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# Preliminary Hydrology Report

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**PRELIMINARY HYDROLOGY STUDY**

**FOR**

**TORREY CREST**
**TENTATIVE MAP / COASTAL DEVELOPMENT PERMIT / DESIGN REVIEW**
**1220-1240 MELBA ROAD / 1190 ISLAND VIEW LANE**

**CASE NUMBERS: MULTI-004309-2021; SUB-004310-2021; DR-004311-2021; CDPNF-004312-2021; CPP-004313-2021; SRVRQST-004316-2021**

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# 1.0 EXECUTIVE SUMMARY

## 1.1 Introduction

This Preliminary Hydrology Study for the proposed Torrey Crest development at 1220-1240 Melba Road and 1190 Island View Lane in the City of Encinitas has been prepared to analyze the hydrologic and hydraulic characteristics of the existing and proposed project site. This report intends to present both the methodology and the calculations used for determining the runoff from the project site in both the pre-developed (existing) conditions and the post-developed (proposed) conditions produced by the 100-year, 6-hour storm. For hydromodification management and compliance including analysis of the 2-year, 6-hour storm event up to the 10-year, 6-hour storm event, refer to the project Storm Water Quality Management Plan (SWQMP) prepared by Pasco, Laret, Suiter & Associates.

## 1.2 Existing Conditions

The subject property is located along Melba Road just south of Oak Crest Middle School in the City of Encinitas. The site is zoned Residential 3 (R-3) and is bound by single-family residential developments to the east and west. Oak Crest Middle School borders the subject property to the north and Melba Road to the south. Existing parcels (APN's 259-181-03, & -04-00) at the northwest corner of the property also contain panhandle portions that connect to the Balour Drive right-of-way further west. The existing site consists single-family residences, most of which are currently occupied, as well as hardscape and landscape surface improvements typical of this type development and the surrounding neighborhood. The site is located within the Batiquitos Lagoon Hydrologic Sub-Area of the San Marcos Creek Hydrologic Area within the Carlsbad Watershed (904.51).

The site itself contains 34 feet of elevation change within the proposed disturbed area. An existing single-family residence and structures toward the center-north portion of the property sit on the property's high point, with drainage falling away in all directions from this location. Existing drainage can be considered urban but runoff primarily drains via sheet flow as there do not appear to be any existing onsite storm drain.

While the site appears to ultimately discharge to two major watersheds and receiving bodies, runoff in the existing condition discharges from the property from 5 main locations (Drainage basins EX-1 through -5). The two discharge locations that eventually are routed to Moonlight State Beach are Drainage basins EX-1 and EX-2. Drainage basin EX-1 discharges from the southwest corner of the property to Melba Road, where it continues west past the intersection of Balour Drive to a low spot at the intersection of Melba Road and Evergreen Drive near Ocean Knoll Elementary. From here, it is routed northwest through the canyon north, eventually reaching infrastructure in Encinitas Boulevard. Drainage basin EX-2 appears to leave the site from the northwest and along Island View Lane (heading west to Balour Drive). Once in Balour Drive, it is routed south to the intersection of Guadalajara Drive before continuing west to an existing curb inlet located at Guadalajara Drive and Avenida de San Clemente. The portion of the subject property under Island View Lane, a 15-ft x 690-ft parcel, is undisturbed by the project and has been excluded from this analysis. Runoff leaving to the west along both Melba Road and Island View Lane continue downstream towards Encinitas Boulevard, ultimately draining to the Pacific Ocean via Moonlight State Beach.

The remaining discharge locations from the property (EX-3, EX-4, and EX-5) are ultimately routed to San Marcos Creek and the Batiquitos Lagoon. Drainage basin EX-3 discharges to the northeast corner of the site towards Witham Road into an existing brow ditch within a public drainage easement. The ditch drains to the north through neighboring properties before outletting via an 18" storm drain connected to a curb outlet in a water line easement to the Witham Road curb face, where it further continues north to a storm drain inlet at Witham Road and Beechtree Drive. Drainage basin EX-4 discharges in a similar situation at the northeast corner, but south of the existing drainage ditch, where it travels through the adjacent properties, heads south on Witham Road and east on Crest Drive, and enters a curb inlet at the Hickoryhill Drive intersection. Lastly, basin EX-5 discharges east of the property onto adjacent lots and eventually makes its way down to Crest Drive to confluence with basin EX-4. Runoff leaving the site to the northeast towards Witham Road as well as the drainage reaching Crest Drive eventually confluence in the storm drain infrastructure at the intersection of Encinitas Boulevard with N. El Camino Real. This system ultimately continues to route drainage north to an outlet to the natural Encinitas Creek channel on the north side of Garden View Lane. This channel then eventually discharges into San Marcos Creek, a tributary of the Batiquitos Lagoon.

Based on an analysis of the existing topography, the subject property accepts offsite runon from a portion of some adjacent properties to the east, both 1250 and 1274 Melba Road, which is conveyed onto the property and discharges at the Melba Road curb face along with the drainage basin EX-1 outlet. The remainder of 1250 and 1274 Melba Road, as well as other properties further east, drain away from the subject property and towards Crest Drive. Existing slopes and improvements for Oak Crest Middle School to the north prevent any discharge onto the site via the northern property boundary, and Melba Road and the properties to the west are at lower elevations downstream. The limits of the analysis can be contained to the area within the property boundary plus the applicable portions of 1250 and 1274 Melba Road, because the site sits on a local high point topographically compared to most of the surrounding properties.

The existing site is comprised of 6.646 gross acres and is 18.4% impervious. In accordance with Section 6.202 of the City of Encinitas Engineering Design Manual (EDM), hydrologic soil group D is assumed for this analysis. Additionally, the Storm Water Management Investigation prepared by the project's geotechnical engineer determined that the surface layer should be classified as soil group D. Runoff coefficients for each sub-drainage basin were determined from section 6.203.1 of the City of Encinitas EDM, using a value of 0.45 for all pervious areas. Using the Rational Method Procedure outlined in the San Diego County Hydrology Manual, a peak flow rate and time of concentration were calculated for each of the existing drainage basins for the 100-year, 6-hour storm event. Table 1 below summarizes the results of the Rational Method calculations.

| EXISTING DRAINAGE FLOWS | | | |
|---|---|---|---|
| DRAINAGE AREA | DRAINAGE AREA (ACRES) | $Q_{100}$ (CFS) | $I_{100}$ (IN/HR) |
| EX-1 | 3.32 Ac | 8.46 | 4.81 |
| EX-2 | 0.75 Ac | 2.02 | 4.99 |
| EX-3 | 0.99 Ac | 2.23 | 5.01 |
| EX-4 | 0.65 Ac | 1.58 | 5.06 |
| EX-5 | 0.96 Ac | 2.59 | 4.57 |

**Table 1. Existing Condition Peak Drainage Flow Rates**

Table 1 above lists the peak flow rates for the project site in the existing condition for the respective rainfall events. Refer to pre-project hydrology calculations included in Section 3.1 of this report for a detailed analysis of the existing drainage basin, as well as a pre-project hydrology node map included in the appendix of this report for pre-project drainage basin delineation and discharge locations leaving the subject property.

### 1.3 Proposed Project

The proposed project includes the demolition of all existing onsite improvements and the construction of 30 new residential lots plus two (2) private road lots, 30 new single-family detached homes plus one proposed ADU, along with miscellaneous surface, grading, and utility improvements typical of this type of construction. A new private road will provide vehicular access to each lot, entering the property off of Melba Road to the south, with an emergency vehicle turnaround in the cul-de-sac to the north. The proposed lot pad elevations range from 378.5 in the southwest part of the property to 399.0 toward the northern portion of the site as can be seen on the Preliminary Grading Plan submitted as part of the Tentative Map / Coastal Development Permit / Design Review application under separate cover.

Similar to the existing condition, the project site will continue to ultimate discharge to two major watersheds and receiving bodies. Pre-project, 61% of the gross surface area drains to Moonlight State Beach (EX-1, EX-2, and the undisturbed area under Island View Lane). Post-project, 61% of the gross surface area continues to drain to Moonlight State Beach (PR-1, PR-2, and the undisturbed area under Island View Lane). Pre-project, 39% of the gross surface area continues to drain to Batiquitos Lagoon (EX-3, EX-4, EX-5). Post project, 39% of the gross surface area continues to drain to Batiquitos Lagoon (PR-3 and PR-4). Additionally, two (2) small self-mitigating areas that drain offsite in the rear yards of Lots 1 and 26 to accommodate existing topography around large Torrey Pine trees have been included in the onsite analysis.

Runoff from the post-project condition discharges from the property at two main locations: PR-1 to Melba Road via the southwest corner of the property and PR-4 to Witham Road via the northeast corner of the property. This will serve to minimize cross-lot drainage onto neighboring properties as much as feasible and help alleviate existing drainage concerns on the neighboring properties. Two (2) small (both less than a tenth of an acre) self-mitigating areas will remain post-project: PR-2, PR-3 (area east of Witham Basin). Two (2) small self-mitigating areas that drain offsite in the rear yards of Lots 1 and 26 to accommodate existing topography around large Torrey Pine trees have been included in the onsite analysis for PR-1.

As outlined above, while the pre-project and post-project surface areas remain consistent, the composition of the existing versus proposed drainage areas do not map directly. The following is a description of which proposed drainage area each existing drainage area drains to:

EX-1: The majority drains to PR-1, while a small portion drains to PR-4. Runon from a portion of 1250 and 1274 Melba Road – delineated as basin OFF-1 – will be conveyed directly to the Melba Road curb face, bypassing the subject property and any treatment. A small self-mitigating area that drains offsite in the rear yard of lot 1 to accommodate existing topography around two (2) large Torrey Pine trees has been included in the onsite analysis for PR-1. The purpose of including this area – considered as part of PR-1 – is to adequately size the detention system to treat this area in the event it eventually drains to the front of Lot 1. The self-mitigating area on Lot 1 drains in a similar manner pre- and post-project.

EX-2: The majority drains to PR-4, a small portion drains to PR-2. A proper drainage channel does not exist along Island View Lane to the northwest, so the project avoids discharging water to the basin EX-2 outlet location other than the small self-mitigating area, PR-2. This PR-2 drainage basin is a small (less than a tenth of an acre) self-mitigating area.

EX-3: The majority drains to PR-4. A small portion drains to PR-3, a small self-mitigating area that drains in a similar manner pre- and post-project.

EX-4: All of runoff drains to PR-4.

EX-5: The majority drains to PR-1, while a small portion drains to PR-4. A small self-mitigating area that drains offsite in the rear yard of lot 26 to accommodate existing topography around a large Torrey Pine tree has been included in the onsite analysis for PR-1. The purpose of including this area – considered as part of PR-1 – is to adequately size the detention system to treat this area in the event it eventually drains to the front of Lot 26. The self-mitigating area on Lot 26 drains in a similar manner pre- and post-project.

For the 39% of the site that drains to Batiquitos Lagoon, 38% of that part drains via a brow ditch in a public drainage easement to an existing 18” storm drain in a water easement to Witham Road where it travels north on the west side of the street to the intersection of Witham Road and Beechtree Drive. The remaining 62% of the water that flows from the project site to Batiquitos Lagoon confluences at the intersection of Witham Road and Crest Drive where it travels east on the north side of the street to the intersection of Crest Drive and Hickoryhill Drive.

It was the strong recommendation of the City of Encinitas engineering staff to not continue to discharge a material amount of stormwater into the existing brow ditch conveyance system in the post-project condition that currently takes storm water from EX-3. This public drainage easement and ditch run through the rear yards of several properties along Witham Road, and present access and maintenance challenges for the City of Encinitas Public Works Department to ensure proper drainage and conveyance over the long term. Section 6.201 of the City of Encinitas Engineering Design Manual (EDM) provides the City Engineer discretion to eliminate existing cross-lot drainage if an alternate solution is feasible. Existing drainage areas EX-4 and EX-5 drain across adjacent lots.

To improve these existing conditions the applicant negotiated a new easement area for storm water across an existing lot on Witham Road at 240 Witham Road. The purchase of this new easement allows the project to propose a way for stormwater to continue to flow to Batiquitos Lagoon. It allows the project to minimize the diversion of stormwater along the way to Batiquitos Lagoon because the easement area drains to a part of Witham Road that flows east to Crest Drive where it confluences with the curb that conveys 62% of the existing stormwater from the project site toward Batiquitos Lagoon (EX-4 and EX-5). The project proposes to route treated runoff through an 18” HDPE private storm drain pipe with watertight joints to two modified 3-inch by 3-feet SDRSD D-25 curb outlet connected to a SDRSD D-9 cleanout. To accommodate the elimination of most existing cross-lot drainage conditions, all lots aside from the self-mitigating areas will be graded to drain from the rear to the face of the private road. Once runoff reaches the private road the grading of the road will direct the water to proposed curb inlets adjacent to the two proposed biofiltration and detention systems. Runoff from PR-1 and PR-4 will outlet at the curb faces along Melba Road and Witham Road respectively.

The onsite HMP-sized flow-control biofiltration detention basins and BMP systems (“Basin”) provides pollutant control as well as hydromodification management and mitigation of the 100-year, 6-hour storm event peak flow rate. The Basins will serve to capture, treat, and detain storm water and are composed of a cross-section of an engineered soil, storage layer, and hydraulic mulch on the surface. Runoff from higher frequency, lower intensity storm events will first be filtered through the Basin section and enter a detention system located beneath the Basin. Basin PR-1 biofiltration basin is equipped with five Brooks Boxes: one 12” x 12”, one 18” x 18”, one 24” x 24” and two 36” x 36” with two 3” x 19” midflow orifices. Basin PR-2 biofiltration is equipped with six Brooks Boxes: five 36” x 36” and one 24” x 24” with three 3” x 23” midflow orifices. The basins emergency outlet structures will convey stormwater during high intensity storm events, providing additional capacity and sized to convey the unmitigated peak flows assuming a 50% clogging factor.

Similar to the existing condition, runoff leaving PR-1 in the southwest corner of the site continues downstream, entering existing public storm drain infrastructure and eventually reaching storm drain improvements in Encinitas Boulevard north of St. John School before out letting in Moonlight State Beach. Drainage area EX-2 in the existing condition was excluded from the peak flow analysis in the proposed condition to ensure discharge leaving the property to Melba Road and ultimately draining to Moonlight State Beach is mitigated to the peak flow draining to that watershed determined in the pre-project condition.

Similar to the existing condition, runoff leaving from PR-4 basin the northeast corner of the site continues downstream, entering existing public storm drain improvements in Crest Drive near Hickoryhill Drive that connect to improvements in El Camino Real before out letting to Batiquitos Lagoon. As discussed in the existing conditions section, runoff from EX-3 confluences with runoff from EX-4 and EX-5 in the public buried storm drain infrastructure at the intersection of Encinitas Boulevard and N. El Camino Real. The proposed routing of runoff from EX-3 to Witham Road at Crest Drive results in a micro diversion as runoff will continue downstream the same way as the existing condition once runoff reaches the intersection of Encinitas Boulevard and N. El Camino Real; therefore, runoff from EX-3 has been included in the analysis of basin PR-4. Runoff basin EX-2 will be excluded from the drainage analysis in the proposed condition to ensure discharge leaving the property to Witham Road and ultimately draining to Batiquitos Lagoon is mitigated to the peak flow draining to the watershed determined in the pre-project condition.

Based on the proposed amount of pervious and impervious surfaces, runoff coefficients for the proposed project site were determined based on Section 6.203.1 of the City of Encinitas Engineering Design Manual. This analysis includes an anticipated future hardscape contingency for each lot to ensure the Basins are sized to handle runoff in the event homeowners want to add patios or other surface improvements. As mentioned in the existing conditions section, per Section 6.202 of the City of Encinitas EDM, hydrologic soil type D is assumed for the proposed condition. Refer to section 3.2 of this report, as well as the post-development hydrology map included in Appendix A, for additional analysis and a summary of runoff coefficients used. Using the Rational Method Procedure outlined in the San Diego County Hydrology Manual, a peak flow rate and time of concentration were calculated for the 100-year, 6-hour storm event for the major drainage basin in the proposed condition. Table 2 below summarizes the results of the Rational Method calculations.

| PROPOSED DRAINAGE FLOWS | | | |
|---|---|---|---|
| DRAINAGE AREA | DRAINAGE AREA (ACRES) | $Q_{100}$ (CFS) | $I_{100}$ (IN/HR) |
| *PR-1 | 4.04 Ac | 15.34 | 5.21 |
| PR-2 | 0.02 Ac | 0.07 | 7.38 |
| PR-3 | 0.02 Ac | 0.06 | 7.38 |
| PR-4 | 2.60 Ac | 8.82 | 4.65 |

**Table 2. Proposed Condition Peak Drainage Flow Rates**

*PR-1 drainage area value includes confluence of PR-1 with OFF-1 at the southwest corner of the site.

Refer to post-development hydrology calculations included in Section 3.2 of this report for detailed analyses of the proposed drainage basin as well as a post-development hydrology node map included in Appendix A of this report for post-development drainage delineation, path of travel, and discharge locations.

Refer to Section 3.3 of this report for a discussion of the detention components of the site. This analysis takes into account the proposed detention, pollutant removal, and hydromodification management facilities proposed onsite. The totality of the detention system as mentioned above includes a pre-treatment biofiltration basin with impermeable liner, proprietary StormTrap detention storage system (or equivalent), or a gravel storage layer. The results of the detention analysis provide a resultant, mitigated peak runoff leaving the site in addition to the detained time to peak (see Appendix B for results of the dynamic detention analysis performed using HydroCAD-10 software). Based on this analysis, the proposed onsite detention facility accommodates the increase in peak runoff generated in the post-project condition, mitigating peak flows to below pre-project conditions. The site has been designed and graded in a way to minimize earthwork to the greatest extent feasible and maintain historic drainage patterns, while also alleviating existing cross-lot drainage concerns and preventing water from entering a substandard drainage conveyance system on the surface just off the northeast corner of the property.

For a discussion regarding hydromodification management requirements and compliance, refer to the project Storm Water Quality Management Plan (SWQMP) under separate cover. An impermeable liner is proposed beneath and along the sides of the Basin cross-sections, as it was deemed infeasible to infiltrate into the underlying topsoil / Very Old Paralic Deposits (Qvop) layer by the project geotechnical engineer.

To comply with City of Encinitas' storm water standards and the Regional Municipal Separate Storm Sewer System (MS4) Permit, the project will implement various source control and site design BMP's required of all development projects. Runoff from proposed hardscape areas will be directed to landscaped areas in an effort to disperse drainage to pervious surfaces. Landscaping will remove sediment and particulate-bound pollutants from storm water and will assist in decreasing peak runoff by slightly increasing the site's overall time of concentration. Additional site design and source control measures will be implemented as applicable.

### 1.4 Conclusions

Based upon the hydrology calculations performed for the project site, there is an increase in peak runoff in the post-project condition compared to the existing condition due to the increase in hardscape without detention. Including the design of the detention system, the post-project peak runoff is less than the pre-project condition. See tables below for a summary of pre- and post-project peak flow rates by drainage area and cumulatively.

| Peak Flow Rate Comparison Table (100 Year, 6 Hour) | | | |
|---|---|---|---|
| Pre-Project | | Post-Project (Unmitigated) | |
| Drainage Area | Peak Flow (CFS) | Drainage Area | Peak Flow (CFS) |
| EX-1 | 8.46 | PR-1 and OFF-1 [portion EX-1; EX-5] | 15.34 |
| EX-2 | 2.02 | PR-2 | 0.07 |
| EX-3 | 2.23 | PR-3 | 0.06 |
| EX-4 | 1.58 | PR-4 [EX-2; EX-3; EX-4; portion EX-1 and EX-5] | 8.82 |
| EX-5 | 2.59 | - | 0.0 |
| TOTAL | 16.88 | TOTAL | 24.29 |

| Peak Flow Rate Comparison Table (100 Year, 6 Hour) | | | |
|---|---|---|---|
| Pre-Project | | Post-Project (Mitigated) | |
| Drainage Area | Peak Flow (CFS) | Drainage Area | Peak Flow (CFS) |
| EX-1 | 8.46 | PR-1 and OFF-1 [portion EX-1; EX-5] | 6.33 |
| EX-2 | 2.02 | PR-2 | 0.07 |
| EX-3 | 2.23 | PR-3 | 0.06 |
| EX-4 | 1.58 | PR-4 [EX-2; EX-3; EX-4; portion EX-1 and EX-5] | 0.18 |
| EX-5 | 2.59 | - | 0.0 |
| TOTAL | 16.88 | TOTAL | 6.64 |

| Offsite Peak Flow Rate Comparison Table (100 Year, 6 Hour) | |
|---|---|
| Description | Peak Flow (CFS) |
| Pre-Project | 16.88 |
| Post-Project (Unmitigated) | 24.29 |
| Post-Project (Mitigated) | 6.64 |

The proposed development and resulting peak runoff will not have an adverse effect on the downstream watershed. It is also worth noting that both of the proposed storm water basins have been designed with additional catch basins – conservatively assuming to reach a level of 50 percent clogging over time - as shown on the project preliminary grading plans under separate cover to continue to mitigate the post-project $Q_{100}$ peak runoff to below the pre-project $Q_{100}$ in the event the basins are not properly maintained over time and drainage through the basin's layers are failing. This design has been incorporated as an additional fail-safe measure to alleviate concerns of the basins not functioning as intended and designed over time.

**1.5 References**

*"San Diego County Hydrology Manual",* revised June 2003, County of San Diego, Department of Public Works, Flood Control Section.

*"San Diego County Hydraulic Design Manual",* revised September 2014, County of San Diego, Department of Public Works, Flood Control Section

"*Engineering Design Manual Chapter 6: Drainage Design Requirements*", revised 2009, City of Encinitas

"*Engineering Design Manual Chapter 7: BMP Design Manual*", revised February 2016, City of Encinitas

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov. Accessed June 16, 2020

"*Storm Water Management Investigation: Torrey Crest, 1220-1240 Melba Road and 1190 Island View Lane Encinitas, California*" revised March 21, 2022 by Geocon, Inc.

# 2.0 METHODOLOGY

## 2.1 Introduction

The hydrologic model used to perform the hydrologic analysis presented in this report utilizes the Rational Method (RM) equation, Q=CIA. The RM formula estimates the peak rate of runoff based on the variables of area, runoff coefficient, and rainfall intensity. The rainfall intensity (I) is equal to:

$$I = 7.44 \times P_6 \times D^{-0.645}$$

Where:

I = Intensity (in/hr)
$P_6$ = 6-hour precipitation (inches)
D = duration (minutes – use Tc)

Using the Time of Concentration (Tc), which is the time required for a given element of water that originates at the most remote point of the basin being analyzed to reach the point at which the runoff from the basin is being analyzed. Rainfall intensity (I) used in the Rational Method calculation is a function of the Time of Concentration (Tc) - it is worth noting that the rainfall intensity equation used in the City of Encinitas is more conservative than methodologies used by other jurisdictions such as the City of San Diego. The RM equation determines the storm water runoff rate (Q) for a given basin in terms of flow (typically in cubic feet per second (cfs) but sometimes as gallons per minute (gpm)). The RM equation is as follows:

$$Q = CIA$$

Where:

Q= flow (in cfs)
C = runoff coefficient, ratio of rainfall that produces storm water runoff (runoff vs. infiltration/evaporation/absorption/etc)
I = average rainfall intensity for a duration equal to the Tc for the area, in inches per hour.
A = drainage area contributing to the basin in acres.

The RM equation assumes that the storm event being analyzed delivers precipitation to the entire basin uniformly, and therefore the peak discharge rate will occur when a raindrop that falls at the most remote portion of the basin arrives at the point of analysis. The RM also assumes that the fraction of rainfall that becomes runoff or the runoff coefficient C is not affected by the storm intensity, I, or the precipitation zone number.

## 2.2 County of San Diego Criteria

As defined by the County Hydrology Manual dated June 2003, the rational method is the preferred equation for determining the hydrologic characteristics of basins up to approximately one square mile in size. The County of San Diego has developed its own tables, nomographs, and methodologies for analyzing storm water runoff for areas within the county. The County has also developed precipitation isopluvial contour maps that show even lines of rainfall anticipated from a given storm event (i.e. 100-year, 6-hour storm).

The County has also illustrated in detail the methodology for determining the time of concentration, in particular the initial time of concentration. The County has adopted the Federal Aviation Agency's (FAA) overland time of flow equation. This equation essentially limits the flow path length for the initial time of concentration to lengths under 100 feet, and is dependent on land use and slope. The time of concentration minimum is 5 minutes per the County of San Diego requirements.

## 2.3 City of Encinitas Standards

One of the variables of the RM equation is the runoff coefficient, C. The runoff coefficient is dependent only to pervious or impervious surfaces, the City of Encinitas has developed runoff coefficients for pervious and impervious surfaces and are to be applied to drainage basins located within the City of Encinitas.

The City of Encinitas has additional requirements for hydrology reports which are outlined in the Grading, Erosion and Sediment Control Ordinance. Please refer to this manual for further details. Additionally, Chapter 6 of the City of Encinitas Engineering Design Manual contains additional information regarding Drainage Design Requirements. Please refer to this manual for further details.

## 2.4 Runoff Coefficient Determination

As stated in section 2.3, the runoff coefficient is dependent only upon surface type, pervious or impervious. Section 6.203.1 of the City of Encinitas Engineering Design Manual outlines the runoff coefficient value to be used for each surface type in hydrology studies. Per Section 6.202 of the City of Encinitas Engineering Design Manual, all hydrology studies shall assume soil group 'D'. Additionally, the project's "Storm Water Management Investigation" by the project geotechnical engineer determined soil group 'D'.

