Safety = 1.25

**Areas and Pre-developed Runoff Coefficient Calculations.**

Area Description	Area (ft2)	Runoff Coefficient	Area * Runoff Coefficient
Pervious Surfaces	13,852	0.30	4156
Seml Impervious	17,090	0.30	5127
Impervious Surfaces	3,110	0.90	2799
<b>Total =</b>	<b>34,052</b>		<b>12082</b>

Pre-developed Runoff Coefficient (Cpre) = (Area \* C-value) / (Total Area) = 0.35

**Areas and Post-developed Runoff Coefficient Calculations.**

Area Description	Area (ft2)	Runoff Coefficient	Area * Runoff Coefficient
Pervious Surfaces	14,130	0.30	4239
Seml Impervious	0	0.30	0
Impervious Surfaces	51,169	0.90	46052
<b>Total =</b>	<b>65,299</b>		<b>50291</b>

Post-developed Runoff Coefficient (Cpost) = (Area \* C-value) / (Total Area) = 0.77

**3. Detention Calculations**

Rainfall Duration (min)	25 YEAR STORM VALUES			DETENTION @ 15 MIN. Require Storage Volume (cf)
	25 Year Intensity (in/hr)	Pre-Development Cpre (cfs)	Post-Development Cpost (cfs)	
1440	0.255	0.079	0.327	-23469
1200	0.277	0.085	0.355	-17567
960	0.306	0.094	0.392	-11922
720	0.348	0.107	0.445	-6631
480	0.416	0.128	0.533	-1886
360	0.473	0.146	0.606	158
240	0.567	0.174	0.726	1831
120	0.772	0.237	0.988	2803
90	0.877	0.270	1.123	2831
60	1.050	0.323	1.345	2686
45	1.194	0.367	1.529	2511
30	1.430	0.440	1.831	2218
20	1.712	0.527	2.193	1913
15	1.946	0.599	2.492	1704
10	2.331	0.717	2.985	1432
5	3.173	0.976	4.063	1039

Required Storage = 2831  
 Required Storage With 1.25 Safety Factor = 3539

**DRAINAGE CALCULATIONS FOR :**  
**547 Airport Blvd**  
**Watsonville, CA**  
**BOWMAN & WILLIAMS FILE: 28191**  
**February 19, 2021**

**Detention Calculations**

**Requirement**

**25 yr Storm Detention**

**Volume (25 yr Pre-**

**Development Release)**

**3539 cf**

**Provided**

Detention Area

2500 sf

Gravel Depth

1.25 ft

Gravel Volume = (Area x

Depth)\*0.4

1250 cf

Media Depth

2 ft

Media Volume = (Area x

Depth)\*0.25

1250 cf

Ponding Depth

0.5 ft

Ponding Volume = Area x

Depth

1250 cf

**Total Volume**

**3750**

Total Depth

3.75

**DRAINAGE CALCULATIONS FOR :**  
**547 Airport Blvd**  
**Watsonville, CA**  
**BOWMAN & WILLIAMS FILE: 28191**

**Orifice & Weir Calculations**

**Basis of Calculation (Orifice Formula)**

**Orifice**

$$Q = C_d * A * (2gh)^{1/2}$$

$$h = (((Q/(C_d * A))^2)/2g)$$

Q = Discharge Rate Through Orifice

C<sub>d</sub> = Discharge Coefficient

A = Area of Orifice

g = Acceleration of gravity

h = Water Depth at Orifice

a = 1/2 Orifice Opening Height

h = Hydraulic Head from

Center of orifice to top of wall

**Control Box DMA 3**

**Orifice Input**

Q <sub>Pre10-Year</sub> =	0.33	cfs
Orifice Invert =	128.76	
Grate =	133.50	
Low Flow Orifice Diameter (D) =	2.50	in
Orifice Coefficient - (Type A) (C <sub>d</sub> ) =	0.62	

