# Preliminary Water Quality Management Plan

**For:**

## Rexford Industrial

**13925 BENSON AVENUE**

**CHINO, CALIFORNIA 91710**

**Prepared for:**

**REXFORD INDUSTRIAL REALTY, INC.**

**555 ANTON BLVD. SUITE 910**

**COSTA MESA, CALIFORNIA 92626**

**(310) 610-7319**

**Prepared by:**

**DRC ENGINEERING, INC.**

**160 SOUTH OLD SPRINGS ROAD, SUITE 210**

**ANAHEIM HILLS, CA 92808**

**(714) 685-6860**

**Submittal Date: 12/08/2023**

**Revision Date: _____**

**Approval Date: _____**

# Project Owner's Certification

This Water Quality Management Plan (WQMP) has been prepared for REXFORD INDUSTRIAL REALTY, INC. by DRC ENGINEERING, INC. The WQMP is intended to comply with the requirements of the City of Chino and the NPDES Areawide Stormwater Program requiring the preparation of a WQMP. The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with San Bernardino County's Municipal Storm Water Management Program and the intent of the NPDES Permit for San Bernardino County and the incorporated cities of San Bernardino County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors in interest and the city/county shall be notified of the transfer. The new owner will be informed of its responsibility under this WQMP. A copy of the approved WQMP shall be available on the subject site in perpetuity.

"I certify under a penalty of law that the provisions (implementation, operation, maintenance, and funding) of the WQMP have been accepted and that the plan will be transferred to future successors."

| Project Data | | | |
|---|---|---|---|
| Permit/Application Number(s): | 23-0091 | Grading Permit Number(s): | |
| Tract/Parcel Map Number(s): | Map of Subdivision of part of Rancho Santa Ana Del Chino | Building Permit Number(s): | |
| CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract): | | | 1021-211-02-0-000 |

| Owner's Signature | | | |
|---|---|---|---|
| **Owner Name: Randall Hooper** | | | |
| Title | Project Manager | | |
| Company | REXFORD INDUSTRIAL REALTY, INC. | | |
| Address | 555 Anton Blvd. Suite 910, Costa Mesa, CA 92626 | | |
| Email | rhooper@rexfordindustrial.com | | |
| Telephone # | (310) 601-7319 | | |
| Signature | Randall Hooper Digitally signed by Randall Hooper DN: C=US, E=rhooper@rexfordindustrial.com, O=DCM, OU=DCM, CN=Randall Hooper Reason: I am approving this document Date: 2023.12.06 10:14:38-08'00' | Date | 12/06/2023 |

# Preparer's Certification

| Project Data | | | |
|---|---|---|---|
| Permit/Application Number(s): | 23-0091 | Grading Permit Number(s): | |
| Tract/Parcel Map Number(s): | Map of Subdivision of part of Rancho Santa Ana Del Chino | Building Permit Number(s): | |
| CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract): | | | 1021-211-02-0-000 |

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan were prepared under my oversight and meet the requirements of Regional Water Quality Control Board Order No. R8-2010-0036."

| **Engineer:** Drew Gates | | PE Stamp Below |
|---|---|---|
| Title | Design Engineer | |
| Company | DRC Engineering, Inc. | |
| Address | 160 S Old Springs Road, Suite 210 | |
| Email | dgates@drc-eng.com | |
| Telephone # | (714) 685 6860 | |
| Signature | | |
| Date | 12/8/23 | |



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# Section 1 Discretionary Permit(s)

## Form 1-1 Project Information

| | | | | | |
|---|---|---|---|---|---|
| Project Name | Rexford Industrial | | | | |
| Project Owner Contact Name: | Randall Hooper | | | | |
| Mailing Address: | 555 Anton Blvd. Suite 910, Costa Mesa, CA 92626 | E-mail Address: | rhooper@rexfordindustrial.com | Telephone: | (310) 601-7319 |
| Permit/Application Number(s): | 23-0091 | Tract/Parcel Map Number(s): | MB 6/15 | | |
| Additional Information/ Comments: | | | | | |
| Description of Project: | The Proposed improvements include the demolition of the existing 43940 square feet warehouse and the construction of a new 129 600 square feet warehouse. The proposed site is connected to Benson Avenue via two driveways. The warehouse is surrounded by two private drive aisles on the North and the East side, loading docks from the south side and parking spaces on the West side.<br>There are additional commercial landscape areas around the building. The impervious area is 5.9 acres, which is 89% of the total area. | | | | |
| Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy. | Preliminary submittal. | | | | |

# Section 2 Project Description

## 2.1 Project Information

This section of the WQMP should provide the information listed below. The information provided for Conceptual/ Preliminary WQMP should give sufficient detail to identify the major proposed site design and LID BMPs and other anticipated water quality features that impact site planning. Final Project WQMP must specifically identify all BMP incorporated into the final site design and provide other detailed information as described herein.

The purpose of this information is to help determine the applicable development category, pollutants of concern, watershed description, and long term maintenance responsibilities for the project, and any applicable water quality credits. This information will be used in conjunction with the information in Section 3, Site Description, to establish the performance criteria and to select the LID BMP or other BMP for the project or other alternative programs that the project will participate in, which are described in Section 4.

### Form 2.1-1 Description of Proposed Project

**1** Development Category (Select all that apply):

| | | | |
|---|---|---|---|
| ☒ Significant re-development involving the addition or replacement of 5,000 ft² or more of impervious surface on an already developed site | ☐ New development involving the creation of 10,000 ft² or more of impervious surface collectively over entire site | ☐ Automotive repair shops with standard industrial classification (SIC) codes 5013, 5014, 5541, 7532- 7534, 7536-7539 | ☐ Restaurants (with SIC code 5812) where the land area of development is 5,000 ft² or more |
| ☐ Hillside developments of 5,000 ft² or more which are located on areas with known erosive soil conditions or where the natural slope is 25 percent or more | ☐ Developments of 2,500 ft² of impervious surface or more adjacent to (within 200 ft) or discharging directly into environmentally sensitive areas or waterbodies listed on the CWA Section 303(d) list of impaired waters. | ☐ Parking lots of 5,000 ft² or more exposed to storm water | ☐ Retail gasoline outlets that are either 5,000 ft² or more, or have a projected average daily traffic of 100 or more vehicles per day |

☐ Non-Priority / Non-Category Project *May require source control LID BMPs and other LIP requirements. Please consult with local jurisdiction on specific requirements*.

| | | | | | |
|---|---|---|---|---|---|
| **2** Project Area (ft2): | 289058 | **3** Number of Dwelling Units: | | **4** SIC Code: | 4225 |

**5** Is Project going to be phased? Yes ☐ No ☒ *If yes, ensure that the WQMP evaluates each phase as a distinct DA, requiring LID BMPs to address runoff at time of completion.*

**6** Does Project include roads? Yes ☐ No ☒ *If yes, ensure that applicable requirements for transportation projects are addressed (see Appendix A of TGD for WQMP)*

# 2.2 Property Ownership/Management

Describe the ownership/management of all portions of the project and site. State whether any infrastructure will transfer to public agencies (City, County, Caltrans, etc.) after project completion. State if a homeowners or property owners association will be formed and be responsible for the long-term maintenance of project stormwater facilities. Describe any lot-level stormwater features that will be the responsibility of individual property owners.

## Form 2.2-1 Property Ownership/Management

| Describe property ownership/management responsible for long-term maintenance of WQMP stormwater facilities: |
|---|
| REXFORD INDUSTRIAL REALTY, INC. owns and is responsible for maintaining the property. REXFORD INDUSTRIAL REALTY, INC. will be responsible for the long-term maintenance of the WQMP stormwater facilities. |

# 2.3 Potential Stormwater Pollutants

Determine and describe expected stormwater pollutants of concern based on land uses and site activities (refer to Table 3-3 in the TGD for WQMP).

| Form 2.3-1 Pollutants of Concern | | | |
|---|---|---|---|
| Pollutant | Please check: E=Expected, N=Not Expected | | Additional Information and Comments |
| Pathogens (Bacterial / Virus) | E ☒ | N ☐ | |
| Nutrients - Phosphorous | E ☒ | N ☐ | |
| Nutrients - Nitrogen | E ☒ | N ☐ | |
| Noxious Aquatic Plants | E ☐ | N ☒ | |
| Sediment | E ☒ | N ☐ | |
| Metals | E ☒ | N ☐ | |
| Oil and Grease | E ☒ | N ☐ | |
| Trash/Debris | E ☒ | N ☐ | |
| Pesticides / Herbicides | E ☒ | N ☐ | |
| Organic Compounds | E ☒ | N ☐ | |
| Other: | E ☐ | N ☐ | |
| Other: | E ☐ | N ☐ | |
| Other: | E ☐ | N ☐ | |
| Other: | E ☐ | N ☐ | |
| Other: | E ☐ | N ☐ | |

# 2.4 Water Quality Credits

A water quality credit program is applicable for certain types of development projects if it is not feasible to meet the requirements for on-site LID. Proponents for eligible projects, as described below, can apply for water quality credits that would reduce project obligations for selecting and sizing other treatment BMP or participating in other alternative compliance programs. Refer to Section 6.2 in the TGD for WQMP to determine if water quality credits are applicable for the project.

## Form 2.4-1 Water Quality Credits

| | | | |
|---|---|---|---|
| **1** Project Types that Qualify for Water Quality Credits: *Select all that apply* | | | |
| ☐ Redevelopment projects that reduce the overall impervious footprint of the project site. [Credit = % impervious reduced] | Higher density development projects<br>☐ Vertical density [20%]<br>☐ 7 units/ acre [5%] | ☐ Mixed use development, (combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that demonstrate environmental benefits not realized through single use projects) [20%] | ☐ Brownfield redevelopment (redevelop real property complicated by presence or potential of hazardous contaminants) [25%] |
| ☐ Redevelopment projects in established historic district, historic preservation area, or similar significant core city center areas [10%] | ☐ Transit-oriented developments (mixed use residential or commercial area designed to maximize access to public transportation) [20%] | ☐ In-fill projects (conversion of empty lots & other underused spaces < 5 acres, substantially surrounded by urban land uses, into more beneficially used spaces, such as residential or commercial areas) [10%] | ☐ Live-Work developments (variety of developments designed to support residential and vocational needs) [20%] |
| **2** Total Credit % *(Total all credit percentages up to a maximum allowable credit of 50 percent)* | | | |
| Description of Water Quality Credit Eligibility (if applicable) | N/A | | |

# Section 3 Site and Watershed Description

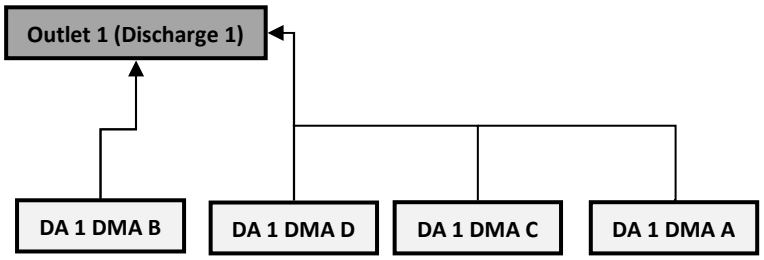
Describe the project site conditions that will facilitate the selection of BMP through an analysis of the physical conditions and limitations of the site and its receiving waters. Identify distinct drainage areas (DA) that collect flow from a portion of the site and describe how runoff from each DA (and sub-watershed DMAs) is conveyed to the site outlet(s). Refer to Section 3.2 in the TGD for WQMP. The form below is provided as an example. Then complete Forms 3.2 and 3.3 for each DA on the project site.

## Form 3-1 Site Location and Hydrologic Features

| Site coordinates *take GPS measurement at approximate center of site* | Latitude 34.0004° N | Longitude 117.6793° W | Thomas Bros Map page 681 H2 |
|---|---|---|---|

**1** San Bernardino County climatic region: ☒ Valley ☐ Mountain

**2** Does the site have more than one drainage area (DA): Yes☒ No☐ *If no, proceed to Form 3-2. If yes, then use this form to show a conceptual schematic describing DMAs and hydrologic feature connecting DMAs to the site outlet(s). An example is provided below that can be modified for proposed project or a drawing clearly showing DMA and flow routing may be attached*




| Conveyance | Briefly describe on-site drainage features to convey runoff that is not retained within a DMA |
|---|---|
| DA1 DMA A flows to Discharge 1 | *DMA A drains via sheet flow and concentrated gutter flow to the proposed aboveground bioretention basin for water quality treatment prior to discharge through proposed storm drain pipe where high flows bubble-up to the u-channel/parkway drain and low flows are pumped to the same u-channel /parkway drain and discharge to Benson Ave. This combination bubble-up and pump system to the u-channel/parkway drain and to Benson Ave is "Discharge 1"* |
| DA1 DMA B flows to Discharge 1 | *DMA B drains via sheet flow and concentrated gutter flow to the proposed aboveground bioretention planter box for water quality treatment prior to routing to "Discharge 1". Note: Basin A, B, & C cumulatively meet the minimum effective area required for LID BMPs (Table 5-7 from the SB TGD) for a Commercial/Industrial project w/FAR > 2.0, Area B includes a proprietary LID BMP with detention storage to treat the remaining DMA B DCV requirement.* |
| DA1 DMA C flows to Discharge 1 | *DMA C drains via sheet flow and concentrated gutter flow to the proposed aboveground bioretention basin for water quality treatment prior to discharge through storm drain pipe to "Discharge 1".* |
| DA1 DMA D to Discharge 1 | *DMA D drains via sheet flow and concentrated gutter flow to the proposed proprietary biotreatment unit with detention storage for water quality treatment prior to discharge through storm drain pipe to "Discharge 1". Note: Basin A, B, & C cumulatively meet the minimum effective area required for LID BMPs (Table 5-7 from the SB TGD) for a Commercial/Industrial project w/FAR > 2.0, Area D proprietary LID BMP serves to treat the area infeasible to route to aboveground basins.* |

| Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1 | | |
|---|---|---|
| For Drainage Area 1's sub-watershed DMA, provide the following characteristics | DA 1 DMA A | |
| **1** DMA drainage area ($ft^2$) | 289058 | |
| **2** Existing site impervious area ($ft^2$) | 24294 | |
| **3** Antecedent moisture condition *For desert areas, use* *http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf* | II | |
| **4** Hydrologic soil group *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/* | D | |
| **5** Longest flowpath length (ft) | 942 | |
| **6** Longest flowpath slope (ft/ft) | 0.006 | |
| **7** Current land cover type(s) *Select from Fig C-3 of Hydrology Manual* | C-15 | |
| **8** Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating* | Poor | |

## Form 3-3 Watershed Description for Drainage Area 1

| | |
|---|---|
| Receiving waters<br>*Refer to Watershed Mapping Tool -*<br>*http://permitrack.sbcounty.gov/wap/*<br>*See 'Drainage Facilities" link at this website* | Chino Creek Reach 1B & 1A, Santa Ana River Reach 3 |
| Applicable TMDLs<br>*Refer to Local Implementation Plan* | Indicator Bacteria |
| 303(d) listed impairments<br>*Refer to Local Implementation Plan and Watershed Mapping Tool –*<br>*http://permitrack.sbcounty.gov/wap/ and State Water Resources Control Board website – http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/index.shtml* | Nutrients, Indicator Bacteria, Chemical oxygen demand (COD), Copper & Lead |
| Environmentally Sensitive Areas (ESA)<br>*Refer to Watershed Mapping Tool –*<br>*http://permitrack.sbcounty.gov/wap/* | Burrowing Owl Habitat |
| Unlined Downstream Water Bodies<br>*Refer to Watershed Mapping Tool –*<br>*http://permitrack.sbcounty.gov/wap/* | Chino Creek 1A & 1B and SAR Reach 3 |
| Hydrologic Conditions of Concern | ☐ Yes *Complete Hydrologic Conditions of Concern (HCOC) Assessment. Include Forms 4.2-2 through Form 4.2-5 and Hydromodification BMP Form 4.3-10 in submittal*<br>☒ No |
| Watershed–based BMP included in a RWQCB approved WAP | ☐ Yes *Attach verification of regional BMP evaluation criteria in WAP*<br>• *More Effective than On-site LID*<br>• *Remaining Capacity for Project DCV*<br>• *Upstream of any Water of the US*<br>• *Operational at Project Completion*<br>• *Long-Term Maintenance Plan*<br>☒ No |

# Section 4 Best Management Practices (BMP)

## 4.1 Source Control BMP

### 4.1.1 Pollution Prevention

Non-structural and structural source control BMP are required to be incorporated into all new development and significant redevelopment projects. Form 4.1-1 and 4.1-2 are used to describe specific source control BMPs used in the WQMP or to explain why a certain BMP is not applicable. Table 7-3 of the TGD for WQMP provides a list of applicable source control BMP for projects with specific types of potential pollutant sources or activities. The source control BMP in this table must be implemented for projects with these specific types of potential pollutant sources or activities.

The preparers of this WQMP have reviewed the source control BMP requirements for new development and significant redevelopment projects. The preparers have also reviewed the specific BMP required for project as specified in Forms 4.1-1 and 4.1-2. All applicable non-structural and structural source control BMP shall be implemented in the project.