## 2.5 AES Rational Method Computer Model

The Rational Method computer program developed by Advanced Engineering Software (AES) satisfies the County of San Diego design criteria, therefore it is the computer model used for this study. The AES hydrologic model is capable of creating independent node-link models of each interior drainage basin and linking these sub-models together at confluence points to determine peak flow rates. The program utilizes base information input by the user to perform calculations for up to 15 hydrologic processes. The required base information includes drainage basin area, storm water facility locations and sizes, land uses, flow patterns, and topographic elevations. The hydrologic conditions were analyzed in accordance with the 2003 County of San Diego Hydrology Manual, and 2009 City of Encinitas Engineering Design Manual criteria as follows:

| | |
|---|---|
| Design Storm | 100-year, 6-hour |
| 100-year, 6-hour Precipitation | 2.8 inches |
| Rainfall Intensity | Based on the 2003 County of San Diego Hydrology Manual criteria |
| Runoff Coefficient | Weighted Runoff Coefficients per Section 6.203.1 of City of Encinitas Engineering Design Manual |

### 2.5.1 AES Computer Model Code Information

0: Enter Comment
2: Initial Subarea Analysis
3: Pipe/Box/Culvert Travel Time
5: Open Channel Travel Time
7: User-Specified hydrology data at Node
8: Addition of sub-area runoff to Main Stream
10: Copy Main Stream data onto a Memory Bank
11: Confluence Memory Bank data with Main Stream
13: Clear the Main Stream

**Note: AES was used as part of the Rational Method Analysis for this project in the proposed condition.

## 3.0 HYDROLOGY MODEL OUTPUT

### 3.1 Existing Condition Hydrologic Model Output (100-Year Event)

**Pre-Development:**

$Q = CIA$ *Rational Method Equation

$P_{100} = 2.8$ in *100-Year, 6-Hour Rainfall Precipitation

**Total Site**

Total Gross Site = 289,479 sf → 6.65 Acres
Analyzed Area = 283,163 sf → 6.50 Acres
Impervious Area = 42,667 sf → 0.98 Acres
Pervious Area = 240,496 sf → 5.52 Acres

$C_{PRE}$, Weighted Runoff Coefficient,

- 0.45, runoff coefficient for pervious area per EDM 6.203.1
- 0.90, runoff coefficient for impervious area per EDM 6.203.1

**Drainage Basin EX-1**

Basin Area = 144,662 sf → 3.32 Acres
Impervious Area = 24,387 sf → 0.56 Ac
Pervious Area = 120,275 sf → 2.76 Ac

- 0.45, runoff coefficient for pervious area per EDM 6.203.1
- 0.90, runoff coefficient for impervious area per EDM 6.203.1

$$C_{PRE} = \frac{0.9 \times 24{,}387 \text{ sf} + 0.45 \times 120{,}275 \text{ sf}}{144{,}662 \text{ sf}} = 0.53$$

$C_{PRE} = 0.53$

$Tc = Ti + Tt$

$Ti =$ **7.0 min** (5% for $L_1 = 100'$) *Per SDCHM Table 3-2 for ~2.9 DU/AC

$Tt \Rightarrow L_2 = 470'$, $\Delta E = 27'$

$Tt = [\{11.9(L_2/5{,}280)^3\}/\Delta E]^{0.385}$

$Tt = [\{11.9*(470/5{,}280)^3\}/27]^{0.385} = 0.045$

$Tt = 0.045 \times 60 =$ **2.7 min**

$Tc = 7.0$ min + 2.7 min = <u>**9.7 min**</u>

$I = 7.44 \times P_{100} \times 9.7^{-0.645}$

$I = 7.44 \times 2.8 \times 9.7^{-0.645} \approx$ <u>4.81 in/hr</u>

$Q = C_{PRE} \times I_{100} \times A$ *Q based on Rational Method equation

<u>Exiting site to SW and discharging on the surface to Melba Road</u>

**$T_C$ = <u>9.7 min</u>** (See above calculation for Tc)

**$Q_{100}$ = <u>8.46 cfs</u>** ($Q_{100} = 0.53 \times 4.81$ in/hr $\times 3.32$ Ac)

**Drainage Basin EX-2**
Basin Area = 32,639 sf $\rightarrow$ 0.75 Acres
Impervious Area = 6,511 sf $\Rightarrow$ 0.15 Ac
Pervious Area = 26,128 sf $\Rightarrow$ 0.60 Ac

- 0.45, runoff coefficient for pervious area per EDM 6.203.1
- 0.90, runoff coefficient for impervious area per EDM 6.203.1

$$C_{PRE} = \frac{0.9 \times 6{,}511 \text{ sf} + 0.45 \times 26{,}128 \text{ sf}}{32{,}639 \text{ sf}} = 0.54$$

$C_{PRE} = 0.54$

Tc = Ti + Tt
Ti = **8.1 min** (3% for $L_1$ = 100') *Per SDCHM Table 3-2 for ~2.9 DU/AC
Tt => $L_2$ = 145', $\Delta E$ = 8'

$Tt = [\{11.9(L_2/5{,}280)^3\}/\Delta E]^{0.385}$
$Tt = [\{11.9(145/5{,}280)^3\}/8]^{0.385} = 0.018$
Tt = 0.018 x 60 = **1.1 min**

Tc = 8.1 min + 1.1 min = **<u>9.2 min</u>**

$I = 7.44 \times P_{100} \times 9.2^{-0.645}$
$I = 7.44 \times 2.8 \times 9.2^{-0.645} \approx$ <u>4.99 in/hr</u>

$Q = C_{PRE} \times I_{100} \times A$ *Q based on Rational Method equation

<u>Exiting site to NW and discharging to adjacent driveway on Island View Lane</u>
**$T_C$ = <u>9.2 min</u>** (See above calculation for Tc)
**$Q_{100}$ = <u>2.02 cfs</u> (**$Q_{100}$ = 0.54 x 4.99 in/hr x 0.75 Ac**)**

**Drainage Basin EX-3**
Basin Area = 43,278 sf $\rightarrow$ 0.993 Acres
Impervious Area = 55 sf $\Rightarrow$ 0.003 Ac
Pervious Area = 43,223 sf $\Rightarrow$ 0.99 Ac

- 0.45, runoff coefficient for pervious area per EDM 6.203.1
- 0.90, runoff coefficient for impervious area per EDM 6.203.1

$$C_{PRE} = \frac{0.9 \times 55 \text{ sf} + 0.45 \times 43{,}223 \text{ sf}}{43{,}278 \text{ sf}} = 0.45$$

$C_{PRE} = 0.45$

Tc = Ti + Tt

Ti = **7.0 min** (5% for $L_1$ = 100’) *Per SDCHM Table 3-2 for ~2.9 DU/AC
Tt => $L_2$ = 346’, ΔE = 19.5’
Tt = [{11.9($L_2$/5,280)^3}/ΔE]^0.385
Tt = [{11.9*(330/5,280)^3}/18.5]^0.385 = 0.034
Tt = 0.034 x 60 = **2.1 min**
Tc = 7.0 min + 2.1 min = **<u>9.1 min</u>**

I = 7.44 x $P_{100}$ x $9.1^{-0.645}$
I = 7.44 x 2.8 x $9.1^{-0.645}$ ≈ <u>5.01 in/hr</u>

Q = $C_{PRE}$ x $I_{100}$ x A *Q based on Rational Method equation

<u>Exiting site to NE and entering adjacent brow ditch to convey runoff north</u>
**$T_C$** = **<u>9.1 min</u>** (See above calculation for Tc)
**$Q_{100}$ = <u>2.01 cfs</u> (**$Q_{100}$ = 0.45 x 5.01 in/hr x 0.993 Ac**)**

**<u>Drainage Basin EX-4</u>**
Basin Area = 28,314 sf → 0.65 Acres
Impervious Area = 1,658 sf ➔ 0.04 Ac
Pervious Area = 26,656 sf ➔ 0.61 Ac

- 0.45, runoff coefficient for pervious area per EDM 6.203.1
- 0.90, runoff coefficient for impervious area per EDM 6.203.1

$$C_{PRE} = \frac{0.9 \times 1{,}658 \text{ sf} + 0.45 \times 26{,}656 \text{ sf}}{28{,}314 \text{ sf}} = 0.48$$

$C_{PRE}$ = 0.48

Tc = Ti + Tt
Ti = **7.0 min** (5% for $L_1$ = 100’) *Per SDCHM Table 3-2 for ~2.9 DU/AC
Tt => $L_2$ = 330’, ΔE = 20.1’
Tt = [{11.9($L_2$/5,280)^3}/ΔE]^0.385
Tt = [{11.9*(330/5,280)^3}/20.1]^0.385 = 0.033
Tt = 0.033 x 60 = **2.0 min**
Tc = 7.0 min + 2.0 min = **<u>9.0 min</u>**

I = 7.44 x $P_{100}$ x $9.0^{-0.645}$
I = 7.44 x 2.8 x $9.0^{-0.645}$ ≈ <u>5.06 in/hr</u>

Q = $C_{PRE}$ x $I_{100}$ x A *Q based on Rational Method equation

<u>Exiting site to NE and entering adjacent brow ditch to convey runoff north</u>
**$T_C$** = **<u>9.0 min</u>** (See above calculation for Tc)
**$Q_{100}$ = <u>1.58 cfs</u> (**$Q_{100}$ = 0.48 x 5.06 in/hr x 0.65 Ac**)**

**<u>Drainage Basin EX-5</u>**
Basin Area = 41,763 sf → 0.96 Acres
Impervious Area = 12,557 sf ➔ 0.29 Ac
Pervious Area = 29,206 sf ➔ 0.67 Ac

- 0.45, runoff coefficient for pervious area per EDM 6.203.1
- 0.90, runoff coefficient for impervious area per EDM 6.203.1

$$C_{PRE} = \frac{0.9 \times 12{,}557 \text{ sf} + 0.45 \times 29{,}206 \text{ sf}}{41{,}763 \text{ sf}} = 0.59$$

$C_{PRE} = 0.59$

Tc = Ti + Tt
Ti = **8.1 min** (3% for $L_1$ = 100') *Per SDCHM Table 3-2 for ~2.9 DU/AC
Tt => $L_2$ = 295', ΔE = 8.5'

$$Tt = [\{11.9 * (L_2/5{,}280)^3\} / \Delta E]^{0.385}$$
$$Tt = [\{11.9 * (295/5{,}280)^3\} / 8.5]^{0.385} = 0.041$$

Tt = 0.041 x 60 = **2.4 min**
Tc = 8.1 min + 2.4 min = **<u>10.5 min</u>**

$I = 7.44 \times P_{100} \times 10.5^{-0.645}$
$I = 7.44 \times 2.8 \times 10.5^{-0.645} \approx$ <u>4.57 in/hr</u>

$Q = C_{PRE} \times I_{100} \times A$ *Q based on Rational Method equation

<u>Entering existing catch basin at southwest corner of site</u>
**$T_C$ = <u>10.5 min</u>** (See above calculation for Tc)
**$Q_{100}$ = <u>2.59 cfs</u> (**$Q_{100}$ = 0.59 x 4.07 in/hr x 0.96 Ac**)**

***Summary of Pre-Project Flows***

**Peak Runoff Generated (Moonlight Beach Watershed)**
Total Area = 177,301 sf (EX-1 + EX-2) → 4.07 Acres
$\mathbf{Q_{100}} = \underline{\mathbf{Q_{EX\text{-}1} + Q_{EX\text{-}2}}}$
= **10.48 cfs**

**Peak Runoff Generated (San Marcos Creek / Batiquitos Lagoon Watershed)**
Total Area = 113,355 sf (EX-3 + EX-4 + EX-5) → 2.60 Acres
$\mathbf{Q_{100}} = \underline{\mathbf{Q_{EX\text{-}3} + Q_{EX\text{-}4} + Q_{EX\text{-}5}}}$
= **6.40 cfs**

**Total Peak Runoff Generated (Existing Condition)**
Total Area = 290,656 sf (EX-1 + EX-2 + EX-3 + EX-4 + EX-5) → 6.67 Acres
$\mathbf{Q_{100}} = \underline{\mathbf{Q_{EX\text{-}1} + Q_{EX\text{-}2} + Q_{EX\text{-}3} + Q_{EX\text{-}4} + Q_{EX\text{-}5}}}$
= **10.48 + 6.40 = 16.88 cfs**

**3.2 Proposed Undetained Condition Hydrologic Model Output (100-Year Event)**

**Post-Project (Without Detention):**

$Q = CIA$ *Rational Method Equation
$P_{100} = 2.8$ in *100-Year, 6-Hour Rainfall Precipitation

**Total Basin**
Total Gross Site = 289,479 sf → 6.646 Acres
Disturbed Area = 273,457 sf → 6.278 Acres

**Basin PR-1**
Total Area = 158,562 sf → 3.53 Acres
Impervious Area = 104,047 sf → 2.39 Ac
Pervious Area = 54,515 sf → 1.25 Ac

- 0.45, runoff coefficient for pervious area per EDM 6.203.1
- 0.90, runoff coefficient for impervious area per EDM 6.203.1

$C_{POST} = \frac{0.9 \text{ x } 104{,}047 \text{ sf} + 0.45 \text{ x } 54{,}515 \text{ sf}}{158{,}962 \text{ sf}} = 0.75$

$C_{POST} = 0.75$ *Weighted Runoff Coefficient for Total Basin

$C_{POST} = 0.75$ *Weighted Runoff Coeff. for Total Basin
$Q = C_{POST} \text{ x } I_{100} \text{ x } A$ *Q based on flow to existing catch basin

Entering southwestern BMP
**$T_C$ = 8.56 min** (See attached AES calculations)
**$Q_{100}$ = 13.96 cfs** (See attached AES calculations)

**Basin PR-2 (Entire Drainage Basin)**

Total Area = 811 sf → 0.02 Acres
Impervious Area = 0 sf → 0.00 Ac
Pervious Area = 811 sf → 0.02 Acres

- 0.45, runoff coefficient for pervious area per EDM 6.203.1
- 0.90, runoff coefficient for impervious area per EDM 6.203.1

$C_{POST} = \frac{0.9 \text{ x } 0 \text{ sf} + 0.45 \text{ x } 811 \text{ sf}}{811 \text{ sf}} = 0.45$

$C_{POST} = 0.45$ *Weighted Runoff Coefficient for Total Basin

Tc = **<u>5.0 Min</u>** * Minimum $T_C$ per SDCHM

$P_6 = 2.8$
$I = 7.44 \times P_6 \times D^{-0.645}$
$I = 7.44 \times 2.8 \times 5.0^{-0.645} \approx \underline{7.38 \text{ in/hr}}$

<u>Drainage to Crest Drive</u>
**$Q_{100}$ = 0.45 x 7.38 in/hr x 0.02 Ac = <u>0.07 cfs</u>**

**<u>Basin PR-3</u>**

Total Area = 937 sf ➔ 0.02 Acres
Impervious Area = 0 sf ➔ 0.00 Ac
Pervious Area = 937 sf ➔ 0.02 Acres

- 0.45, runoff coefficient for pervious area per EDM 6.203.1
- 0.90, runoff coefficient for impervious area per EDM 6.203.1

$$C_{POST} = \frac{0.9 \times 0 \text{ sf} + 0.45 \times 937 \text{ sf}}{937 \text{ sf}} = 0.45$$

Tc = **<u>5.0 Min</u>** * Minimum $T_C$ per SDCHM

$P_6 = 2.8$
$I = 7.44 \times P_6 \times D^{-0.645}$
$I = 7.44 \times 2.8 \times 5.0^{-0.645} \approx \underline{7.38 \text{ in/hr}}$

<u>Drainage to Crest Drive</u>
**$Q_{100}$ = 0.45 x 7.38 in/hr x 0.02 Ac = <u>0.06 cfs</u>**

**<u>Basin PR-4</u>**
Basin PR-4 Area = 113,286 sf ➔ 2.60 Acres
Impervious Area = 70,687 sf ➔ 1.62 Ac
Pervious Area = 42,599 sf ➔ 0.98 Acres

- 0.45, runoff coefficient for pervious area per EDM 6.203.1
- 0.90, runoff coefficient for impervious area per EDM 6.203.1

$$C_{POST} = \frac{0.9 \times 70{,}687 \text{ sf} + 0.45 \times 42{,}599 \text{ sf}}{113{,}286 \text{ sf}} = 0.73$$

$C_{POST} = 0.73$ *Weighted Runoff Coeff. for Total Basin
$Q = C_{POST} \times I_{100} \times A$ *Q based on flow to biofiltration basin

Entering northeastern BMP
**$T_C$ = 10.23 min** (See attached AES calculations)
**$Q_{100}$ = 8.82 cfs** (See attached AES calculations)

**Basin OFF-1 (Entire Drainage Basin)**

Total Area = 17,499 sf → 0.40 Acres

Cn, Weighted Runoff Coefficient,
- 0.45, runoff coefficient for pervious area per EDM 6.203.1
- 0.90, runoff coefficient for impervious area per EDM 6.203.1

$$Cn = \frac{0.90 \times 5{,}385 \text{ sf} + 0.45 \times 7{,}100 \text{ sf}}{9{,}984 \text{ sf}} = 0.59$$

Tc = **5.0 Min** * Minimum $T_C$ per SDCHM

$P_6 = 2.8$
$I = 7.44 \times P_6 \times D^{-0.645}$
$I = 7.44 \times 2.8 \times 5.0^{-0.645} \approx$ 7.38 in/hr

Draining to Melba Road's curb and gutter
**$Q_{100}$ = 0.59 x 7.38 in/hr x 0.40 Ac = 1.74 cfs**

***Summary of Post-Project Flows Without Detention***

**Peak Runoff Generated (Proposed Condition)**
Total Area = 158,562 sf (PR-1) → 3.64 Acres
**$Q_{100}$** = **$Q_{PR-1}$**
= **13.96 cfs**

Total Area = 811 sf (PR-2) →0.02 Acres
**$Q_{100}$** = **$Q_{PR-2}$**
= **0.07 cfs < 2.02 cfs for Basin EX-2**

Total Area = 957 sf (PR-3) → 0.02 Acres
**$Q_{100}$** = **$Q_{PR-3}$**
= **0.06 cfs**

Total Area = 113,286 sf (PR-4) → 2.62 Acres
**$Q_{100}$** = **$Q_{PR-4}$**
= **8.82 cfs**

Total Area = 17,499 sf (OFF-1) → 0.40 Acres
**$Q_{100}$** = **$Q_{OFF-1}$**
= **1.74 cfs**

**Total Peak Runoff Generated (Moonlight Beach Watershed)**

Total Area = 176,061 sf (PR-1 + OFF-1) → 4.04 Acres

$Q_{100}$ = $Q_{PR\text{-}1} + Q_{OFF\text{-}1}$

= **13.96 cfs + 1.74 cfs**

= **15.32 cfs** (Confluenced see AES)

**Total Peak Runoff Generated (San Marcos Creek / Batiquitos Lagoon Watershed)**

Total Area = 114,223 sf (PR-3 + PR-4) → 2.62 Acres

$Q_{100}$ = $Q_{PR\text{-}4}$

= **8.88 cfs**

### 3.3 Detention Analysis (100-Year Event)

The onsite HMP-sized flow-control biofiltration basin and BMP systems ("Basin") provide pollutant control as well as hydromodification management and mitigation of the 100-year, 6-hour storm event peak flow rate. The 100-year storm event detention analysis was performed using HydroCAD-10 software as well as Advanced Engineering Software (A.E.S). HydroCAD-10 has the ability to route the 100-year, 6-hour storm event inflow hydrograph through the biofiltration facility, and based on the facility cross sectional geometry, stage-storage, and outlet structure data, calculate the detained peak flow rate and detained time to peak. The inflow runoff hydrograph to the biofiltration basin was modeled using RatHydro which is a Rational Method Design Storm Hydrograph software that creates a hydrograph using the results of the Rational Method calculations.

The two HMP-sized flow-control and pollutant removal facilities consist of a pre-treatment biofiltration basin with surface area square footage per plan. Basin PR-1 biofiltration basin consist of 18 inches of engineered soil and as well as a 33 inches storage layer consisting of 3/8" and 3/4" crushed rock gravel along with an impermeable liner to prevent infiltration into the surrounding topsoil and Very Old Paralic Deposit (Qvop) layer. Basin PR-2 biofiltration basin consist of 18 inches of engineer soil along with a 78 inches StormTrap detention system (or equivalent). Runoff generated during high-frequency, low-intensity storm events will be biofiltered through the engineered soil and storage layers. Runoff will be mitigated to comply with HMP low-flow requirements by infiltrating through the engineered soil and storage layers, as well as with an orifice plate connected to the inside of the overflow catch basin, restricting flow leaving the site.

In larger storm events, runoff not filtered through the engineered soil and storage layers will be conveyed via overflow outlet structures. Basin PR-1 biofiltration basin is equipped with five Brooks Boxes: one 12" x 12", one 18" x 18", one 24" x 24" and two 36" x 36" with two 3" x 19" midflow orifices. Basin PR-2 biofiltration is equipped with six Brooks Boxes: five 36" x 36" and one 24" x 24" with three 3" x 23" midflow orifices. The outlet structures on each basin have been designed to mitigate the post-project $Q_{100}$ to below the pre-project $Q_{100}$ peak flow rate with the basins functioning as intended. Additionally, both of the proposed basins have been designed with additional outlet structures – conservatively assuming to reach a level of 50 percent clogging over time - as shown on the project preliminary grading plans under separate cover to continue to mitigate the post-project $Q_{100}$ peak runoff to below the pre-project $Q_{100}$ in the event the basins are not properly maintained over time and drainage through the basin's layers are failing. Runoff conveyed via the outlet structure will bypass the soil layers and be conveyed directly to a proposed 18-inch PVC drainpipe to direct discharge offsite, ultimately outletting to the Melba Road or Witham Road curb face through a curb outlet drainage channel.

| PROPOSED DRAINAGE FLOWS (MIT) | | | |
|---|---|---|---|
| DRAINAGE AREA | DRAINAGE AREA (ACRES) | $Q_{100}$ (CFS) | $I_{100}$ (IN/HR) |
| *PR-1 (Mit) | 4.04 | 6.33 | - |
| PR-2 | 0.02 | 0.10 | 7.38 |
| PR-3 | 0.004 | 0.06 | 7.38 |
| PR-4 | 2.60 | 0.18 | - |
| TOTAL | 6.68 | 6.63 | - |

**Table 3. Proposed Condition Peak Drainage Flow Rates (Mitigated)**

*PR-1 Mitigated value includes confluence of PR-1 with OFF-1 at the southwest corner of the site.

Table 3 above lists the peak flow rates for the project site in the proposed, mitigated condition after being routed through the biofiltration basin. Based on the results of the HydroCAD-10 analysis, the HMP biofiltration facility, detention system, and outlet structure provide mitigation for the 100-year, 6-hour storm event peak flow rate. Runoff leaving the site continues to flow to the southwest or northwest to outlet to the curb face along Melba Road or Witham Road respectively. The resulting total peak discharge leaving the site to the Moonlight Beach watershed confluence with the offsite basin is 6.33 cfs, which is mitigated at or below the pre-development $Q_{100}$ of 8.46 cfs discharging to the same ultimate receiving water body. The resulting total peak discharge leaving the site to San Marcos Creek / Batiquitos Lagoon Watershed is 0.24 cfs below the pre-development $Q_{100}$ of 6.40 cfs. Refer to Appendix A of this Hydrology Report and also to Appendix B for the HydroCAD-10 detailed output, which shows the effect of the detention characteristics of the biofiltration basins on the resulting peak discharge and time of concentration leaving the subject property.

### 3.3.1 Proposed Detained Condition Output Summary (100-Year Event)

***Summary of Pre-Project Flows***

**Peak Runoff Generated (Moonlight Beach Watershed)**
Total Area = 177,301 sf (EX-1 + EX-2) → 4.07 Acres
$Q_{100}$ = $Q_{EX-1} + Q_{EX-2}$
= **10.48 cfs**

**Peak Runoff Generated (San Marcos Creek / Batiquitos Lagoon Watershed)**
Total Area = 113,355 sf (EX-3 + EX-4 + EX-5) → 2.60 Acres
$Q_{100}$ = $Q_{EX-3} + Q_{EX-4} + Q_{EX-5}$
= **6.40 cfs**

**Total runoff leaving the project site in the existing condition to the Batiquitos Lagoon watershed not included in the proposed drainage analysis discharging to Melba Road.

**Total Peak Runoff Generated (Existing Condition)**
Total Area = 290,656 sf (EX-1 + EX-2 + EX-3 + EX-4 + EX-5) → 6.67 Acres
$Q_{100}$ = $Q_{EX-1} + Q_{EX-2} + Q_{EX-3} + Q_{EX-4} + Q_{EX-5}$
= **10.48 cfs + 6.40 cfs = 16.48 cfs**

***Summary of Post-Project Flows With Detention (Mitigated)***

**Peak Runoff Generated (Moonlight Beach Watershed)**
Total Area = 176,061 sf (PR-1 + OFF-1) → 4.04 Acres
$Q_{100}$ = $Q_{PR-1} + Q_{OFF-1}$
= **5.35 cfs + 1.74 cfs = 6.33 cfs (see attached AES calculations)***

*6.33 cfs in the existing condition draining to Melba Road at Evergreen Drive prior to discharging to the canyon east and north of Ocean Knoll Elementary and then routing to Encinitas Boulevard, reduced to 8.25 cfs in the post-project condition with detention.

**Peak Runoff Generated (San Marcos Creek / Batiquitos Lagoon Watershed)**
Total Area = 114,223 sf (PR-3 + PR-4) → 2.62 Acres
$Q_{100}$ = $Q_{PR-3} + Q_{PR-4}$
= **0.06 + 0.18 cfs = 0.24 cfs****

**2.01 cfs in the existing condition draining to the existing brow ditch within a public drainage easement outletting to the Witham Road curb face via an 18” storm drain connected to a curb outlet in a water line easement, reduced to 0.06 cfs in the post-project condition with detention. 1.58 cfs in the existing condition traveling through adjacent properties at the northeast corner of the property, heading south to Witham Road and then northeast on Crest Drive, and entering a curb inlet at the Hickoryhill Drive intersection, reduced to 0.18 cfs in the post-project condition with detention. 2.55 cfs in the existing condition traveling through adjacent properties at the Midwest corner of the property, heading west toward Crest Drive, and also entering the curb inlet at the Hickoryhill Drive, reduced to 0.0 cfs in the post-project condition.

### 3.4 Hydromodification Analysis

Refer to the project Storm Water Quality Management Plan (SWQMP) prepared by Pasco, Laret, Suiter & Associates under separate cover for discussion of hydromodification management strategy and compliance to satisfy the requirements of the MS4 Permit.

### 3.5 Storm Water Pollutant Control

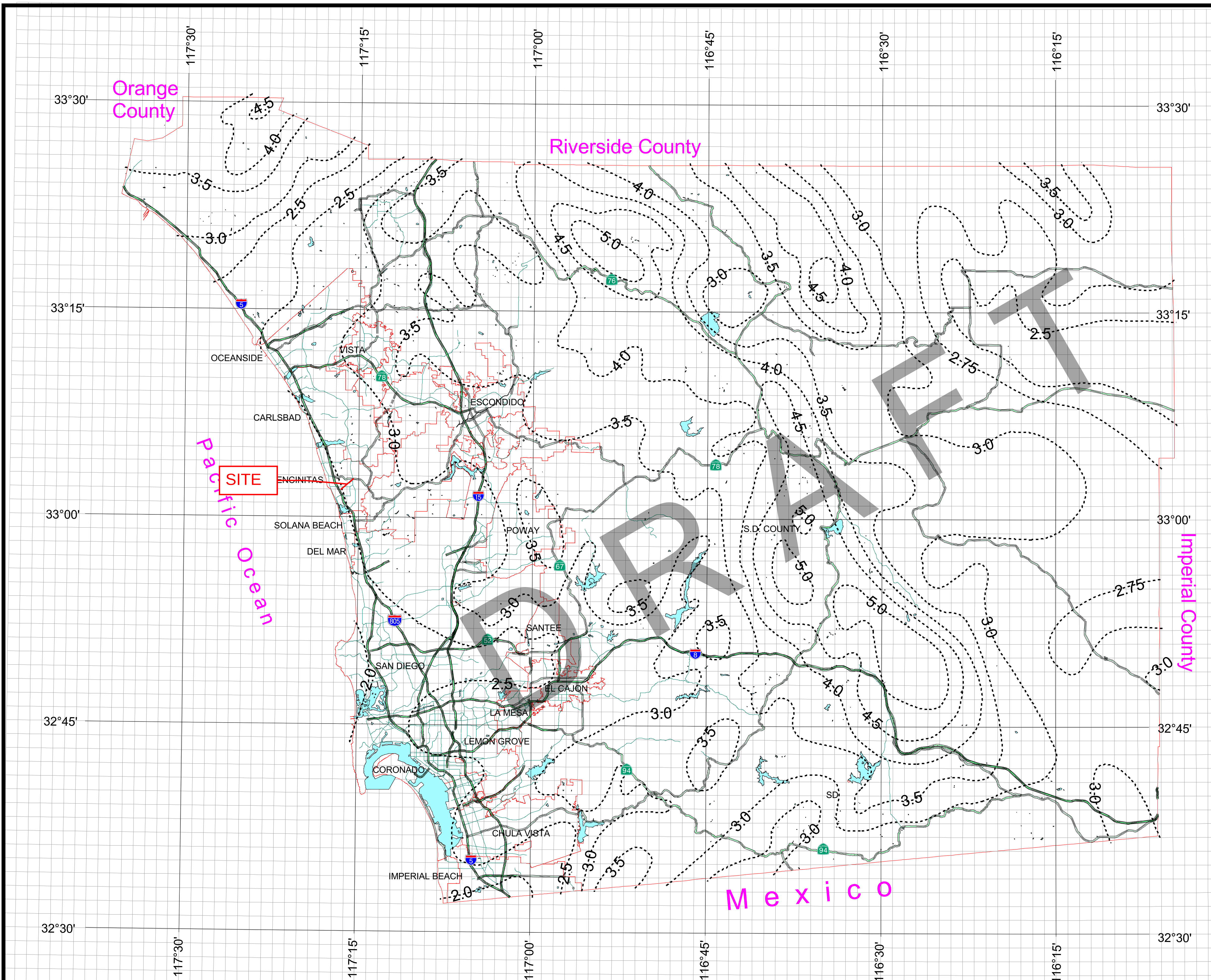
To meet the requirements of the MS4 Permit, the HMP bioretention facility is designed to treat onsite storm water pollutants contained in the volume of runoff from a 24-hour, 85th percentile storm event by slowly infiltrating runoff through an engineered soil layer. Refer to the project Storm Water Quality Management Plan (SWQMP) prepared by Pasco, Laret, Suiter & Associates under separate cover for discussion of pollutant control.