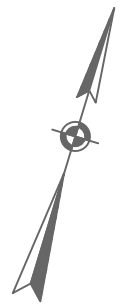
**Orifice Output**

Low Flow Orifice Area (A) =	0.03	sf
Head to Discharge Q <sub>Pre</sub> (h) =	3.75	ft
Top of Wall =	132.61	
Freeboard =	0.89	ft

## APPENDIX C

### SYSTEM MAP AND MODELING RESULTS

## **1. EXISTING CONDITIONS (PREDEVELOPMENT)**



SDMH 2B  
RIM 136.00 (RESET)  
INV 125.35

PIPE 2A  
446 LF 27"  
RCP @ 0.42%

SDMH 1C  
RIM 133.64  
INV 127.24

PIPE 1C  
43 LF 27"  
RCP @ 0.0%

SDDI 0B  
RIM 132.69  
INV 127.95

PIPE 2B  
30 LF 27"  
RCP @ 0.6%

ASSUMED OUTFALL  
INV 125.17  
WATER EL 127.42

SDDI 2A  
RIM 132.86  
INV 127.24

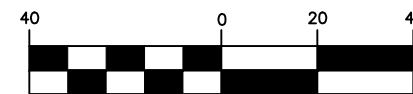
PIPE 0B  
89 LF 24"  
RCP @ 0.8%

PIPE 0A  
67 LF 15"  
RCP @ 1.2%

SDDI 0A  
RIM 133.20  
INV 130.27

EXISTING OFFSITE DRAINAGE SYSTEM MAP

GRAPHIC SCALE



( IN FEET )  
1 inch = 40 ft.