## Form 4.1-1 Non-Structural Source Control BMPs

| Identifier | Name | Check One | | Describe BMP Implementation OR, if not applicable, state reason |
|---|---|---|---|---|
| | | Included | Not Applicable | |
| N1 | Education of Property Owners, Tenants and Occupants on Stormwater BMPs | ☒ | ☐ | The project owner's representative shall be familiar with the contents of this WQMP and shall provide BMP education to all tenants, occupants, and contractors on the site. The WQMP Report shall also be kept on-site and passed along to future owners. |
| N2 | Activity Restrictions | ☒ | ☐ | Examples of activity restrictions are:<br>• Require dumpster lids to be closed at all times.<br>• Prohibit vehicle washing, maintenance, or repair on the premises.<br>Owner is responsible for due diligence regarding enforcement of Activity Restrictions to ensure proper function of the site BMPs. |
| N3 | Landscape Management BMPs | ☒ | ☐ | Landscape plans will be consistent with the San Bernardino county requirements for water conservation vegetation utilizing programmable irrigation systems.<br>To prevent contamination of runoff, steep and unstable landscaped slopes will be avoided. In the bioretention pond areas, slopes will be protected by grasses tolerant of seasonal water inundation with a layer of mulch. Regular visual inspection and removal of trash and sediment will be utilized. |
| N4 | BMP Maintenance | ☒ | ☐ | All site BMPs requiring regular inspection/maintenance shall be managed per the procedures described in Form 5-1 of this document. |
| N5 | Title 22 CCR Compliance (How development will comply) | ☒ | ☐ | If any hazardous materials are stored or handled on site, the owner shall ensure compliance with Title 22 of the CCR. |
| N6 | Local Water Quality Ordinances | ☒ | ☐ | The site shall be in compliance with the City of Chino's Stormwater Quality Ordinance through consistent implementation of stormwater BMPs, as required by the Owner. |

| Form 4.1-1 Non-Structural Source Control BMPs | | | | |
|---|---|---|---|---|
| N7 | Spill Contingency Plan | ☒ | ☐ | Non Hazardous Spills will be indentified and cleaned per CASQA BMP requirements.<br>Hazardous chemical spills shall be contained/cleaned per SB County CUPA Agency requirements. |
| N8 | Underground Storage Tank Compliance | ☐ | ☒ | Underground Storage Tanks will not be utilized as part of this project site. |
| N9 | Hazardous Materials Disclosure Compliance | ☒ | ☐ | If hazmats are stored or used on site, the owner and his tenant shall ensure all required disclosure requirements are met. |

## Form 4.1-1 Non-Structural Source Control BMPs

| Identifier | Name | Check One | | Describe BMP Implementation OR, if not applicable, state reason |
|---|---|---|---|---|
| | | Included | Not Applicable | |
| N10 | Uniform Fire Code Implementation | ☒ | ☐ | The Owner and any tenants are responsible for Compliance with Article 80 of the Uniform Fire Code enforced by fire protection agency. |
| N11 | Litter/Debris Control Program | ☒ | ☐ | The owner will ensure that cleanup occurs onsite outside the trash areas by sweeping and will make sure trash container areas are screened or walled to prevent off-site transport of trash. At a minimum all paved areas of the site shall be vacuum swept monthly. |
| N12 | Employee Training | ☒ | ☐ | The owner will ensure that training will be annually conducted hiring appropriate trainers. |
| N13 | Housekeeping of Loading Docks | ☒ | ☐ | Owner will ensure proper housekeeping of loading docks by requiring weekly sweeping of these areas. |
| N14 | Catch Basin Inspection Program | ☒ | ☐ | The owner is required to have 100 percent of drainage facilities inspected, cleaned and maintained for debris accumulation and evidence of illegal/illicit discharges on a quarterly basis. |
| N15 | Vacuum Sweeping of Private Streets and Parking Lots | ☒ | ☐ | At a minimum, all paved areas of a business shall be vacuum swept at least at the beginning of every month, or as required and owner will ensure that it is done. The collected waste shall be properly disposed of at an approved dumpsite. |
| N16 | Other Non-structural Measures for Public Agency Projects | ☐ | ☒ | No public agency projects associated. |
| N17 | Comply with all other applicable NPDES permits | ☒ | ☐ | The site Owner shall apply for coverage under the CA Industrial General Stormwater Permit by filing an NOI & SWPPP with the SWRCB and obtaining a WDID#, prior to construction start. Following the NOT filing and prior to occupancy, the Occupant shall comply with all requirements of the General Industrial Permit filing requirements. |

## Form 4.1-2 Structural Source Control BMPs

| Identifier | Name | Check One | | Describe BMP Implementation OR, If not applicable, state reason |
|---|---|---|---|---|
| | | Included | Not Applicable | |
| S1 | Provide storm drain system stencilling and signage (CASQA New Development BMP Handbook SD-13) | ☒ | ☐ | The stencils contain a brief statement that prohibits dumping of improper materials into the MS4 and are typically placed directly adjacent to storm drain inlets. The Owner shall provide and maintain stenciling or labeling within the project areas with prohibitive language (such as: "No Dumping – Flows to Creek") and/or graphical icons to discourage illegal dumping |
| S2 | Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34) | ☐ | ☒ | No outdoor material storage is proposed and the owner shall prohibit all outside storage of materials. |
| S3 | Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32) | ☒ | ☐ | The trash container areas are paved with impervious surface, designed not to allow run-on from adjoining areas, screened to prevent off-site transport of trash and constructed with a solid roof to prevent exposure to direct precipitation. |
| S4 | Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control (Statewide Model Landscape Ordinance; CASQA New Development BMP Handbook SD-12) | ☒ | ☐ | Landscape areas are designed to reduce excess irrigation runoff and promote surface filtration. Irrigation systems are designed to each landscape area's specific water requirements. The timing and application methods of irrigation water are designed and regularly maintained/adjusted to minimize the runoff of excess irrigation water into the municipal storm drain system. |
| S5 | Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement | ☒ | ☐ | Per the landscape plans the finished grade of landscape areas are at minimum of 1-2 inches below top of curb, sidewalk or pavement. |
| S6 | Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10) | ☐ | ☒ | N/A |
| S7 | Covered dock areas (CASQA New Development BMP Handbook SD-31) | ☒ | ☐ | Drainage around dock high rollup doors shall be designed and maintained to preclude urban run-on and runoff. Depressed loading docks are not a feature of this site. If a dock high rollup door bay is used for repair/maintenance, all fluids shall be kept indoors and flooring should be paved with Portland cement concrete. |
| S8 | Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31) | ☐ | ☒ | The site Owner shall prohibit on site vehicle/equipment maintenance. |

## Form 4.1-2 Structural Source Control BMPs

| Identifier | Name | Check One | | Describe BMP Implementation OR, If not applicable, state reason |
|---|---|---|---|---|
| | | Included | Not Applicable | |
| S9 | Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33) | ☐ | ☒ | The site Owner shall prohibit on site vehicle washing. |
| S10 | Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36) | ☐ | ☒ | Not featured in this project. |
| S11 | Equipment wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33) | ☐ | ☒ | Not featured in this project. |
| S12 | Fueling areas (CASQA New Development BMP Handbook SD-30) | ☐ | ☒ | Not featured in this project. |
| S13 | Hillside landscaping (CASQA New Development BMP Handbook SD-10) | ☐ | ☒ | Not featured in this project. |
| S14 | Wash water control for food preparation areas | ☐ | ☒ | Not featured in this project. |
| S15 | Community car wash racks (CASQA New Development BMP Handbook SD-33) | ☐ | ☒ | Not featured in this project. |

### 4.1.2 Preventative LID Site Design Practices

Site design practices associated with new LID requirements in the MS4 Permit should be considered in the earliest phases of a project. Preventative site design practices can result in smaller DCV for LID BMP and hydromodification control BMP by reducing runoff generation. Describe site design and drainage plan including:

- A narrative of site design practices utilized or rationale for not using practices
- A narrative of how site plan incorporates preventive site design practices
- Include an attached Site Plan layout which shows how preventative site design practices are included in WQMP

Refer to Section 5.2 of the TGD for WQMP for more details.

**Form 4.1-3 Preventative LID Site Design Practices Checklist**

| Site Design Practices<br>*If yes, explain how preventative site design practice is addressed in project site plan. If no, other LID BMPs must be selected to meet targets* |
|---|
| Minimize impervious areas: Yes ☒ No ☐<br>Explanation: Impervious areas have been minimized whenever possible by designing sidewalks and parking drive aisles to the minimum widths while still following city standards. |
| Maximize natural infiltration capacity: Yes ☐ No ☒<br>Explanation: Existing soil does not support infiltration. |
| Preserve existing drainage patterns and time of concentration: Yes ☒ No ☐<br>Explanation: Preserving drain pattern to Benson Avenue |
| Disconnect impervious areas: Yes ☒ No ☐<br>Explanation: Where possible, impervious areas will drain to landscaping and/or bioretention improvements for treatment. |
| Protect existing vegetation and sensitive areas: Yes ☐ No ☒<br>Explanation: Existing site is mostly impervious with minimal vegetation. |
| Re-vegetate disturbed areas: Yes ☒ No ☐<br>Explanation: Remaining disturbed areas will be landscaped per the landscaping plan for the project. |
| Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐<br>Explanation: Care will be taken to minimize the traffic of heavy construction equipment over the bioretention basin and planter box areas. |
| Utilize vegetated drainage swales in place of underground piping or imperviously lined swales: Yes ☒ No ☐<br>Explanation: three basins are proposed in the project |
| Stake off areas that will be used for landscaping to minimize compaction during construction: Yes ☒ No ☐<br>Explanation: Landscaped areas to be staked off and noted on plans. |

# 4.2 Project Performance Criteria

The purpose of this section of the Project WQMP is to establish targets for post-development hydrology based on performance criteria specified in the MS4 Permit. These targets include runoff volume for water quality control (referred to as LID design capture volume), and runoff volume, time of concentration, and peak runoff for protection of any downstream waterbody segments with a HCOC. ***If the project has more than one outlet for stormwater runoff, then complete additional versions of these forms for each DA / outlet.***

Methods applied in the following forms include:

- For LID BMP Design Capture Volume (DCV), the San Bernardino County Stormwater Program requires use of the $P_6$ method (MS4 Permit Section XI.D.6a.ii) – Form 4.2-1
- For HCOC pre- and post-development hydrologic calculation, the San Bernardino County Stormwater Program requires the use of the Rational Method (San Bernardino County Hydrology Manual Section D). Forms 4.2-2 through Form 4.2-5 calculate hydrologic variables including runoff volume, time of concentration, and peak runoff from the project site pre- and post-development using the Hydrology Manual Rational Method approach. For projects greater than 640 acres (1.0 $mi^2$), the Rational Method and these forms should not be used. For such projects, the Unit Hydrograph Method (San Bernardino County Hydrology Manual Section E) shall be applied for hydrologic calculations for HCOC performance criteria.

Refer to Section 4 in the TGD for WQMP for detailed guidance and instructions.

## Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 1-DMA A)

| | | |
|---|---|---|
| **1** Project area<br>DA 1 – DMA A ($ft^2$):<br>58,029 | **2** Imperviousness after applying preventative site design practices (Imp%): 81.1 | **3** Runoff Coefficient (Rc): _0.61<br>*$R_c = 0.858(Imp\%)^{\wedge 3} - 0.78(Imp\%)^{\wedge 2} + 0.774(Imp\%) + 0.04$* |
| **4** Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.589 *http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html* | | |
| **5** Compute $P_6$, Mean 6-hr Precipitation (inches): 0.872<br>*$P_6$ = Item 4 *$C_1$, where $C_1$ is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)* | | |
| **6** Drawdown Rate<br>*Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.* | | 24-hrs ☐<br>48-hrs ☒ |
| **7** Compute design capture volume, DCV ($ft^3$): 5,049<br>*DCV = 1/12 * [Item 1* Item 3 *Item 5 * $C_2$], where $C_2$ is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)*<br>*Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2* | | |

## Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 1-DMA B)

| | | |
|---|---|---|
| **1** Project area DA 2-DMA C ($ft^2$): 192,469 | **2** Imperviousness after applying preventative site design practices (Imp%): 94.7 | **3** Runoff Coefficient (Rc): _ 0.80 *$R_c = 0.858(Imp\%)^{\wedge 3}-0.78(Imp\%)^{\wedge 2}+0.774(Imp\%)+0.04$* |
| **4** Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.589 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html | | |
| **5** Compute $P_6$, Mean 6-hr Precipitation (inches): 0.872 *$P_6$ = Item 4 *$C_1$, where $C_1$ is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)* | | |
| **6** Drawdown Rate *Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.* | | 24-hrs ☐<br>48-hrs ☒ |
| **7** Compute design capture volume, DCV ($ft^3$): 21,963 *DCV = 1/12 * [Item 1* Item 3 *Item 5 * $C_2$], where $C_2$ is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)* *Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2* | | |

## Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 1-DMA C)

| | | |
|---|---|---|
| **1** Project area DA 2-DMA C ($ft^2$): 16,695 | **2** Imperviousness after applying preventative site design practices (Imp%): 71.7 | **3** Runoff Coefficient (Rc): _0.51 *$R_c = 0.858(Imp\%)^{\wedge 3}-0.78(Imp\%)^{\wedge 2}+0.774(Imp\%)+0.04$* |
| **4** Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.589 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html | | |
| **5** Compute $P_6$, Mean 6-hr Precipitation (inches): 0.872 *$P_6$ = Item 4 *$C_1$, where $C_1$ is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)* | | |
| **6** Drawdown Rate *Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.* | | 24-hrs ☐<br>48-hrs ☒ |
| **7** Compute design capture volume, DCV ($ft^3$): 1,215 *DCV = 1/12 * [Item 1* Item 3 *Item 5 * $C_2$], where $C_2$ is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)* *Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2* | | |

# Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 1-DMA D)

| | | |
|---|---|---|
| **1** Project area DA 2-DMA D ($ft^2$): 21,863 | **2** Imperviousness after applying preventative site design practices (Imp%): 70.9 | **3** Runoff Coefficient (Rc): _0.50 *$R_c = 0.858(Imp\%)^{\wedge 3}-0.78(Imp\%)^{\wedge 2}+0.774(Imp\%)+0.04$* |
| **4** Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.589 *http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html* | | |
| **5** Compute $P_6$, Mean 6-hr Precipitation (inches): 0.872 *$P_6$ = Item 4 *$C_1$, where $C_1$ is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)* | | |
| **6** Drawdown Rate *Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.* | | 24-hrs ☐<br>48-hrs ☒ |
| **7** Compute design capture volume, DCV ($ft^3$): 1,559 *DCV = 1/12 * [Item 1* Item 3 *Item 5 * $C_2$], where $C_2$ is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)* *Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2* | | |

# Form 4.2-2 Summary of HCOC Assessment (DA 1)

Does project have the potential to cause or contribute to an HCOC in a downstream channel: Yes ☒ No ☐

*Go to*: *http://permitrack.sbcounty.gov/wap/*

If "Yes", then complete HCOC assessment of site hydrology for 2yr storm event using Forms 4.2-3 through 4.2-5 and insert results below *(Forms 4.2-3 through 4.2-5 may be replaced by computer software analysis based on the San Bernardino County Hydrology Manual)*

If "No," then proceed to Section 4.3 Project Conformance Analysis

| Condition | Runoff Volume ($ft^3$) | Time of Concentration (min) | Peak Runoff (cfs) |
|---|---|---|---|
| Pre-developed | **1** 17,676<br>*Form 4.2-3 Item 12* | **2** 12.8<br>*Form 4.2-4 Item 13* | **3** 8.6<br>*Form 4.2-5 Item 10* |
| Post-developed | **4** 17,676<br>*Form 4.2-3 Item 13* | **5** 12.2<br>*Form 4.2-4 Item 14* | **6** 9.9<br>*Form 4.2-5 Item 14* |
| Difference | **7** *0*<br>*Item 4 – Item 1* | **8** *0.6*<br>*Item 2 – Item 5* | **9** *1.3*<br>*Item 6 – Item 3* |
| Difference<br>(as % of pre-developed) | **10** *0%*<br>*Item 7 / Item 1* | **11** *4%*<br>*Item 8 / Item 2* | **12** *15%*<br>*Item 9 / Item 3* |

## Form 4.2-3 HCOC Assessment for Runoff Volume (DA 1)

| **Weighted Curve Number Determination for: Pre-developed DA** | DMA A | DMA | DMA | DMA | DMA | DMA | DMA | DMA |
|---|---|---|---|---|---|---|---|---|
| **1a** Land Cover type | Urban Commercial | | | | | | | |
| **2a** Hydrologic Soil Group (HSG) | D | | | | | | | |
| **3a** DMA Area, $ft^2$ *sum of areas of DMA should equal area of DA* | 289,058 | | | | | | | |
| **4a** Curve Number (CN) *use Items 1 and 2 to select the appropriate CN from Appendix C-2 of the TGD for WQMP* | 75 | | | | | | | |
| **Weighted Curve Number Determination for: Post-developed DA** | DMA A | DMA B | DMA C | DMA D | DMA | DMA | DMA | DMA |
| **1b** Land Cover type | Urban Commercial | Urban Com. | Urban Com. | Urban Com. | | | | |
| **2b** Hydrologic Soil Group (HSG) | D | D | D | D | | | | |
| **3b** DMA Area, $ft^2$ *sum of areas of DMA should equal area of DA* | 58,029 | 192,469 | 16,695 | 21,863 | | | | |
| **4b** Curve Number (CN) *use Items 5 and 6 to select the appropriate CN from Appendix C-2 of the TGD for WQMP* | 75 | 75 | 75 | 75 | | | | |

| | | |
|---|---|---|
| **5** Pre-Developed area-weighted CN: 75 | **7** Pre-developed soil storage capacity, S (in): 3.3<br>*S = (1000 / Item 5) - 10* | **9** Initial abstraction, $I_a$ (in): 0.7<br>*$I_a$ = 0.2 * Item 7* |
| **6** Post-Developed area-weighted CN: 75 | **8** Post-developed soil storage capacity, S (in): 3.3<br>*S = (1000 / Item 6) - 10* | **10** Initial abstraction, $I_a$ (in): 0.7<br>*$I_a$ = 0.2 * Item 8* |