# Appendix A

# HYDROLOGY SUPPORT MATERIAL

# County of San Diego Hydrology Manual

*Rainfall Isopluvials*




**100 Year Rainfall Event - 6 Hours**

| | |
|---|---|
| - - - - - - - | Isopluvial (inches) |

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Geographic Information Services

SanGIS
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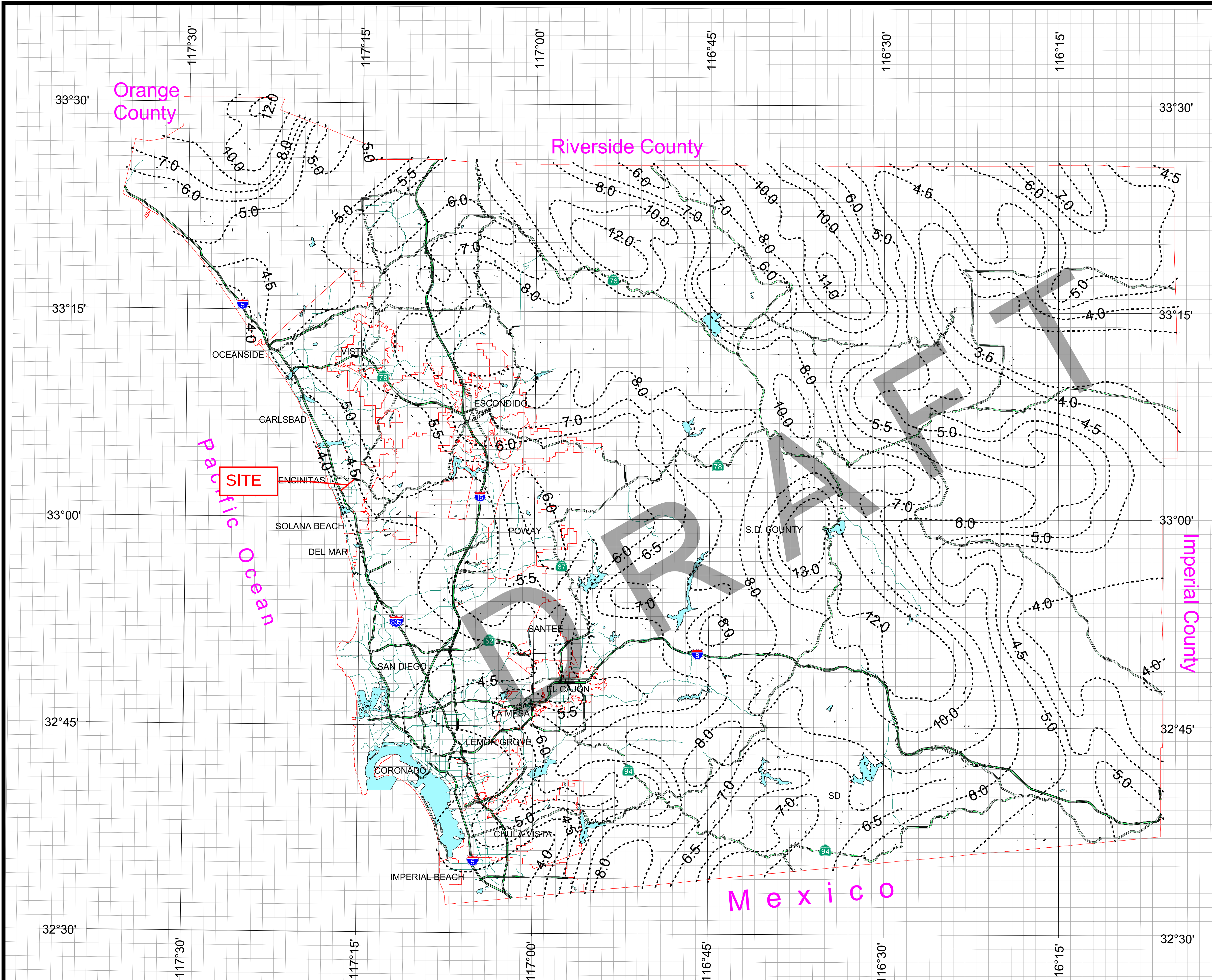
3 0 3 Miles

# County of San Diego Hydrology Manual

*Rainfall Isopluvials*

**100 Year Rainfall Event - 24 Hours**




Isopluvial (inches)

Department of Public Works
Geographic Information Services

We Have San Diego Covered!

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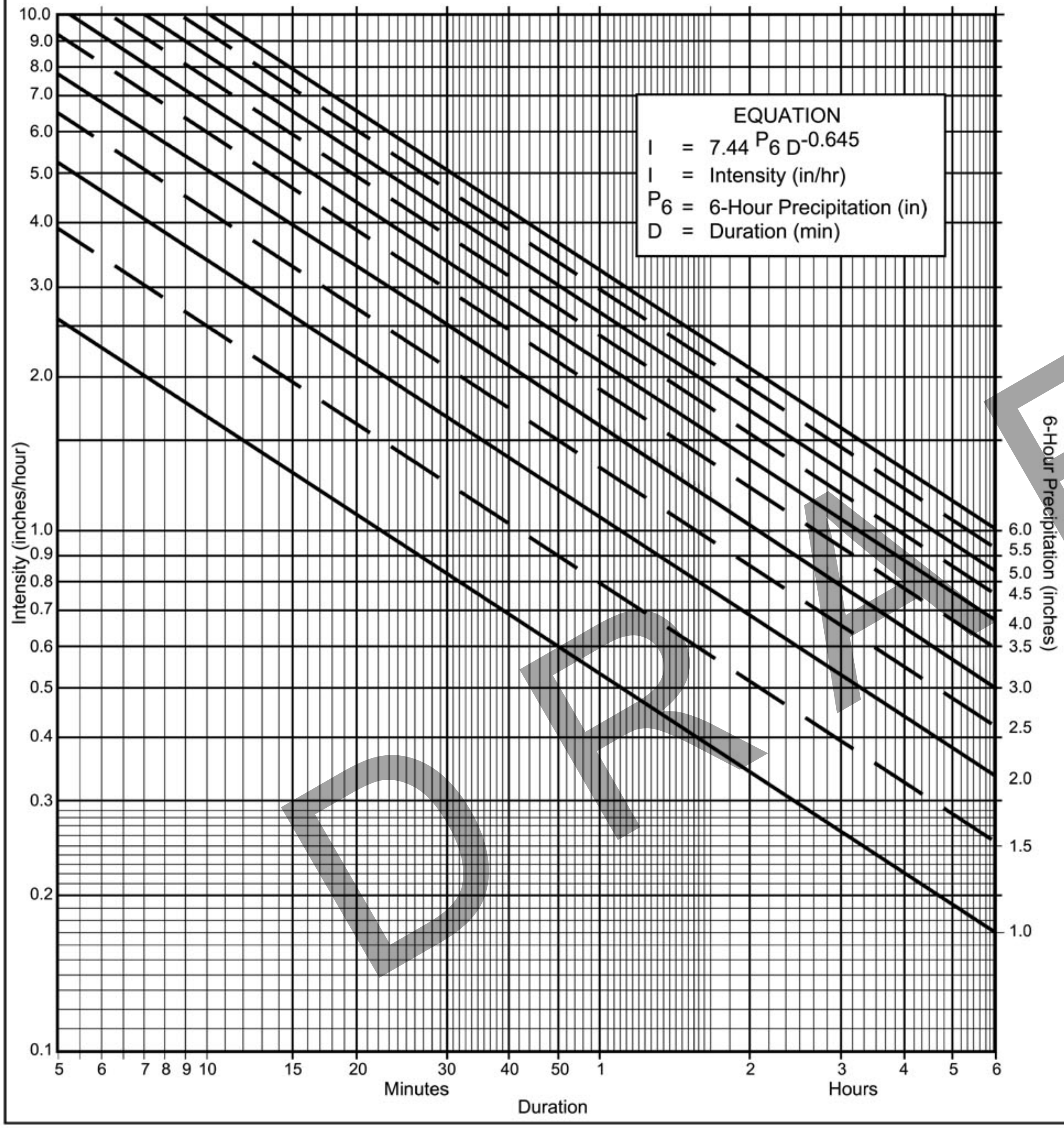
3 0 3 Miles




EQUATION

$$I = 7.44\, P_6\, D^{-0.645}$$

$I$ = Intensity (in/hr)

$P_6$ = 6-Hour Precipitation (in)

$D$ = Duration (min)

**Directions for Application:**

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

**Application Form:**

(a) Selected frequency _______ year

(b) $P_6$ = _______ in., $P_{24}$ = _______ , $\frac{P_6}{P_{24}}$ = _______ %(2)

(c) Adjusted $P_6$(2) = _______ in.

(d) $t_x$ = _______ min.

(e) I = _______ in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

| P6 | 1 | 1.5 | 2 | 2.5 | 3 | 3.5 | 4 | 4.5 | 5 | 5.5 | 6 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Duration | I | I | I | I | I | I | I | I | I | I | I |
| **5** | 2.63 | 3.95 | 5.27 | 6.59 | 7.90 | 9.22 | 10.54 | 11.86 | 13.17 | 14.49 | 15.81 |
| **7** | 2.12 | 3.18 | 4.24 | 5.30 | 6.36 | 7.42 | 8.48 | 9.54 | 10.60 | 11.66 | 12.72 |
| **10** | 1.68 | 2.53 | 3.37 | 4.21 | 5.05 | 5.90 | 6.74 | 7.58 | 8.42 | 9.27 | 10.11 |
| **15** | 1.30 | 1.95 | 2.59 | 3.24 | 3.89 | 4.54 | 5.19 | 5.84 | 6.49 | 7.13 | 7.78 |
| **20** | 1.08 | 1.62 | 2.15 | 2.69 | 3.23 | 3.77 | 4.31 | 4.85 | 5.39 | 5.93 | 6.46 |
| **25** | 0.93 | 1.40 | 1.87 | 2.33 | 2.80 | 3.27 | 3.73 | 4.20 | 4.67 | 5.13 | 5.60 |
| **30** | 0.83 | 1.24 | 1.66 | 2.07 | 2.49 | 2.90 | 3.32 | 3.73 | 4.15 | 4.56 | 4.98 |
| **40** | 0.69 | 1.03 | 1.38 | 1.72 | 2.07 | 2.41 | 2.76 | 3.10 | 3.45 | 3.79 | 4.13 |
| **50** | 0.60 | 0.90 | 1.19 | 1.49 | 1.79 | 2.09 | 2.39 | 2.69 | 2.98 | 3.28 | 3.58 |
| **60** | 0.53 | 0.80 | 1.06 | 1.33 | 1.59 | 1.86 | 2.12 | 2.39 | 2.65 | 2.92 | 3.18 |
| **90** | 0.41 | 0.61 | 0.82 | 1.02 | 1.23 | 1.43 | 1.63 | 1.84 | 2.04 | 2.25 | 2.45 |
| **120** | 0.34 | 0.51 | 0.68 | 0.85 | 1.02 | 1.19 | 1.36 | 1.53 | 1.70 | 1.87 | 2.04 |
| **150** | 0.29 | 0.44 | 0.59 | 0.73 | 0.88 | 1.03 | 1.18 | 1.32 | 1.47 | 1.62 | 1.76 |
| **180** | 0.26 | 0.39 | 0.52 | 0.65 | 0.78 | 0.91 | 1.04 | 1.18 | 1.31 | 1.44 | 1.57 |
| **240** | 0.22 | 0.33 | 0.43 | 0.54 | 0.65 | 0.76 | 0.87 | 0.98 | 1.08 | 1.19 | 1.30 |
| **300** | 0.19 | 0.28 | 0.38 | 0.47 | 0.56 | 0.66 | 0.75 | 0.85 | 0.94 | 1.03 | 1.13 |
| **360** | 0.17 | 0.25 | 0.33 | 0.42 | 0.50 | 0.58 | 0.67 | 0.75 | 0.84 | 0.92 | 1.00 |



**Intensity-Duration Design Chart - Template**

FIGURE

**3-1**

**Table 3-1**
**RUNOFF COEFFICIENTS FOR URBAN AREAS**

| Land Use | | Runoff Coefficient "C" | | | | |
|---|---|---|---|---|---|---|
| | | | Soil Type | | | |
| NRCS Elements | County Elements | % IMPER. | A | B | C | D |
| Undisturbed Natural Terrain (Natural) | Permanent Open Space | 0* | 0.20 | $\boxed{0.25}$ | 0.30 | 0.35 |
| Low Density Residential (LDR) | Residential, 1.0 DU/A or less | 10 | 0.27 | 0.32 | 0.36 | 0.41 |
| Low Density Residential (LDR) | Residential, 2.0 DU/A or less | 20 | 0.34 | 0.38 | 0.42 | 0.46 |
| Low Density Residential (LDR) | Residential, 2.9 DU/A or less | 25 | 0.38 | 0.41 | 0.45 | 0.49 |
| Medium Density Residential (MDR) | Residential, 4.3 DU/A or less | 30 | 0.41 | 0.45 | 0.48 | 0.52 |
| Medium Density Residential (MDR) | Residential, 7.3 DU/A or less | 40 | 0.48 | 0.51 | 0.54 | 0.57 |
| Medium Density Residential (MDR) | Residential, 10.9 DU/A or less | 45 | 0.52 | 0.54 | 0.57 | 0.60 |
| Medium Density Residential (MDR) | Residential, 14.5 DU/A or less | 50 | 0.55 | 0.58 | 0.60 | 0.63 |
| High Density Residential (HDR) | Residential, 24.0 DU/A or less | 65 | 0.66 | 0.67 | 0.69 | 0.71 |
| High Density Residential (HDR) | Residential, 43.0 DU/A or less | 80 | 0.76 | 0.77 | 0.78 | 0.79 |
| Commercial/Industrial (N. Com) | Neighborhood Commercial | 80 | 0.76 | 0.77 | 0.78 | 0.79 |
| Commercial/Industrial (G. Com) | General Commercial | 85 | 0.80 | 0.80 | 0.81 | 0.82 |
| Commercial/Industrial (O.P. Com) | Office Professional/Commercial | 90 | 0.83 | 0.84 | 0.84 | 0.85 |
| Commercial/Industrial (Limited I.) | Limited Industrial | 90 | 0.83 | 0.84 | 0.84 | 0.85 |
| Commercial/Industrial (General I.) | General Industrial | 95 | 0.87 | 0.87 | 0.87 | 0.87 |

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service

Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

Table 3-2 provides limits of the length (Maximum Length ($L_M$)) of sheet flow to be used in hydrology studies. Initial $T_i$ values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the "Regulating Agency" when submitted with a detailed study.

**Table 3-2**

**MAXIMUM OVERLAND FLOW LENGTH ($L_M$)**
**& INITIAL TIME OF CONCENTRATION ($T_i$)**

| Element* | DU/ Acre | .5% | | 1% | | 2% | | 3% | | 5% | | 10% | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $L_M$ | $T_i$ | $L_M$ | $T_i$ | $L_M$ | $T_i$ | $L_M$ | $T_i$ | $L_M$ | $T_i$ | $L_M$ | $T_i$ |
| Natural | | 50 | 13.2 | 70 | 12.5 | 85 | 10.9 | 100 | 10.3 | 100 | 8.7 | 100 | 6.9 |
| LDR | 1 | 50 | 12.2 | 70 | 11.5 | 85 | 10.0 | 100 | 9.5 | 100 | 8.0 | 100 | 6.4 |
| LDR | 2 | 50 | 11.3 | 70 | 10.5 | 85 | 9.2 | 100 | 8.8 | 100 | 7.4 | 100 | 5.8 |
| LDR | 2.9 | 50 | 10.7 | 70 | 10.0 | 85 | 8.8 | 95 | 8.1 | 100 | 7.0 | 100 | 5.6 |
| MDR | 4.3 | 50 | 10.2 | 70 | 9.6 | 80 | 8.1 | 95 | 7.8 | 100 | 6.7 | 100 | 5.3 |
| MDR | 7.3 | 50 | 9.2 | 65 | 8.4 | 80 | 7.4 | 95 | 7.0 | 100 | 6.0 | 100 | 4.8 |
| MDR | 10.9 | 50 | 8.7 | 65 | 7.9 | 80 | 6.9 | 90 | 6.4 | 100 | 5.7 | 100 | 4.5 |
| MDR | 14.5 | 50 | 8.2 | 65 | 7.4 | 80 | 6.5 | 90 | 6.0 | 100 | 5.4 | 100 | 4.3 |
| HDR | 24 | 50 | 6.7 | 65 | 6.1 | 75 | 5.1 | 90 | 4.9 | 95 | 4.3 | 100 | 3.5 |
| HDR | 43 | 50 | 5.3 | 65 | 4.7 | 75 | 4.0 | 85 | 3.8 | 95 | 3.4 | 100 | 2.7 |
| N. Com | | 50 | 5.3 | 60 | 4.5 | 75 | 4.0 | 85 | 3.8 | 95 | 3.4 | 100 | 2.7 |
| G. Com | | 50 | 4.7 | 60 | 4.1 | 75 | 3.6 | 85 | 3.4 | 90 | 2.9 | 100 | 2.4 |
| O.P./Com | | 50 | 4.2 | 60 | 3.7 | 70 | 3.1 | 80 | 2.9 | 90 | 2.6 | 100 | 2.2 |
| Limited I. | | 50 | 4.2 | 60 | 3.7 | 70 | 3.1 | 80 | 2.9 | 90 | 2.6 | 100 | 2.2 |
| General I. | | 50 | 3.7 | 60 | 3.2 | 70 | 2.7 | 80 | 2.6 | 90 | 2.3 | 100 | 1.9 |

*See Table 3-1 for more detailed description

# EXISTING HYDROLOGY EXHIBIT

## TORREY CREST

## 1220-1240 MELBA ROAD / 1190 ISLAND VIEW LANE


### PLAN VIEW - EXISTING NODE MAP

SCALE: 1" = 20' HORIZONTAL

### LEGEND

- PROPERTY BOUNDARY
- CENTERLINE OF ROAD
- RIGHT-OF-WAY BOUNDARY
- ADJACENT PROPERTY LINE
- EXISTING CONTOUR LINE
- EXISTING PATH OF TRAVEL
- EXISTING DIRECTION OF FLOW
- EXISTING MAJOR DRAINAGE BASIN BOUNDARY
- EXISTING IMPERVIOUS AREA

### BASIN EX-2 - AREA CALCULATIONS

| | |
|---|---|
| TOTAL BASIN EX-2 AREA | 32,639 SF (0.75 AC) |
| $C_{PRE}$ | 0.54 |
| Q100 | 2.02 CFS |

### BASIN EX-3 - AREA CALCULATIONS

| | |
|---|---|
| TOTAL BASIN EX-3 AREA | 43,278 SF (0.99 AC) |
| $C_{PRE}$ | 0.45 |
| Q100 | 2.23 CFS |

### BASIN EX-4 - AREA CALCULATIONS

| | |
|---|---|
| TOTAL BASIN EX-4 AREA | 28,314 SF (0.65 AC) |
| $C_{PRE}$ | 0.48 |
| Q100 | 1.58 CFS |

### PROJECT SITE - AREA CALCULATIONS

| | |
|---|---|
| SUBJECT PROPERTY GROSS AREA | 289,479 SF (6.65 AC) |
| SUBJECT PROPERTY IMPERVIOUS AREA | 39,852 SF |
| TOTAL ANALYZED AREA | 290,656 SF (6.67 AC) |
| TOTAL EXISTING IMPERVIOUS AREA | 45,168 SF (1.04 AC) |
| TOTAL EXISTING PERVIOUS AREA | 245,524 SF (5.64 AC) |
| % IMPERVIOUS | 18.4% |

GRAPHIC SCALE: 1" = 20'

20 0 20 40 60

EXISTING HYDROLOGY EXHIBIT
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CITY OF ENCINITAS

PASCO LARET SUITER & ASSOCIATES
San Diego | Solana Beach | Orange County
Phone 858.259.8212 | www.plsaengineering.com

# EXISTING HYDROLOGY EXHIBIT

## 1220-1240 MELBA ROAD / 1190 ISLAND VIEW LANE

### LEGEND

- PROPERTY BOUNDARY
- CENTERLINE OF ROAD
- RIGHT-OF-WAY BOUNDARY
- ADJACENT PROPERTY LINE
- EXISTING CONTOUR LINE
- EXISTING PATH OF TRAVEL
- EXISTING DIRECTION OF FLOW
- EXISTING MAJOR DRAINAGE BASIN BOUNDARY
- EXISTING IMPERVIOUS AREA

### BASIN EX-1 - AREA CALCULATIONS

| | |
|---|---|
| TOTAL BASIN EX-1 AREA | 144,662 SF (3.32 AC) |
| $C_{PRE}$ | 0.53 |
| Q100 | 8.46 CFS |

### BASIN EX-5 - AREA CALCULATIONS

| | |
|---|---|
| TOTAL BASIN EX-5 AREA | 41,763 SF (0.96 AC) |
| $C_{PRE}$ | 0.59 |
| Q100 | 2.55 CFS |


PLAN VIEW - EXISTING NODE MAP

SCALE: 1" = 20' HORIZONTAL

GRAPHIC SCALE: 1" = 20'

20 0 20 40 60

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San Diego | Solana Beach | Orange County
Phone 858.259.8212 | www.plsaengineering.com


MATCHLINE: SEE SHEET 2 FOR CONTINUATION

## PLAN VIEW - POST-DEVELOPED NODE MAP

SCALE: 1" = 20' HORIZONTAL

GRAPHIC SCALE: 1" = 20'

20 0 20 40 60

### BASIN PR-1- AREA CALCULATIONS

| | |
|---|---|
| TOTAL BASIN PR-1.1 AREA | 158,562 SF (3.64 AC) |
| Cn | 0.75 |
| Q100 (UNMITIGATED) | 13.96 CFS |
| Q100 (MITIGATED) | 6.33 CFS |

### BASIN PR-4 - AREA CALCULATIONS

| | |
|---|---|
| TOTAL BASIN PR-1.2 AREA | 114,153 SF (2.62 AC) |
| Cn | 0.73 |
| Q100 (UNMITIGATED) | 8.82 CFS |
| Q100 (MITIGATED) | 0.18 CFS |

PROPOSED HYDROLOGY EXHIBIT
1220-1240 MELBA ROAD
CITY OF ENCINITAS

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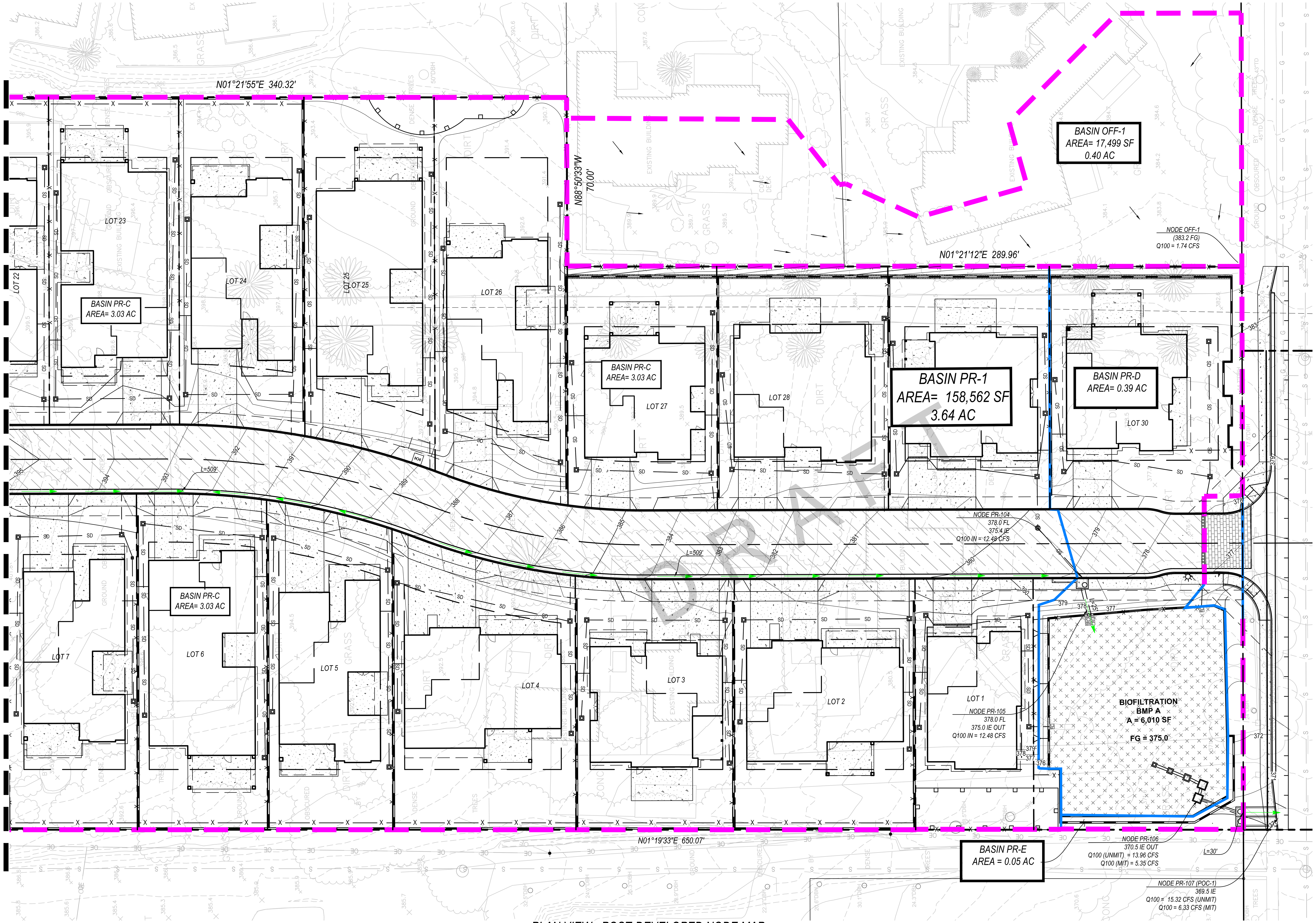
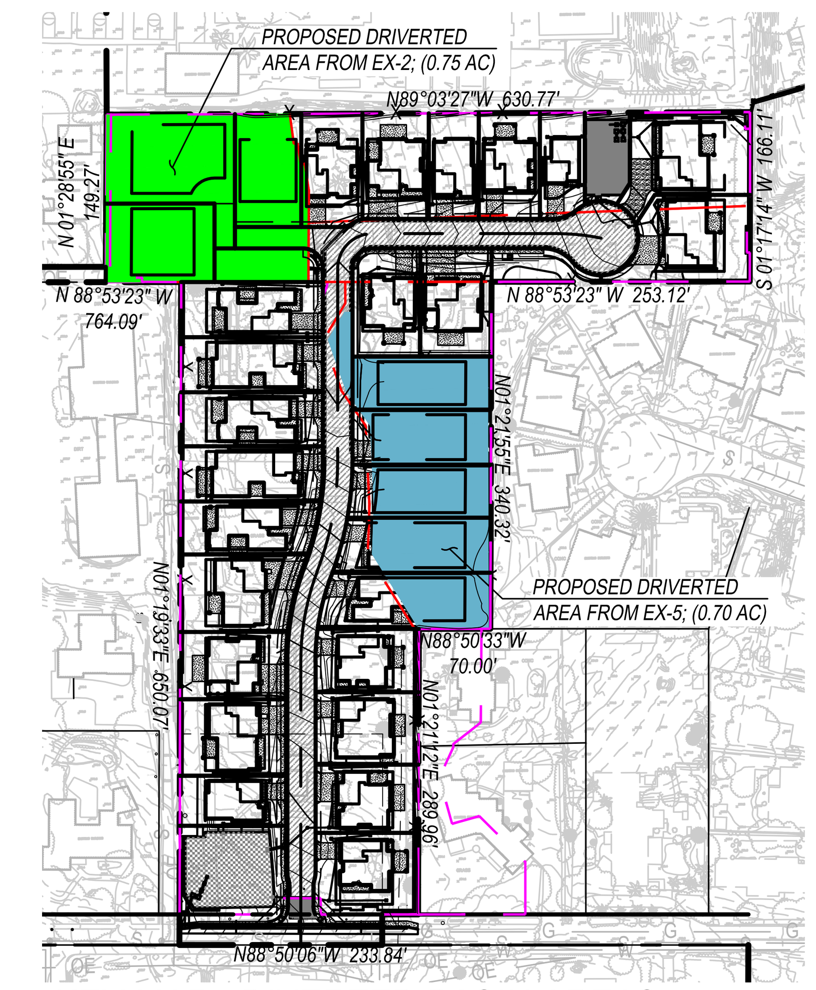



PLAN VIEW - POST-DEVELOPED NODE MAP

SCALE: 1" = 20' HORIZONTAL

## LEGEND

| | |
|---|---|
| PROPERTY BOUNDARY | |
| CENTERLINE OF ROAD | |
| RIGHT-OF-WAY BOUNDARY | |
| ADJACENT PROPERTY LINE | |
| EXISTING CONTOUR LINE | |
| PROPOSED CONTOUR LINE | |
| PROPOSED PATH OF TRAVEL | |
| PROPOSED DIRECTION OF FLOW | |
| PROPOSED MAJOR DRAINAGE BASIN BOUNDARY | |
| EXISTING MAJOR DRAINAGE BASIN BOUNDARY | |
| PROPOSED SUB-DRAINAGE / AES NODE BASIN BOUNDARY | |
| PROPOSED DIVERTED AREA TO MOONLIGHT BEACH WATERSHED | |
| PROPOSED DIVERTED AREA SAN MARCOS CREEK / BATIQUITOS LAGOON WATERSHED | |




KEY MAP - DIVERTED BASIN AREAS

SCALE: 1" = 150'

## BASIN PR-1- AREA CALCULATIONS

| | |
|---|---|
| TOTAL BASIN PR-1.1 AREA | 158,562 SF (3.64 AC) |
| Cn | 0.75 |
| Q100 (UNMITIGATED) | 13.96 CFS |
| Q100 (MITIGATED) | 6.33 CFS |

## BASIN OFF-1 - AREA CALCULATIONS

| | |
|---|---|
| TOTAL BASIN OFF-1 AREA | 17,499 SF (0.40 AC) |
| Cn | 0.59 |
| Q100 | 1.74 CFS |

## POC-1 - AREA CALCULATIONS

| | |
|---|---|
| TOTAL BASIN OFF-1 AREA | 176,061 SF (4.04 AC) |
| Q100 | 15.32 CFS |
| Q100 (MITIGATED) | 5.35 CFS |

## BASIN PR-4 - AREA CALCULATIONS

| | |
|---|---|
| TOTAL BASIN PR-1.2 AREA | 114,153 SF (2.62 AC) |
| Cn | 0.73 |
| Q100 (UNMITIGATED) | 8.82 CFS |
| Q100 (MITIGATED) | 0.18 CFS |

GRAPHIC SCALE: 1" = 20'

20 0 20 40 60

PROPOSED HYDROLOGY EXHIBIT
1220-1240 MELBA ROAD
CITY OF ENCINITAS

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```
____________________________________________________________________________
****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2016 Advanced Engineering Software (aes)
             Ver. 23.0 Release Date: 07/01/2016  License ID 1452