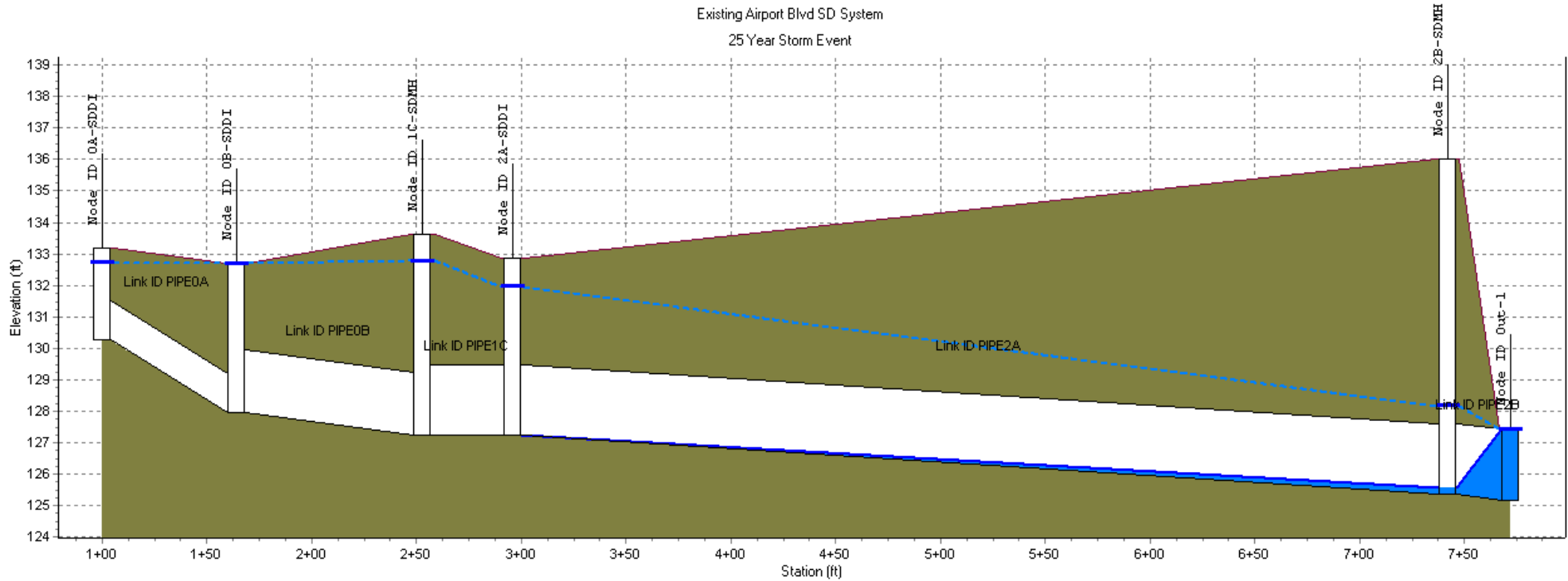
**BOWMAN & WILLIAMS**

CONSULTING CIVIL ENGINEERS  
AND LAND SURVEYORS

3949 RESEARCH PARK CT., STE. 100, SOQUEL, CA 95073  
(831) 426-3560

SCALE 1" = 40'	JOB NO.
DATE	DWG NAME
DRAWN	FILE NO.

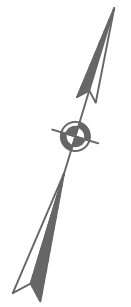
Existing Airport Blvd SD System  
25 Year Storm Event



Node ID:	0A-SDDI	0B-SDDI	1C-SDMH	2A-SDDI		2B-SDMH	Out-1
Rim (ft):	133.20	132.69	133.64	132.86		136.00	
Invert (ft):	130.27	127.95	127.24	127.24		125.35	125.17
Min Pipe Cover (ft):	1.68	2.74	4.15	3.37		8.40	
Max HGL (ft):	132.71	132.69	132.78	131.94		128.16	127.42
Link ID:	PIPE0A	PIPE0B	PIPE1C		PIPE2A		PIPE2B
Length (ft):	64.00	89.00	43.00		446.00		30.00
Dia (ft):	1.25	2.00	2.25		2.25		2.25
Slope (ft/ft):	0.0363	0.0080	0.0000		0.0042		0.0060
Up Invert (ft):	130.27	127.95	127.24		127.24		125.35