**11** Precipitation for 2 yr, 24 hr storm (in): 2.64
*Go to: http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html*

**12** Pre-developed Volume ($ft^3$): 17,676
*$V_{pre}$ =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 9)^2 / ((Item 11 – Item 9 + Item 7)*

**13** Post-developed Volume ($ft^3$): 17,676
*$V_{pre}$ =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 10)^2 / ((Item 11 – Item 10 + Item 8)*

**14** Volume Reduction needed to meet HCOC Requirement, ($ft^3$): None Required
*$V_{HCOC}$ = (Item 13 * 0.95) – Item 12*

# Form 4.2-4 HCOC Assessment for Time of Concentration (DA 1)

Compute time of concentration for pre and post developed conditions for each DA *(For projects using the Hydrology Manual complete the form below)*

| Variables | Pre-developed DA1 *Use additional forms if there are more than 4 DMA* | | | | Post-developed DA1 *Use additional forms if there are more than 4 DMA* | | | |
|---|---|---|---|---|---|---|---|---|
| | DMA A | DMA | DMA | DMA | DMA A+C+D | DMA B | DMA | |
| **1** Length of flowpath (ft) *Use Form 3-2 Item 5 for pre-developed condition* | 942 | | | | 650 | 590 | | |
| **2** Change in elevation (ft) | 5.7 | | | | 5.6 | 6.2 | | |
| **3** Slope (ft/ft), $S_o$ = *Item 2 / Item 1* | 0.006 | | | | 0.008 | 0.011 | | |
| **4** Land cover | Urban Commercial | | | | Urban Commercial | Urban Commercial | | |
| **5** Initial DMA Time of Concentration (min) *Appendix C-1 of the TGD for WQMP* | 12.8 | | | | 10.3 | 10.0 | | |
| **6** Length of conveyance from DMA outlet to project site outlet (ft) *May be zero if DMA outlet is at project site outlet* | 0 | | | | 450 | 500 | | |
| **7** Cross-sectional area of channel ($ft^2$) | | | | | 0.36 | 0.39 | | |
| **8** Wetted perimeter of channel (ft) | | | | | 1.8 | 2.0 | | |
| **9** Manning's roughness of channel (n) | | | | | 0.013 | 0.013 | | |
| **10** Channel flow velocity (ft/sec) $V_{fps}$ = *(1.49 / Item 9) * (Item 7/Item 8)^0.67 * (Item 3)^0.5* | | | | | 3.62 | 3.74 | | |
| **11** Travel time to outlet (min) $T_t$ = *Item 6 / (Item 10 * 60)* | | | | | 2.1 | 2.2 | | |
| **12** Total time of concentration (min) $T_c$ = *Item 5 + Item 11* | | | | | 12.4 | 12.2 | | |

**13** Pre-developed time of concentration (min): 12.8 *Minimum of Item 12 pre-developed DMA*

**14** Post-developed time of concentration (min): 12.2 *Minimum of Item 12 post-developed DMA*

**15** Additional time of concentration needed to meet HCOC requirement (min): 0 $T_{C\text{-}HCOC}$ = *(Item 13 * 0.95) – Item 14*

# Form 4.2-5 HCOC Assessment for Peak Runoff (DA 1)

Compute peak runoff for pre- and post-developed conditions

| Variables | | Pre-developed DA to Project Outlet (*Use additional forms if more than 3 DMA)* | | | Post-developed DA to Project Outlet (*Use additional forms if more than 3 DMA)* | | |
|---|---|---|---|---|---|---|---|
| | | DMA A | DMA | DMA | DMA A+C+D | DMA B | DMA |
| **1** Rainfall Intensity for storm duration equal to time of concentration<br>*$I_{peak}$ = 10^(LOG Form 4.2-1 Item 4 - 0.6 LOG Form 4.2-4 Item 5 /60)* | | 1.49 | | | 1.70 | 1.73 | |
| **2** Drainage Area of each DMA (Acres)<br>*For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)* | | 6.64 | | | 2.22 | 4.42 | |
| **3** Ratio of pervious area to total area<br>*For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)* | | 0.093 | | | 0.228 | 0.053 | |
| **4** Pervious area infiltration rate (in/hr)<br>*Use pervious area CN and antecedent moisture condition with Appendix C-3 of the TGD for WQMP* | | 0.47 | | | 0.47 | 0.47 | |
| **5** Maximum loss rate (in/hr)<br>*$F_m$ = Item 3 * Item 4*<br>*Use area-weighted $F_m$ from DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)* | | 0.044 | | | 0.107 | 0.025 | |
| **6** Peak Flow from DMA (cfs)<br>*$Q_p$ =Item 2 * 0.9 * (Item 1 - Item 5)* | | 8.6 | | | 3.2 | 6.8 | |
| **7** Time of concentration adjustment factor for other DMA to site discharge point<br>*Form 4.2-4 Item 12 DMA / Other DMA upstream of site discharge point (If ratio is greater than 1.0, then use maximum value of 1.0)* | DMA A | *n/a* | | | *n/a* | 0.97 | |
| | DMA B | | *n/a* | | 1.00 | *n/a* | |
| | DMA C | | | *n/a* | | | *n/a* |

**8** Pre-developed $Q_p$ at $T_c$ for DMA A: 8.6 *$Q_p$ = Item $6_{DMAA}$ + [Item $6_{DMAB}$ * (Item $1_{DMAA}$ - Item $5_{DMAB}$)/(Item $1_{DMAB}$ - Item $5_{DMAB}$)* Item $7_{DMAA/2}$] + [Item $6_{DMAC}$ * (Item $1_{DMAA}$ - Item $5_{DMAC}$)/(Item $1_{DMAC}$ - Item $5_{DMAC}$)* Item $7_{DMAA/3}$]*

**9** Pre-developed $Q_p$ at $T_c$ for DMA B: n/a *$Q_p$ = Item $6_{DMAB}$ + [Item $6_{DMAA}$ * (Item $1_{DMAB}$ - Item $5_{DMAA}$)/(Item $1_{DMAA}$ - Item $5_{DMAA}$)* Item $7_{DMAB/1}$] + [Item $6_{DMAC}$ * (Item $1_{DMAB}$ - Item $5_{DMAC}$)/(Item $1_{DMAC}$ - Item $5_{DMAC}$)* Item $7_{DMAB/3}$]*

**10** Pre-developed $Q_p$ at $T_c$ for DMA C: n/a *$Q_p$ = Item $6_{DMAC}$ + [Item $6_{DMAA}$ * (Item $1_{DMAC}$ - Item $5_{DMAA}$)/(Item $1_{DMAA}$ - Item $5_{DMAA}$)* Item $7_{DMAC/1}$] + [Item $6_{DMAB}$ * (Item $1_{DMAC}$ - Item $5_{DMAB}$)/(Item $1_{DMAB}$ - Item $5_{DMAB}$)* Item $7_{DMAC/2}$]*

**10** Peak runoff from pre-developed condition confluence analysis (cfs): 8.6 *Maximum of Item 8, 9, and 10 (including additional forms as needed)*

**11** Post-developed $Q_p$ at $T_c$ for DMA A: 9.8
*Same as Item 8 for post-developed values*

**12** Post-developed $Q_p$ at $T_c$ for DMA B: 9.9
*Same as Item 9 for post-developed values*

**13** Post-developed $Q_p$ at $T_c$ for DMA C: n/a
*Same as Item 10 for post-developed values*

**14** Peak runoff from post-developed condition confluence analysis (cfs): 9.9 *Maximum of Item 11, 12, and 13 (including additional forms as needed)*

**15** Peak runoff reduction needed to meet HCOC Requirement (cfs): 0.8 *$Q_{p\text{-}HCOC}$ = (Item 14 * 0.95) – Item 10*

# 4.3 Project Conformance Analysis

Complete the following forms for each project site DA to document that the proposed LID BMPs conform to the project DCV developed to meet performance criteria specified in the MS4 Permit (WQMP Template Section 4.2). For the LID DCV, the forms are ordered according to hierarchy of BMP selection as required by the MS4 Permit (see Section 5.3.1 in the TGD for WQMP). The forms compute the following for on-site LID BMP:

- Site Design and Hydrologic Source Controls (Form 4.3-2)
- Retention and Infiltration (Form 4.3-3)
- Harvested and Use (Form 4.3-4) or
- Biotreatment (Form 4.3-5).

At the end of each form, additional fields facilitate the determination of the extent of mitigation provided by the specific BMP category, allowing for use of the next category of BMP in the hierarchy, if necessary.

The first step in the analysis, using Section 5.3.2.1 of the TGD for WQMP, is to complete Forms 4.3-1 and 4.3-3) to determine if retention and infiltration BMPs are infeasible for the project. For each feasibility criterion in Form 4.3-1, if the answer is "Yes," provide all study findings that includes relevant calculations, maps, data sources, etc. used to make the determination of infeasibility.

Next, complete Forms 4.3-2 and 4.3-4 to determine the feasibility of applicable HSC and harvest and use BMPs, and, if their implementation is feasible, the extent of mitigation of the DCV.

If no site constraints exist that would limit the type of BMP to be implemented in a DA, evaluate the use of combinations of LID BMPs, including all applicable HSC BMPs to maximize on-site retention of the DCV. If no combination of BMP can mitigate the entire DCV, implement the single BMP type, or combination of BMP types, that maximizes on-site retention of the DCV within the minimum effective area.

If the combination of LID HSC, retention and infiltration, and harvest and use BMPs are unable to mitigate the entire DCV, then biotreatment BMPs may be implemented by the project proponent. If biotreatment BMPs are used, then they must be sized to provide sufficient capacity for effective treatment of the remainder of the volume-based performance criteria that cannot be achieved with LID BMPs (TGD for WQMP Section 5.4.4.2). **Under no circumstances shall any portion of the DCV be released from the site without effective mitigation and/or treatment**.

## Form 4.3-1 Infiltration BMP Feasibility (DA 1)

Feasibility Criterion – Complete evaluation for each DA on the Project Site

[1] Would infiltration BMP pose significant risk for groundwater related concerns? Yes ☐ No ☒
*Refer to Section 5.3.2.1 of the TGD for WQMP*

If Yes, Provide basis: (attach)

[2] Would installation of infiltration BMP significantly increase the risk of geotechnical hazards? Yes ☐ No ☒
(Yes, if the answer to any of the following questions is yes, as established by a geotechnical expert):

- The location is less than 50 feet away from slopes steeper than 15 percent
- The location is less than eight feet from building foundations or an alternative setback.
- A study certified by a geotechnical professional or an available watershed study determines that stormwater infiltration would result in significantly increased risks of geotechnical hazards.

If Yes, Provide basis: (attach)

[3] Would infiltration of runoff on a Project site violate downstream water rights? Yes ☐ No ☒

If Yes, Provide basis: (attach)

[4] Is proposed infiltration facility located on hydrologic soil group (HSG) D soils or does the site geotechnical investigation indicate presence of soil characteristics, which support categorization as D soils? Yes ☒ No ☐

If Yes, Provide basis: (attach) see Appendix A

[5] Is the design infiltration rate, after accounting for safety factor of 2.0, below proposed facility less than 0.3 in/hr (accounting for soil amendments)? Yes ☒ No ☐

If Yes, Provide basis: (attach) see Appendix A

[6] Would on-site infiltration or reduction of runoff over pre-developed conditions be partially or fully inconsistent with watershed management strategies as defined in the WAP, or impair beneficial uses? Yes ☐ No ☒
*See Section 3.5 of the TGD for WQMP and WAP*

If Yes, Provide basis: (attach)

[7] Any answer from Item 1 through Item 3 is "Yes": Yes ☐ No ☒
*If yes, infiltration of any volume is not feasible onsite. Proceed to Form 4.3-4, Harvest and Use BMP. If no, then proceed to Item 8 below.*

[8] Any answer from Item 4 through Item 6 is "Yes": Yes ☒ No ☐
*If yes, infiltration is permissible but is not required to be considered. Proceed to Form 4.3-2, Hydrologic Source Control BMP. If no, then proceed to Item 9, below.*

[9] All answers to Item 1 through Item 6 are "No":
*Infiltration of the full DCV is potentially feasible, LID infiltration BMP must be designed to infiltrate the full DCV to the MEP. Proceed to Form 4.3-2, Hydrologic Source Control BMP.*

## 4.3.1 Site Design Hydrologic Source Control BMP

Section XI.E. of the Permit emphasizes the use of LID preventative measures; and the use of LID HSC BMPs reduces the portion of the DCV that must be addressed in downstream BMPs. Therefore, all applicable HSC shall be provided except where they are mutually exclusive with each other, or with other BMPs. Mutual exclusivity may result from overlapping BMP footprints such that either would be potentially feasible by itself, but both could not be implemented. Please note that while there are no numeric standards regarding the use of HSC, if a project cannot feasibly meet BMP sizing requirements or cannot fully address HCOCs, feasibility of all applicable HSC must be part of demonstrating that the BMP system has been designed to retain the maximum feasible portion of the DCV. Complete Form 4.3-2 to identify and calculate estimated retention volume from implementing site design HSC BMP. Refer to Section 5.4.1 in the TGD for more detailed guidance.

**Form 4.3-2 Site Design Hydrologic Source Control BMPs (DA 1)**

| | | | |
|---|---|---|---|
| **1** Implementation of Impervious Area Dispersion BMP (i.e. routing runoff from impervious to pervious areas), excluding impervious areas planned for routing to on-lot infiltration BMP: Yes ☐ No ☒ *If yes, complete Items 2-5; If no, proceed to Item 6* | DA DMA BMP Type | DA DMA BMP Type | DA DMA BMP Type *(Use additional forms for more BMPs)* |
| **2** Total impervious area draining to pervious area ($ft^2$) | | | |
| **3** Ratio of pervious area receiving runoff to impervious area | | | |
| **4** Retention volume achieved from impervious area dispersion ($ft^3$) *V = Item2 * Item 3 * (0.5/12), assuming retention of 0.5 inches of runoff* | | | |
| **5** Sum of retention volume achieved from impervious area dispersion ($ft^3$): | $V_{retention}$ *=Sum of Item 4 for all BMPs* | | |
| **6** Implementation of Localized On-lot Infiltration BMPs (e.g. on-lot rain gardens): Yes ☐ No ☒ *If yes, complete Items 7-13 for aggregate of all on-lot infiltration BMP in each DA; If no, proceed to Item 14* | DA DMA BMP Type | DA DMA BMP Type | DA DMA BMP Type *(Use additional forms for more BMPs)* |
| **7** Ponding surface area ($ft^2$) | | | |
| **8** Ponding depth (ft) | | | |
| **9** Surface area of amended soil/gravel ($ft^2$) | | | |
| **10** Average depth of amended soil/gravel (ft) | | | |
| **11** Average porosity of amended soil/gravel | | | |
| **12** Retention volume achieved from on-lot infiltration ($ft^3$) $V_{retention}$ *= (Item 7 *Item 8) + (Item 9 * Item 10 * Item 11)* | | | |
| **13** Runoff volume retention from on-lot infiltration ($ft^3$): | $V_{retention}$ *=Sum of Item 12 for all BMPs* | | |

# Form 4.3-2 Site Design Hydrologic Source Control BMPs (DA 1)

## Form 4.3-2 cont. Site Design Hydrologic Source Control BMPs (DA 1)

| | | | |
|---|---|---|---|
| **14** Implementation of evapotranspiration BMP (green, brown, or blue roofs): Yes ☐ No ☒<br>*If yes, complete Items 15-20. If no, proceed to Item 21* | DA DMA<br>BMP Type | DA DMA<br>BMP Type | DA DMA<br>BMP Type<br>*(Use additional forms for more BMPs)* |
| **15** Rooftop area planned for ET BMP ($ft^2$) | | | |
| **16** Average wet season ET demand (in/day)<br>*Use local values, typical ~ 0.1* | | | |
| **17** Daily ET demand ($ft^3$/day)<br>*Item 15 * (Item 16 / 12)* | | | |
| **18** Drawdown time (hrs)<br>*Copy Item 6 in Form 4.2-1* | | | |
| **19** Retention Volume ($ft^3$)<br>$V_{retention}$ *= Item 17 * (Item 18 / 24)* | | | |
| **20** Runoff volume retention from evapotranspiration BMPs ($ft^3$): $V_{retention}$ *=Sum of Item 19 for all BMPs* | | | |
| **21** Implementation of Street Trees: Yes ☐ No ☒<br>*If yes, complete Items 22-25. If no, proceed to Item 26* | DA DMA<br>BMP Type | DA DMA<br>BMP Type | DA DMA<br>BMP Type<br>*(Use additional forms for more BMPs)* |
| **22** Number of Street Trees | | | |
| **23** Average canopy cover over impervious area ($ft^2$) | | | |
| **24** Runoff volume retention from street trees ($ft^3$)<br>$V_{retention}$ *= Item 22 * Item 23 * (0.05/12) assume runoff retention of 0.05 inches* | | | |
| **25** Runoff volume retention from street tree BMPs ($ft^3$): $V_{retention}$ *= Sum of Item 24 for all BMPs* | | | |
| **26** Implementation of residential rain barrel/cisterns: Yes ☐ No ☒ *If yes, complete Items 27-29; If no, proceed to Item 30* | DA DMA<br>BMP Type | DA DMA<br>BMP Type | DA DMA<br>BMP Type<br>*(Use additional forms for more BMPs)* |
| **27** Number of rain barrels/cisterns | | | |
| **28** Runoff volume retention from rain barrels/cisterns ($ft^3$)<br>$V_{retention}$ *= Item 27 * 3* | | | |
| **29** Runoff volume retention from residential rain barrels/Cisterns (ft3): $V_{retention}$ *=Sum of Item 28 for all BMPs* | | | |
| **30** Total Retention Volume from Site Design Hydrologic Source Control BMPs: *Sum of Items 5, 13, 20, 25 and 29* | | | |

### 4.3.2 Infiltration BMPs

Use Form 4.3-3 to compute on-site retention of runoff from proposed retention and infiltration BMPs. Volume retention estimates are sensitive to the percolation rate used, which determines the amount of runoff that can be infiltrated within the specified drawdown time. The infiltration safety factor reduces field measured percolation to account for potential inaccuracy associated with field measurements, declining BMP performance over time, and compaction during construction. Appendix D of the TGD for WQMP provides guidance on estimating an appropriate safety factor to use in Form 4.3-3.