                           Analysis prepared by:

                      Pasco Laret Suiter & Associates
                             119 Aberdeen Drive
                         Cardiff, California 92007
                                858-259-8212

 ************************** DESCRIPTION OF STUDY **************************
* PASCO LARET SUITER & ASSOCIATES                                          *
* BASIN PR-1 POST DEVELOPMENT HYDROLOGY                                    *
* PLSA 3086                                                                *
 **************************************************************************

  FILE NAME: 3086-PR1.DAT
  TIME/DATE OF STUDY: 12:46 03/20/2023
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.800
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   14.0      1.0    0.018/0.018/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.50 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  0.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
  UPSTREAM ELEVATION(FEET) =    397.70
  DOWNSTREAM ELEVATION(FEET) =    397.00
  ELEVATION DIFFERENCE(FEET) =      0.70
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    5.271
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.130
  SUBAREA RUNOFF(CFS) =      0.21
  TOTAL AREA(ACRES) =      0.04   TOTAL RUNOFF(CFS) =      0.21

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    397.00  DOWNSTREAM(FEET) =    395.60
  CHANNEL LENGTH THRU SUBAREA(FEET) =    75.00   CHANNEL SLOPE =  0.0187
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =  50.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   0.50
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.168
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.51
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   0.94
  AVERAGE FLOW DEPTH(FEET) =   0.07   TRAVEL TIME(MIN.) =   1.33
  Tc(MIN.) =    6.60
  SUBAREA AREA(ACRES) =     0.13       SUBAREA RUNOFF(CFS) =    0.60
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.750
  TOTAL AREA(ACRES) =        0.2         PEAK FLOW RATE(CFS) =       0.79

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.09   FLOW VELOCITY(FEET/SEC.) =   0.97
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    103.00 =     145.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    104.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  395.60  DOWNSTREAM ELEVATION(FEET) =  378.00
  STREET LENGTH(FEET) =   509.00   CURB HEIGHT(INCHES) =  6.0
```

```
  STREET HALFWIDTH(FEET) = 14.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   1.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       6.72
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.35
    HALFSTREET FLOOD WIDTH(FEET) =   12.51
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.43
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.56
  STREET FLOW TRAVEL TIME(MIN.) =   1.92   Tc(MIN.) =    8.51
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.234
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.750
  SUBAREA AREA(ACRES) =    3.03      SUBAREA RUNOFF(CFS) =   11.81
  TOTAL AREA(ACRES) =        3.2       PEAK FLOW RATE(CFS) =      12.48

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.38   HALFSTREET FLOOD WIDTH(FEET) =  14.00
  FLOW VELOCITY(FEET/SEC.) =  4.72   DEPTH*VELOCITY(FT*FT/SEC.) =   1.79
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    104.00 =     654.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    105.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   375.40  DOWNSTREAM(FEET) =   375.00
  FLOW LENGTH(FEET) =    25.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  14.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.35
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      12.48
  PIPE TRAVEL TIME(MIN.) =   0.05    Tc(MIN.) =    8.56
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    105.00 =     679.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
```

```
===========================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.214
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7500
  SUBAREA AREA(ACRES) =    0.39   SUBAREA RUNOFF(CFS) =    1.53
  TOTAL AREA(ACRES) =        3.6   TOTAL RUNOFF(CFS) =      13.96
  TC(MIN.) =    8.56

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    107.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
===========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   370.50  DOWNSTREAM(FEET) =   369.50
  FLOW LENGTH(FEET) =    30.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  11.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  11.60
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      13.96
  PIPE TRAVEL TIME(MIN.) =   0.04    Tc(MIN.) =    8.61
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    107.00 =     709.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    108.00 TO NODE    108.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
===========================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.197
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7500
  SUBAREA AREA(ACRES) =    0.05   SUBAREA RUNOFF(CFS) =    0.19
  TOTAL AREA(ACRES) =        3.6   TOTAL RUNOFF(CFS) =      14.11
  TC(MIN.) =    8.61

****************************************************************************
  FLOW PROCESS FROM NODE    109.00 TO NODE    109.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
===========================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.61
  RAINFALL INTENSITY(INCH/HR) =   5.20
  TOTAL STREAM AREA(ACRES) =     3.64
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     14.11
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    110.00 TO NODE    107.00 IS CODE =   7
----------------------------------------------------------------------------
  >>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<
============================================================================
  USER-SPECIFIED VALUES ARE AS FOLLOWS:
  TC(MIN) =   5.00   RAIN INTENSITY(INCH/HOUR) =  7.38
  TOTAL AREA(ACRES) =     0.40   TOTAL RUNOFF(CFS) =      1.74

****************************************************************************
  FLOW PROCESS FROM NODE    111.00 TO NODE    111.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    5.00
  RAINFALL INTENSITY(INCH/HR) =   7.38
  TOTAL STREAM AREA(ACRES) =     0.40
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.74

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1       14.11     8.61       5.197         3.64
      2        1.74     5.00       7.377         0.40

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1        9.94     5.00      7.377
      2       15.34     8.61      5.197

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      15.34   Tc(MIN.) =    8.61
  TOTAL AREA(ACRES) =        4.0
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    111.00 =     709.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        4.0  TC(MIN.) =      8.61
  PEAK FLOW RATE(CFS)   =      15.34
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
____________________________________________________________________________
****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
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             Ver. 23.0 Release Date: 07/01/2016  License ID 1452

                           Analysis prepared by:

                      PASCO LARET SUITER & ASSOCIATES
                        535 NORTH HIGHWAY 101, STE A
                           SOLANA BEACH, CA 92075
                                858-259-8212

 ************************** DESCRIPTION OF STUDY **************************
 * PASCO LARET SUITER & ASSOCIATES                                          *
 * BASIN PR-1 POST DEVELOPMENT HYDROLOGY    DETAINED                        *
 * PLSA 3086                                                                *
 **************************************************************************

  FILE NAME: 3086PD00.DAT
  TIME/DATE OF STUDY: 11:32 05/03/2023
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.800
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   14.0      1.0    0.018/0.018/0.020   0.50    1.50 0.0312 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.50 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  0.0 (FT*FT/S)
   *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
    OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
  UPSTREAM ELEVATION(FEET) =    397.70
  DOWNSTREAM ELEVATION(FEET) =    397.00
  ELEVATION DIFFERENCE(FEET) =      0.70
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    5.271
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.130
  SUBAREA RUNOFF(CFS) =      0.21
  TOTAL AREA(ACRES) =      0.04   TOTAL RUNOFF(CFS) =      0.21

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    397.00  DOWNSTREAM(FEET) =    395.60
```

```
  CHANNEL LENGTH THRU SUBAREA(FEET) =    75.00   CHANNEL SLOPE =  0.0187
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =  50.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   0.50
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.168
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.51
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   0.94
  AVERAGE FLOW DEPTH(FEET) =   0.07   TRAVEL TIME(MIN.) =   1.33
  Tc(MIN.) =    6.60
  SUBAREA AREA(ACRES) =     0.13       SUBAREA RUNOFF(CFS) =    0.60
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.750
  TOTAL AREA(ACRES) =        0.2         PEAK FLOW RATE(CFS) =       0.79

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.09   FLOW VELOCITY(FEET/SEC.) =   0.97
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    103.00 =     145.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    104.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  395.60  DOWNSTREAM ELEVATION(FEET) =  378.00
  STREET LENGTH(FEET) =   509.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 14.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   1.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       6.72
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.35
    HALFSTREET FLOOD WIDTH(FEET) =   12.51
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.43
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.56
  STREET FLOW TRAVEL TIME(MIN.) =    1.92   Tc(MIN.) =    8.51
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.234
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.750
  SUBAREA AREA(ACRES) =    3.01      SUBAREA RUNOFF(CFS) =   11.81
  TOTAL AREA(ACRES) =        3.2        PEAK FLOW RATE(CFS) =      12.48

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.38   HALFSTREET FLOOD WIDTH(FEET) =  14.00
  FLOW VELOCITY(FEET/SEC.) =  4.72   DEPTH*VELOCITY(FT*FT/SEC.) =   1.79
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    104.00 =     654.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    105.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   375.40  DOWNSTREAM(FEET) =   375.00
  FLOW LENGTH(FEET) =    25.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  14.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.35
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      12.48
  PIPE TRAVEL TIME(MIN.) =   0.05    Tc(MIN.) =    8.56
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    105.00 =     679.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.214
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7500
  SUBAREA AREA(ACRES) =    0.39   SUBAREA RUNOFF(CFS) =    1.53
  TOTAL AREA(ACRES) =        3.6   TOTAL RUNOFF(CFS) =      13.96
  TC(MIN.) =    8.56

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 IS CODE =   7
----------------------------------------------------------------------------
  >>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<
============================================================================
  USER-SPECIFIED VALUES ARE AS FOLLOWS:
  TC(MIN) =  15.16   RAIN INTENSITY(INCH/HOUR) =  3.61
  TOTAL AREA(ACRES) =     3.60   TOTAL RUNOFF(CFS) =      5.35

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    107.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   370.50  DOWNSTREAM(FEET) =   369.50
  FLOW LENGTH(FEET) =    30.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   8.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.05
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.35
  PIPE TRAVEL TIME(MIN.) =   0.06    Tc(MIN.) =   15.22
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    107.00 =     709.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    107.00 TO NODE    108.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   15.22
  RAINFALL INTENSITY(INCH/HR) =   3.60
  TOTAL STREAM AREA(ACRES) =     3.60
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      5.35

****************************************************************************
  FLOW PROCESS FROM NODE    108.00 TO NODE    108.00 IS CODE =   7
----------------------------------------------------------------------------
  >>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<
============================================================================
  USER-SPECIFIED VALUES ARE AS FOLLOWS:
  TC(MIN) =   8.61   RAIN INTENSITY(INCH/HOUR) =  5.20
  TOTAL AREA(ACRES) =     0.05   TOTAL RUNOFF(CFS) =      0.19

****************************************************************************
  FLOW PROCESS FROM NODE    107.00 TO NODE    108.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.61
  RAINFALL INTENSITY(INCH/HR) =   5.20
  TOTAL STREAM AREA(ACRES) =     0.05
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.19

  ** CONFLUENCE DATA **
```

```
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
     1        5.35    15.22        3.599          3.60
     2        0.19     8.61        5.196          0.05

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
     1        3.22     8.61       5.196
     2        5.48    15.22       3.599

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       5.48   Tc(MIN.) =   15.22
  TOTAL AREA(ACRES) =       3.6
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    108.00 =     709.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    109.00 TO NODE    109.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   15.22
  RAINFALL INTENSITY(INCH/HR) =   3.60
  TOTAL STREAM AREA(ACRES) =     3.65
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      5.48

****************************************************************************
  FLOW PROCESS FROM NODE    110.00 TO NODE    107.00 IS CODE =   7
----------------------------------------------------------------------------
  >>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<
============================================================================
  USER-SPECIFIED VALUES ARE AS FOLLOWS:
  TC(MIN) =   5.00   RAIN INTENSITY(INCH/HOUR) =  7.38
  TOTAL AREA(ACRES) =     0.40   TOTAL RUNOFF(CFS) =      1.74

****************************************************************************
  FLOW PROCESS FROM NODE    111.00 TO NODE    111.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    5.00
  RAINFALL INTENSITY(INCH/HR) =   7.38
  TOTAL STREAM AREA(ACRES) =     0.40
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.74

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
     1        5.48    15.22        3.599          3.65
     2        1.74     5.00        7.377          0.40

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
     1        4.41     5.00       7.377
     2        6.33    15.22       3.599

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       6.33   Tc(MIN.) =   15.22
  TOTAL AREA(ACRES) =       4.0
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    111.00 =     709.00 FEET.
============================================================================
```

```
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        4.0  TC(MIN.) =     15.22
  PEAK FLOW RATE(CFS)   =       6.33
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2016 Advanced Engineering Software (aes)
             Ver. 23.0 Release Date: 07/01/2016  License ID 1452

                           Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* PASCO LARET SUITER & ASSOCIATES                                          *
* BASIN PR-2 POST DEVELOPMENT HYDORLOGY                                     *
* PLSA 3086                                                                *
 **************************************************************************

  FILE NAME: 3086-PR2.DAT
  TIME/DATE OF STUDY: 14:28 12/05/2023
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.800
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======   ===== ====== ===== =======
  1   14.0      1.0    0.018/0.018/0.020   0.50    1.50 0.0312 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.50 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  0.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
```

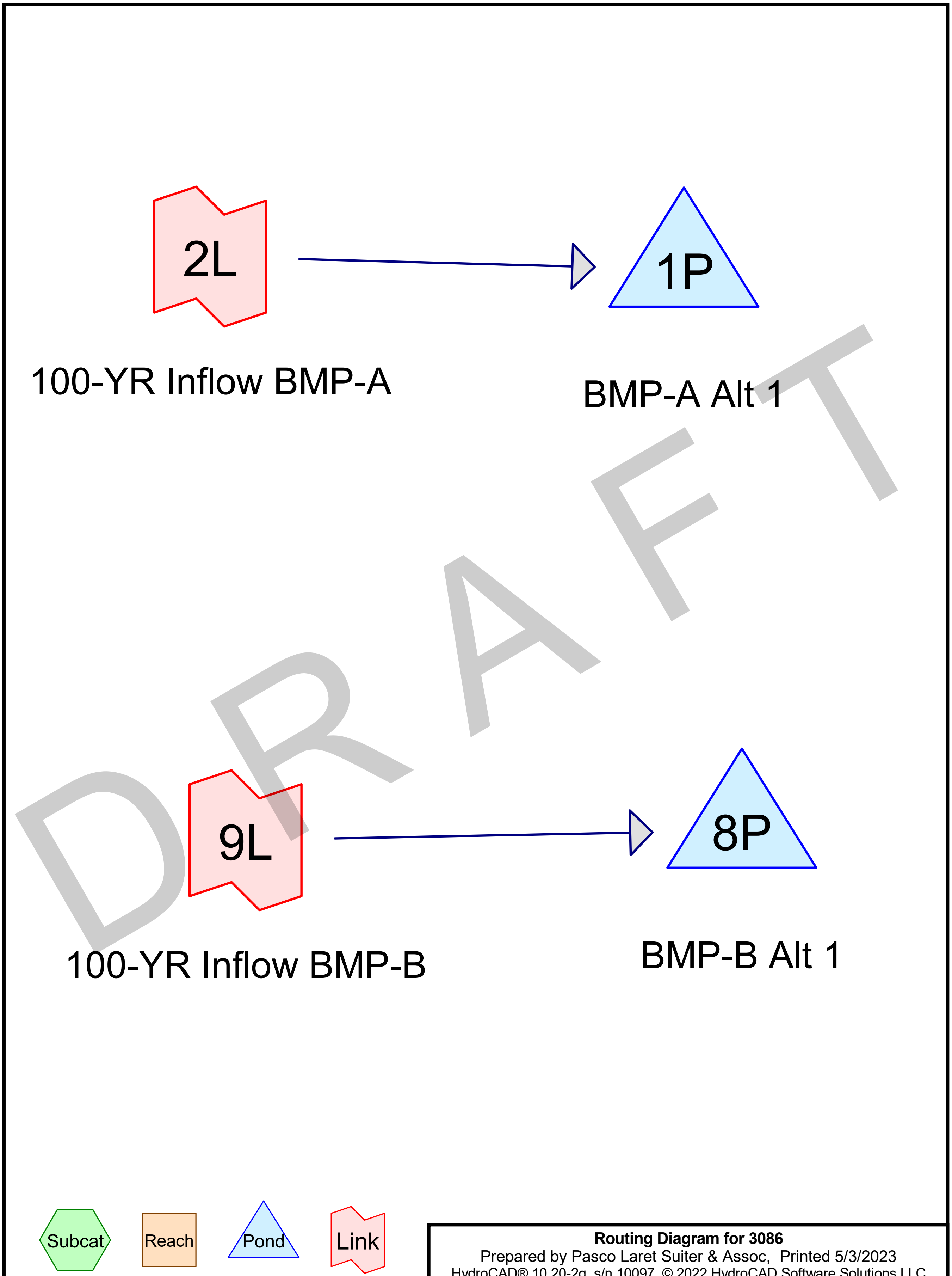
```
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7300
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
  UPSTREAM ELEVATION(FEET) =    399.00
  DOWNSTREAM ELEVATION(FEET) =    398.30
  ELEVATION DIFFERENCE(FEET) =      0.70
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    5.572
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.879
  SUBAREA RUNOFF(CFS) =      0.30
  TOTAL AREA(ACRES) =      0.06   TOTAL RUNOFF(CFS) =      0.30

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    203.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    398.30  DOWNSTREAM(FEET) =    394.80
  CHANNEL LENGTH THRU SUBAREA(FEET) =   180.00   CHANNEL SLOPE =  0.0194
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =  50.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   0.50
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.196
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7300
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.72
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   0.99
  AVERAGE FLOW DEPTH(FEET) =   0.08   TRAVEL TIME(MIN.) =   3.04
  Tc(MIN.) =    8.61
  SUBAREA AREA(ACRES) =     0.22       SUBAREA RUNOFF(CFS) =    0.83
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.730
  TOTAL AREA(ACRES) =       0.3         PEAK FLOW RATE(CFS) =      1.06

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.10   FLOW VELOCITY(FEET/SEC.) =   1.12
  LONGEST FLOWPATH FROM NODE    201.00 TO NODE    203.00 =     250.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    204.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  394.80  DOWNSTREAM ELEVATION(FEET) =  386.00
  STREET LENGTH(FEET) =   282.00   CURB HEIGHT(INCHES) =  6.0
```

```
  STREET HALFWIDTH(FEET) = 14.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   1.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.35
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.27
    HALFSTREET FLOOD WIDTH(FEET) =    7.74
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.32
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.89
  STREET FLOW TRAVEL TIME(MIN.) =   1.42   Tc(MIN.) =   10.03
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.709
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7300
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.730
  SUBAREA AREA(ACRES) =    1.91      SUBAREA RUNOFF(CFS) =    6.57
  TOTAL AREA(ACRES) =        2.2       PEAK FLOW RATE(CFS) =       7.53

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.31   HALFSTREET FLOOD WIDTH(FEET) =   9.99
  FLOW VELOCITY(FEET/SEC.) =  3.72   DEPTH*VELOCITY(FT*FT/SEC.) =   1.15
  LONGEST FLOWPATH FROM NODE    201.00 TO NODE    204.00 =     532.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    205.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   386.00  DOWNSTREAM(FEET) =   381.50
  FLOW LENGTH(FEET) =   126.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS   8.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.26
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       7.53
  PIPE TRAVEL TIME(MIN.) =   0.20    Tc(MIN.) =   10.23
  LONGEST FLOWPATH FROM NODE    201.00 TO NODE    205.00 =     658.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    205.00 TO NODE    205.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
```

```
==============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.648
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7300
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7300
  SUBAREA AREA(ACRES) =    0.41   SUBAREA RUNOFF(CFS) =    1.39
  TOTAL AREA(ACRES) =        2.6   TOTAL RUNOFF(CFS) =       8.82
  TC(MIN.) =   10.23
==============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.6  TC(MIN.) =     10.23
  PEAK FLOW RATE(CFS)   =       8.82
==============================================================================
==============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

# Appendix B

# DETENTION CALCULATIONS





**Routing Diagram for 3086**
Prepared by Pasco Laret Suiter & Assoc, Printed 5/3/2023

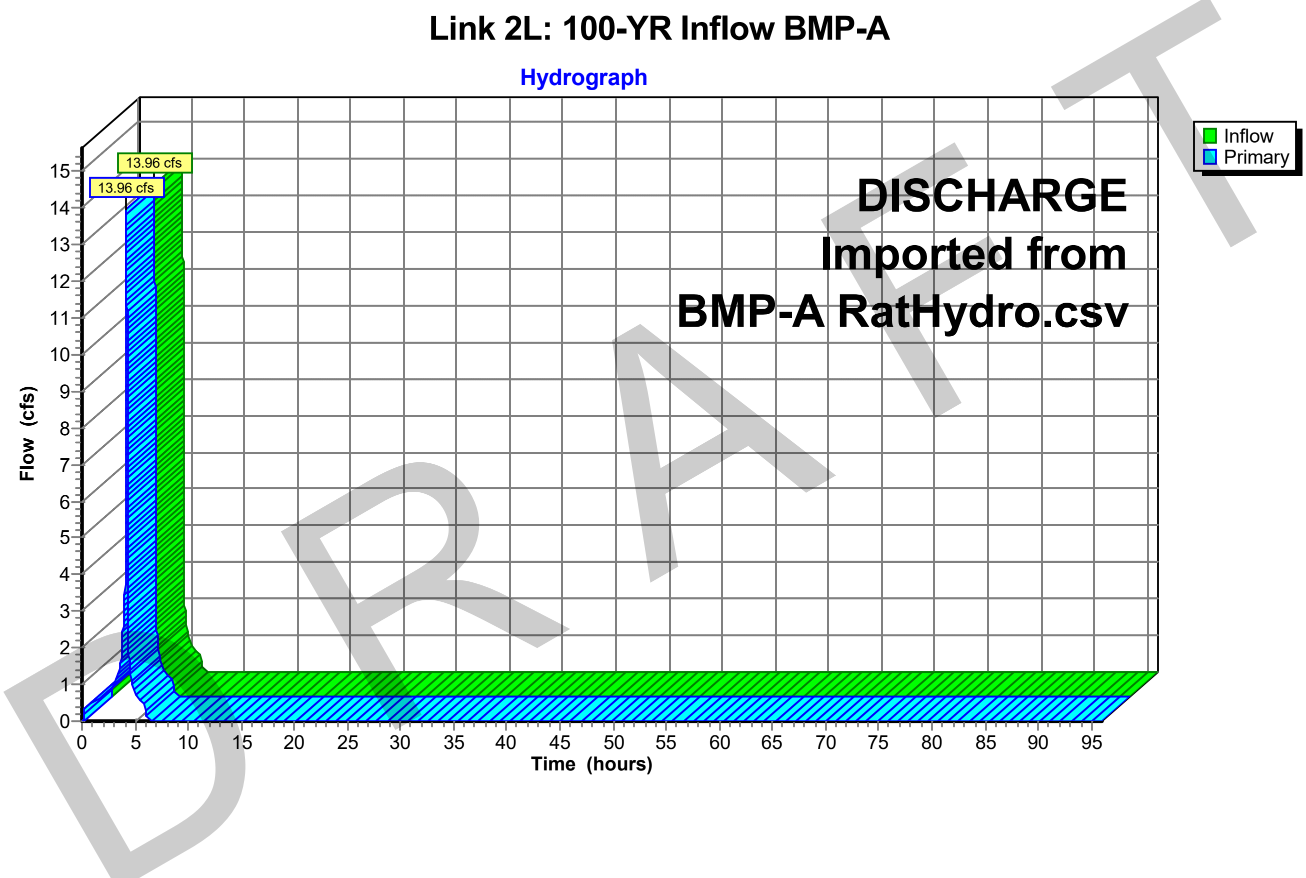
## Summary for Link 2L: 100-YR Inflow BMP-A

| | | | | | |
|---|---|---|---|---|---|
| Inflow | = | 13.96 cfs @ | 4.20 hrs, | Volume= | 26,978 cf |
| Primary | = | 13.96 cfs @ | 4.20 hrs, | Volume= | 26,978 cf, Atten= 0%, Lag= 0.0 min |

Routed to Pond 1P : BMP-A Alt 1

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.001 hrs

DISCHARGE Imported from BMP-A RatHydro.csv



## Summary for Pond 1P: BMP-A Alt 1

Inflow = 13.96 cfs @ 4.20 hrs, Volume= 26,978 cf
Outflow = 5.35 cfs @ 4.31 hrs, Volume= 26,362 cf, Atten= 62%, Lag= 6.6 min
Primary = 5.35 cfs @ 4.31 hrs, Volume= 26,362 cf
Routed to nonexistent node 17P

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.001 hrs
Peak Elev= 376.48' @ 4.31 hrs Surf.Area= 6,010 sf Storage= 17,593 cf

100-yr storm water surface elevation does not exceed 18" of ponding in the mitigated condition (Peak Elev = 376.48', BMP FG = 375.0')

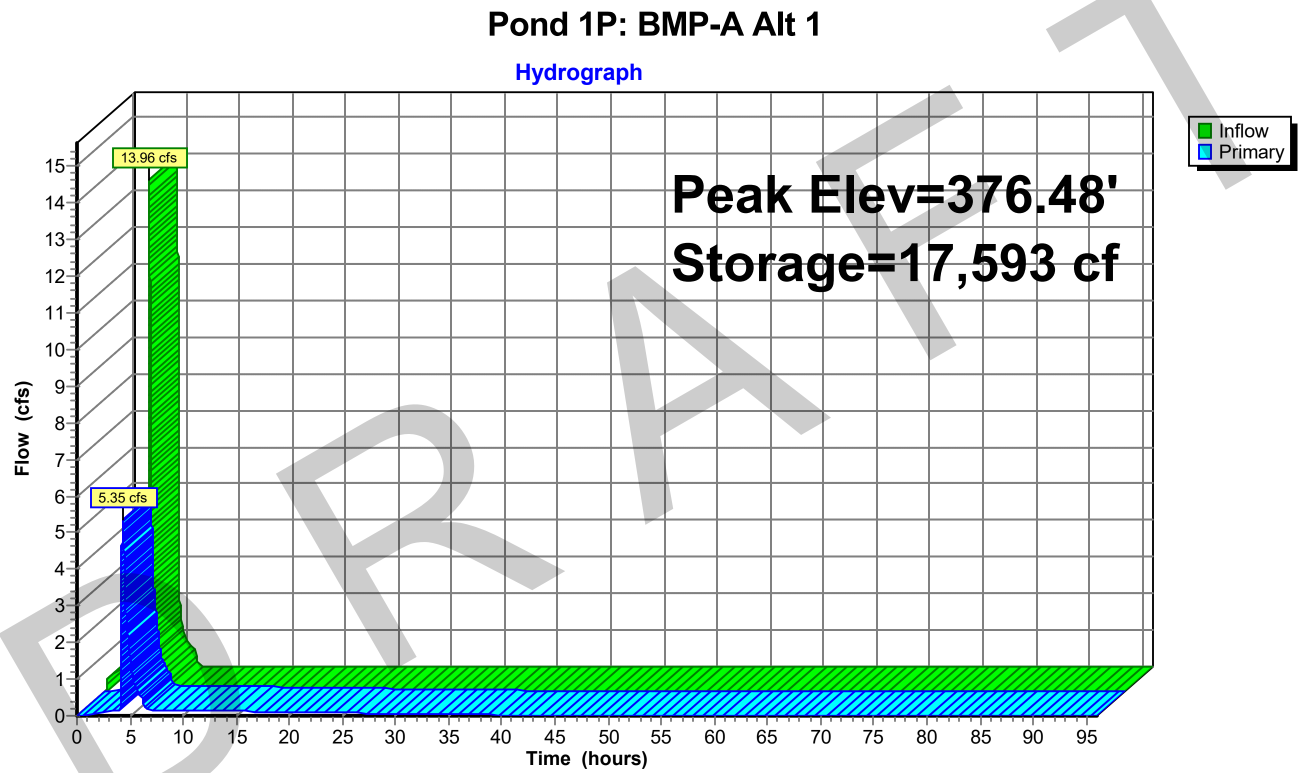
Plug-Flow detention time= 442.8 min calculated for 26,361 cf (98% of inflow)
Center-of-Mass det. time= 439.7 min ( 658.5 - 218.8 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 370.50' | 20,735 cf | **BMP-A (Conic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Voids (%) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|---|
| 370.50 | 6,010 | 0.00 | 0 | 0 | 6,010 |
| 373.25 | 6,010 | 40.00 | 6,611 | 6,611 | 6,766 |
| 375.00 | 6,010 | 20.00 | 2,104 | 8,715 | 7,247 |
| 377.00 | 6,010 | 100.00 | 12,020 | 20,735 | 7,796 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 370.50' | **18.000" Round Culvert**<br>L= 18.0' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 370.50' / 370.41' S= 0.0050 '/' Cc= 0.900<br>n= 0.013, Flow Area= 1.77 sf |
| #2 | Device 1 | 370.75' | **1.675" Vert. Orifice** C= 0.600 Limited to weir flow at low heads |
| #3 | Device 1 | 375.50' | **19.000" W x 3.000" H Vert. Orifice X 2.00** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Device 1 | 376.00' | **12.000" x 12.000" Horiz. Grate X 0.50**<br>C= 0.600 in 12.000" x 12.000" Grate (100% open area)<br>Limited to weir flow at low heads |
| #5 | Device 1 | 376.50' | **18.000" x 18.000" Horiz. Grate X 0.50**<br>C= 0.600 in 18.000" x 18.000" Grate (100% open area)<br>Limited to weir flow at low heads |
| #6 | Device 1 | 376.50' | **24.000" x 24.000" Horiz. Grate X 0.50**<br>C= 0.600 in 24.000" x 24.000" Grate (100% open area)<br>Limited to weir flow at low heads |
| #7 | Device 1 | 376.70' | **36.000" x 36.000" Horiz. Grate X 0.50**<br>C= 0.600 in 36.000" x 36.000" Grate (100% open area)<br>Limited to weir flow at low heads |
| #8 | Device 1 | 376.70' | **36.000" x 36.000" Horiz. Grate X 0.50**<br>C= 0.600 in 36.000" x 36.000" Grate (100% open area)<br>Limited to weir flow at low heads |
| #9 | Device 2 | 370.50' | **5.000 in/hr Infiltration through soil over Surface area below 375.00'** |