Dn Invert (ft):	127.95	127.24	127.24		125.35		125.17
Max Q (cfs):	1.27	4.31	22.96		22.96		22.96
Max Vel (ft/s):	3.81	1.37	5.77		5.77		5.77
Max Depth (ft):	1.25	2.00	2.25		2.25		2.25



## **2. ROPER PROPOSED DEVELOPMENT**



SDMH 2B  
RIM 136.00 (RESET)  
INV 125.35

PIPE 2A  
446 LF 27"  
RCP @ 0.42%

SDMH 1C  
RIM 133.64  
INV 127.24

PIPE 1C  
43 LF 27"  
RCP @ 0.0%

PIPE 2B  
30 LF 27"  
RCP @ 0.6%

ASSUMED OUTFALL  
INV 125.17  
WATER EL 127.42

SDDI 2A  
RIM 132.86  
INV 127.24

PIPE 1B  
64 LF 15"  
RCP @ 0.5%

(P) SDDI 1B  
GR 133.80  
INV 128.70

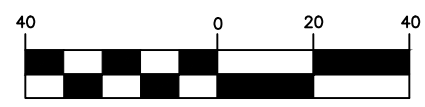
PIPE 1A  
12 LF 15"  
RCP @ 6.7%

(P) SDDI 1A  
GR 134.0  
INV 129.50

BIORETENTION AND  
DETENTION 2870 SF  
(1.5 FT GRAVEL  
DETENTION)  
4.6 IN ORIFICE

ROPER OFFSITE DRAINAGE SYSTEM MAP

GRAPHIC SCALE



( IN FEET )  
1 inch = 40 ft.