If site constraints limit the use of BMPs to a single type and implementation of retention and infiltration BMPs mitigate no more than 40% of the DCV, then they are considered infeasible and the Project Proponent may evaluate the effectiveness of BMPs lower in the LID hierarchy of use (Section 5.5.1 of the TGD for WQMP)

If implementation of infiltrations BMPs is feasible as determined using Form 4.3-1, then LID infiltration BMPs shall be implemented to the MEP (section 4.1 of the TGD for WQMP).

## Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 1)

| | | | |
|---|---|---|---|
| **1** Remaining LID DCV not met by site design HSC BMP ($ft^3$): *$V_{unmet}$ = Form 4.2-1 Item 7 - Form 4.3-2 Item 30* | | | |
| BMP Type *Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs* | DA DMA BMP Type | DA DMA BMP Type | DA DMA BMP Type *(Use additional forms for more BMPs)* |
| **2** Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix D of the TGD for WQMP for minimum requirements for assessment methods* | | | |
| **3** Infiltration safety factor *See TGD Section 5.4.2 and Appendix D* | | | |
| **4** Design percolation rate (in/hr) *$P_{design}$ = Item 2 / Item 3* | | | |
| **5** Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1* | | | |
| **6** Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details* | | | |
| **7** Ponding Depth (ft) *$d_{BMP}$ = Minimum of (1/12*Item 4*Item 5) or Item 6* | | | |
| **8** Infiltrating surface area, *$SA_{BMP}$* ($ft^2$) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP* | | | |
| **9** Amended soil depth, *$d_{media}$* (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details* | | | |
| **10** Amended soil porosity | | | |
| **11** Gravel depth, *$d_{media}$* (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details* | | | |
| **12** Gravel porosity | | | |
| **13** Duration of storm as basin is filling (hrs) *Typical ~ 3hrs* | | | |
| **14** Above Ground Retention Volume ($ft^3$) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]* | | | |
| **15** Underground Retention Volume ($ft^3$) *Volume determined using manufacturer's specifications and calculations* | | | |
| **16** Total Retention Volume from LID Infiltration BMPs: *(Sum of Items 14 and 15 for all infiltration BMP included in plan)* | | | |
| **17** Fraction of DCV achieved with infiltration BMP: % *Retention% = Item 16 / Form 4.2-1 Item 7* | | | |
| **18** Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? Yes ☐ No ☐ *If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.* | | | |

### 4.3.3 Harvest and Use BMP

Harvest and use BMP may be considered if the full LID DCV cannot be met by maximizing infiltration BMPs. Use Form 4.3-4 to compute on-site retention of runoff from proposed harvest and use BMPs.

Volume retention estimates for harvest and use BMPs are sensitive to the on-site demand for captured stormwater. Since irrigation water demand is low in the wet season, when most rainfall events occur in San Bernardino County, the volume of water that can be used within a specified drawdown period is relatively low. The bottom portion of Form 4.3-4 facilitates the necessary computations to show infeasibility if a minimum incremental benefit of 40 percent of the LID DCV would not be achievable with MEP implementation of on-site harvest and use of stormwater (Section 5.5.4 of the TGD for WQMP).

**Form 4.3-4 Harvest and Use BMPs (DA 1)**

**1** Remaining LID DCV not met by site design HSC or infiltration BMP ($ft^3$):
*$V_{unmet}$ = Form 4.2-1 Item 7 - Form 4.3-2 Item 30 – Form 4.3-3 Item 16*

| BMP Type(s) *Compute runoff volume retention from proposed harvest and use BMP (Select BMPs from Table 5-4 of the TGD for WQMP) - Use additional forms for more BMPs* | DA DMA BMP Type | DA DMA BMP Type | DA DMA BMP Type *(Use additional forms for more BMPs)* |
|---|---|---|---|
| **2** Describe cistern or runoff detention facility | | | |
| **3** Storage volume for proposed detention type ($ft^3$) *Volume of cistern* | | | |
| **4** Landscaped area planned for use of harvested stormwater ($ft^2$) | | | |
| **5** Average wet season daily irrigation demand (in/day) Use local values, typical ~ 0.1 in/day | | | |
| **6** Daily water demand ($ft^3$/day) *Item 4 * (Item 5 / 12)* | | | |
| **7** Drawdown time (hrs) *Copy Item 6 from Form 4.2-1* | | | |
| **8** Retention Volume ($ft^3$) *$V_{retention}$ = Minimum of (Item 3) or (Item 6 * (Item 7 / 24))* | | | |

**9** Total Retention Volume ($ft^3$) from Harvest and Use BMP *Sum of Item 8 for all harvest and use BMP included in plan*

**10** Is the full DCV retained with a combination of LID HSC, retention and infiltration, and harvest & use BMPs? Yes ☐ No ☐

*If yes, demonstrate conformance using Form 4.3-10. If no, then re-evaluate combinations of all LID BMP and optimize their implementation such that the maximum portion of the DCV is retained on-site (using a single BMP type or combination of BMP types). If the full DCV cannot be mitigated after this optimization process, proceed to Section 4.3.4.*

## 4.3.4 Biotreatment BMP

Biotreatment BMPs may be considered if the full LID DCV cannot be met by maximizing retention and infiltration, and harvest and use BMPs. A key consideration when using biotreatment BMP is the effectiveness of the proposed BMP in addressing the pollutants of concern for the project (see Table 5-5 of the TGD for WQMP).

Use Form 4.3-5 to summarize the potential for volume based and/or flow based biotreatment options to biotreat the remaining unmet LID DCV w. Biotreatment computations are included as follows:

- Use Form 4.3-6 to compute biotreatment in small volume based biotreatment BMP (e.g. bioretention w/underdrains);
- Use Form 4.3-7 to compute biotreatment in large volume based biotreatment BMP (e.g. constructed wetlands);
- Use Form 4.3-8 to compute sizing criteria for flow-based biotreatment BMP (e.g. bioswales)

### Form 4.3-5 Selection and Evaluation of Biotreatment BMP (DA 1)

| | | |
|---|---|---|
| **1** Remaining LID DCV not met by site design HSC, infiltration, or harvest and use BMP for potential biotreatment ($ft^3$): 29,786 *Form 4.2-1 Item 7 - Form 4.3-2 Item 30 – Form 4.3-3 Item 16- Form 4.3-4 Item 9* | List pollutants of concern *Copy from Form 2.3-1.* Pathogens (Bacterial / Virus), Nutrients - Phosphorous, Nutrients - Nitrogen, Metals, Organic Compounds, COD. | |
| **2** Biotreatment BMP Selected *(Select biotreatment BMP(s) necessary to ensure all pollutants of concern are addressed through Unit Operations and Processes, described in Table 5-5 of the TGD for WQMP)* | Volume-based biotreatment *Use Forms 4.3-6 and 4.3-7 to compute treated volume* | Flow-based biotreatment *Use Form 4.3-8 to compute treated volume* |
| | ☒ Bioretention with underdrain<br>☒ Planter box with underdrain<br>☐ Constructed wetlands<br>☐ Wet extended detention<br>☐ Dry extended detention<br>☒ Proprietary biotreatment | ☐ Vegetated swale<br>☐ Vegetated filter strip<br>☐ Proprietary biotreatment |
| **3** Volume biotreated in volume based biotreatment BMP ($ft^3$): 30,940 *Form 4.3-6 Item 15 + Form 4.3-7 Item 13* | **4** Compute remaining LID DCV with implementation of volume based biotreatment BMP ($ft^3$): *Item 1 – Item 3* | **5** Remaining fraction of LID DCV for sizing flow based biotreatment BMP: % *Item 4 / Item 1* |
| **6** Flow-based biotreatment BMP capacity provided (cfs): *Use Figure 5-2 of the TGD for WQMP to determine flow capacity required to provide biotreatment of remaining percentage of unmet LID DCV (Item 5), for the project's precipitation zone (Form 3-1 Item 1)* | | |
| **7** Metrics for MEP determination:<br>• Provided a WQMP with the portion of site area used for suite of LID BMP equal to minimum thresholds in Table 5-7 of the TGD for WQMP for the proposed category of development: ☐ *If maximized on-site retention BMPs is feasible for partial capture, then LID BMP implementation must be optimized to retain and infiltrate the maximum portion of the DCV possible within the prescribed minimum effective area. The remaining portion of the DCV shall then be mitigated using biotreatment BMP.* | | |

## Form 4.3-6 Volume Based Biotreatment (DA 1)
## Bioretention and Planter Boxes with Underdrains

| Biotreatment BMP Type *(Bioretention w/underdrain, planter box w/underdrain, other comparable BMP)* | DA 1 DMA A BMP Type Bioretention | DA 1 DMA B BMP Type Bioretention | DA 1 DMA B BMP Type Proprietary |
|---|---|---|---|
| **1** Pollutants addressed with BMP *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP* | Pathogens (Bacterial / Virus), Nutrients - Phosphorous, Nutrients - Nitrogen, Metals, Organic Compounds, COD. | | |
| **2** Amended soil infiltration rate *Typical ~ 5.0* | 5.0 | 5.0 | N/A |
| **3** Amended soil infiltration safety factor *Typical ~ 2.0* | 2.0 | 2.0 | N/A |
| **4** Amended soil design percolation rate (in/hr) $P_{design}$ *= Item 2 / Item 3* | 2.5 | 2.5 | N/A |
| **5** Ponded water drawdown time (hr) *Copy Item 6 from Form 4.2-1* | 48 | 48 | N/A |
| **6** Maximum ponding depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details* | 1.5 | 1.5 | N/A |
| **7** Ponding Depth (ft) $d_{BMP}$ *= Minimum of (1/12 * Item 4 * Item 5) or Item 6* | 1.5 | 1.5 | N/A |
| **8** Amended soil surface area ($ft^2$) | 1,621 | 4,652 | N/A |
| **9** Amended soil depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details* | 3.0 | 2.0 | N/A |
| **10** Amended soil porosity, *n* | 0.40 | 0.40 | N/A |
| **11** Gravel depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details* | 1.5 | 1.5 | N/A |
| **12** Gravel porosity, *n* | 0.4 | 0.4 | N/A |
| **13** Duration of storm as basin is filling (hrs) *Typical ~ 3hrs* | 3 | 3 | N/A |
| **14** Biotreated Volume ($ft^3$) $V_{biotreated}$ *= Item 8 * [(Item 7/2) + (Item 9 * Item 10) +(Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]end* | 5,147 | 12,909 | 9,111 Per Calculations (Appendix B) |
| **15** Total biotreated volume from bioretention and/or planter box with underdrains BMP: See Next Page *Sum of Item 14 for all volume-based BMPs included in this form* | | | |

# Form 4.3-6 Volume Based Biotreatment (DA 2)
# Bioretention and Planter Boxes with Underdrains

| Biotreatment BMP Type *(Bioretention w/underdrain, planter box w/underdrain, other comparable BMP)* | DA 1 DMA C BMP Type Bioretention | DA 2 DMA D BMP Type Proprietary | DA DMA BMP TYPE | DA DMA BMP TYPE |
|---|---|---|---|---|
| **1** Pollutants addressed with BMP *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP* | Pathogens (Bacterial / Virus), Nutrients, Phosphorous, Nitrogen, Metals, Organic Compounds, COD. | | | |
| **2** Amended soil infiltration rate *Typical ~ 5.0* | 5.0 | N/A | | |
| **3** Amended soil infiltration safety factor *Typical ~ 2.0* | 2.0 | N/A | | |
| **4** Amended soil design percolation rate (in/hr) $P_{design}$ *= Item 2 / Item 3* | 2.5 | N/A | | |
| **5** Ponded water drawdown time (hr) *Copy Item 6 from Form 4.2-1* | 48 | N/A | | |
| **6** Maximum ponding depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details* | 0.5 | N/A | | |
| **7** Ponding Depth (ft) $d_{BMP}$ *= Minimum of (1/12 * Item 4 * Item 5) or Item 6* | 0.5 | N/A | | |
| **8** Amended soil surface area ($ft^2$) | 956 | N/A | | |
| **9** Amended soil depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details* | 2.0 | N/A | | |
| **10** Amended soil porosity, *n* | 0.40 | N/A | | |
| **11** Gravel depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details* | 1.5 | N/A | | |
| **12** Gravel porosity, *n* | 0.4 | N/A | | |
| **13** Duration of storm as basin is filling (hrs) *Typical ~ 3hrs* | 3 | N/A | | |
| **14** Biotreated Volume ($ft^3$) $V_{biotreated}$ *= Item 8 * [(Item 7/2) + (Item 9 * Item 10) +(Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]end* | 2,175 | 1,634 Per Calculations (Appendix B) | | |
| **15** Total biotreated volume from bioretention and/or planter box with underdrains BMP: 30,940 *, 104%* *Sum of Item 14 for all volume-based BMPs included in this form* | | | | |

# Form 4.3-7 Volume Based Biotreatment (DA 1) – Constructed Wetlands and Extended Detention

| Biotreatment BMP Type<br>*Constructed wetlands, extended wet detention, extended dry detention, or other comparable proprietary BMP. If BMP includes multiple modules (e.g. forebay and main basin), provide separate estimates for storage and pollutants treated in each module.* | DA DMA BMP Type | | DA DMA BMP Type<br>*(Use additional forms for more BMPs)* | |
|---|---|---|---|---|
| | Forebay | Basin | Forebay | Basin |
| **1** Pollutants addressed with BMP forebay and basin<br>*List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP* | | | | |
| **2** Bottom width (ft) | | | | |
| **3** Bottom length (ft) | | | | |
| **4** Bottom area ($ft^2$) $A_{bottom}$ = *Item 2 * Item 3* | | | | |
| **5** Side slope (ft/ft) | | | | |
| **6** Depth of storage (ft) | | | | |
| **7** Water surface area ($ft^2$)<br>$A_{surface}$ =*(Item 2 + (2 * Item 5 * Item 6)) * (Item 3 + (2 * Item 5 * Item 6))* | | | | |
| **8** Storage volume ($ft^3$) *For BMP with a forebay, ensure fraction of total storage is within ranges specified in BMP specific fact sheets, see Table 5-6 of the TGD for WQMP for reference to BMP design details*<br>V =*Item 6 / 3 * [Item 4 + Item 7 + (Item 4 * Item 7)^0.5]* | | | | |
| **9** Drawdown Time (hrs) *Copy Item 6 from Form 2.1* | | | | |
| **10** Outflow rate (cfs) $Q_{BMP}$ = *(Item* $8_{forebay}$ *+ Item* $8_{basin}$*) / (Item 9 * 3600)* | | | | |
| **11** Duration of design storm event (hrs) | | | | |
| **12** Biotreated Volume ($ft^3$)<br>$V_{biotreated}$ = *(Item* $8_{forebay}$ *+ Item* $8_{basin}$*) +( Item 10 * Item 11 * 3600)* | | | | |
| **13** Total biotreated volume from constructed wetlands, extended dry detention, or extended wet detention :<br>*(Sum of Item 12 for all BMP included in plan)* | | | | |

## Form 4.3-8 Flow Based Biotreatment (DA 1)

| Biotreatment BMP Type<br>*Vegetated swale, vegetated filter strip, or other comparable proprietary BMP* | DA DMA<br>BMP Type | DA DMA<br>BMP Type | DA DMA<br>BMP Type<br>*(Use additional forms for more BMPs)* |
|---|---|---|---|
| **1** Pollutants addressed with BMP<br>*List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in TGD Table 5-5* | | | |
| **2** Flow depth for water quality treatment (ft)<br>*BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details* | | | |
| **3** Bed slope (ft/ft)<br>*BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details* | | | |
| **4** Manning's roughness coefficient | | | |
| **5** Bottom width (ft)<br>$b_w$ *= (Form 4.3-5 Item 6 * Item 4) / (1.49 * Item 2^1.67 * Item 3^0.5)* | | | |
| **6** Side Slope (ft/ft)<br>*BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details* | | | |
| **7** Cross sectional area ($ft^2$)<br>*A = (Item 5 * Item 2) + (Item 6 * Item 2^2)* | | | |
| **8** Water quality flow velocity (ft/sec)<br>*V = Form 4.3-5 Item 6 / Item 7* | | | |
| **9** Hydraulic residence time (min)<br>*Pollutant specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details* | | | |
| **10** Length of flow based BMP (ft)<br>*L = Item 8 * Item 9 * 60* | | | |
| **11** Water surface area at water quality flow depth ($ft^2$)<br>$SA_{top}$ *= (Item 5 + (2 * Item 2 * Item 6)) * Item 10* | | | |

## 4.3.5 Conformance Summary

Complete Form 4.3-9 to demonstrate how on-site LID DCV is met with proposed site design hydrologic source control, infiltration, harvest and use, and/or biotreatment BMP. The bottom line of the form is used to describe the basis for infeasibility determination for on-site LID BMP to achieve full LID DCV, and provides methods for computing remaining volume to be addressed in an alternative compliance plan. If the project has more than one outlet, then complete additional versions of this form for each outlet.