**Primary OutFlow** Max=5.35 cfs @ 4.31 hrs HW=376.48' (Free Discharge)
└**1=Culvert** (Passes 5.35 cfs of 19.45 cfs potential flow)
  ├**2=Orifice** (Orifice Controls 0.18 cfs @ 11.45 fps)
  │ └**9=Infiltration through soil** (Passes 0.18 cfs of 0.70 cfs potential flow)
  ├**3=Orifice** (Orifice Controls 3.52 cfs @ 4.44 fps)
  ├**4=Grate** (Orifice Controls 1.66 cfs @ 1.66 fps)
  ├**5=Grate** ( Controls 0.00 cfs)
  ├**6=Grate** ( Controls 0.00 cfs)
  ├**7=Grate** ( Controls 0.00 cfs)
  └**8=Grate** ( Controls 0.00 cfs)

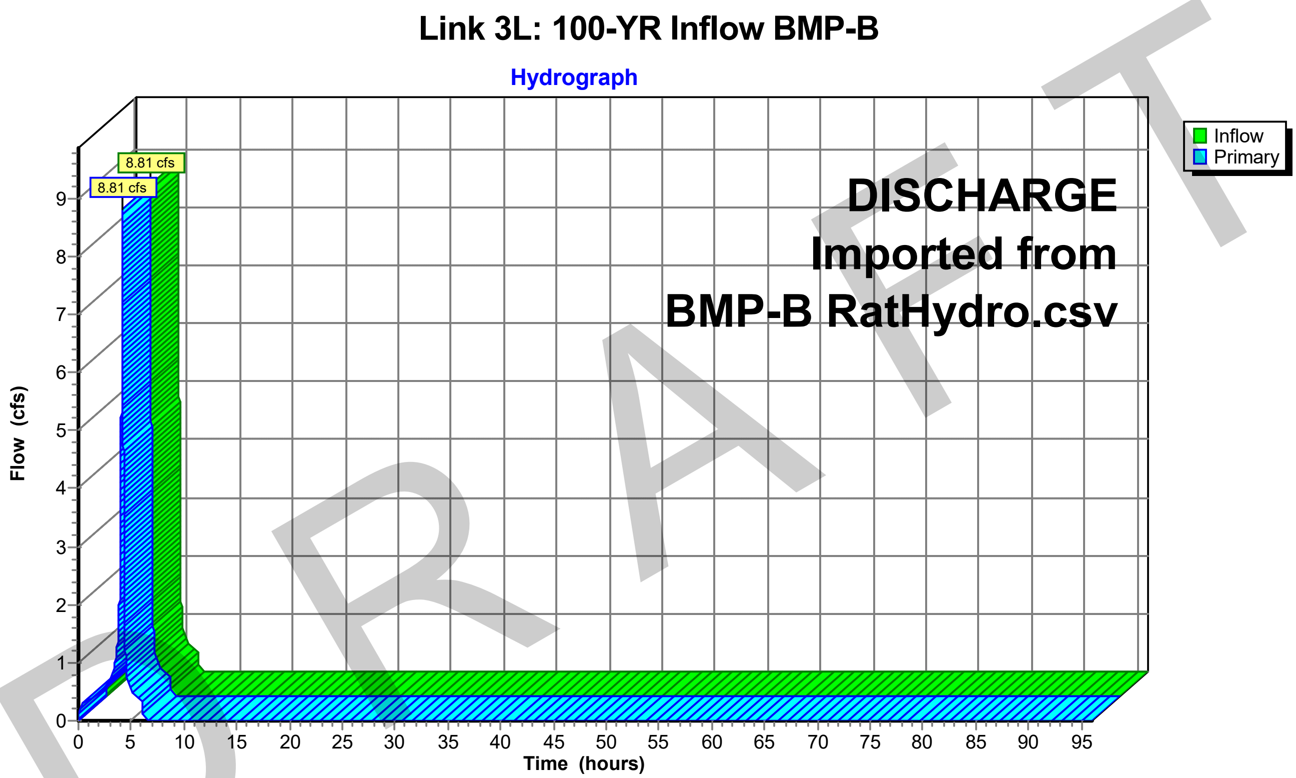


## Summary for Link 3L: 100-YR Inflow BMP-B

Inflow = 8.81 cfs @ 4.17 hrs, Volume= 19,212 cf
Primary = 8.81 cfs @ 4.17 hrs, Volume= 19,212 cf, Atten= 0%, Lag= 0.0 min
Routed to Pond 3P : BMP-B Alt 1

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.001 hrs

DISCHARGE Imported from BMP-B RatHydro.csv



## Summary for Pond 3P: BMP-B Alt 1

| | | | | |
|---|---|---|---|---|
| Inflow | = | 8.81 cfs @ | 4.17 hrs, Volume= | 19,212 cf |
| Outflow | = | 0.18 cfs @ | 6.07 hrs, Volume= | 18,463 cf, Atten= 98%, Lag= 114.0 min |
| Primary | = | 0.18 cfs @ | 6.07 hrs, Volume= | 18,463 cf |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.001 hrs
Peak Elev= 379.21' @ 6.07 hrs Surf.Area= 3,030 sf Storage= 17,156 cf

Plug-Flow detention time= 1,056.6 min calculated for 18,463 cf (96% of inflow)
Center-of-Mass det. time= 1,051.4 min ( 1,267.3 - 215.9 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 373.25' | 25,831 cf | **BMP-B (Conic)** Listed below (Recalc) |

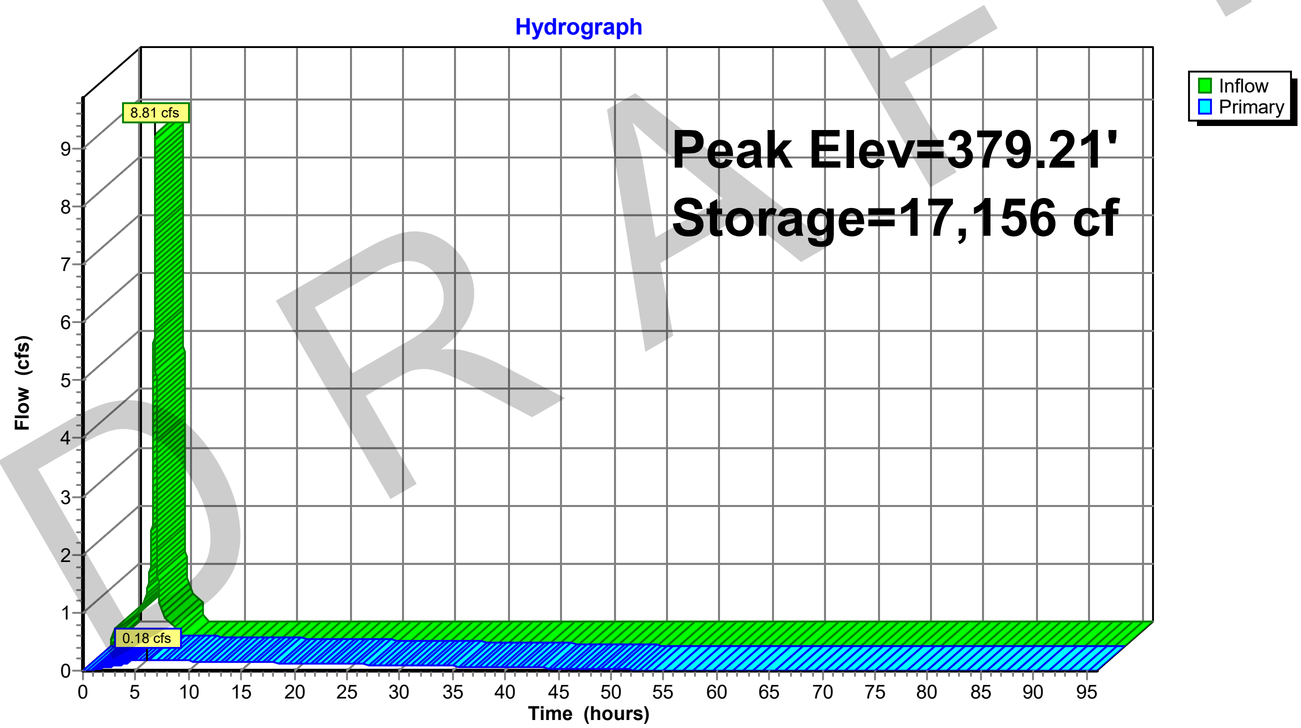
| Elevation (feet) | Surf.Area (sq-ft) | Voids (%) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|---|
| 373.25 | 3,030 | 0.00 | 0 | 0 | 3,030 |
| 379.75 | 3,030 | 95.00 | 18,710 | 18,710 | 4,298 |
| 381.50 | 3,030 | 20.00 | 1,061 | 19,771 | 4,640 |
| 383.50 | 3,030 | 100.00 | 6,060 | 25,831 | 5,030 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 373.50' | **6.000" Round 6" Culvert**<br>L= 18.0' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 373.50' / 373.32' S= 0.0100 '/' Cc= 0.900<br>n= 0.013, Flow Area= 0.20 sf |
| #2 | Device 1 | 373.50' | **1.700" Vert. Orifice** C= 0.600 Limited to weir flow at low heads |
| #3 | Device 1 | 382.00' | **23.000" W x 3.000" H Vert. Midflow Orifice X 3.00** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Device 1 | 383.00' | **24.000" x 24.000" Horiz. Grate X 0.50**<br>C= 0.600 in 24.000" x 24.000" Grate (100% open area)<br>Limited to weir flow at low heads |
| #5 | Primary | 373.25' | **18.000" Round 18" Culvert**<br>L= 10.0' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 373.25' / 373.15' S= 0.0100 '/' Cc= 0.900<br>n= 0.013, Flow Area= 1.77 sf |
| #6 | Device 5 | 383.25' | **36.000" x 36.000" Horiz. Grate X 0.50**<br>C= 0.600 in 36.000" x 36.000" Grate (100% open area)<br>Limited to weir flow at low heads |
| #7 | Device 5 | 383.25' | **36.000" x 36.000" Horiz. Grate X 0.50**<br>C= 0.600 in 36.000" x 36.000" Grate (100% open area)<br>Limited to weir flow at low heads |
| #8 | Device 5 | 383.25' | **36.000" x 36.000" Horiz. Grate X 0.50**<br>C= 0.600 in 36.000" x 36.000" Grate (100% open area)<br>Limited to weir flow at low heads |
| #9 | Device 5 | 383.25' | **36.000" x 36.000" Horiz. Grate X 0.50**<br>C= 0.600 in 36.000" x 36.000" Grate (100% open area)<br>Limited to weir flow at low heads |
| #10 | Device 5 | 383.25' | **36.000" x 36.000" Horiz. Grate X 0.50**<br>C= 0.600 in 36.000" x 36.000" Grate (100% open area) |

| | | | |
|---|---|---|---|
| | | | Limited to weir flow at low heads |
| #11 | Device 2 | 373.25' | **5.000 in/hr Infiltration through soil over Surface area below 381.50'** |

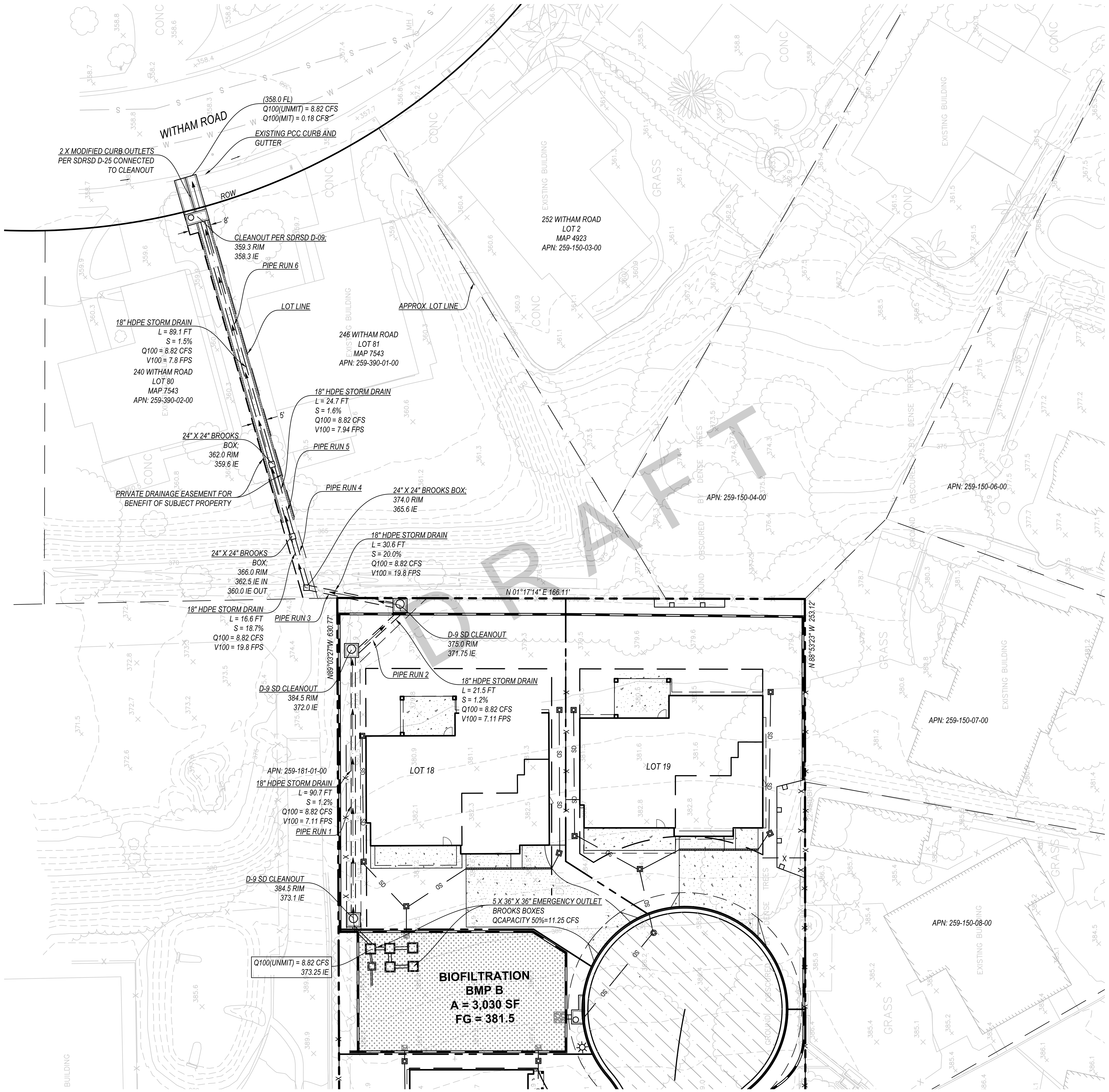
**Primary OutFlow** Max=0.18 cfs @ 6.07 hrs HW=379.21' (Free Discharge)
- **1=6" Culvert** (Passes 0.18 cfs of 2.14 cfs potential flow)
  - **2=Orifice** (Orifice Controls 0.18 cfs @ 11.43 fps)
    - **11=Infiltration through soil** (Passes 0.18 cfs of 0.35 cfs potential flow)
  - **3=Midflow Orifice** ( Controls 0.00 cfs)
  - **4=Grate** ( Controls 0.00 cfs)
- **5=18" Culvert** (Passes 0.00 cfs of 19.42 cfs potential flow)
  - **6=Grate** ( Controls 0.00 cfs)
  - **7=Grate** ( Controls 0.00 cfs)
  - **8=Grate** ( Controls 0.00 cfs)
  - **9=Grate** ( Controls 0.00 cfs)
  - **10=Grate** ( Controls 0.00 cfs)

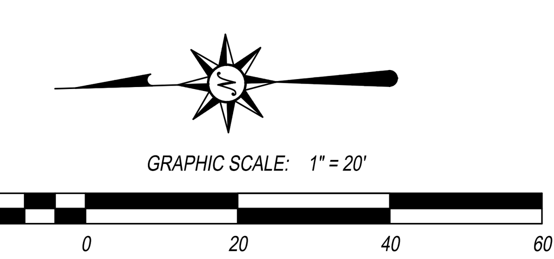
## Pond 3P: BMP-B Alt 1



# Appendix C

# PRELIMINARY HYDRAULIC SUPPORT MATERIAL




PLAN VIEW - WITHAM BASIN PRELIM HYDRAULICS

SCALE: 1" = 20' HORIZONTAL

PLSA
PLSAENGINEERING.COM

# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Jan 8 2024

## PIPE RUN 1 - 18-INCH HDPE @1.2 PERCENT

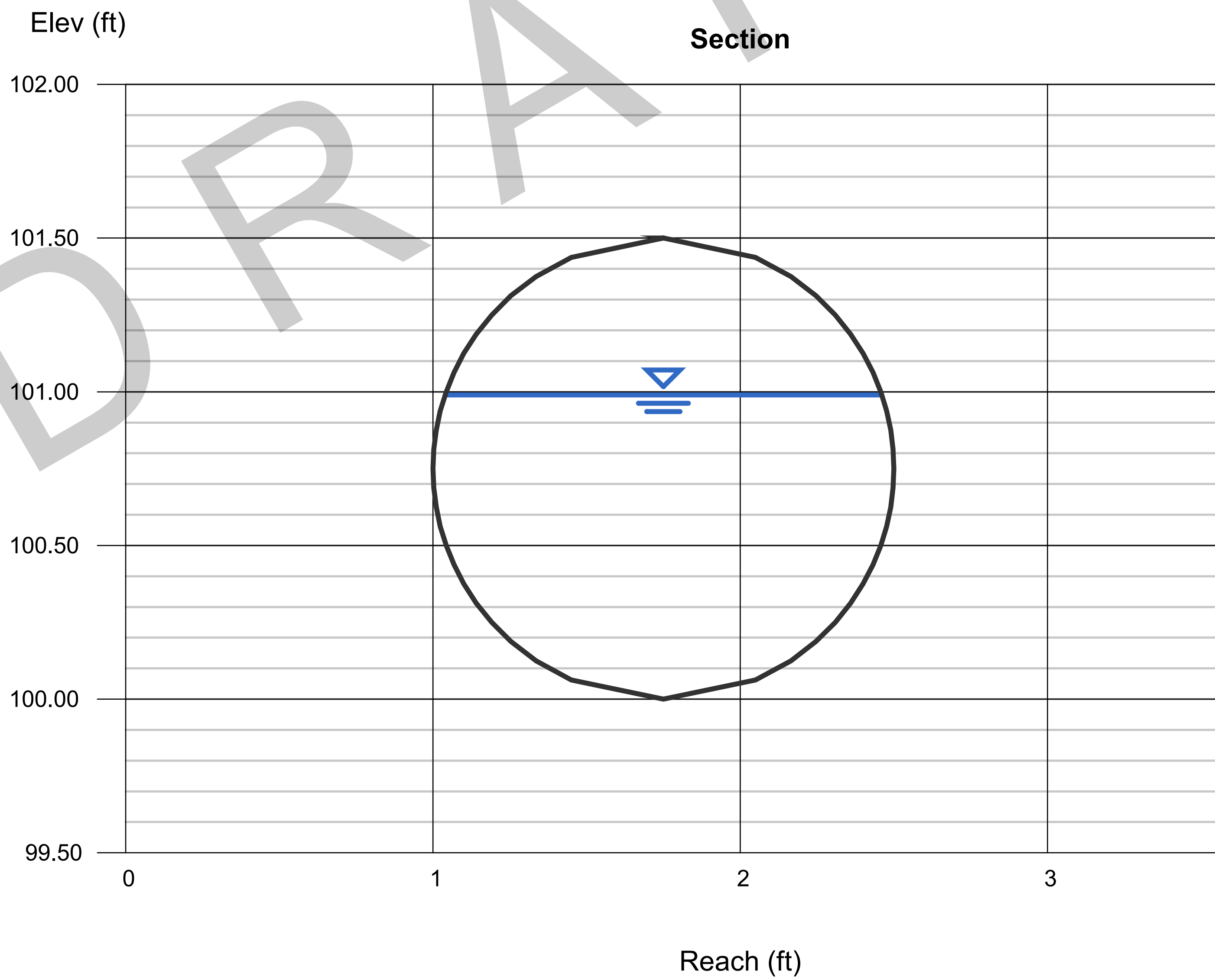
**Circular**
Diameter (ft) = 1.50

Invert Elev (ft) = 100.00
Slope (%) = 1.20
N-Value = 0.013

**Calculations**
Compute by: Known Q
Known Q (cfs) = 8.82

**Highlighted**
Depth (ft) = 0.99
Q (cfs) = 8.820
Area (sqft) = 1.24
Velocity (ft/s) = 7.11
Wetted Perim (ft) = 2.85
Crit Depth, Yc (ft) = 1.15
Top Width (ft) = 1.42
EGL (ft) = 1.78



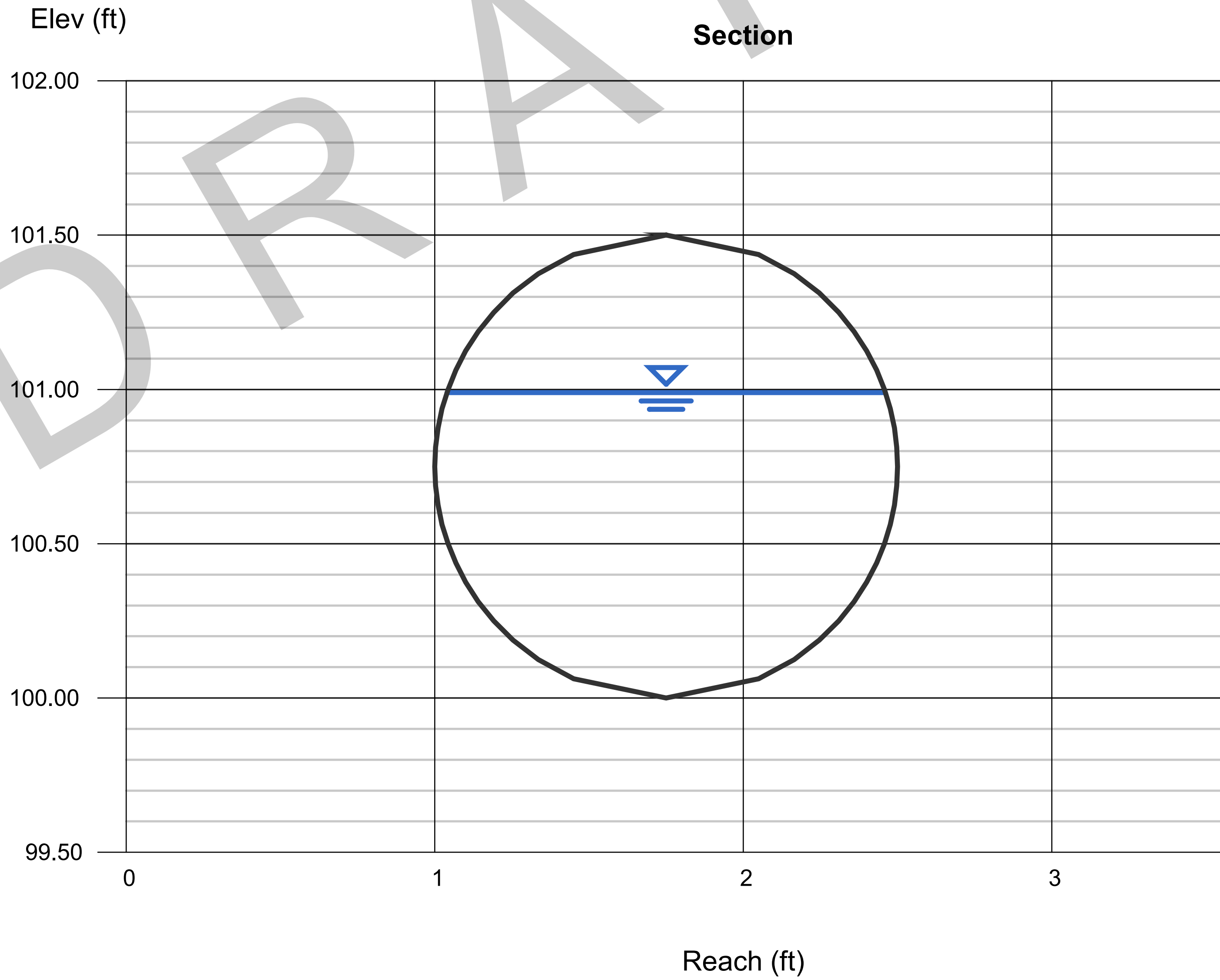


# Channel Report



## PIPE RUN 2 - 18-INCH HDPE @1.2 PERCENT

| | | | |
|---|---|---|---|
| **Circular** | | **Highlighted** | |
| Diameter (ft) | = 1.50 | Depth (ft) | = 0.99 |
| | | Q (cfs) | = 8.820 |
| | | Area (sqft) | = 1.24 |
| Invert Elev (ft) | = 100.00 | Velocity (ft/s) | = 7.11 |
| Slope (%) | = 1.20 | Wetted Perim (ft) | = 2.85 |
| N-Value | = 0.013 | Crit Depth, Yc (ft) | = 1.15 |
| | | Top Width (ft) | = 1.42 |
| **Calculations** | | EGL (ft) | = 1.78 |
| Compute by: | Known Q | | |
| Known Q (cfs) | = 8.82 | | |



# Channel Report



## PIPE RUN 3 - 18-INCH HDPE @20 PERCENT

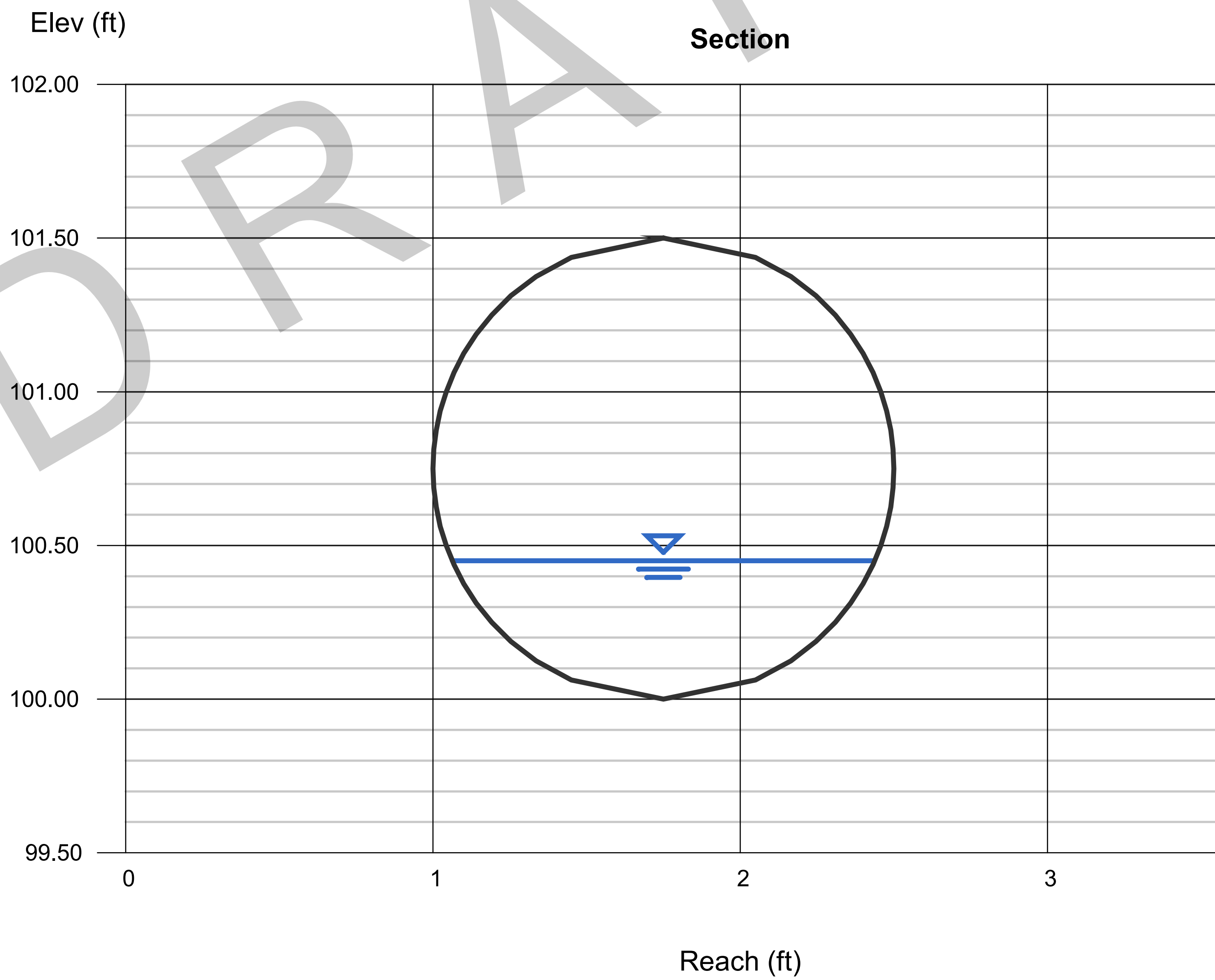
**Circular**
Diameter (ft) = 1.50

Invert Elev (ft) = 100.00
Slope (%) = 20.00
N-Value = 0.013

**Calculations**
Compute by: Known Q
Known Q (cfs) = 8.82

**Highlighted**
Depth (ft) = 0.45
Q (cfs) = 8.820
Area (sqft) = 0.45
Velocity (ft/s) = 19.75
Wetted Perim (ft) = 1.74
Crit Depth, Yc (ft) = 1.15
Top Width (ft) = 1.38
EGL (ft) = 6.52