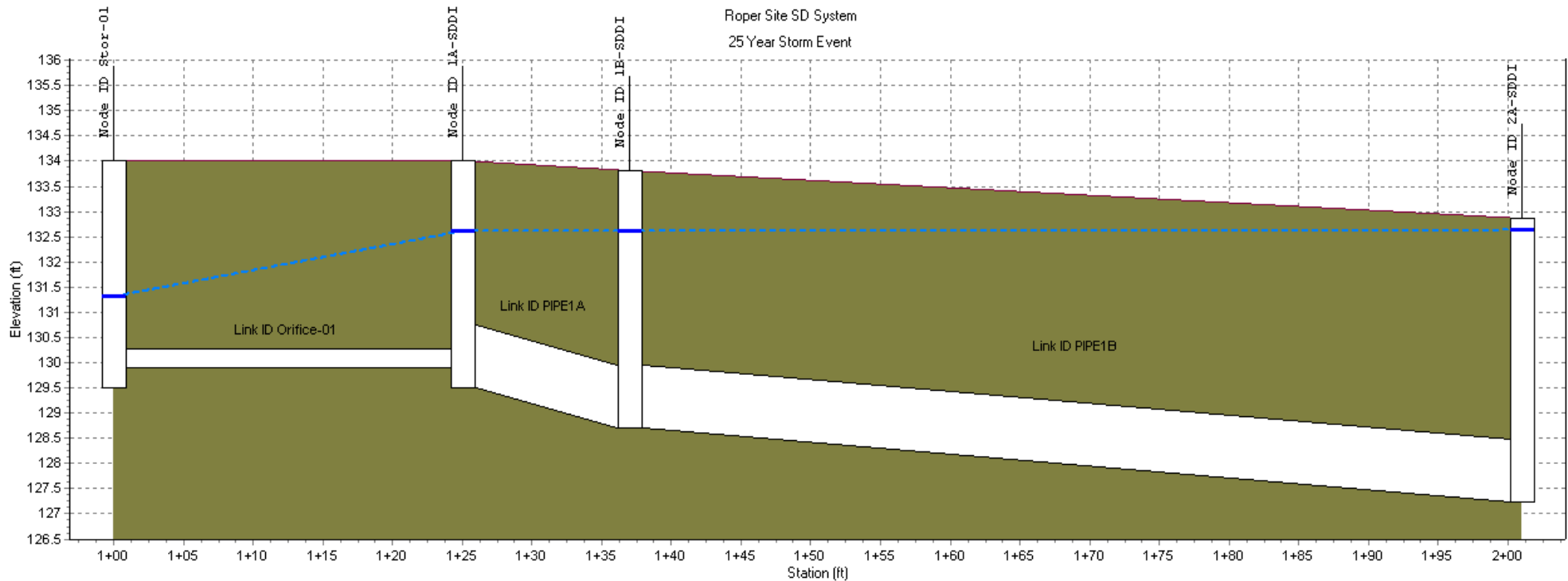
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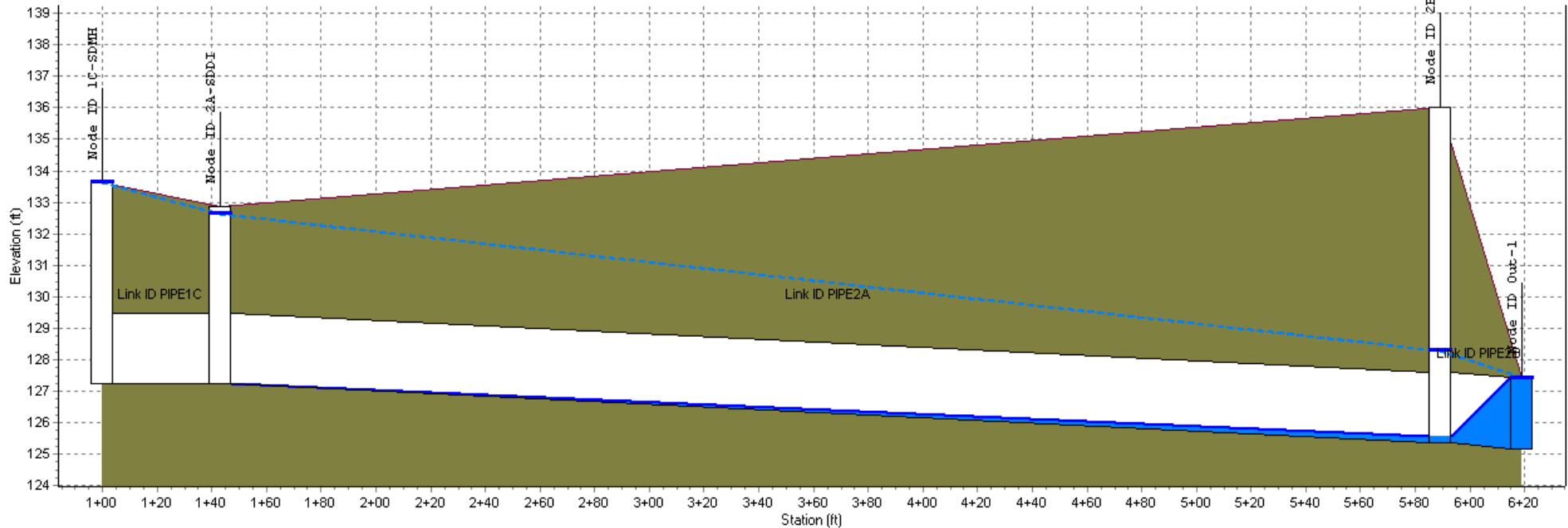
SCALE 1" = 40'	JOB NO.
DATE	DWG NAME
DRAWN	FILE NO.