### Form 4.3-9 Conformance Summary and Alternative Compliance Volume Estimate (DA 1&2)

**1** Total LID DCV for the Project DA-1&2 ($ft^3$): 29,787 *Copy Item 7 in Form 4.2-1*

**2** On-site retention with site design hydrologic source control LID BMP ($ft^3$): *Copy Item 30 in Form 4.3-2*

**3** On-site retention with LID infiltration BMP ($ft^3$): *Copy Item 16 in Form 4.3-3*

**4** On-site retention with LID harvest and use BMP ($ft^3$): *Copy Item 9 in Form 4.3-4*

**5** On-site biotreatment with volume based biotreatment BMP ($ft^3$): 30,940 *Copy Item 3 in Form 4.3-5*

**6** Flow capacity provided by flow based biotreatment BMP (cfs): *Copy Item 6 in Form 4.3-5*

**7** LID BMP performance criteria are achieved if answer to any of the following is "Yes":

- Full retention of LID DCV with site design HSC, infiltration, or harvest and use BMP: Yes ☐ No ☒
  *If yes, sum of Items 2, 3, and 4 is greater than Item 1*
- Combination of on-site retention BMPs for a portion of the LID DCV and volume-based biotreatment BMP that address all pollutants of concern for the remaining LID DCV: Yes ☒ No ☐
  *If yes, a) sum of Items 2, 3, 4, and 5 is greater than Item 1, and Items 2, 3 and 4 are maximized; or b) Item 6 is greater than Form 4.3--5 Item 6 and Items 2, 3 and 4 are maximized*
- On-site retention and infiltration is determined to be infeasible and biotreatment BMP provide biotreatment for all pollutants of concern for full LID DCV: Yes ☐ No ☐
  *If yes, Form 4.3-1 Items 7 and 8 were both checked yes*

**8** If the LID DCV is not achieved by any of these means, then the project may be allowed to develop an alternative compliance plan. Check box that describes the scenario which caused the need for alternative compliance:

- Combination of HSC, retention and infiltration, harvest and use, and biotreatment BMPs provide less than full LID DCV capture: ☐
  *Checked yes for Form 4.3-5 Item 7, Item 6 is zero, and sum of Items 2, 3, 4, and 5 is less than Item 1. If so, apply water quality credits and calculate volume for alternative compliance,* $V_{alt}$ *= (Item 1 – Item 2 – Item 3 – Item 4 – Item 5) * (100 - Form 2.4-1 Item 2)%*
- An approved Watershed Action Plan (WAP) demonstrates that water quality and hydrologic impacts of urbanization are more effective when managed in at an off-site facility: ☐
  *Attach appropriate WAP section, including technical documentation, showing effectiveness comparisons for the project site and regional watershed*

## 4.3.6 Hydromodification Control BMP

Use Form 4.3-10 to compute the remaining runoff volume retention, after LID BMP are implemented, needed to address HCOC, and the increase in time of concentration and decrease in peak runoff necessary to meet targets for protection of waterbodies with a potential HCOC. Describe hydromodification control BMP that address HCOC, which may include off-site BMP and/or in-stream controls. Section 5.6 of the TGD for WQMP provides additional details on selection and evaluation of hydromodification control BMP.

### Form 4.3-10 Hydromodification Control BMPs (DA 1)

| | |
|---|---|
| **1** Volume reduction needed for HCOC performance criteria ($ft^3$): 16,792 *(Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1* | **2** On-site retention with site design hydrologic source control, infiltration, and harvest and use LID BMP ($ft^3$): 30,940 *Sum of Form 4.3-9 Items 2, 3, and 4 Evaluate option to increase implementation of on-site retention in Forms 4.3-2, 4.3-3, and 4.3-4 in excess of LID DCV toward achieving HCOC volume reduction* |
| **3** Remaining volume for HCOC volume capture ($ft^3$): 0 *Item 1 – Item 2* | **4** Volume capture provided by incorporating additional on-site or off-site retention BMPs ($ft^3$): 0 *Existing downstream BMP may be used to demonstrate additional volume capture (if so, attach to this WQMP a hydrologic analysis showing how the additional volume would be retained during a 2-yr storm event for the regional watershed)* |

**5** If Item 4 is less than Item 3, incorporate in-stream controls on downstream waterbody segment to prevent impacts due to hydromodification ☐ *Attach in-stream control BMP selection and evaluation to this WQMP*

**6** Is Form 4.2-2 Item 11 less than or equal to 5%: Yes ☒ No ☐ See Section 6.4 Appendix B Supporting Calculations

*If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:*

- Demonstrate increase in time of concentration achieved by proposed LID site design, LID BMP, and additional on-site or off-site retention BMP ☐
  *BMP upstream of a waterbody segment with a potential HCOC may be used to demonstrate increased time of concentration through hydrograph attenuation (if so, show that the hydraulic residence time provided in BMP for a 2-year storm event is equal or greater than the addition time of concentration requirement in Form 4.2-4 Item 15)*
- Increase time of concentration by preserving pre-developed flow path and/or increase travel time by reducing slope and increasing cross-sectional area and roughness for proposed on-site conveyance facilities ☐
- Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California ☐

**7** Form 4.2-2 Item 12 less than or equal to 5%: Yes ☐ No ☒ See Section 6.4 Appendix B Supporting Calculations

HCOC mitigation Unit Hydrograph Calculations shown in Appendix B 'Supporting Calculations'

*If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:*

- Demonstrate reduction in peak runoff achieved by proposed LID site design, LID BMPs, and additional on-site or off-site retention BMPs ☒
  *BMPs upstream of a waterbody segment with a potential HCOC may be used to demonstrate additional peak runoff reduction through hydrograph attenuation (if so, attach to this WQMP, a hydrograph analysis showing how the peak runoff would be reduced during a 2-yr storm event)*
- Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California ☐

# 4.4 Alternative Compliance Plan (if applicable)

Describe an alternative compliance plan (if applicable) for projects not fully able to infiltrate, harvest and use, or biotreat the DCV via on-site LID practices. A project proponent must develop an alternative compliance plan to address the remainder of the LID DCV. Depending on project type some projects may qualify for water quality credits that can be applied to reduce the DCV that must be treated prior to development of an alternative compliance plan (see Form 2.4-1, Water Quality Credits). Form 4.3-9 Item 8 includes instructions on how to apply water quality credits when computing the DCV that must be met through alternative compliance. Alternative compliance plans may include one or more of the following elements:

- On-site structural treatment control BMP - All treatment control BMP should be located as close to possible to the pollutant sources and should not be located within receiving waters;
- Off-site structural treatment control BMP - Pollutant removal should occur prior to discharge of runoff to receiving waters;
- Urban runoff fund or In-lieu program, if available

Depending upon the proposed alternative compliance plan, approval by the executive officer may or may not be required (see Section 6 of the TGD for WQMP).

# Section 5 Inspection and Maintenance Responsibility for Post Construction BMP

All BMP included as part of the project WQMP are required to be maintained through regular scheduled inspection and maintenance (refer to Section 8, Post Construction BMP Requirements, in the TGD for WQMP). Fully complete Form 5-1 summarizing all BMP included in the WQMP. Attach additional forms as needed. The WQMP shall also include a detailed Operation and Maintenance Plan for all BMP and may require a Maintenance Agreement (consult the jurisdiction's LIP). If a Maintenance Agreement is required, it must also be attached to the WQMP.

**Form 5-1 BMP Inspection and Maintenance (use additional forms as necessary)**

| BMP | Reponsible Party(s) | Inspection/ Maintenance Activities Required | Minimum Frequency of Activities |
|---|---|---|---|
| S1 - Provide storm drain system stenciling and signage | REXFORD INDUSTRIAL | Spray and install storm drain stencils that contain a brief statement prohibiting the dumping of improper materials into the onsite drains and municipal system. | Annually, repair as necessary. |
| S3 - Design and construct trash and waste storage areas to reduce pollution introduction | REXFORD INDUSTRIAL | The integrity of structural elements that are subject to damage (i.e., screens, covers, and signs) must be maintained by the owner/operator. Trash enclosure areas are to be regularly inspected and cleaned and checked daily to ensure the lids are closed. | Monthly |
| S4 - Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control | REXFORD INDUSTRIAL | Inspect and repair damaged irrigation equipment. Adjust irrigation heads and timing as necessary to control/reduce excessive irrigation runoff and erosion from landscaped areas. | Monthly |
| S5 - Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement | REXFORD INDUSTRIAL | Maintain the finish grade at all landscape pockets, fingers, and parkway strips at a minimum of 1-2 inches below top of curb or sidewalk for increased retention/infiltration of stormwater and irrigation water. | Monthly |
| Landscape Maintenance | REXFORD INDUSTRIAL | Maintain landscape areas by regularly removing trash/debris to prevent waste from entering the storm drain and ensuring the vegetation in sloped landscape areas is preserved to prevent erosion. | Bi-Weekly |

| | | | |
|---|---|---|---|
| SC-43 Parking/Storage Area/Loading Dock Area Maintenance | REXFORD INDUSTRIAL | The paved parking lot and loading dock area shall be vacuum swept on a regular basis to remove trash and debris. | Monthly |
| Proprietary Biotreatment BMP – Modular Wetlands | REXFORD INDUSTRIAL | Inspection and maintenance per manufacturer's specifications included in this report. (To be included in Final WQMP report)<br>Inspect and maintain planting in the biotreatment unit. Inspect and maintain irrigation connection to the planting in the biotreatment unit. | Per manufacturer's specifications |
| Storm Drain Catch Basins/Risers & Kristar Filter Inserts | REXFORD INDUSTRIAL | Inspect catch basins/risers for visual evidence of illicit/illegal discharge and report any evidence to document and prevent future illicit/illegal discharge.<br>Inspect catch basins/risers and filter inserts for accumulated sediment, trash, and debris and remove/clean the catch basins to prevent clogging.<br>See manufacturer's specifications for inspection, maintenance, and cleaning for Kristar Filter Inserts | Monthly |
| Onsite Storm Drainage System | REXFORD INDUSTRIAL | Inspect onsite storm drain lines for visual evidence of illicit/illegal connections and report any evidence to document and prevent future illicit/illegal connection.<br>Inspect storm drain lines and outlet control structure manholes for accumulated sediment, trash, and debris and remove/clean the storm drain and outlet control structures to prevent clogging. Refer to CASQA BMP #SC-44. | Monthly during the Rain Season |
| Bioretention Basin/Planter Box | REXFORD INDUSTRIAL | Inspect soil and repair eroded areas.<br>Inspect for erosion damage to vegetation and walls, preferably at the end of the wet season to schedule summer maintenance and before fall runoff to be sure the basins are ready for winter.<br>Inspect to ensure vegetation cover of grasses tolerant of seasonal water inundation is well established. If not, either prepare soil and reseed or replace with alternative species. Install erosion control blanket for basin side slopes and inlets.<br>Check for debris and litter, and areas of sediment accumulation. Remove litter and debris monthly.<br>Inspect health of trees and shrubs. | |

| | | | |
|---|---|---|---|
| | | Water plants daily for 2 weeks at project completion.<br>Refer to CASQA BMP TC-32. | |
| Pump Unit & Valve Box | REXFORD INDUSTRIAL | Inspection and maintenance per manufacturer's specifications included in this report. (To be included in Final WQMP report) | Monthly during the Rain Season & per manufacturer's specifications |
| 48" HDPE Detention Pipe | REXFORD INDUSTRIAL | Inspection and maintenance per manufacturer's specifications included in this report. (To be included in Final WQMP report) | Per manufacturer's specifications |

# Section 6 WQMP Attachments

## 6.1. Site Plan, Drainage Plan, & Conceptual Utility Plan (for reference)

Include a site plan and drainage plan sheet set containing the following minimum information:

- Project location
- Site boundary
- Land uses and land covers, as applicable
- Suitability/feasibility constraints
- Structural Source Control BMP locations
- Site Design Hydrologic Source Control BMP locations
- LID BMP details
- Drainage delineations and flow information
- Drainage connections

## 6.2 Electronic Data Submittal

Minimum requirements include submittal of PDF exhibits in addition to hard copies. Format must not require specialized software to open. If the local jurisdiction requires specialized electronic document formats (as described in their local Local Implementation Plan), this section will describe the contents (e.g., layering, nomenclature, geo-referencing, etc.) of these documents so that they may be interpreted efficiently and accurately.

## 6.3 Post Construction

Attach all O&M Plans and Maintenance Agreements for BMP to the WQMP.

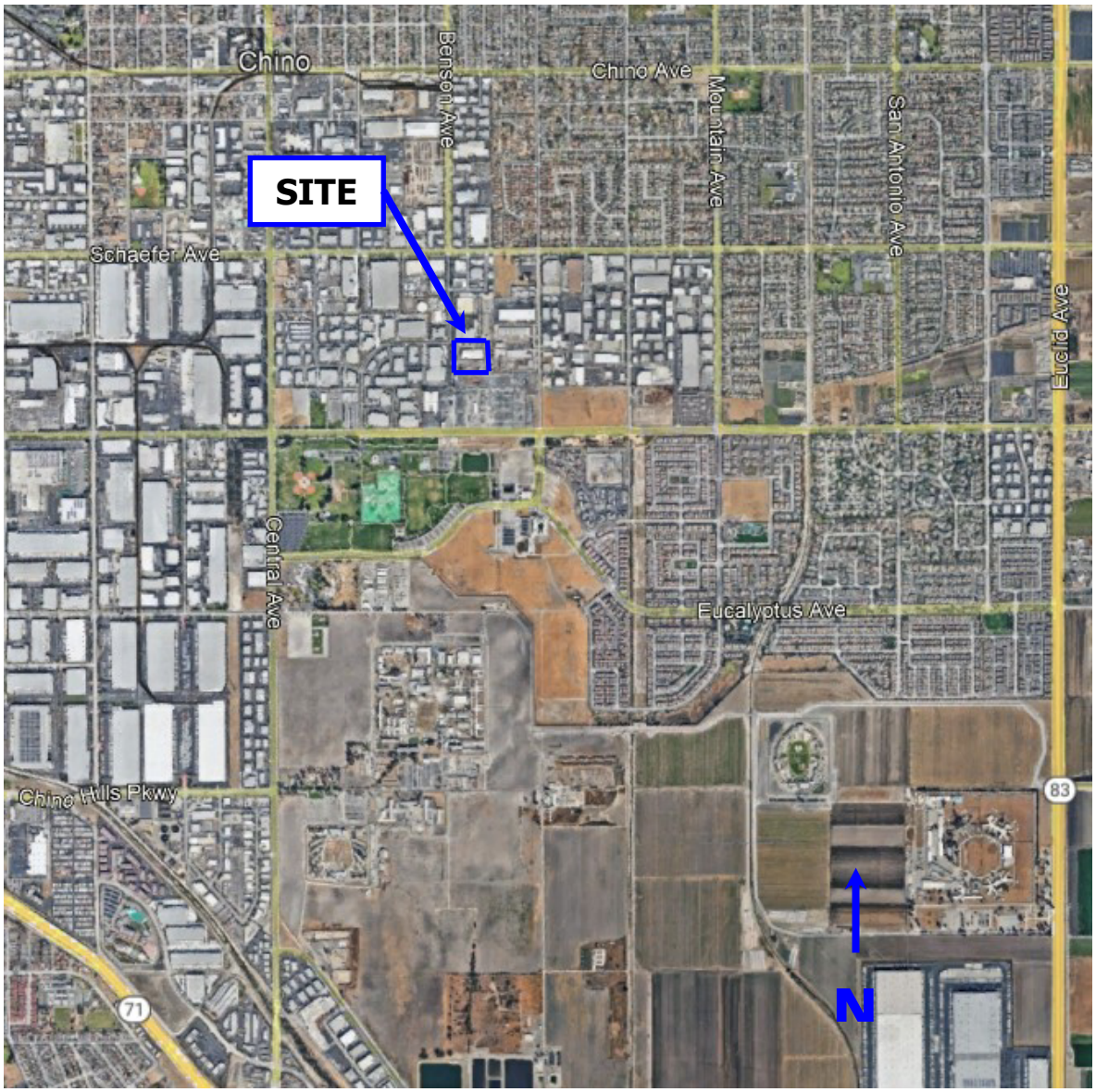
## 6.4 Other Supporting Documentation

- BMP Educational Materials
- Activity Restriction – C, C&R's & Lease Agreements

# Section 6.1

Site Plan, Drainage Plan, & Conceptual Utility Plan (For reference)

# Vicinity Map



DANIELS ST

BENSON AVE

2'W CURB CUT W/ RIP RAP

BIORETENTION BASIN A
$V_{TREATMENT}$=5,147 CF
$V_{TOTAL}$=7,384 CF

A 1.33 — 81.1% IMPERVIOUS 18.9% PERVIOUS

B 4.42 — 94.7% IMPERVIOUS 5.3% PERVIOUS

C 0.38 — 71.7% IMPERVIOUS 28.3% PERVIOUS

2'W CURB CUT W/ RIP RAP, TYP.