# Channel Report



## PIPE RUN 4 - 18-INCH HDPE @18.7 PERCENT

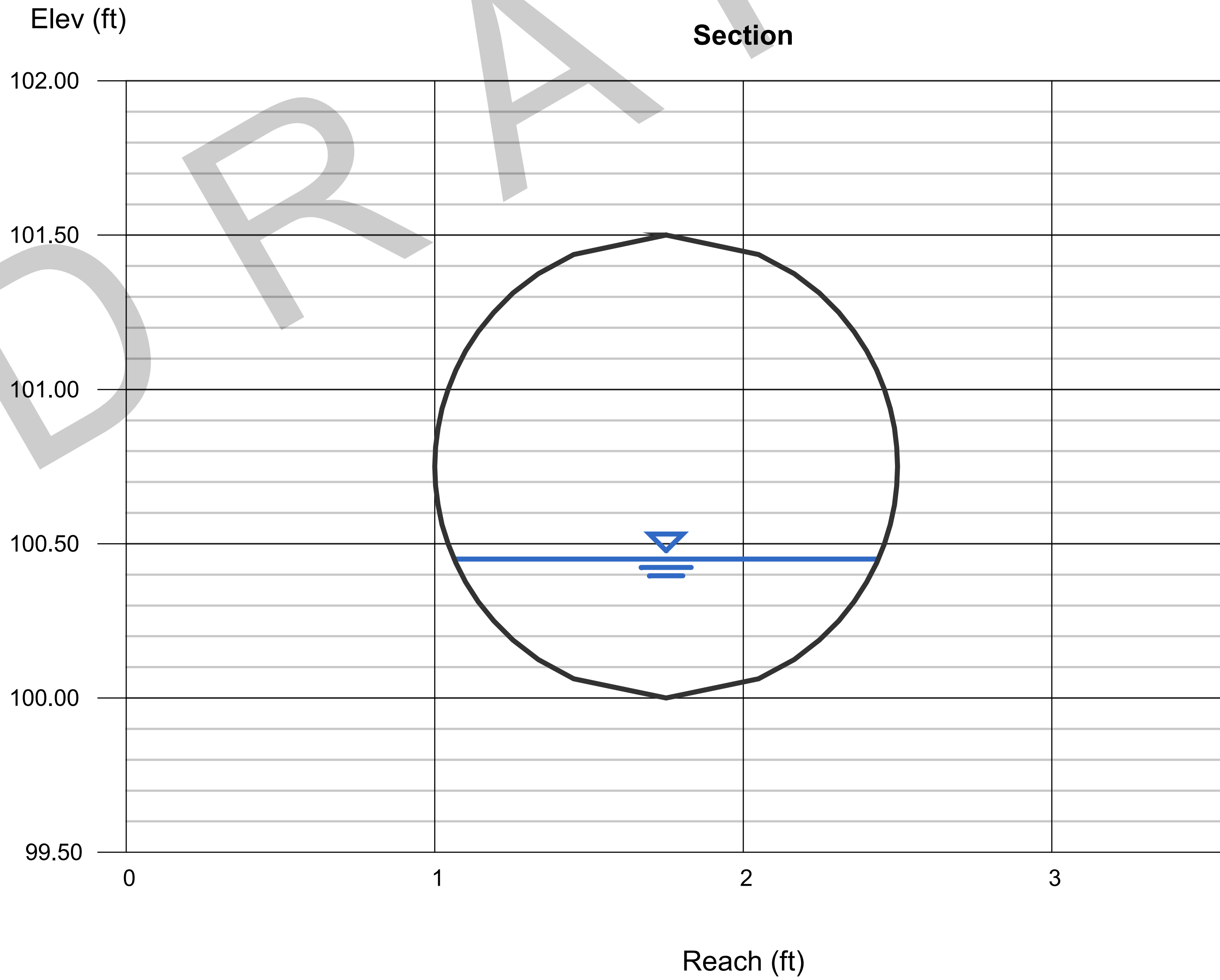
**Circular**
Diameter (ft) = 1.50

Invert Elev (ft) = 100.00
Slope (%) = 18.70
N-Value = 0.013

**Calculations**
Compute by: Known Q
Known Q (cfs) = 8.82

**Highlighted**
Depth (ft) = 0.45
Q (cfs) = 8.820
Area (sqft) = 0.45
Velocity (ft/s) = 19.75
Wetted Perim (ft) = 1.74
Crit Depth, Yc (ft) = 1.15
Top Width (ft) = 1.38
EGL (ft) = 6.52





# Channel Report



## PIPE RUN 5 - 18-INCH HDPE @1.6 PERCENT

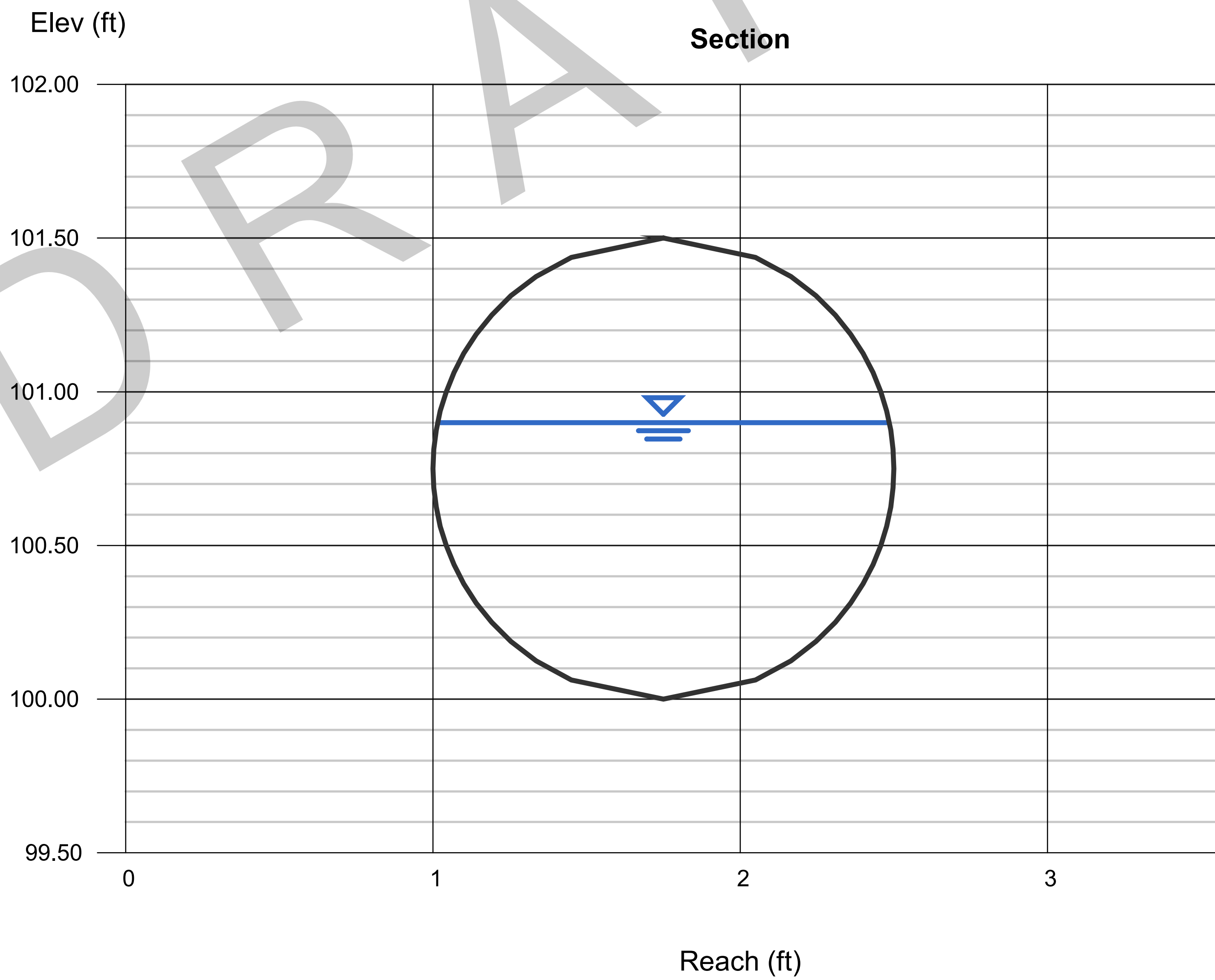
**Circular**
Diameter (ft) = 1.50

Invert Elev (ft) = 100.00
Slope (%) = 1.60
N-Value = 0.013

**Calculations**
Compute by: Known Q
Known Q (cfs) = 8.82

**Highlighted**
Depth (ft) = 0.90
Q (cfs) = 8.820
Area (sqft) = 1.11
Velocity (ft/s) = 7.94
Wetted Perim (ft) = 2.66
Crit Depth, Yc (ft) = 1.15
Top Width (ft) = 1.47
EGL (ft) = 1.88





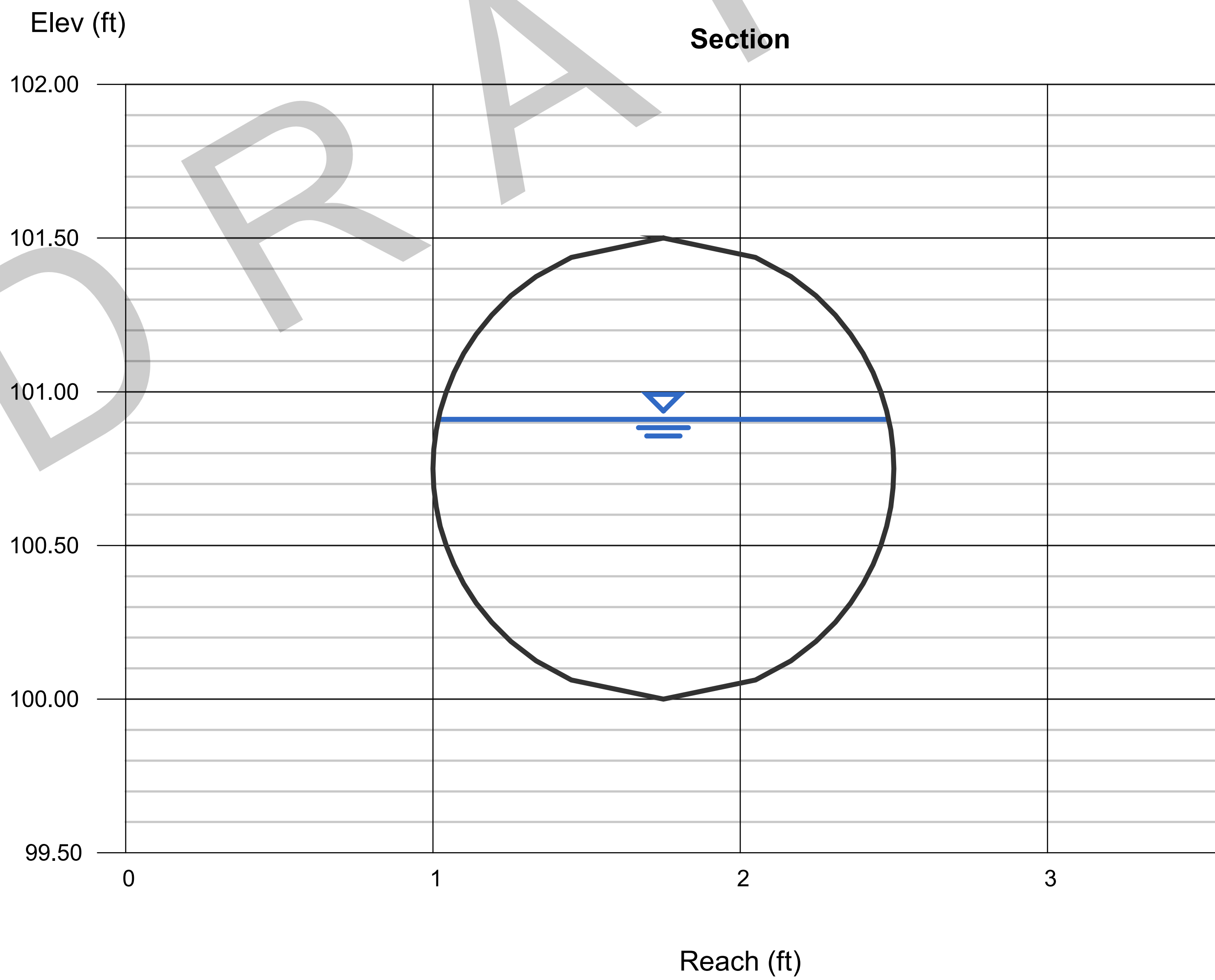
# Channel Report



## PIPE RUN 6 - 18-INCH HDPE @1.5 PERCENT

| | | | |
|---|---|---|---|
| **Circular** | | **Highlighted** | |
| Diameter (ft) | = 1.50 | Depth (ft) | = 0.91 |
| | | Q (cfs) | = 8.820 |
| | | Area (sqft) | = 1.13 |
| Invert Elev (ft) | = 100.00 | Velocity (ft/s) | = 7.83 |
| Slope (%) | = 1.50 | Wetted Perim (ft) | = 2.68 |
| N-Value | = 0.013 | Crit Depth, Yc (ft) | = 1.15 |
| | | Top Width (ft) | = 1.46 |
| **Calculations** | | EGL (ft) | = 1.86 |
| Compute by: | Known Q | | |
| Known Q (cfs) | = 8.82 | | |





# WITHAM BASIN GRATED INLET CAPACITY CALCULATION

36-in Grated Inlet in Sag (Assumed 50% Clogging)

| | | | | | | |
|---|---|---|---|---|---|---|
| Cw | 3 | Unitless | | | L | 3 ft |
| Pe | 6.00 | ft | | | W | 3 ft |
| C0 | 0.67 | Unitless | Ae | 4.5 | | |

*Pe assumes 50% clogging

Weir

| Q (cfs) | d (ft) |
|---|---|
| 2.25 | 0.25 |
| 6.36 | 0.5 |
| 11.69 | 0.75 |
| 18.00 | 1 |
| 25.16 | 1.25 |
| 33.07 | 1.5 |

Orifice

| Q (cfs) | d (ft) |
|---|---|
| 12.10 | 0.25 |
| 17.11 | 0.5 |
| 20.95 | 0.75 |
| 24.20 | 1 |
| 27.05 | 1.25 |
| 29.63 | 1.5 |

*TWO 36" X 36" GRATED INLETS ASSUMING 50% CLOG RATE PROVIDE CAPACITY FOR 12.72 CFS

WITHAM Q100 (UNMIT) = 9.36 CFS
WITHAM Q100 (UNMIT) < GRATE CAPACITY



**Step 1.** Calculate the capacity of a grate inlet operating as a weir, using the weir equation (Equation 2-16) with a length equivalent to perimeter of the grate. When the grate is located next to a curb, disregard the length of the grate against the curb.

$$Q = C_W P_e d^{3/2} \tag{2-16}$$

where …

$Q$ = inlet capacity of the grated inlet (ft$^3$/s);
$C_W$ = weir coefficient ($C_W$=3.0 for U.S. Traditional Units);
$P_e$ = effective grate perimeter length (ft); and
$d$ = flow depth approaching inlet (ft).

To account for the effects of clogging of a grated inlet operating as a weir, a clogging factor of fifty percent ($C_L$=0.50) shall be applied to the actual (unclogged) perimeter of the grate ($P$):

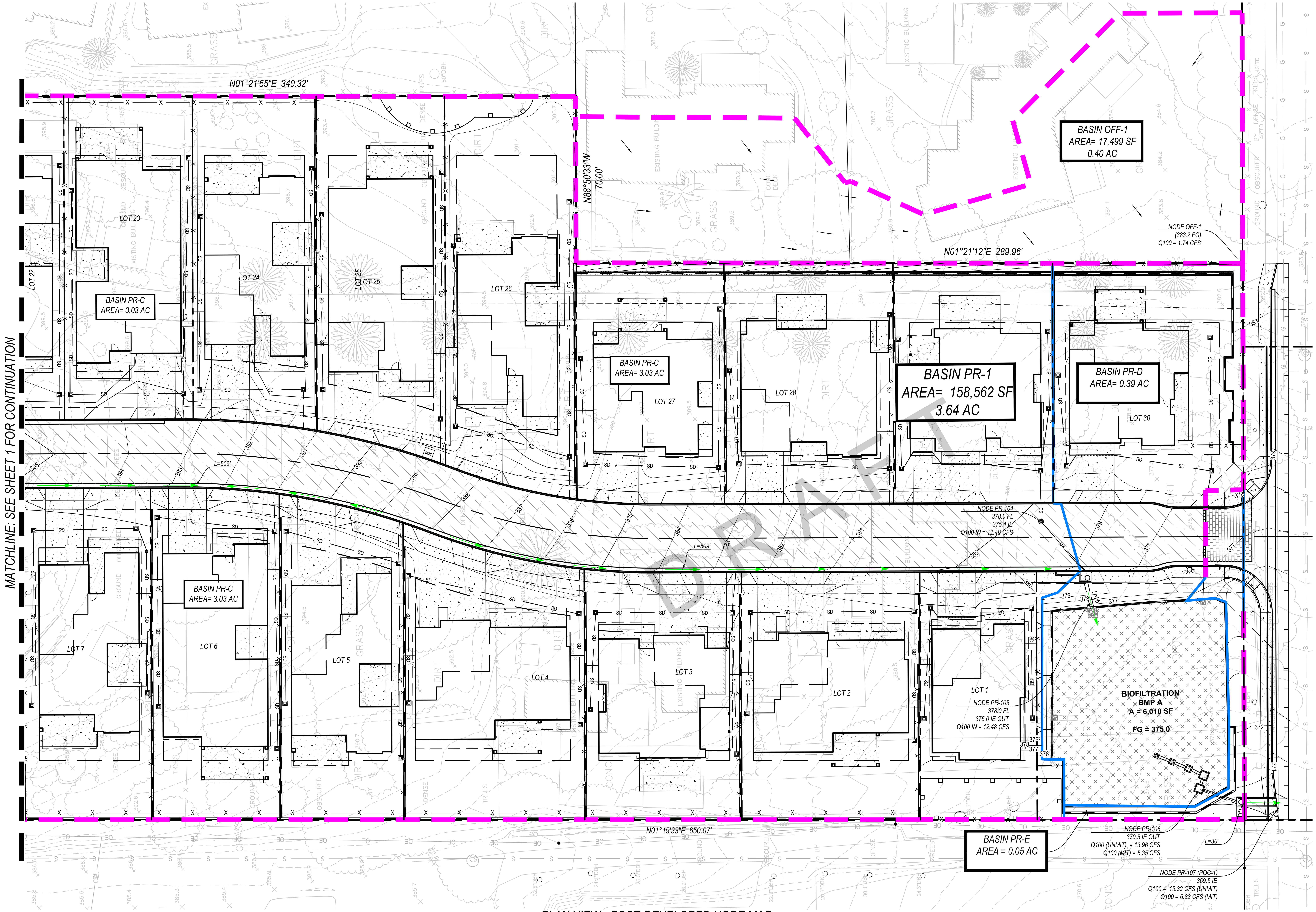
**Step 2.** Calculate the capacity of a grate inlet operating as an orifice. Use the orifice equation (Equation 2-18), assuming the clear opening of the grate reduced by a clogging factor $C_A$=0.50 (Equation 2-19). A San Diego Regional Standard No. D-15 grate has an actual clear opening of $A$=4.7 ft$^2$. The Federal Highway Administration's *Urban Drainage Design Manual* (HEC-22) provides guidance for other grate types and configurations.

$$Q = C_O A_e \left(2gd\right)^{1/2} \tag{2-18}$$

$$A_e = (1 - C_A) A \tag{2-19}$$

where …

$Q$ = inlet capacity of the grated inlet (ft$^3$/s);
$C_O$ = orifice coefficient ($C_O$=0.67 for U.S. Traditional Units);
$g$ = gravitational acceleration (ft/s$^2$);
$d$ = flow depth above inlet (ft);
$A_e$ = effective (clogged) grate area (ft2);
$C_A$ = area clogging factor ($C_A$=0.50); and
$A$ = actual opening area of the grate inlet (i.e., the total area less the area of bars or vanes). The actual opening area for a San Diego Regional Standard No. D-15 grate is $A$=4.7 ft$^2$. The Federal Highway Administration's *Urban Drainage Design Manual* (HEC-22) provides guidance for other grate types and configurations.




## LEGEND

| | |
|---|---|
| PROPERTY BOUNDARY | |
| CENTERLINE OF ROAD | |
| RIGHT-OF-WAY BOUNDARY | |
| ADJACENT PROPERTY LINE | |
| EXISTING CONTOUR LINE | |
| PROPOSED CONTOUR LINE | |
| PROPOSED PATH OF TRAVEL | |
| PROPOSED DIRECTION OF FLOW | |
| PROPOSED MAJOR DRAINAGE BASIN BOUNDARY | |
| EXISTING MAJOR DRAINAGE BASIN BOUNDARY | |
| PROPOSED SUB-DRAINAGE / AES NODE BASIN BOUNDARY | |
| PROPOSED DIVERTED AREA TO MOONLIGHT BEACH WATERSHED | |
| PROPOSED DIVERTED AREA SAN MARCOS CREEK / BATIQUITOS LAGOON WATERSHED | |

## PLAN VIEW - POST-DEVELOPED NODE MAP

SCALE: 1" = 20' HORIZONTAL

### BASIN PR-1- AREA CALCULATIONS

| | |
|---|---|
| TOTAL BASIN PR-1.1 AREA | 158,562 SF (3.64 AC) |
| Cn | 0.75 |
| Q100 (UNMITIGATED) | 13.96 CFS |
| Q100 (MITIGATED) | 6.33 CFS |

### BASIN OFF-1 - AREA CALCULATIONS

| | |
|---|---|
| TOTAL BASIN OFF-1 AREA | 17,499 SF (0.40 AC) |
| Cn | 0.59 |
| Q100 | 1.74 CFS |

### POC-1 - AREA CALCULATIONS

| | |
|---|---|
| TOTAL BASIN OFF-1 AREA | 176,061 SF (4.04 AC) |
| Q100 | 15.32 CFS |
| Q100 (MITIGATED) | 5.35 CFS |

### BASIN PR-4 - AREA CALCULATIONS

| | |
|---|---|
| TOTAL BASIN PR-1.2 AREA | 114,153 SF (2.62 AC) |
| Cn | 0.73 |
| Q100 (UNMITIGATED) | 8.82 CFS |
| Q100 (MITIGATED) | 0.18 CFS |

GRAPHIC SCALE: 1" = 20'

20 0 20 40 60

PROPOSED HYDROLOGY EXHIBIT
1220-1240 MELBA ROAD
CITY OF ENCINITAS

PLSA
PLSAENGINEERING.COM

# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Mar 23 2023

## 18-IN HDPE @ 1.6%

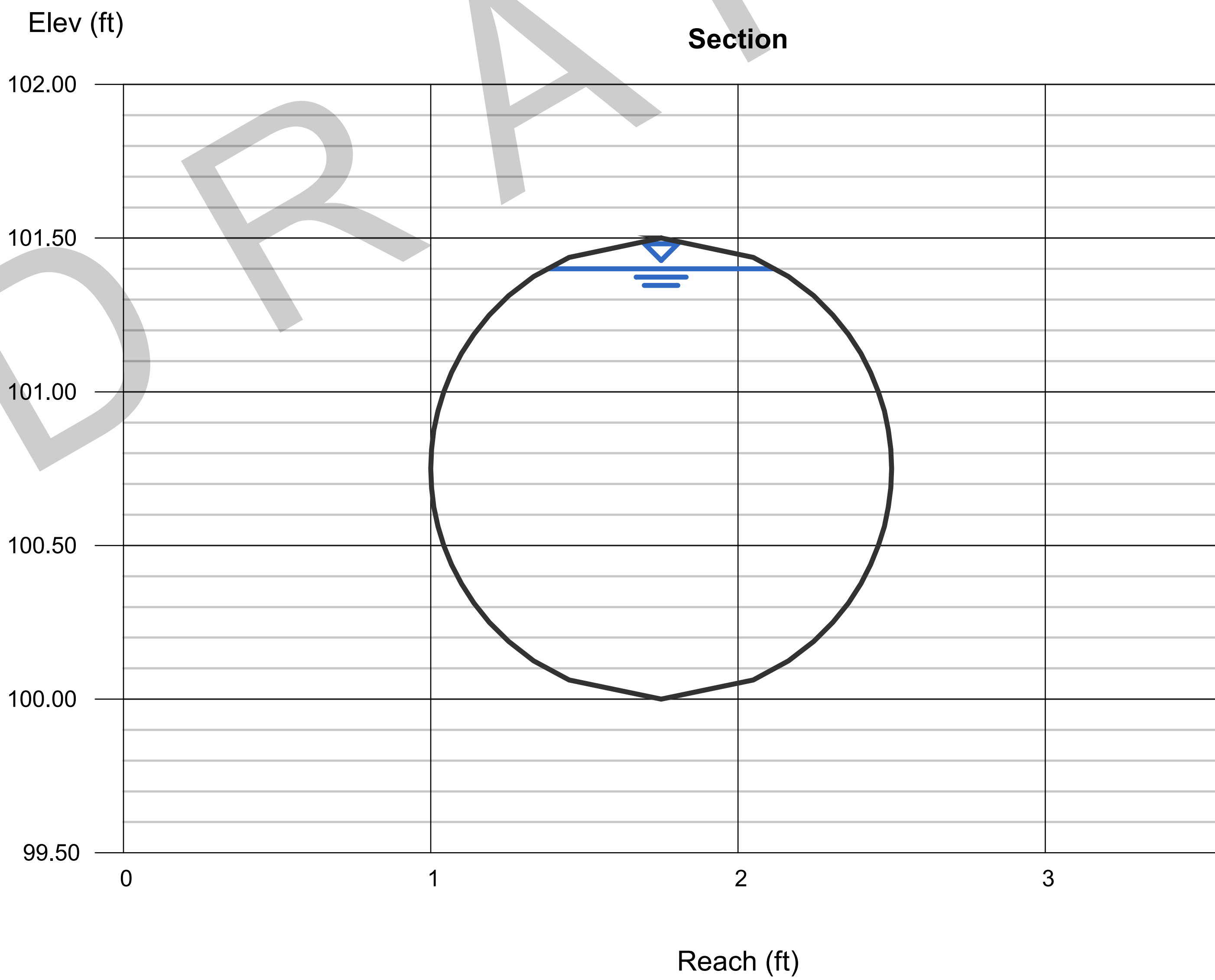
**Circular**
Diameter (ft) = 1.50

Invert Elev (ft) = 100.00
Slope (%) = 1.60
N-Value = 0.013

**Calculations**
Compute by: Known Depth
Known Depth (ft) = 1.40

**Highlighted**
Depth (ft) = 1.40
Q (cfs) = 14.29
Area (sqft) = 1.72
Velocity (ft/s) = 8.32
Wetted Perim (ft) = 3.93
Crit Depth, Yc (ft) = 1.39
Top Width (ft) = 0.75
EGL (ft) = 2.48

Minimum flow rate through 18-inch HDPE storm drain = 14.29 cfs
Witham Basin Q100 = 9.36 cfs



# MELBA BASIN GRATED INLET CAPACITY CALCULATION

36-in Grated Inlet in Sag (Assumed 50% Clogging)

| | | | | | | |
|---|---|---|---|---|---|---|
| Cw | 3 | Unitless | | | L | 3 ft |
| Pe | 6.00 | ft | | | W | 3 ft |
| C0 | 0.67 | Unitless | Ae | 4.5 | | |

*Pe assumes 50% clogging

Weir

| Q (cfs) | d (ft) |
|---|---|
| 2.25 | 0.25 |
| 6.36 | 0.5 |
| 11.69 | 0.75 |
| 18.00 | 1 |
| 25.16 | 1.25 |
| 33.07 | 1.5 |

Orifice

| Q (cfs) | d (ft) |
|---|---|
| 12.10 | 0.25 |
| 17.11 | 0.5 |
| 20.95 | 0.75 |
| 24.20 | 1 |
| 27.05 | 1.25 |
| 29.63 | 1.5 |

*TWO 36" X 36" GRATED INLETS ASSUMING 50% CLOG RATE PROVIDE CAPACITY FOR 23.38 CFS

MELBA Q100 (UNMIT) = 13.96 CFS
MELBA Q100 (UNMIT) < GRATE CAPACITY



**Step 1.** Calculate the capacity of a grate inlet operating as a weir, using the weir equation (Equation 2-16) with a length equivalent to perimeter of the grate. When the grate is located next to a curb, disregard the length of the grate against the curb.

$$Q = C_W P_e d^{3/2} \tag{2-16}$$

where …

- $Q$ = inlet capacity of the grated inlet (ft$^3$/s);
- $C_W$ = weir coefficient ($C_W$=3.0 for U.S. Traditional Units);
- $P_e$ = effective grate perimeter length (ft); and
- $d$ = flow depth approaching inlet (ft).