Roper Site SD System  
25 Year Storm Event



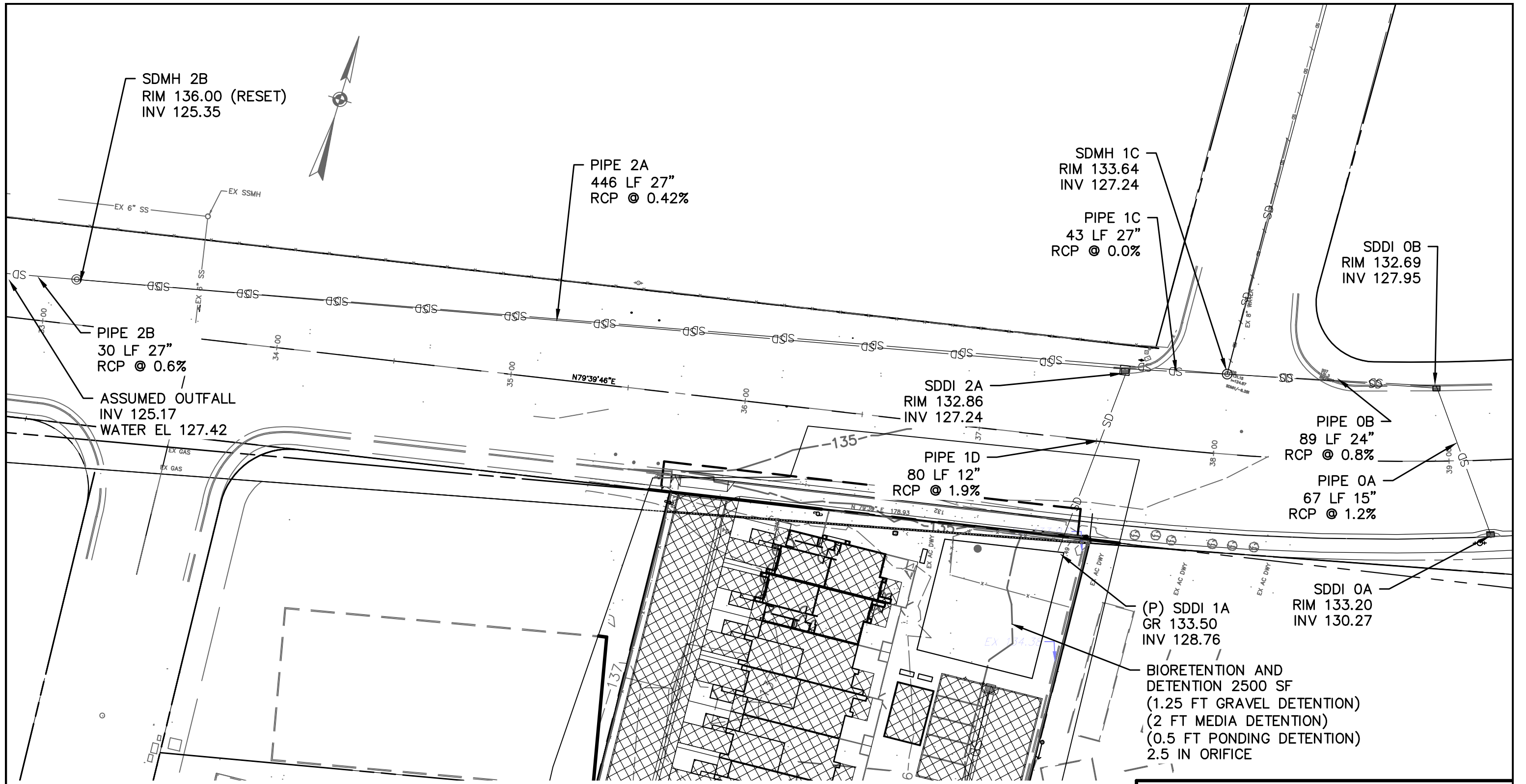
Node ID:	Stor-01	1A-SDDI	1B-SDDI	2A-SDDI
Rim (ft):	134.00	134.00	133.80	132.86
Invert (ft):	129.50	129.50	128.70	127.24
Min Pipe Cover (ft):		0.00	3.85	3.37
Max HGL (ft):	131.31	132.62	132.62	132.63
Link ID:	Orifice-01	PIPE1A	PIPE1B	
Length (ft):		12.00	64.00	
Dia (ft):	0.39	1.25	1.25	
Slope (ft/ft):		0.0667	0.0228	
Up Invert (ft):	129.89	129.50	128.70	
Dn Invert (ft):	129.89	128.70	127.24	
Max Q (cfs):	0.73	1.07	1.15	
Max Vel (ft/s):	0.00	4.41	3.17	
Max Depth (ft):	0.00	1.25	1.25	

Roper Airport Blvd SD System  
25 Year Storm Event



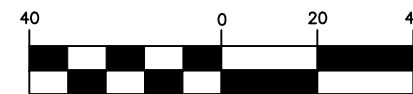
Node ID:	1C-SDMH	2A-SDDI			2B-SDMH	Out-1
Rim (ft):	133.64	132.86			136.00	
Invert (ft):	127.24	127.24			125.35	125.17
Min Pipe Cover (ft):	4.15	3.37			8.40	
Max HGL (ft):	133.64	132.63			128.27	127.42
Link ID:	PIPE1C		PIPE2A		PIPE2B	
Length (ft):	43.00		446.00		30.00	
Dia (ft):	2.25		2.25		2.25	
Slope (ft/ft):	0.0000		0.0042		0.0060	
Up Invert (ft):	127.24		127.24		125.35	
Dn Invert (ft):	127.24		125.35		125.17	
Max Q (cfs):	25.36		24.65		24.65	
Max Vel (ft/s):	6.38		6.20		6.20	
Max Depth (ft):	2.25		2.25		2.25	