EX. SCE EASEMENT TO BE VACATED

BIORETENTION BASIN C
$V_{TREATMENT}$=2,175 CF
$V_{TOTAL}$=3,064 CF

D 0.50 — 70.9% IMPERVIOUS 29.1% PERVIOUS

DETENTION 1:
170 LF OF 48" HDPE,
$V_{TREATMENT}$=1,598 CF
$V_{TOTAL}$=2,137 CF

DETENTION 2:
775 LF OF 48" HDPE,
$V_{TREATMENT}$=9,111 CF
$V_{TOTAL}$=9,741

MWS-L-8-8

DISCHARGE POINT #1

SEE DETAIL 1 HEREON

2'W CURB CUT W/ RIP RAP, TYP.

BIORETENTION BASIN B
$V_{TREATMENT}$=12,909 CF
$V_{TOTAL}$=17,430 CF

2'W CURB CUT W/ RIP RAP, TYP.

R/W

TYP.

## DETAIL 1
1" = 10'

PUMP UNIT FOR LOW FLOWS

MWS-L-4-4

CONFLUENCE

LOW FLOWS TO U-CHANNEL

PARKWAY DRAIN

DISCHARGE #1 TO CURB FACE

MANHOLE WITH EASTERLY OPENING TO U-CHANNEL, NORTHERLY INVERT TO PUMP

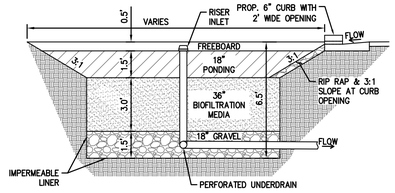
U-CHANNEL

## LEGEND

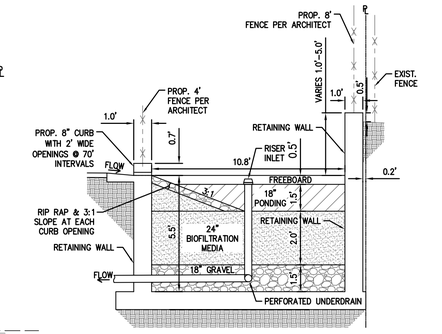
- DMA BOUNDARY
- SUBAREA BOUNDARY
- X / XXX — SUBAREA / SUBAREA ACREAGE
- DIRECTION OF RUNOFF
- LANDSCAPE AREA
- STORM DRAIN FLOW ARROW / STORM DRAIN LINE
- OUTLET CONTROL STRUCTURE MANHOLE (WEIR PLATE, WEIR PLATE)
- 2' WIDE CURB CUT OPENING W/ RIP RAP ON SLOPE

**BMPS:**

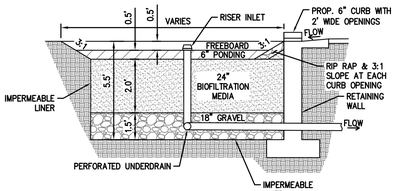
1. STORM DRAIN STENCIL AND SIGNAGE
2. TRASH/WASTE AREAS
3. EFFICIENT IRRIGATION, FINISHED GRADE AT LANDSCAPE AREAS, & LANDSCAPE MAINTENANCE
4. VACUUM SWEEPING PARKING & LOADING DOCK AREA
5. PROPRIETARY BIOTREATMENT: MODULAR WETLANDS UNIT
6. MAINTAIN STORM DRAIN CATCH BASINS
7. BIORETENTION BASIN/PLANTER BOX
8. 48" HDPE DETENTION PIPE
9. PUMP AND VALVE BOX
10. OUTLET CONTROL STRUCTURE MANHOLE W/ WEIR
11. KRISTAR FLOGARD+ CATCH BASIN/RISER FILTER INSERT




## 'BASIN A' BIORETENTION DETAIL
N.T.S.




## 'BASIN B' PLANTER BOX DETAIL
N.T.S.




## 'BASIN C' BIORETENTION DETAIL
N.T.S.

30' 0' 30' 60' 90'
GRAPHIC SCALE: 1"=30'


160 S. Old Springs Road
Suite 210
Anaheim Hills, CA 92808
714-685-6860
DRC Engineering, Inc.
Civil Engineering/Land Surveying/Land Planning


NOT FOR CONSTRUCTION

| NO: | REVISION: | DATE: |
|---|---|---|
| | | |

PROJECT: REXFORD INDUSTRIAL
13925 BENSON AVENUE
CHINO, CA

DRAWING NAME: WQMP MAP

| | |
|---|---|
| ISSUE: | CONCEPTUAL |
| DATE: | 12/8/23 |
| CHECKED: DG | DRAWN: DG |
| DRAWING FILE: | 23646wqmp |
| PROJECT NO.: | 23-646 |
| SHEET NUMBER: | 1 |
| OF | 1 SHEETS |
| SCALE: | AS SHOWN |

FILENAME: M:\2023\23-646 Rexford Chino 13925 Benson\WQMP\23646 WQMP Map.dwg, LAST SAVED ON: Dec 06 2023 2:30pm PLOTTED BY: DREW, ON: Dec 06 2023 2:31pm, CFG:

NOT FOR CONSTRUCTION

EX. 4" PUBLIC GAS LINE
EX. PUBLIC ELECTRIC LINE
EX. 30" PUBLIC STORM DRAIN LINE
EX. 4" PUBLIC GAS LINE
EX. PUBLIC SD CATCH BASIN
SEE DETAIL 'A' ON SHEET 4
BIORETENTION BASIN A 79.7TOP, 77.7BOT
679.2 TG 673.70 INV
EX. 6" PUBLIC SEWER LINE
EX. 6" PUBLIC RECLAIMED WATER LINE
EX. 8" PUBLIC WATER LINE
BENSON AVE.
BIORETENTION BASIN C 679.7TOP 678.7BOT
679.2 TG 674.4 INV
680.1 RIM 674.5 INV
(679.5) RIM 673.4 INV IN-W (673.2) INV IN-N (673.1) INV OUT-S
681.5 RIM 675.6 INV
679.5 TG 676.5 INV
679.5 TG 676.5 INV
677.8 RIM WEIR 672.0 INV-N,S 671.9 INV-E,W
678.2 RIM 671.8 INV-E 671.3 INV-W
678.7 RIM 678.0 INV-W 668.8 INV-N,S
677.8 INV-4" 677.8 INV
(678.3) TC 677.6 INV (677.6) FL
678.8 RIM 677.8 INV-W 669.1 INV-E 669.0 INV-N
PROP. U-CHANNEL & PKWY DRAIN
672.2 INV
672.5 INV
678.1 TC 673.1 INV
677.7 RIM 670.9 INV-S 670.3 INV-N
677.5 RIM WEIR 671.2 INV-W 671.1 INV-S,E
676.8 TG 672.3 INV
676.8 TG 672.3 INV
676.8 TG 672.3 INV
671.7 INV
PROP. BATTERY STORAGE
PROP. TRANSFORMER
EX. 6' SCE EASEMENT TO BE VACATED
EX. RIBBON GUTTER TO BE REMOVED
0.5% FLOOR SLOPE
FF=683.38
FF=682.04
BIORETENTION BASIN B 677.3 TOP OF POND 671.8 BOT OF BOX
BIORETENTION BASIN B 677.3 TOP OF POND 671.8 BOT OF BOX
N.A.P.
PUBLIC
PRIVATE
R/W
S=0.005
S=0.020
S=0.056
S=0.160
S=0.180
S=0.003
S=0.009
S=0.017
S=0.030

## STORM DRAIN CONSTRUCTION NOTES:

30 CONNECT TO BACK OF EXISTING CURB INLET CATCH BASIN
31 INSTALL 4" PVC STORM DRAIN PIPE
32 INSTALL 8" PVC STORM DRAIN PIPE
33 INSTALL 12" HDPE STORM DRAIN PIPE
34 INSTALL 18" HDPE STORM DRAIN PIPE
35 INSTALL 48" HDPE STORM DRAIN PIPE
36 INSTALL 48" STORM DRAIN MANHOLE WITH WEIR & ORIFICE DIVERSION PLATE
37 INSTALL 48" STORM DRAIN MANHOLE
38 INSTALL 12"X12" DROP INLET
39 INSTALL 30" RISER INLET
40 INSTALL 3.5' WIDE CURB INLET
41 INSTALL IRRIGATED CONTECH MWS-L-4-4 UNIT
42 INSTALL IRRIGATED CONTECH MWS-L-8-8 UNIT
43 INSTALL PUMP STATION & VALVE BOX PER PLUMBING PLANS

## FIRE WATER CONSTRUCTION NOTES:

60 CONNECT TO EXISTING WATER LINE
61 INSTALL 6" PVC FIRE WATER LINE
62 INSTALL 8" PVC FIRE WATER LINE
63 INSTALL 8" DOUBLE CHECK DETECTOR ASSEMBLY
64 INSTALL FIRE DEPARTMENT CONNECTION
65 INSTALL POST INDICATOR VALVE
66 INSTALL 6" FIRE HYDRANT WITH GATE VALVE

## WATER CONSTRUCTION NOTES:

80 CONNECT TO EXISTING WATER LINE
81 INSTALL 2" IRRIGATION LINE
82 INSTALL 2" IRRIGATION METER
83 INSTALL 2" DOMESTIC WATER LINE
84 INSTALL 2" DOMESTIC WATER METER
85 INSTALL 2" REDUCED PRESSURE ASSEMBLY

## SEWER CONSTRUCTION NOTES:

90 CONNECT TO EXISTING 10"SEWER MAIN (INVERT ELEVATION TO BE FIELD VERIFIED)
91 INSTALL 6" SEWER LINE
92 INSTALL SEWER CLEANOUT
93 INSTALL 48" SEWER MONITORING MANHOLE PER CITY OF CHINO STD. 527
94 INSTALL SAMPLING WYE CLEANOUT PER CITY OF CHINO STD. 527

**BASIS OF BEARINGS:**
*THE BEARING OF N 89°59'57" W ALONG THE CENTERLINE OF SCHAEFER AVENUE PER PARCEL MAP NO. 5169, PMB 57/13-14, IN THE CITY OF CHINO, COUNTRY OF SAN BERNARDINO, STATE OF CALIFORNIA WAS USED AS THE BASIS OF BEARINGS FOR THIS SURVEY.*

N

20' 0' 20' 40' 60'
GRAPHIC SCALE: 1"=20'

**DATE ISSUED: 12/8/23**

REGISTERED PROFESSIONAL ENGINEER LAWRENCE MITCHELL GILLES No. 45715 Exp. 12-31-24 CIVIL STATE OF CALIFORNIA

DIGALERT — DIAL BEFORE YOU DIG — TWO WORKING DAYS BEFORE YOU DIG — TOLL FREE 1-800-227-2600

| PREPARED BY | | |
|---|---|---|
| FIRM: | DRC ENGINEERING, INC. | |
| ADDRESS: | 160 SOUTH OLD SPRINGS ROAD, STE 210 | |
| | ANAHEIM HILLS, CA. 92808 | |
| TELEPHONE: (714)685-6860 | FAX: (714)685-6801 | |
| 45715 | | |
| SIGNATURE | RCE | DATE |

| REVISIONS | MADE BY | MADE DATE | APPROVED BY | APPROVED DATE |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |

**BENCH MARK DATA**
NO. 141/61 ELEV. 674.9730 LOCATION: A 2 1/2" BRASS DISK STAMPED "141/61" REST 6-01", IN THE TOP OF CURB 1' SOUTH OF A CATCH BASIN AT THE NORTHWEST INTERSECTION OF MAGNOLIA AVENUE AND EDISON AVENUE
VERTICAL DATUM: NGVD 29

**REFERENCE DRAWINGS**

| REVIEWED BY STAFF | BY | DATE |
|---|---|---|
| WATER: | | |
| SEWER: | | |
| FIRE: | | |
| PLANNING: | | |
| TRAFFIC: | | |
| SERVICES: | | |

| CITY ENGINEER'S STAFF | BY | DATE |
|---|---|---|
| DRAWN: | | |
| DESIGNED: | | |
| CHECKED: | | |
| RECOMMENDED: | | |

**APPROVED BY:**
CITY ENGINEER
DATE:

# CITY OF CHINO ENGINEERING DIVISION
## REXFORD INDUSTRIAL, 13925 BENSON AVENUE, CHINO CA
## CONCEPTUAL SITE IMPROVEMENT PLAN
### CONCEPTUAL UTILITY PLAN

PROJECT NO. PL23-0091
SHEET 3 OF 4
DRAWING NO.

EXTERNAL REFERENCES: 23646xc01 23-646 AS Site 23646x101 23646x100 23646x101 23646x101
FILENAME: M:\2023\23-646 Rexford Chino 13925 Benson\C01\23646xg103 01.dwg, LAST SAVED ON: Dec 06 2023 9:08am PLOTTED BY: DREW ON: Dec 06 2023 9:14am, DTC

# Section 6.2

Electronic Data Submittal

Note: A PDF copy of the approved Final WQMP will be provided to the Owner and the City of Chino for record.

# Section 6.3

Post-Construction

AND WHEN RECORDED MAIL TO

City Clerk
City of Chino
P.O. Box 667
Chino, CA 91708

SPACE ABOVE THIS LINE FOR RECORDER'S USE

# WATER QUALITY MANAGEMENT PLAN AND STORMWATER BMP TRANSFER, ACCESS AND MAINTENANCE AGREEMENT

## CITY OF CHINO, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA

This Agreement is made and entered into this _____ day of _____, 20___, by and between the CITY OF CHINO, a municipal corporation, hereinafter referred to as CITY, and _____ hereinafter referred to as OWNER.

WHEREAS, the Owner is the legal property owner of the real property situated in the State of California, County of San Bernardino, located at _____ in the City of Chino, more commonly referred to as San Bernardino County Tax Assessor Parcel No._____ described in Exhibit A and depicted in Exhibit B attached hereto and incorporated herein by this reference; and

WHEREAS, at the time of initial approval of the development project known as _____ within the Property described herein, the City required the project to employ Best Management Practices, hereinafter referred to as "BMPs, " to minimize pollutants in urban runoff; and

WHEREAS, the Owner has chosen to install and/or implement BMPs as described in the Water Quality Management Plan, on file with the City, hereinafter referred to as "WQMP," to minimize pollutants in urban runoff and to minimize other adverse impacts of urban runoff; and

WHEREAS, said WQMP has been certified by the Owner and reviewed and approved by the City; and

WHEREAS, said BMPs, with installation and/or implementation on private property and draining only private property, are part of a private facility with all maintenance or replacement therefore, the sole responsibility of the Owner in accordance with the terms of this Agreement;

WHEREAS, the Owner is aware that periodic and continuous maintenance, including, but not necessarily limited to, filter material replacement and sediment removal, is required to assure peak performance of all BMPs in the WQMP and that, furthermore, such maintenance activity will require compliance with all Local, State, or Federal laws and regulations, including those pertaining to confined space and waste disposal methods, in effect at the time such maintenance occurs;

NOW THEREFORE, it is mutually stipulated and agreed as follows:

1. The Owner hereby provides the City or the City's designee complete access, of any duration, to the BMPs and their immediate vicinity at any time, upon reasonable notice, or in the event of emergency, as determined by City's Director of Public Works with no advance notice, for the purpose of inspection, sampling, testing of the BMPs, and in case of emergency, to undertake all necessary repairs or other preventative measures at the owner's expense as provided in paragraph 3 below. The City shall make every effort at all times to minimize or avoid interference with the Owner's use of the Property.

2. The Owner shall use its best efforts diligently to maintain all BMPs in a manner assuring peak performance at all times. All reasonable precautions shall be exercised by the Owner and the Owner's representative or contractor in the removal and extraction of any material(s) from the BMPs and the ultimate disposal of the material(s) in a manner consistent with all relevant laws and regulations in effect at the time. As may be requested from time to time by the City, the Owner shall provide the City with documentation identifying the material(s) removed, the quantity, and disposal destination.