To account for the effects of clogging of a grated inlet operating as a weir, a clogging factor of fifty percent ($C_L$=0.50) shall be applied to the actual (unclogged) perimeter of the grate ($P$):

**Step 2.** Calculate the capacity of a grate inlet operating as an orifice. Use the orifice equation (Equation 2-18), assuming the clear opening of the grate reduced by a clogging factor $C_A$=0.50 (Equation 2-19). A San Diego Regional Standard No. D-15 grate has an actual clear opening of $A$=4.7 ft$^2$. The Federal Highway Administration's *Urban Drainage Design Manual* (HEC-22) provides guidance for other grate types and configurations.

$$Q = C_O A_e (2gd)^{1/2} \tag{2-18}$$

$$A_e = (1 - C_A) A \tag{2-19}$$

where …

| | | |
|---|---|---|
| $Q$ | = | inlet capacity of the grated inlet (ft$^3$/s); |
| $C_O$ | = | orifice coefficient ($C_O$=0.67 for U.S. Traditional Units); |
| $g$ | = | gravitational acceleration (ft/s$^2$); |
| $d$ | = | flow depth above inlet (ft); |
| $A_e$ | = | effective (clogged) grate area (ft2); |
| $C_A$ | = | area clogging factor ($C_A$=0.50); and |
| $A$ | = | actual opening area of the grate inlet (i.e., the total area less the area of bars or vanes). The actual opening area for a San Diego Regional Standard No. D-15 grate is $A$=4.7 ft$^2$. The Federal Highway Administration's *Urban Drainage Design Manual* (HEC-22) provides guidance for other grate types and configurations. |

# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Mar 23 2023

## SDRSD D-25 3-IN X 3-FT @2.0%

**Rectangular**
Bottom Width (ft) = 3.00
Total Depth (ft) = 0.25

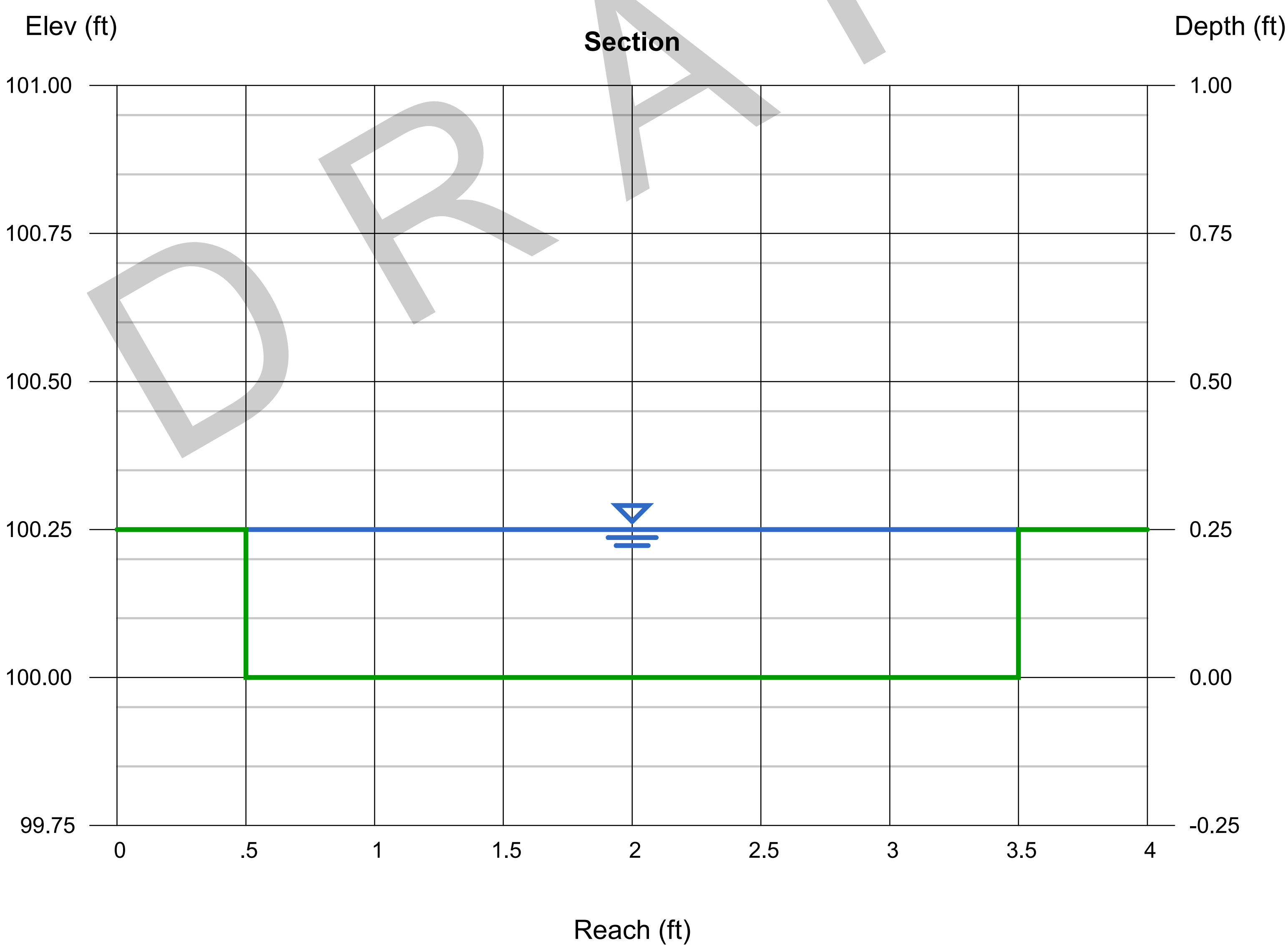
Invert Elev (ft) = 100.00
Slope (%) = 2.00
N-Value = 0.013

**Calculations**
Compute by: Known Depth
Known Depth (ft) = 0.25

**Highlighted**
Depth (ft) = 0.25
Q (cfs) = 4.339
Area (sqft) = 0.75
Velocity (ft/s) = 5.79
Wetted Perim (ft) = 3.50
Crit Depth, Yc (ft) = 0.25
Top Width (ft) = 3.00
EGL (ft) = 0.77

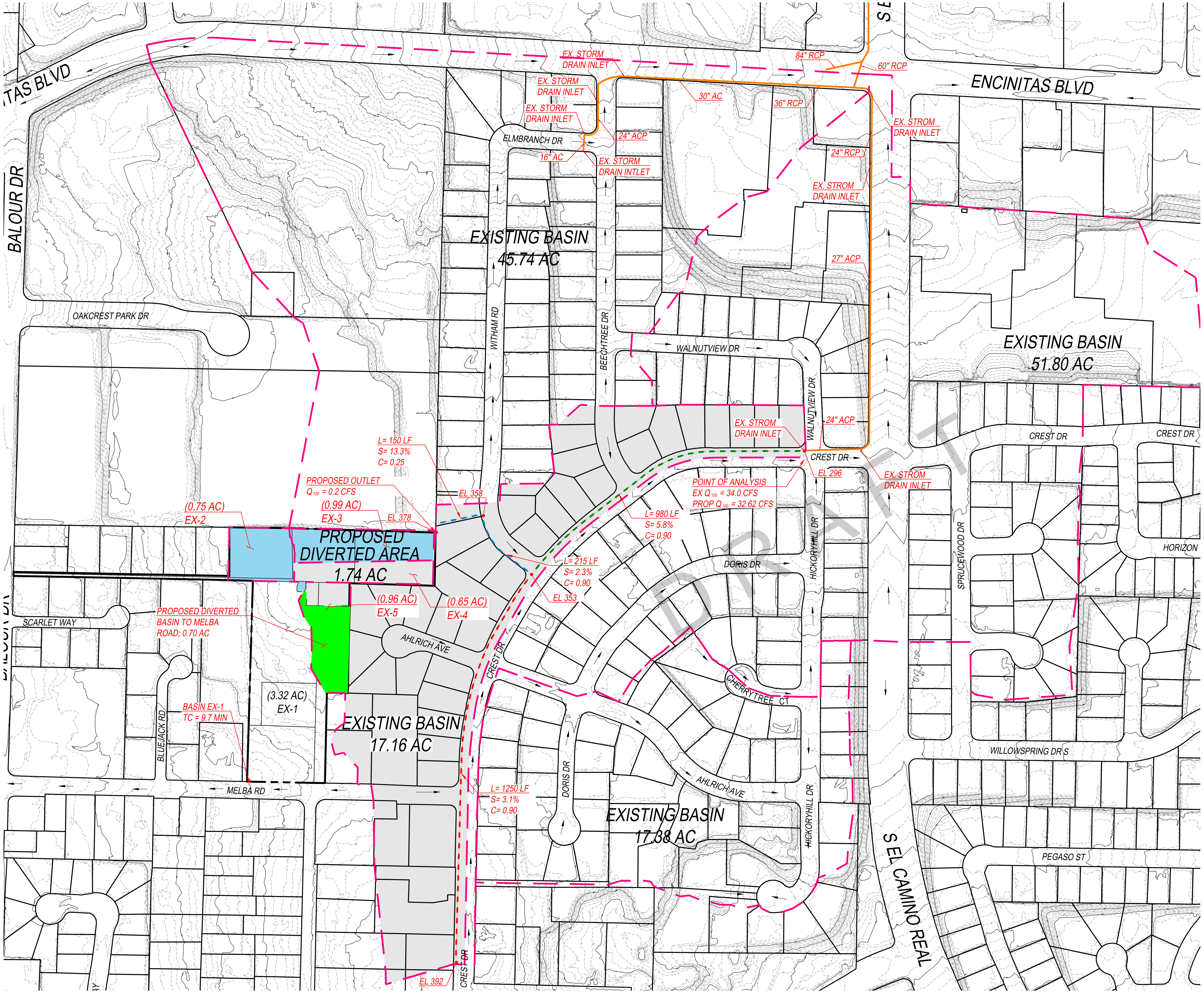
Melba Basin to have 2 * curb outlet = 4.34 cfs * 2
Melba Capacity = 8.68 cfs

Witham Basin to have 2 * curb outlet = 4.34 cfs * 2
Witham Capacity = 8.68 cfs



# Appendix D

# CREST DRIVE CURB AND GUTTER ANALYSIS




## LEGEND

- PROPPROPERY BOUNDARY
- EXISTING NATURAL FLOW DIRECTION
- EXISTING DRAINAGE BASIN
- PROPOSED FLOW DIRECTION
- PROPOSED DIVERTED AREA (TO CREST DRIVE)
- PROPOSED DIVERTED AREA (TO MELBA ROAD)

PLAN VIEW - CREST DRIVE CURB AND GUTTER ANALYSIS

SCALE: 1" = 150'

0 150' 300' 450'
SCALE: 1"=150'

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STATE OF CALIFORNIA

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Phone 858.259.8212 | www.plsaengineering.com

March 29, 2023 PLSA 3086

# APPENDIX

## RATIONAL METHOD PARAMETERS AND CALCULATIONS

Q = CIA *Rational Method Equation

Total Basin Area = 17.16 ac

Basin Land Use = Medium Density Residential (MDR), 4.3 DU/acre

Soil Type = Hydrologic Group “D” per USGS Soils Survey

**EXISTING DRAINAGE BASIN:**

Total Area: **A = 17.16 ac**

$C_n$, Weighted Runoff Coefficient

Assuming 4.3 DU/ac with Type D soils, per SDHM Table 3-1

**$C_n$ = 0.52**

$T_c$, Time of Concentration

$T_c = T_i + \Sigma T_t$

$T_i = \left(\frac{1.8\ (1.1 - C)\ \sqrt{D}}{\sqrt[3]{s}}\right)$ * Per SDHM Figure 3-3

C = 0.52

D = 100 * Maximum overland flow length per SDHM Table 3-2

s = 3.1

$T_i = \left(\frac{1.8\ (1.1 - 0.52)\ \sqrt{100}}{\sqrt[3]{3.1}}\right)$ = 2.5 minutes

**$T_i$ = 2.5 minutes**

$T_t = \left(\frac{11.9\ L^3}{\Delta E}\right)^{0.385}$

Flow Path 1:

L = 1150 ft

ΔE = 36 ft

$T_{t1} = \left(\frac{11.9\ L^3}{\Delta E}\right)^{0.385} = \left(\frac{11.9\ (1150/5280)^3}{36}\right)^{0.385}$ = 6.7 minutes

**$T_{t1}$ = 6.7 minutes**

<u>Flow Path 2:</u>

L = 980 ft

ΔE = 57 ft

$T_{t2} = \left(\frac{11.9\,L^3}{\Delta E}\right)^{0.385} = \left(\frac{11.9\,(980)^3}{57}\right)^{0.385} = 4.7$ minutes

**$T_{t2}$ = 4.7 minutes**

$T_c = T_i + \Sigma T_t = T_i + T_{t1} + T_{t12}$

= 2.5 + 6.7 + 4.7

= 13.9 minutes

$T_c$ = **13.9 minutes**

$I = 7.44 \times P_{100} \times D^{-0.645}$

$P_{100}$ = 2.8 in *100-Year, 6-Hour Rainfall Precipitation per SDHM

$D = T_C$ = 14.4 minutes

$I = 7.44 \times 2.8 \text{ in} \times 13.9^{-0.645} = 3.81$ in/hr

**I = 3.81 in/hr**

Q = C I A

$Q_{100}$ = 0.52 * 3.81 in/hr * 17.16 acres

**$Q_{100}$ = 34.0 cfs** *Pre-Development Flow to Existing Curb Inlet Crest Dr

**PROPOSED DRAINAGE BASIN:**

EX-4 contribution to existing condition

Q100 = 1.58 cfs

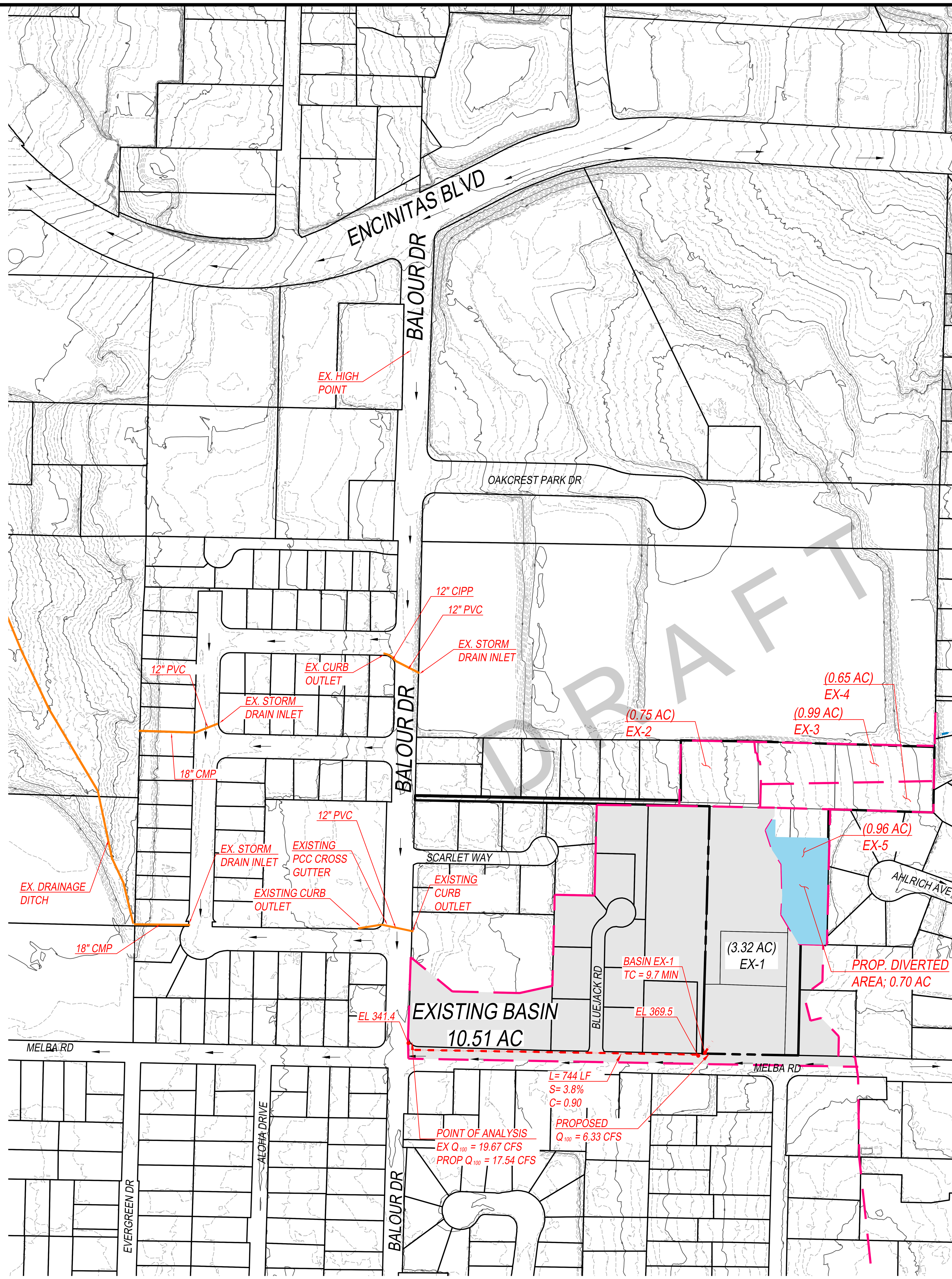
Total Additional Area: **A = 2.62 ac**

Additional runoff leaving project site**: $Q_{100}$ = 0.2 cfs**

**$Q_{100}$ = 34.0 cfs (pre) + 0.2 cfs – 1.58 cfs**

**= 32.62 cfs** *Post-Development Flow to Existing Curb Inlet Crest Drive

subject property drains through a buried storm drain in Lot 81 to outlet at curb face through modified curb outlet




PLAN VIEW - MELBA ROAD CURB AND GUTTER ANALYSIS

SCALE: 1" = 150'

## LEGEND

| | |
|---|---|
| PROPPROPERY BOUNDARY | |
| EXISTING NATURAL FLOW DIRECTION | |
| EXISTING DRAINAGE BASIN | |
| PROPOSED FLOW DIRECTION | |
| PROPOSED DIVERTED BASIN | |

0 150' 300' 450'

SCALE: 1"=150'

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CIVIL
STATE OF CALIFORNIA

PREPARED BY:

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San Diego | Solana Beach | Orange County

Phone 858.259.8212 | www.plsaengineering.com

# APPENDIX

## RATIONAL METHOD PARAMETERS AND CALCULATIONS

Q = CIA *Rational Method Equation

Total Basin Area = 10.51 ac

Basin Land Use = Medium Density Residential (MDR), 4.3 DU/acre

Soil Type = Hydrologic Group “D” per USGS Soils Survey

**EXISTING DRAINAGE BASIN:**

Total Area (including onsite basin EX-1): **A = 10.51 ac**

$C_n$, Weighted Runoff Coefficient

Assuming 4.3 DU/ac with Type D soils, per SDHM Table 3-1

$\mathbf{C_n = 0.52}$

$T_c$, Time of Concentration (Melba Road)

$T_c = T_i + \Sigma T_t$

$T_i$ = (EX-1 $T_c$; Hydrology Report, section 3.1)

= 9.7 mins

$$T_t = \left(\frac{11.9\ L^3}{\Delta\ E}\right)^{0.385}$$

Flow Path 1:

L = 744 ft

ΔE = 28.1 ft

$$T_{t1} = \left(\frac{11.9\ L^3}{\Delta\ E}\right)^{0.385} = \left(\frac{11.9\ (744/5280)^3}{28.1}\right)^{0.385} = 4.5 \text{ minutes}$$

$\mathbf{T_{t1}}$ **= 4.5 minute**

$T_c = T_i + T_{t1}$

= 9.7 + 4.5

= 14.2 minutes

$T_c$ = **14.2 minutes**

$I = 7.44 \times P_{100} \times D^{-0.645}$

$P_{100} = 2.8$ in *100-Year, 6-Hour Rainfall Precipitation per SDHM

$D = T_C = 14.2$ minutes

$I = 7.44 \times 2.8 \text{ in} \times 14.2^{-0.645} = 3.76$ in/hr

**I = 3.76 in/hr**

Q = C I A

$Q_{100} = 0.52 * 3.76$ in/hr * 10.51 acres

**$Q_{100}$ = 19.67 cfs** *Pre-Development Flow on Melba Road to Balour Drive

**PROPOSED DRAINAGE BASIN:**

EX-1 contribution to existing condition

$Q_{100} = 8.46$

Total Additional Area: **A = 3.64 ac**

Additional runoff leaving project site confluenced with OFF-1**: $Q_{100}$ = 6.33 cfs**

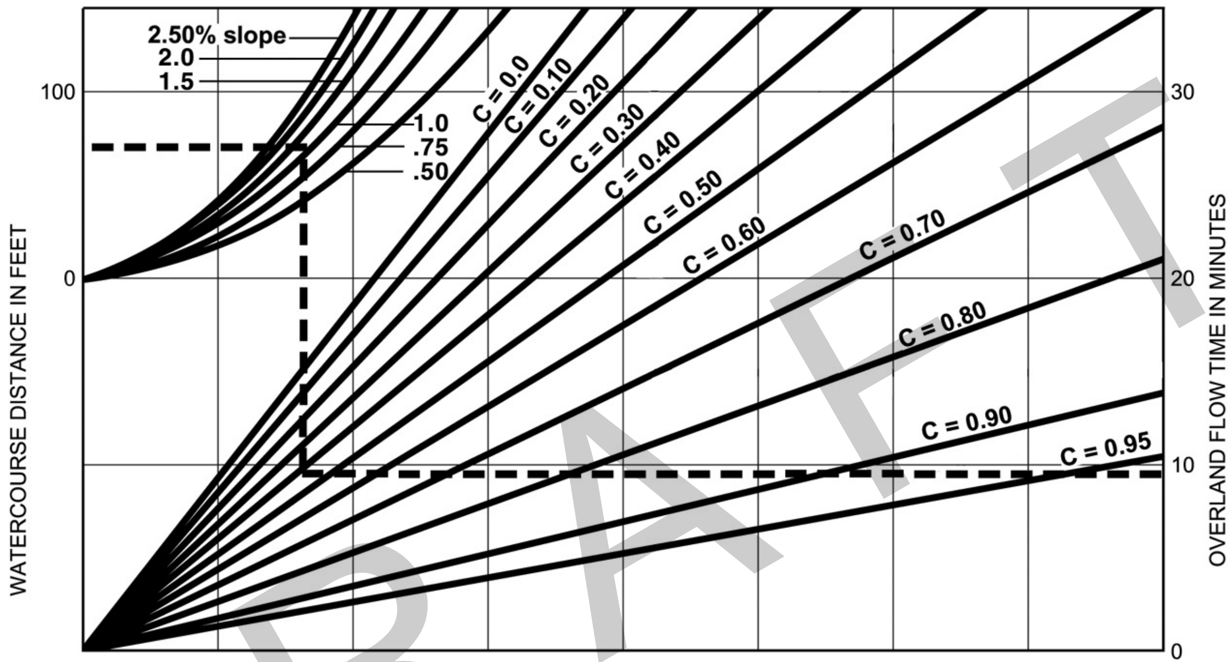
**$Q_{100}$ = 19.67 cfs (pre) + 6.33 cfs – 8.46 cfs**

**= 17.54 cfs** *Post-Development Flow to Melba Road and Balour Drive Intersection.

**Table 3-1**
**RUNOFF COEFFICIENTS FOR URBAN AREAS**

| Land Use | | Runoff Coefficient "C" | | | | |
|---|---|---|---|---|---|---|
| | | | Soil Type | | | |
| NRCS Elements | County Elements | % IMPER. | A | B | C | D |
| Undisturbed Natural Terrain (Natural) | Permanent Open Space | 0* | 0.20 | 0.25 | 0.30 | 0.35 |
| Low Density Residential (LDR) | Residential, 1.0 DU/A or less | 10 | 0.27 | 0.32 | 0.36 | 0.41 |
| Low Density Residential (LDR) | Residential, 2.0 DU/A or less | 20 | 0.34 | 0.38 | 0.42 | 0.46 |
| Low Density Residential (LDR) | Residential, 2.9 DU/A or less | 25 | 0.38 | 0.41 | 0.45 | 0.49 |
| Medium Density Residential (MDR) | Residential, 4.3 DU/A or less | 30 | 0.41 | 0.45 | 0.48 | 0.52 |
| Medium Density Residential (MDR) | Residential, 7.3 DU/A or less | 40 | 0.48 | 0.51 | 0.54 | 0.57 |
| Medium Density Residential (MDR) | Residential, 10.9 DU/A or less | 45 | 0.52 | 0.54 | 0.57 | 0.60 |
| Medium Density Residential (MDR) | Residential, 14.5 DU/A or less | 50 | 0.55 | 0.58 | 0.60 | 0.63 |
| High Density Residential (HDR) | Residential, 24.0 DU/A or less | 65 | 0.66 | 0.67 | 0.69 | 0.71 |
| High Density Residential (HDR) | Residential, 43.0 DU/A or less | 80 | 0.76 | 0.77 | 0.78 | 0.79 |
| Commercial/Industrial (N. Com) | Neighborhood Commercial | 80 | 0.76 | 0.77 | 0.78 | 0.79 |
| Commercial/Industrial (G. Com) | General Commercial | 85 | 0.80 | 0.80 | 0.81 | 0.82 |
| Commercial/Industrial (O.P. Com) | Office Professional/Commercial | 90 | 0.83 | 0.84 | 0.84 | 0.85 |
| Commercial/Industrial (Limited I.) | Limited Industrial | 90 | 0.83 | 0.84 | 0.84 | 0.85 |
| Commercial/Industrial (General I.) | General Industrial | 95 | 0.87 | 0.87 | 0.87 | 0.87 |

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service




EXAMPLE:

Given: Watercourse Distance (D) = 70 Feet
Slope (s) = 1.3%
Runoff Coefficient (C) = 0.41
Overland Flow Time (T) = 9.5 Minutes

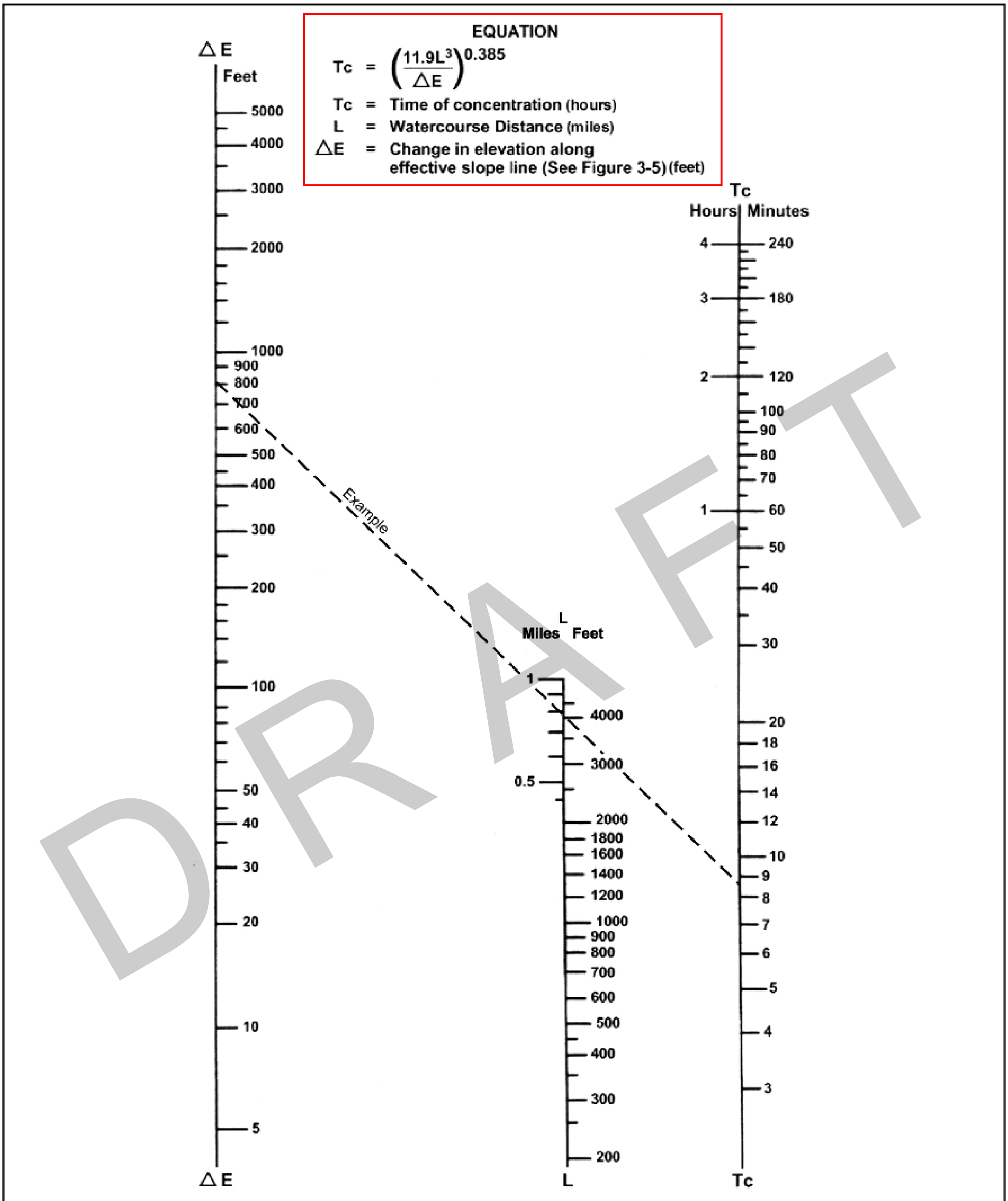
$$T = \frac{1.8\,(1.1\text{-}C)\sqrt{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965