### **3. MODIFIED PROPOSED DEVELOPMENT**



**MODIFIED OFFSITE DRAINAGE SYSTEM MAP**

**GRAPHIC SCALE**



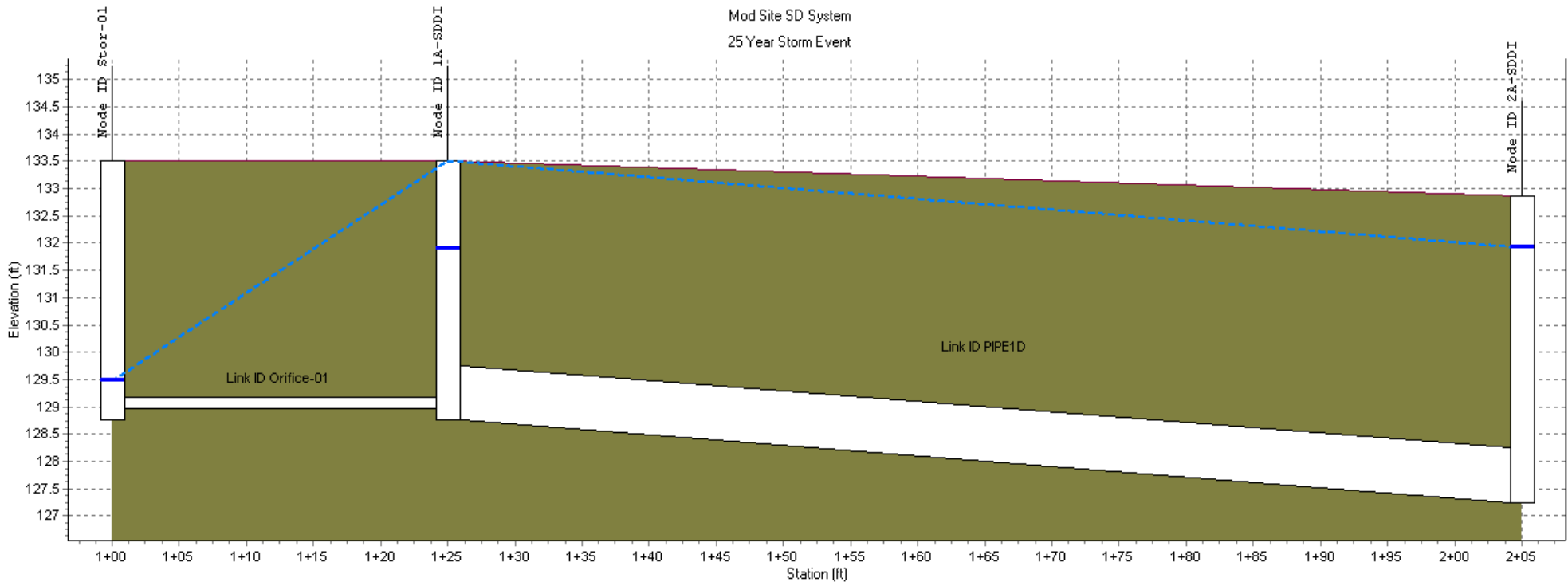
( IN FEET )  
1 inch = 40 ft.