3. In the event the Owner, or its successors or assigns, fails to accomplish the necessary maintenance contemplated by this Agreement, within five (5) days of being given written notice by the City, the City is hereby authorized to cause any maintenance necessary to be done and charge the entire cost and expense to the Owner or the Owner's successors or assigns, including administrative costs, attorneys fees and interest thereon at the maximum rate authorized by the Civil Code from the date of the notice of expense until paid in full.

4. The City may require the Owner to post security in form and for a time period satisfactory to the City to guarantee the performance of the obligations stated herein. Should the Owner fail to perform the obligations under this Agreement, the City may, in the case of a cash bond, act for the Owner using the proceeds from it, or in the case of a surety bond, require the sureties to perform the obligations of this Agreement. As an additional remedy, the Director may withdraw any previous stormwater-related approval with respect to the property on which BMPs have been installed and/or implemented until such time as the Owner repays to the City its reasonable costs incurred in accordance with paragraph 3 above.

5. This Agreement shall be recorded in the Office of the Recorder of San Bernardino County, California, at the expense of the Owner and shall constitute notice to all successors and assigns of the title to said Property of the obligation herein set forth, and also a lien in such amount as will fully reimburse the City, including interest as herein above set forth, subject to foreclosure in event of default in payment.

6. In event of legal action occasioned by any default or action of the Owner, or its successors or assigns, then the Owner and its successors or assigns agree(s) to pay all costs incurred by the City in enforcing the terms of this Agreement, including reasonable attorney's fees and costs, and that the same shall become a part of the lien against said Property.

7. It is the intent of the parties hereto that burdens and benefits herein undertaken shall constitute covenants that run with said Property and constitute a lien against the Property.

8. The obligations herein undertaken shall be binding upon the heirs, successors, executors, administrators and assigns of the parties hereto. The term "Owner" shall include not only the present Owner, but also its heirs, successors, executors, administrators, and assigns. The Owner shall notify any successor to title of all or part of the Property about the existence of this Agreement. The Owner shall provide such notice prior to such successor obtaining an interest in all or part of the Property. The Owner shall provide a copy of such notice to the City at the same time such notice is provided to the successor.

9. Time is of the essence in the performance of this Agreement.

10. Any notice to a party required or called for in this Agreement shall be served in person, or by deposit in the U.S. Mail, first class postage prepaid, to the address set forth below. Notice(s) shall be deemed effective upon receipt, or seventy-two (72) hours after deposit in the U.S. Mail, whichever is earlier. A party may change a notice address only by providing written notice thereof to the other party.

| IF TO CITY: | IF TO OWNER: |
|---|---|
| Amer Jakher | |
| Director of Public Works | |
| 13220 Central Avenue | |
| Chino, CA 91710 | |

IN WITNESS THEREOF, the parties hereto have affixed their signatures as of the date first written above.

APPROVED AS TO FORM:

By: (Signature Not Required)
City Attorney

City of Chino

By: _____
Linda Reich
City Manager

ATTEST:

_____
Angela Robles, City Clerk

APPROVED AS TO CONTENT:

By: _____
Amer Jakher
Director of Public Works
City of Chino

Owner: _____
*(Company)*

By: _____
*(Signature and Date)*

Name: _____
*(Please Print or Type Name)*

Title: _____
*(Please Print or Type Title)*

**NOTE: OWNER'S SIGNATURE MUST BE NOTARIZED FOR RECORDATION**

13220 Central Ave, Chino, CA 91710
Phone: (909) 334-3265 | Fax: (909) 334-3724

# City of Chino
# Public Works

## FIELD VERIFICATION OF BMPs

### Project Data

Address: _____ Grading Permit Number(s): _____

Project Number: _____ Building Permit Number(s): _____

WDID No.: _____

BMP Types: _____

BMP Locations: _____

(Attach Site Map) _____

### BMP Maintenance Responsibility Information

Name: _____

Address: _____

Phone: _____

***The engineer below has conducted field verification that all site design, source control, and treatment control BMPs have been designed, constructed, and are functional per the approved WQMP.***

| | |
|---|---|
| Engineer: RCE#: | PE Stamp Below |
| Title: | |
| Company: | |
| Address: | |
| Email: | |
| Telephone: | |
| Signature: | |
| Date: | |

# Section 6.4

Other Supporting Documentation

# APPENDIX A

Geotechnical Report

# GEOTECHNICAL EXPLORATION REPORT
# PROPOSED INDUSTRIAL BUILDING
# 13925 BENSON AVENUE
# CHINO, CALIFORNIA

Prepared For

**REXFORD INDUSTRIAL REALTY AND MANAGEMENT, INC.**
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Prepared By

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Project No. 13807.001

March 17, 2023

Leighton Consulting, Inc.
A Leighton Group Company

March 17, 2023

Project No. 13807.001

Rexford Industrial Realty & Management, Inc.
11620 Wilshire Boulevard, Suite 1000
Los Angeles, California 90025

Attention: Mr. Corey Guerrero

**Subject: Geotechnical Exploration Report**
**Proposed Industrial Building**
**13925 Benson Avenue**
**Chino, California**

In response to your request and authorization, Leighton Consulting, Inc. (Leighton) has prepared this geotechnical exploration report for the subject project. Based on review of the *Conceptual Site Plan* (A1-0), dated July 19, 2022, we understand the proposed development will include a new one-story industrial building constructed at-grade with a total building area of 150,000 square feet. The proposed building is planned to include dock-high truck loading on the southern side of the building with associated surface parking on the west, south, and east sides of the building. San Bernardino County Fire Department access is also planned around the entire building. Ancillary improvements will likely consist of utility infrastructure, pavement, flatwork, and landscaping.

The purpose of our geotechnical exploration was to evaluate the subsurface conditions at the site, identify potential geologic and seismic hazards that may impact the project, and provide geotechnical recommendations for design and construction of the proposed improvements as currently planned.

Based on the results of our study, the project is considered feasible from a geotechnical standpoint. This report presents the results of our exploration, conclusions and geotechnical design recommendations for the proposed development.

We appreciate the opportunity to be of service to you on this project. If you have any questions or if we can be of further service, please contact us at ***(866) LEIGHTON***; or specifically at the phone extensions or e-mail addresses listed below.

Respectfully submitted,

LEIGHTON CONSULTING, INC.




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# 1.0 INTRODUCTION

## 1.1 Site Description and Proposed Development

The project site is located at 13925 Benson Avenue in the city of Chino, San Bernardino County, California. The site location (latitude 34.0003°, longitude -117.6792°) and immediate vicinity are shown on Figure 1, *Site Location Map.*

The project site is rectangular in shape and covers approximately 6.6 acres. The site is bordered by Benson Avenue to the west, existing industrial properties to the north and east, and a Southern California Edison (SCE) substation to the south. Access to the site is via Benson Avenue from the west. The site is currently occupied by one (1) existing industrial building with several mobile trailers, storage containers, various equipment storage areas, and associated paved surface parking and access.

The project site is relatively flat with sheet flow generally directed to the south over paved surfaces to curbs and gutters. Review of the United States Geological Survey (USGS) 7.5-Minute Ontario Quadrangle (USGS, 1981) indicates the ground surface at the site is between approximately Elevation (El.) +680 to +690 feet mean sea level (msl).

Based on review of historic aerial photographs (NETR, 2023), the site was vacant, undeveloped land until at least 1966. Between approximately 1966 and 1972, the existing building located in the central portion of the site was constructed to its current configuration.

Based on *Conceptual Site Plan* (Sheet A1-0), dated July 19, 2022, and discussions with you, we understand the proposed development concept for the site consists of a new one-story industrial building constructed at-grade with a total building area of 150,000 square feet. The proposed building is planned to include dock-high truck loading on the southern side of the building with associated surface parking on the west, south, and east sides of the building. San Bernardino County Fire Department access is also planned around the entire building. Ancillary improvements will likely consist of utility infrastructure, pavement, flatwork, and landscaping. Preliminary structural loading information was not yet available at the time this report was prepared.

## 1.2 Purpose and Scope

The purpose of our geotechnical exploration was to evaluate the subsurface conditions at the site relative to the proposed development concept and provide geotechnical recommendations to aid in the design and construction for the project as currently planned. The scope of this geotechnical exploration included the following tasks:

- *Background Review* – We reviewed readily available in-house geotechnical reports, literature, aerial photographs, and maps relevant to the site. We evaluated geological hazards and potential geotechnical issues that may significantly impact the site. The documents reviewed are listed in Section 5.0.

- *Pre-Field Exploration Activities* – A site visit was performed by a member of our technical staff to mark the proposed exploration locations. Dig Alert (811) was notified to locate and mark existing underground utilities prior to our subsurface exploration.

- *Field Exploration* – Our subsurface exploration was performed on February 7, 2023 and included drilling, logging, and sampling of five (5) hollow-stem auger borings (designated LB-1 through LB-5) to approximate depths between 31½ and 51½ feet below the existing ground surface (bgs). Two (2) additional borings (designated LP-1 and LP-2) were drilled to an approximate depth of 10 feet bgs, respectively, for subsequent percolation testing. The approximate locations of the explorations are shown on Figure 2, *Exploration Location Map.* The boring logs are presented in Appendix A, *Exploration Logs.*

  During drilling of the hollow-stem auger borings, bulk and drive samples were obtained from the borings for geotechnical laboratory testing. Driven ring samples were collected from the borings using a Modified California ring-lined sampler conducted in accordance with ASTM Test Method D 3550. Standard Penetration Tests (SPTs) were also performed within the borings in accordance with ASTM Test Method D 1586. Samples were collected at 2½ and 5-foot intervals throughout the depth of exploration. In both test methods, the sampler is driven below the bottom of the borehole by a 140-pound weight (hammer) free-falling 30 inches. The drilling rig was equipped with an automatic hammer to provide greater consistency in the drop height and striking frequency. The number of blows to drive the sampler the final 12-inches of the 18-inch drive interval is termed the “blowcount” or SPT N-value. The N-values provide a measure of relative density in granular (non-cohesive) soils and comparative

consistency in cohesive soils. The number of blows per 6 inches of penetration was recorded on the boring logs, see Appendix A, *Exploration Logs*.

The borings were logged in the field by a geologist from our firm. Each soil sample collected was reviewed and described in accordance with the Unified Soil Classification System (USCS). The samples were sealed and packaged for transportation to our laboratory. After completion of drilling, the borings were backfilled with soil cuttings and patched with cold-mix asphalt concrete at the surface.

- *Percolation Testing* – Borings LP-1 and LP-2 were converted to temporary percolation test wells upon completion of drilling and sampling. The test wells consisted of 2-inch slotted (0.020") PVC well casing surrounded by #3 Monterey Sand placed in the annulus of the well within the test zone. In-situ percolation testing was performed on February 8, 2023 in general accordance with *San Bernardino County Technical Guidance Document (TGD) for Water Quality Management Plans* (2013). The results of the percolation testing are presented in Appendix B, *Percolation Test Data*. Refer to the discussion of infiltration rate presented in Section 2.4.1, *Infiltration*. Upon completion of the percolation testing, the well casing was removed from each boring and the borings were backfilled with soil cuttings and patched at the surface with cold-mix asphalt concrete to match existing site conditions.

- *Laboratory Testing* – Laboratory tests were performed on selected soil samples obtained from the borings during our field investigation. The laboratory testing program was designed to evaluate the physical and engineering characteristics of the onsite soil. Tests performed during this investigation include:

  - In- situ Moisture Content and Dry Density (ASTM D2216 and ASTM D2937);
  - Maximum Dry Density (ASTM D 1557);
  - Expansion Index (ASTM D 4829);
  - Atterberg Limits (ASTM D 4318);
  - Direct Shear (ASTM D 3080);
  - Consolidation (ASTM D 2435);
  - R-value; and
  - Corrosivity Suite – pH, Sulfate, Chloride, and Resistivity (California Test Methods 417, 422, and 532/643).

Results of the in-situ moisture content and dry density testing are presented on the boring logs in Appendix A. Other laboratory test results are presented in Appendix C, *Laboratory Test Results*

- *Engineering Analysis* – The data obtained from our background review and field exploration were evaluated and analyzed to develop recommendations for the proposed development.

- *Report Preparation* – This report presents our findings, conclusions, and recommendations for the proposed development.

# 2.0 GEOTECHNICAL FINDINGS

## 2.1 Regional Geologic Setting

The project site is located in the southwestern portion of the Chino Basin in the northern portion of the Peninsular Ranges geomorphic province of California. Major structural features surround this region, including the Cucamonga fault and the San Gabriel Mountains to the north, the Chino fault and Puente/Chino Hills to the west, and the San Jacinto fault to the east. This is an area of large-scale crustal disturbance as the relatively northwestward moving Peninsular Ranges province collides with the Transverse Ranges province (San Gabriel Mountains) to the north. Several active and potentially active faults have been mapped in the region and are believed to accommodate compression associated with this collision. The Sierra Madre fault, a major structural feature along the southern flank of the San Gabriel Mountains, is located approximately 9.5 miles northwest of the site. This fault, as well as other faults in the region, has the potential for generating strong ground motions at the project site. Further discussion of faulting relative to the site is provided in Section 3.1, Faulting and Seismicity, of this report.

The site is located in an area underlain by thick accumulations of alluvial sand, silt, gravel, cobbles, and boulders eroded from the mountains and deposited in the site vicinity by the Santa Ana River and smaller tributaries such as the San Antonio Creek and Cucamonga Creek (Morton and Miller, 2006; Dibblee, 2002).

## 2.2 Surficial Geology

The Quaternary-age deposits that cover the floor and margins of the Chino Basin at the surface are mapped to be composed primarily of recent (middle Holocene) young alluvial fan deposits. These young sediments consist predominately of slightly to moderately consolidated silt, sand and coarse-grained sand to boulder alluvial deposits derived from the surrounding mountains and hills with finer clays and silts deposited into the basin over the broad floodplain. The surficial geologic units mapped in the vicinity of the project site are shown on Figure 3, *Regional Geology Map*.

## 2.3 Subsurface Soil Conditions

Based on our subsurface explorations, the site is underlain by a layer of undocumented artificial fill materials (Afu) overlying Quaternary-aged (middle Holocene) young alluvial fan deposits (Qyf). A layer of undocumented artificial fill

(Afu) on the order of approximately 2 to 3 feet in thickness was encountered at the explored locations overlying natural alluvial soils. The fill materials encountered generally consist of dark brown silty sand and are likely associated with the existing and previous site improvements. Localized thicker accumulations of the fill materials should be anticipated between explored locations during future earthwork construction, particularly below the existing structures. Since there is no documentation for the placement, compaction and testing of the existing fill onsite, the artificial fill is considered undocumented and unsuitable for structural support in its current condition.

Below the artificial fill materials, Quaternary-aged young alluvial fan deposits (Qyf) were encountered in the borings to the maximum depth explored (51½ feet bgs). The alluvial materials encountered generally consist of light gray to grayish brown, moist, soft to hard clay, silt, and silty clay to light gray to yellowish brown, moist, medium dense to very dense silty sand and sand with variable amounts of gravel.

Detailed descriptions of the subsurface soils encountered in the borings are presented on the logs included in Appendix A. Some of the engineering properties of these soils are described in the following sections. The locations of the borings are shown on Figure 2.

### 2.3.1 Expansive Soil Characteristics

Expansive soils contain significant amounts of clay particles that swell considerably when wetted and which shrink when dried. Foundations constructed on these soils are subject to uplifting forces caused by the swelling. Without proper mitigation measures, heaving and cracking of both building foundations and slabs-on-grade could result.

One (1) near-surface bulk soil sample obtained during our subsurface exploration was tested for expansion potential. The test results indicate an Expansion Index (EI) value of 6 (“very low” potential for expansion). The Expansion Index laboratory test results are included in Appendix C of this report.

Variance in expansion potential of onsite soil is anticipated; therefore, additional testing is recommended upon completion of site grading and excavation to confirm the expansion potential presented in this report. For purposes of this report and based upon visual characterization of alluvial

materials at approximate foundation depth, very low expansion potential of site materials may be considered to support design and verified upon completion of earthwork grading.

### 2.3.2 Soil Corrosivity

One (1) near-surface bulk soil sample obtained during our subsurface exploration was tested for corrosivity to assess corrosion potential to buried concrete. The chemical analysis test results for the onsite soil from our geotechnical exploration are included in Appendix C of this report.

The test results indicate a soluble sulfate concentration of 156 parts per million (ppm), chloride content of 40 ppm, pH value of 7.80, and minimum resistivity value of 5,600 ohm-cm.

The results of the resistivity tests indicate the underlying soil is mildly corrosive to buried ferrous metals per ASTM STP 1013. Based on the measured water-soluble sulfate contents from the soil samples, concrete in contact with the soil is expected to have moderate exposure to sulfate attack (S1) per ACI 318 (ACI, 2014). The samples tested for water-soluble chloride content indicate a low potential for corrosion of steel in concrete due to the chloride content of the soil. Concrete below grade is assigned a chloride exposure class C1 due to its likely exposure to moisture.

### 2.3.3 Soil Compressibility

Three (3) samples of the onsite soils recovered from the borings were subjected to consolidation testing to evaluate the compressibility of these materials under assumed loads representative of anticipated structural bearing stresses. The results of testing indicate these soils exhibit a low to moderate compressibility potential. The results of testing are presented in Appendix C.