**Rational Formula - Overland Time of Flow Nomograph**

FIGURE
**3-3**




SOURCE: California Division of Highways (1941) and Kirpich (1940)



FIGURE

**3-4**

Nomograph for Determination of
Time of Concentration (Tc) or Travel Time (Tt) for Natural Watersheds

# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Mar 29 2023

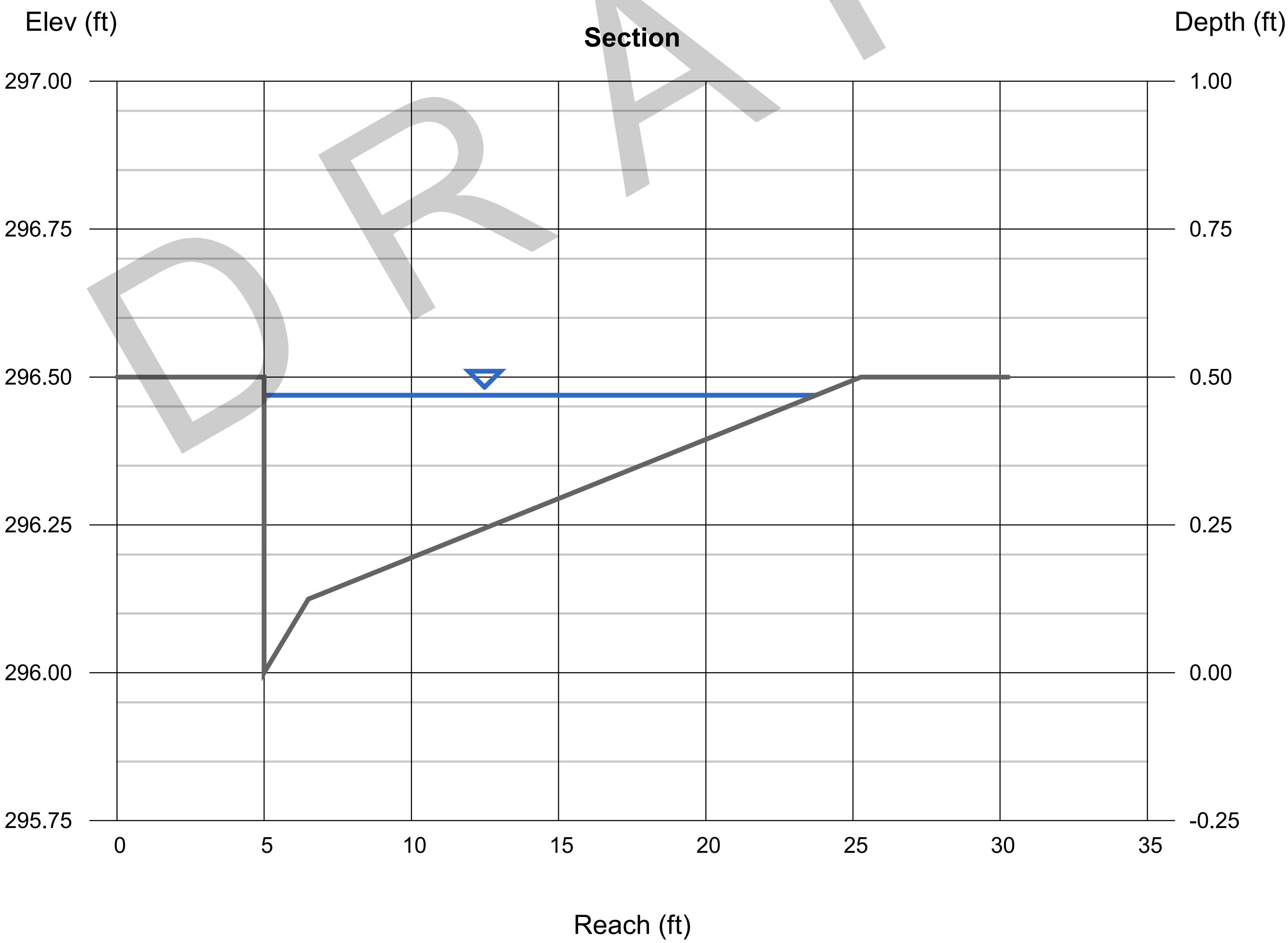
## EXISTING GUTTER FLOW TO INLET - CREST DRIVE

| **Gutter** | | **Highlighted** | |
|---|---|---|---|
| Cross Sl, Sx (ft/ft) | = 0.020 | Depth (ft) | = 0.47 |
| Cross Sl, Sw (ft/ft) | = 0.083 | Q (cfs) | = 34.00 |
| Gutter Width (ft) | = 1.50 | Area (sqft) | = 3.58 |
| Invert Elev (ft) | = 296.00 | Velocity (ft/s) | = 9.50 |
| Slope (%) | = 5.80 | Wetted Perim (ft) | = 19.20 |
| N-Value | = 0.015 | Crit Depth, Yc (ft) | = 0.75 |
| | | Spread Width (ft) | = 18.72 |
| | | EGL (ft) | = 1.87 |

**Calculations**

| | |
|---|---|
| Compute by: | Known Q |
| Known Q (cfs) | = 34.00 |





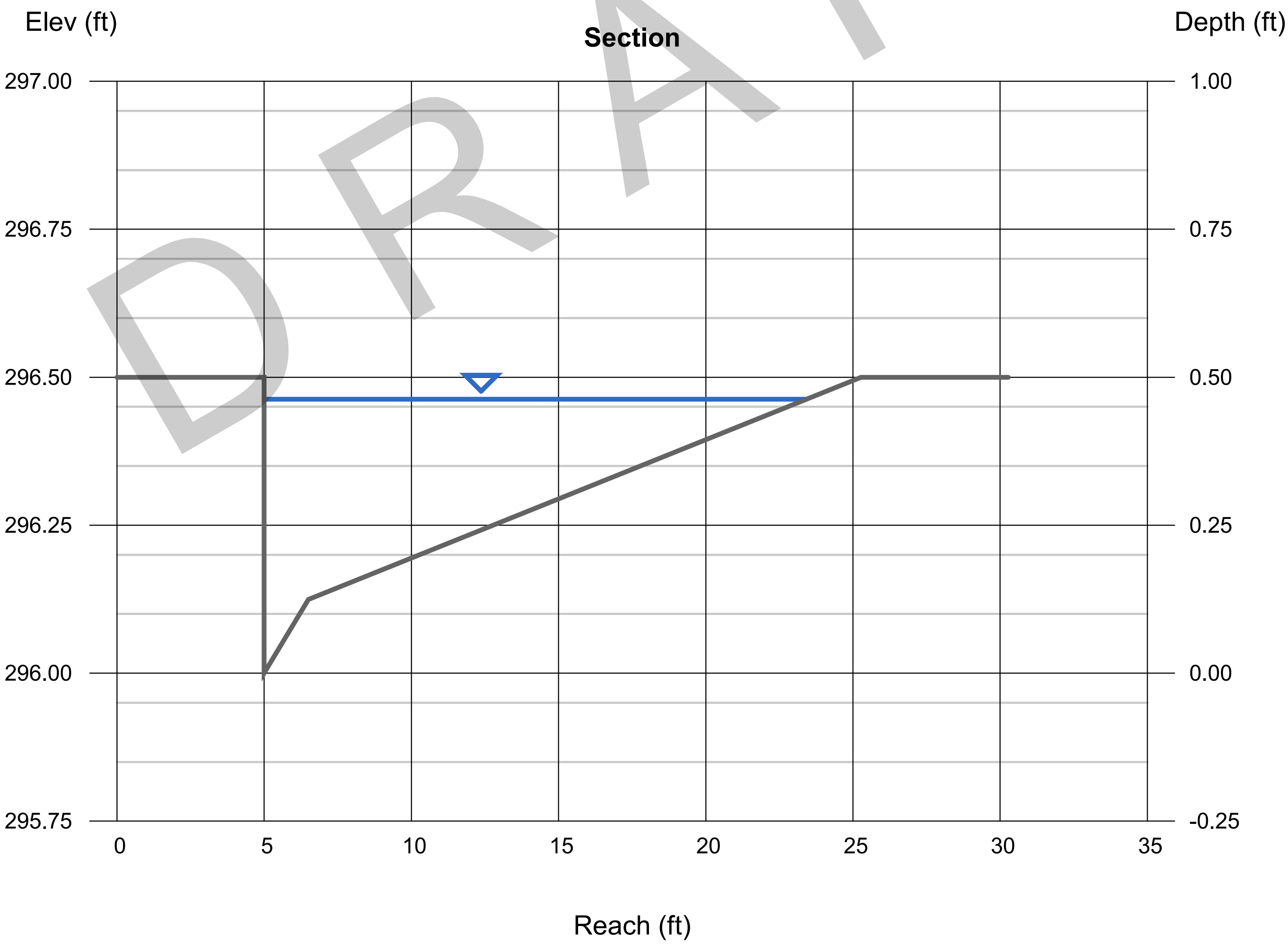
# Channel Report



## PROPOSED GUTTER FLOW TO INLET - CREST DRIVE

| **Gutter** | | **Highlighted** | |
|---|---|---|---|
| Cross Sl, Sx (ft/ft) | = 0.020 | Depth (ft) | = 0.46 |
| Cross Sl, Sw (ft/ft) | = 0.083 | Q (cfs) | = 32.62 |
| Gutter Width (ft) | = 1.50 | Area (sqft) | = 3.47 |
| Invert Elev (ft) | = 296.00 | Velocity (ft/s) | = 9.41 |
| Slope (%) | = 5.80 | Wetted Perim (ft) | = 18.90 |
| N-Value | = 0.015 | Crit Depth, Yc (ft) | = 0.74 |
| | | Spread Width (ft) | = 18.42 |
| **Calculations** | | EGL (ft) | = 1.84 |
| Compute by: | Known Q | | |
| Known Q (cfs) | = 32.62 | | |





# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Wednesday, Mar 29 2023

## 24-IN ACP STORM DRAIN PER TM 3057-2

**Circular**

| | |
|---|---|
| Diameter (ft) | = 2.00 |
| Invert Elev (ft) | = 100.00 |
| Slope (%) | = 3.23 |
| N-Value | = 0.011 |

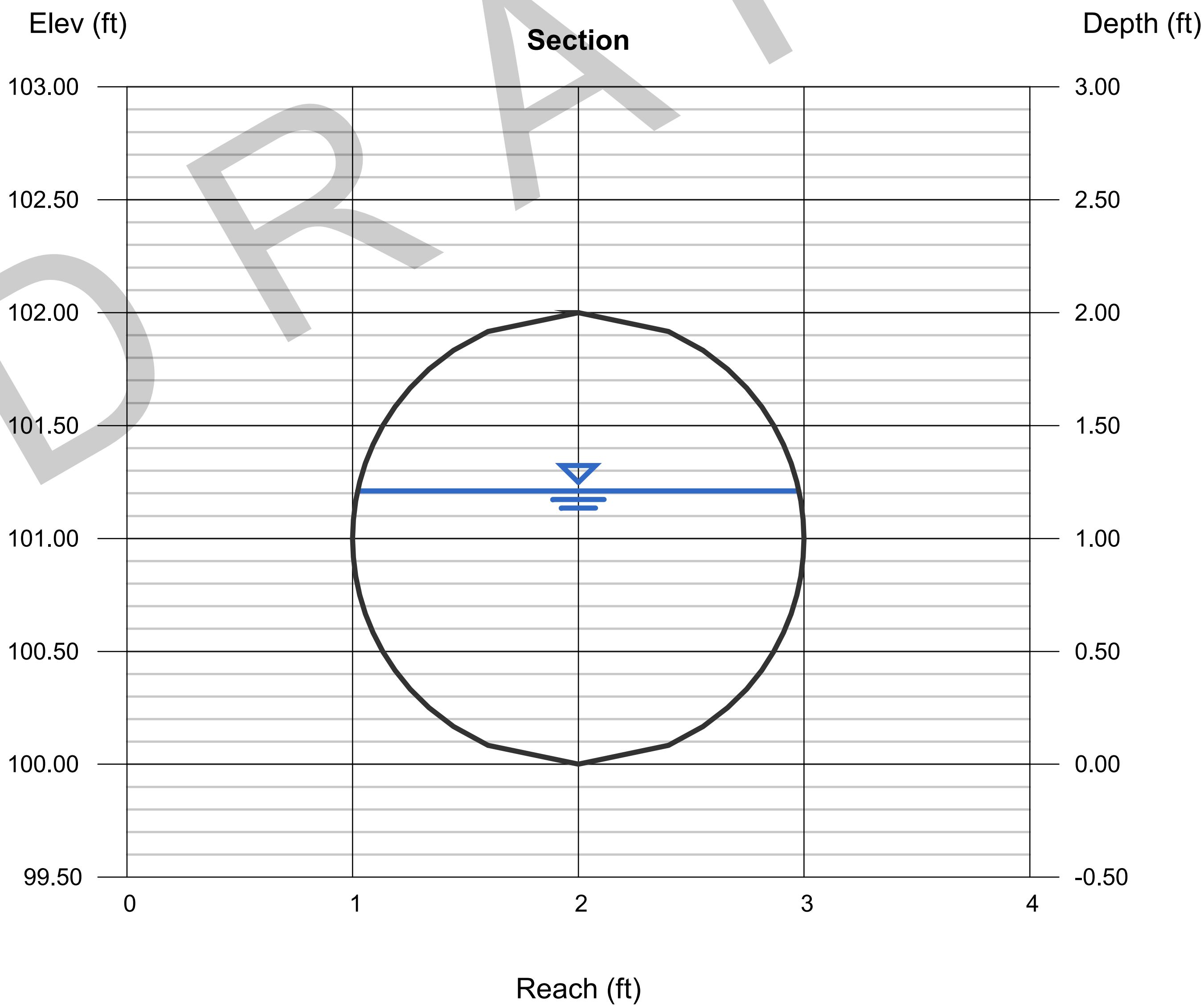
**Calculations**

| | |
|---|---|
| Compute by: | Known Q |
| Known Q (cfs) | = 32.62 |

**Highlighted**

| | |
|---|---|
| Depth (ft) | = 1.21 |
| Q (cfs) | = 32.62 |
| Area (sqft) | = 1.99 |
| Velocity (ft/s) | = 16.37 |
| Wetted Perim (ft) | = 3.57 |
| Crit Depth, Yc (ft) | = 1.90 |
| Top Width (ft) | = 1.95 |
| EGL (ft) | = 5.38 |





# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Mar 28 2023

## EXISTING GUTTER FLOW TO INLET - MELBA ROAD

**Gutter**

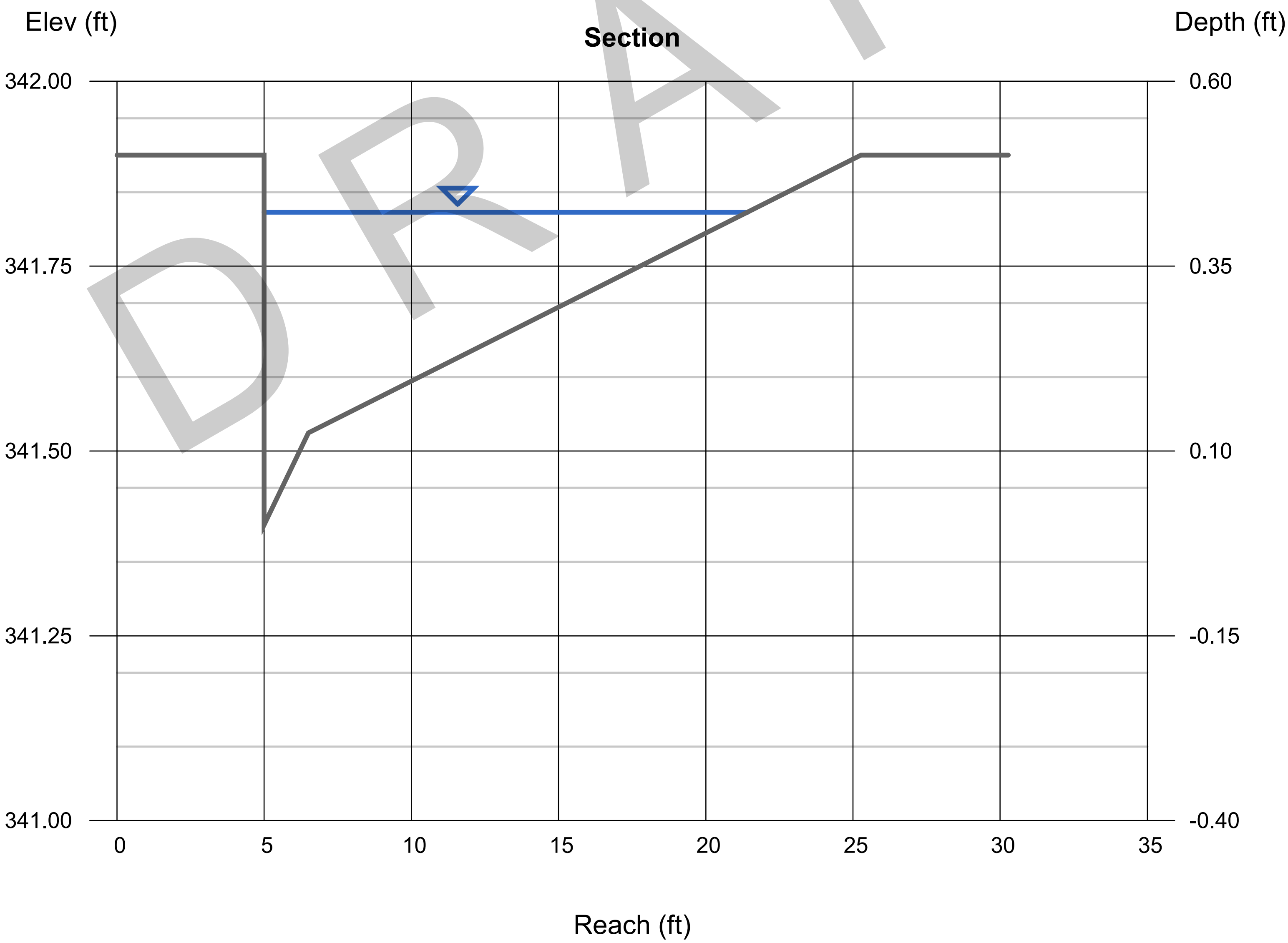
| | |
|---|---|
| Cross Sl, Sx (ft/ft) | = 0.020 |
| Cross Sl, Sw (ft/ft) | = 0.083 |
| Gutter Width (ft) | = 1.50 |
| Invert Elev (ft) | = 341.40 |
| Slope (%) | = 3.80 |
| N-Value | = 0.015 |

**Calculations**

| | |
|---|---|
| Compute by: | Known Q |
| Known Q (cfs) | = 19.76 |

**Highlighted**

| | |
|---|---|
| Depth (ft) | = 0.42 |
| Q (cfs) | = 19.76 |
| Area (sqft) | = 2.77 |
| Velocity (ft/s) | = 7.14 |
| Wetted Perim (ft) | = 16.86 |
| Crit Depth, Yc (ft) | = 0.62 |
| Spread Width (ft) | = 16.42 |
| EGL (ft) | = 1.21 |



# Channel Report



## PROPOSED GUTTER FLOW TO INLET - MELBA ROAD

**Gutter**

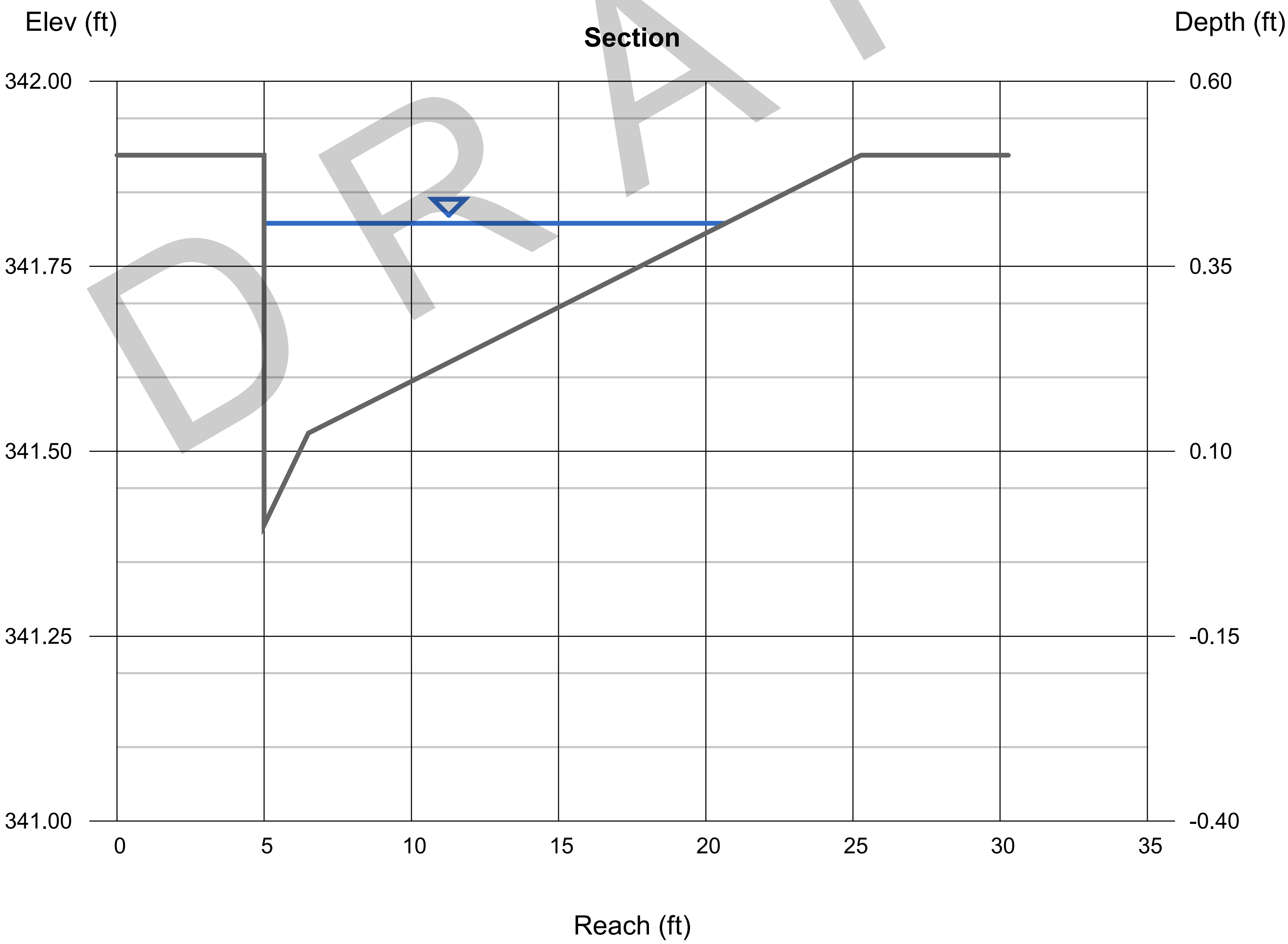
| | |
|---|---|
| Cross Sl, Sx (ft/ft) | = 0.020 |
| Cross Sl, Sw (ft/ft) | = 0.083 |
| Gutter Width (ft) | = 1.50 |
| Invert Elev (ft) | = 341.40 |
| Slope (%) | = 3.80 |
| N-Value | = 0.015 |

**Calculations**

| | |
|---|---|
| Compute by: | Known Q |
| Known Q (cfs) | = 17.54 |

**Highlighted**

| | |
|---|---|
| Depth (ft) | = 0.41 |
| Q (cfs) | = 17.54 |
| Area (sqft) | = 2.53 |
| Velocity (ft/s) | = 6.94 |
| Wetted Perim (ft) | = 16.09 |
| Crit Depth, Yc (ft) | = 0.59 |
| Spread Width (ft) | = 15.67 |
| EGL (ft) | = 1.16 |




117° 15' 56" W
117° 15' 35" W
475190
475280
475370
475460
475550
475640
475730
33° 2' 39" N
33° 2' 15" N
3656210
3656120
3656030
3655940
3655850
3655760
3655670
3655580
3655490
Walnutview Dr
LvF3
LvF3
CfB
Witham Rd
CgC
Cherrytree Ct
Doris Dr
Hickoryhill Dr
CbC
Wotan Dr
Crest Dr
Santa Fe
Soil Map may not be valid at this scale.
Map Scale: 1:3,590 if printed on A portrait (8.5" x 11") sheet.
Meters
0 50 100 200 300
Feet
0 150 300 600 900
N
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil Rating Polygons**

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

**Soil Rating Lines**

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

**Soil Rating Points**

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

**Water Features**

Streams and Canals

**Transportation**

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

**Background**

Aerial Photography

## MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: San Diego County Area, California
Survey Area Data: Version 15, May 27, 2020

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

Date(s) aerial images were photographed: Jan 23, 2020—Feb 13, 2020

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

# Hydrologic Soil Group

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| CbC | Carlsbad gravelly loamy sand, 5 to 9 percent slopes | B | 7.4 | 38.5% |
| CfB | Chesterton fine sandy loam, 2 to 5 percent slopes | D | 3.9 | 20.0% |
| CgC | Chesterton-Urban land complex, 2 to 9 percent slopes | D | 6.2 | 32.3% |
| LvF3 | Loamy alluvial land-Huerhuero complex, 9 to 50 percent slopes, severely eroded | B | 1.8 | 9.3% |
| **Totals for Area of Interest** | | | **19.3** | **100.0%** |

## Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff: None Specified*

*Tie-break Rule:* Higher


Map Scale: 1:3,590 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 50, 100, 200, 300

Feet: 0, 150, 300, 600, 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil Rating Polygons**

A

A/D

B

B/D

C

C/D

D

Not rated or not available

**Soil Rating Lines**

A

A/D

B

B/D

C

C/D

D

Not rated or not available

**Soil Rating Points**

A

A/D

B

B/D

C

C/D

D

Not rated or not available

**Water Features**

Streams and Canals

**Transportation**

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

**Background**

Aerial Photography

## MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: San Diego County Area, California
Survey Area Data: Version 15, May 27, 2020

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

Date(s) aerial images were photographed: Jan 23, 2020—Feb 13, 2020

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

# Hydrologic Soil Group

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| CbC | Carlsbad gravelly loamy sand, 5 to 9 percent slopes | B | 7.4 | 38.5% |
| CfB | Chesterton fine sandy loam, 2 to 5 percent slopes | D | 3.9 | 20.0% |
| CgC | Chesterton-Urban land complex, 2 to 9 percent slopes | D | 6.2 | 32.3% |
| LvF3 | Loamy alluvial land-Huerhuero complex, 9 to 50 percent slopes, severely eroded | B | 1.8 | 9.3% |
| **Totals for Area of Interest** | | | **19.3** | **100.0%** |

## Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

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Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff: None Specified*

*Tie-break Rule:* Higher


Map Scale: 1:1,920 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 25, 50, 100, 150

Feet: 0, 50, 100, 200, 300

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil Rating Polygons**

A

A/D

B

B/D

C

C/D

D

Not rated or not available

**Soil Rating Lines**

A

A/D

B

B/D

C

C/D

D

Not rated or not available

**Soil Rating Points**

A

A/D

B

B/D

C

C/D

D

Not rated or not available

**Water Features**

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**Background**

Aerial Photography

## MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: San Diego County Area, California
Survey Area Data: Version 18, Sep 14, 2022

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

Date(s) aerial images were photographed: Mar 14, 2022—Mar 17, 2022

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

# Hydrologic Soil Group

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| CbB | Carlsbad gravelly loamy sand, 2 to 5 percent slopes | B | 0.9 | 7.8% |
| CbC | Carlsbad gravelly loamy sand, 5 to 9 percent slopes | B | 10.1 | 91.8% |
| CgC | Chesterton-Urban land complex, 2 to 9 percent slopes | D | 0.1 | 0.5% |
| **Totals for Area of Interest** | | | **11.0** | **100.0%** |

## Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

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## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff: None Specified*

*Tie-break Rule:* Higher

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