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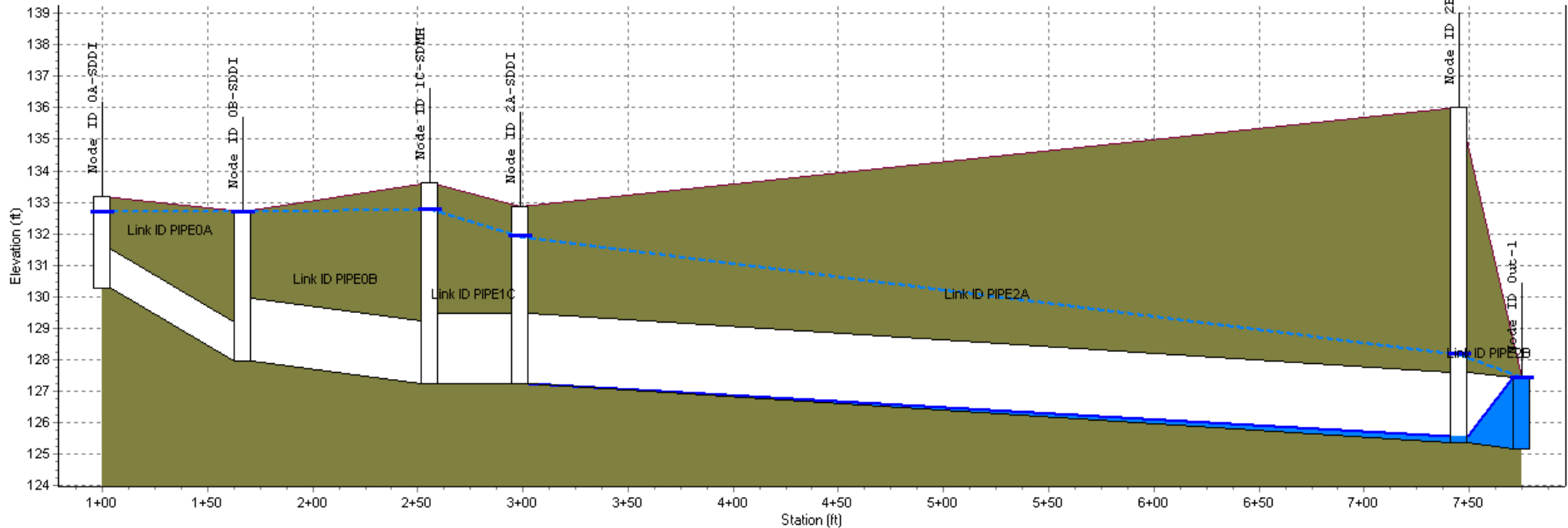
3949 RESEARCH PARK CT., STE. 100, SOQUEL, CA 95073  
(831) 426-3560

SCALE 1" = 40'	JOB NO.
DATE	DWG NAME
DRAWN	FILE NO.



Node ID:	Stor-01	1A-SDDI	2A-SDDI
Rim (ft):	133.50	133.50	132.86
Invert (ft):	128.76	128.76	127.24
Min Pipe Cover (ft):		0.00	3.37
Max HGL (ft):	129.48	133.50	131.92
Link ID:	Orifice-01		PIPE1D
Length (ft):			80.00
Dia (ft):	0.21		1.00
Slope (ft/ft):			0.0190
Up Invert (ft):	128.96		128.76
Dn Invert (ft):	128.96		127.24
Max Q (cfs):	0.30		1.43
Max Vel (ft/s):	0.00		1.88
Max Depth (ft):	0.00		1.00

Mod Airport Blvd SD System  
25 Year Storm Event



Node ID:	0A-SDDI	0B-SDDI	1C-SDMH	2A-SDDI		2B-SDMH	Out-1
Rim (ft):	133.20	132.69	133.64	132.86		136.00	
Invert (ft):	130.27	127.95	127.24	127.24		125.35	125.17
Min Pipe Cover (ft):	1.68	2.74	4.15	3.37		8.40	
Max HGL (ft):	132.69	132.69	132.77	131.92		128.15	127.42
Link ID:	PIPE0A	PIPE0B	PIPE1C		PIPE2A		PIPE2B
Length (ft):	67.00	89.00	43.00		446.00		30.00
Dia (ft):	1.25	2.00	2.25		2.25		2.25
Slope (ft/ft):	0.0346	0.0080	0.0000		0.0042		0.0060
Up Invert (ft):	130.27	127.95	127.24		127.24		125.35
Dn Invert (ft):	127.95	127.24	127.24		125.35		125.17
Max Q (cfs):	0.92	4.10	23.17		22.91		22.91
Max Vel (ft/s):	3.55	1.30	5.83		5.76		5.76
Max Depth (ft):	1.25	2.00	2.25		2.25		2.25