### 2.3.4 Shear Strength

Evaluation of the shear strength characteristics of the soils included laboratory direct shear testing on three (3) samples of the onsite soils recovered from the borings. The results of testing are included in Appendix

C as well as summary graphs that provide values of angle of internal friction (ø) and cohesion (c) for use in geotechnical analysis.

### 2.3.5 Excavation Characteristics

Based on our subsurface explorations performed at the site and our experience from grading jobs in the vicinity of the site, we anticipate the onsite artificial fill and alluvial materials can generally be excavated using conventional excavation equipment in good operating condition.

The soils within the planned excavation depths are variable, and locally consist of layers that contain granular, unconsolidated soils with little or no cementation and few fines. These materials are prone to cave in or collapse in unshored excavations. See Section 3.7, *Temporary Excavations* for additional information on soil type and excavation characteristics.

## 2.4 Groundwater Conditions

Groundwater was not encountered during our subsurface exploration performed at the site to the maximum depth of 51½ feet bgs. Based on review of information available from the Chino Basin Watermaster (2016), groundwater depth at the site is anticipated to be greater than 100 feet bgs. In addition, based on review of available information from the California Department of Water Resources (DWR, 2023) for a nearby groundwater monitoring well located approximately 2.1 miles east of the project site (Local Well Name CHINO-1208672), the shallowest groundwater level measured for a monitoring period between September 2011 and April 2022 was approximately 135 feet bgs in April 2020.

Based on these findings, groundwater is not expected to pose a constraint during or after construction. Fluctuations of the groundwater level, localized zones of perched water, and an increase in soil moisture, should be anticipated during and following the rainy seasons or periods of locally intense rainfall or storm water runoff, or from stormwater infiltration.

### 2.4.1 Infiltration

Percolation testing was performed in temporary wells installed within borings LP-1 and LP-2 located in the southwestern and southeastern portions of the site to evaluate the infiltration characteristics of subsurface soils. The percolation tests were conducted in general accordance with the *San*

*Bernardino County Technical Guidance Document (TGD) for Water Quality Management Plans* (2013). Results of the percolation testing are presented in Appendix B. The test locations and zones tested are shown on Figure 2.

A boring percolation test is useful for field measurements of the infiltration rate of soils, and is suited for testing when the design depth of the infiltration device is deeper than current existing grades, especially in areas where it is difficult to dig test pits, or where the depths of these test pits would be considerably deep. At the subject site, testing consisted of advancing the borings to general depths anticipated for the invert of typical infiltration devices.

The falling-head test method was employed for test wells LP-1 and LP-2 in which the volume of discharge was calculated by adding the total volume of water that dropped within the PVC pipe and within the annulus, and incorporating a porosity reduction factor to account for the porosity of the annulus material. The flow area was based on the average water height within the slotted pipe section of the test well. The infiltration rate was calculated by dividing the rate of discharge by the infiltration surface area, or flow area.

Detailed results of the field testing and measured infiltration rate for the tests performed are presented in Appendix B. The test results are summarized in the table below:

**Table 1 – Measured (Unfactored) Infiltration Rate**

| Test Well Designation | Approximate Depth of Test Zone (feet bgs) | Measured Infiltration Rate (inches per hour) |
|---|---|---|
| LP-1 | 5 to 10 | 0.09 |
| LP-2 | 5 to 10 | 0.05 |

Based on the results of our field percolation testing that was performed at the site, the measured (unfactored) infiltration rates for the two (2) tests performed were 0.09 inch per hour (LP-1) and 0.05 inch per hour (LP-2), respectively. According to the *San Bernardino County Technical Guidance Document (TGD) for Water Quality Management Plans* (2013), the measured infiltration rate at both test well locations do **not** meet the

minimum feasibility criteria of 0.3 inch per hour. Therefore, due to the unfavorable infiltration characteristics of the subsurface at the tested locations and depths, stormwater infiltration is not feasible at the subject site.

## 2.5 Surface Fault Rupture

Our review of available literature indicates that no known active faults have been mapped across the site, and the site is **not** located within a currently established *Alquist-Priolo Earthquake Fault Zone* (CGS, 2018; Bryant and Hart, 2007). Therefore, a surface fault rupture hazard evaluation is not mandated for this site and the potential for surface fault rupture at the site is expected to be low.

The location of the closest active faults to the site was evaluated using the United States Geological Survey (USGS) Earthquake Hazards Program National Seismic Hazard Maps (USGS, 2008b). The closest active faults to the site with the potential for surface fault rupture are the Chino fault, San Jose fault and Elsinore Fault Zone located approximately 2.4 miles, 6.5 miles and 8.7 miles from the site, respectively. The San Andreas fault, which is the largest active fault in California, is approximately 22 miles northeast of the site. Major regional faults with surface expression in proximity to the site are shown on Figure 4, *Regional Fault and Historic Seismicity Map*.

## 2.6 Strong Ground Shaking

The principal seismic hazard to the site is ground shaking resulting from an earthquake occurring along any of several major active and potentially active faults in southern California (Figure 4). The intensity of ground shaking at a given location depends primarily upon the earthquake magnitude, the distance from the source, and the site response characteristics.

Accordingly, design of the project should be performed in accordance with all applicable current codes and standards utilizing the appropriate seismic design parameters to reduce seismic risk as defined by California Geological Survey (CGS) Chapter 2 of Special Publication 117A (CGS, 2008). The 2022 edition of the California Building Code (CBC) is the current edition of the code. Through compliance with these regulatory requirements and the utilization of appropriate seismic design parameters selected by the design professionals, potential effects relating to seismic shaking can be reduced.

The following code-based seismic parameters should be considered for design under the 2022 CBC:

**Table 2 – 2022 CBC Based Ground Motion Parameters (Mapped Values)**

| Categorization/Coefficient | Value |
|---|---|
| Site Latitude | 34.0003° |
| Site Longitude | -117.6792° |
| Site Class | D |
| Mapped Spectral Response Acceleration at Short Period (0.2 sec), $S_S$ | 1.682 g |
| Mapped Spectral Response Acceleration at Long Period (1 sec), $S_1$ | 0.6 g |
| Short Period (0.2 sec) Site Coefficient, $F_a$ | 1.0 |
| Long Period (1 sec) Site Coefficient, $F_v$ | 1.7[1] |
| Adjusted Spectral Response Acceleration at Short Period (0.2 sec), $S_{MS}$ | 1.682 g |
| Adjusted Spectral Response Acceleration at Long Period (1 sec), $S_{M1}$ | 1.02 g[1] |
| Design Spectral Response Acceleration at Short Period (0.2 sec), $S_{DS}$ | 1.122 g |
| Design Spectral Response Acceleration at Long Period (1 sec), $S_{D1}$ | 0.68 g[1] |
| Site-adjusted geometric mean Peak Ground Acceleration, $PGA_M$ | 0.757 g |

[1]See Section 11.4.8 of ASCE 7-16. A site-specific ground motion hazard analysis in accordance with Section 21.2 of ASCE 7-16 is required for this site. Per Supplement 3 to ASCE 7-16, a site-specific ground motion hazard analysis is not required where the value of the parameters SM1 and SD1 in the table are increased by 50%.

## 2.7 Liquefaction Potential

The term liquefaction is generally referenced to loss of strength and stiffness in soils due to build-up of pore water pressure when subject to cyclic or monotonic loading. Both sandy and clayey soils are susceptible to loss of strength and stiffness. Because of the difference in strength characteristic and methods for evaluating strength loss potential for granular and clayey soils, the term liquefaction is used for granular soils while cyclic softening is used for fine-grained soils (i.e. clays and plastic silts).

In general, adverse effects of liquefaction or cyclic softening include excessive ground settlement, loss of bearing support for structural foundations, and seismically-induced lateral ground deformations such as lateral spreading. Depending upon the relative thickness of the liquefied strata with respect to overlying non-liquefiable soils, other potentially adverse effects such as ground oscillation and ground fissuring may occur.

The project site is in an area that has not been evaluated by the CGS for liquefaction hazard or earthquake-induced landslide hazard. However, based on review of the *San Bernardino County Land Use Plan – Geologic Hazard Overlays* map (San Bernardino County, 2010), the project site is **not** located within a liquefaction susceptibility zone. In addition, groundwater was not encountered during our subsurface investigation to the maximum depth explored of approximately 51½ feet bgs and current depth to groundwater is anticipated to be greater than 100 feet bgs. Based on these findings, liquefaction is not considered a hazard at the site.

## 2.8 Seismically-Induced Settlement

Seismically-induced settlement consists of dynamic settlement of unsaturated soil (above groundwater) and liquefaction-induced settlement (below groundwater). These settlements occur primarily within low density sandy soil due to reduction in volume during and shortly after an earthquake event.

Based on our evaluation of the onsite natural soils below the anticipated bearing grade of the proposed structure, the potential total seismically-induced settlement is estimated to be less than ½ inch. The differential/settlement can be taken as half the total settlement over a horizontal distance of 30 feet.

## 2.9 Lateral Spreading

Liquefaction may also cause lateral spreading. For lateral spreading to occur, the liquefiable zone must be continuous, unconstrained laterally, and free to move along gently sloping ground toward an unconfined area. Since liquefaction is not considered a hazard at the site and the site is constrained laterally, earthquake-induced lateral spreading is also not considered a hazard at the site.

## 2.10 Earthquake-Induced Landsliding

The project site is located in an area that has not been evaluated by the CGS for earthquake-induced landslide hazard. However, based on review of the *San Bernardino County Land Use Plan – Geologic Hazard Overlays* map (San Bernardino County, 2010), the project site is **not** located within a landslide susceptibility zone. Based on this consideration, the potential for seismically-induced landslide hazard at the site is not considered a hazard at the site.

## 2.11 Flooding

According to a Federal Emergency Management Agency (FEMA) flood insurance rate map (FEMA, 2008), the project site is located within an area identified as having a 0.2 percent annual chance flood hazard. Accordingly, the project site **is** located within a 500-year flood hazard zone as shown on Figure 5, *Flood Hazard Zone Map*. Regionally, storm runoff flow is generally directed to the south.

Earthquake-induced flooding can be caused by failure of dams or other water-retaining structures as a result of earthquakes. As shown on Figure 6, the site is **not** mapped within a dam inundation zone. Therefore, the risk of seismically-induced flooding due to dam failure is considered low.

## 2.12 Seiches and Tsunamis

Seiches are large waves generated in enclosed bodies of water in response to ground shaking. Tsunamis are waves generated in large bodies of water by fault displacement or major ground movement. Based on the absence of an enclosed water body near the site and the inland location of the site, seiche and tsunami risks at the site are considered nil.

## 2.13 Methane

Based on review of State of California Geologic Energy Management Division (CalGEM) records, the project site is **not** located within an oil field boundary and there are no documented oil wells onsite (CalGEM, 2023). The nearest documented oil well to the site is located approximately 0.5 miles northwest of the site (API# 0407100142; Lease by C.S. Summar, Well No. 1) and is reported as idle (CalGEM, 2023). Based on these findings, the potential for methane hazard at the site is low.

# 3.0 GEOTECHNICAL DESIGN RECOMMENDATIONS

Based on this study, we conclude that the proposed development for the subject site is feasible from a geotechnical standpoint, provided that the recommendations presented in this report are properly incorporated in design and construction.

The proposed structure may be supported on shallow spread-type foundations established in engineered fill or undisturbed natural soils. The floor slab may be supported directly on grade. There may be existing underground utilities that will also be impacted. Information on these utilities should be provided to Leighton for evaluation.

All existing undocumented fill is recommended to be removed from the proposed building pad and other structural improvement areas prior to placement of engineered fill. We estimate removal and recompaction of existing undocumented fill materials will generally be on the order of approximately 2 to 3 feet below existing grades across the site. Localized areas anticipated to require deeper removals, in particular beneath existing building. The lateral extent of overexcavation beyond foundations should be equal to the depth of overexcavation below the proposed foundations.

The recommendations below are based upon the exhibited geotechnical engineering properties of the soils and their anticipated response both during and after construction. Additional exploration and/or evaluation may be required in the future once more detailed development plans become available. The recommendations are also based upon proper field observation and testing during construction. The project geotechnical engineer should be notified of suspected variances in field conditions to determine the effect upon the recommendations subsequently presented. These recommendations are considered minimal and may be superseded by more restrictive requirements of the civil and structural engineers, the City of Chino, the County of San Bernardino and other governing agencies.

Leighton should review the grading plans, foundation plans and project specifications as they become available to verify that the recommendations presented in this report have been incorporated into the plans for this project.

## 3.1 Site Grading

Earthwork for the project is expected to consist of surcharging and removal of unsuitable soil materials, excavation, and placement of compacted fill. We recommend that earthwork on the site be performed in accordance with the

recommendations presented in this report and the project specifications as prepared by others. The *Earthwork and Grading Guide Specifications* included in Appendix D may be used for guidance in developing the project specifications. If conflict arises, the recommendations in Appendix D shall be superseded by the project specifications, recommendations contained in this report and/or the County of San Bernardino Guidelines, whichever is more stringent. All site grading should be performed in accordance with the applicable local codes and in accordance with the project specifications that are prepared by the appropriate design professional.

### 3.1.1 Site Preparation

Prior to construction, the site should be cleared of any vegetation, trash, and/or debris within the area of proposed grading. These materials should be removed from the site. Any underground obstructions onsite should be removed. Efforts should be made to locate any existing utility lines to be removed or rerouted where interfering with the proposed construction. Any resulting cavities should be properly backfilled and compacted. After the site is cleared, the soils should be carefully observed for the removal of all unsuitable deposits. All undocumented fill or man-made debris, unsuitable native soils and former foundation remnants should be excavated and removed from the proposed building/structure footprint prior to placement of engineered fill.

### 3.1.2 Removals and Overexcavations

To provide uniform foundation support and reduce the potential for excessive static settlement, all existing undocumented fill and any unsuitable soil, as deemed by the geotechnical engineer, should be removed to expose suitable native soils and replaced as engineered fill below the proposed building and other structural improvements. Based on our field explorations, we estimate removals of existing undocumented fill will be approximately 2 to 3 feet below existing grades across the site. Localized areas may require deeper removals as determined during grading by a representative of the geotechnical engineer depending on observed subsurface conditions. Unexplored portions of the site, including areas beneath existing building, in areas of existing utilities, and areas disturbed during demolition of existing buildings and improvements may also require deeper removals. The lateral extent of removals and overexcavation

beyond foundations should be equal to the depth of overexcavation below the proposed foundations.

The depth of overexcavation in non-structural areas planned for new pavement construction is recommended to be 2 feet below the current grade or planned subgrade elevation to develop a suitable bearing subgrade for pavement support. Deeper overexcavations in localized areas may be recommended during grading by a representative of the geotechnical engineer depending on observed subsurface conditions. Preparation limited to 2 feet of overexcavation below subgrade may result in the need for increased pavement maintenance and periodic repairs where existing undocumented fill is left in place below the recommended overexcavation depth of 2 feet. Alternatively, removals can be performed such that all undocumented fill is removed to expose suitable natural soils (alluvium) and replaced as engineered fill.

### 3.1.3 Excavation Bottom Preparation

All excavation bottoms or removal bottoms should be observed by a representative of the geotechnical engineer prior to placement of fill or other improvements to determine that geotechnically suitable soil is exposed. Excavation bottoms observed to be suitable for fill placement or other improvements should be scarified to a depth of at least 8 inches, moisture-conditioned as necessary to achieve a moisture content within 2 percentage points of optimum moisture content, and then compacted to a minimum of 90 percent of the laboratory derived maximum density as determined by ASTM Test Method D 1557 (Modified Proctor).

### 3.1.4 Fill Materials

Onsite soil that is free of construction debris, organics, cobbles, boulders, rubble, or rock larger than 6 inches in largest dimension is suitable to be used as fill for support of structures. Oversized materials larger than 6 inches in diameter encountered during site grading may require special handling, and may be placed in non-structural areas or areas of deep fill at depth below anticipated excavations such as for any footings, utilities, future developments, etc. Any imported fill soil should be approved by the geotechnical engineer prior to import or use onsite.

### 3.1.5 Fill Placement and Compaction

Fill soils should be placed in thin, loose lifts, moisture-conditioned to within 2 percent of optimum moisture content and compacted using appropriate equipment and methods to achieve to a minimum of 90 percent of the maximum dry density as determined by ASTM Test Method D 1557. Aggregate base should be compacted to a minimum of 95 percent relative compaction.

### 3.1.6 Shrinkage

The change in volume of excavated and recompacted soil varies according to soil type and location. This volume change is represented as a percentage increase (bulking) or decrease (shrinkage) in volume of fill after removal and recompaction. Field and laboratory data used in our calculations included laboratory-measured maximum dry density for the general soil type encountered at the subject site, the measured in-place densities of near surface soils encountered and our experience.

Based upon the results of the in-place density and the moisture-density relationship exhibited by representative bulk samples of the near surface soils, recompaction of the soils is anticipated to result in volume shrinkage in the range of 10 to 15 percent. The estimated shrinkage does not include material losses due to removal of organic material or other unsuitable bearing materials (debris, rubble, oversize material greater than 6-inches) and the actual shrinkage that occurs during grading may vary throughout the site.

### 3.1.7 Reuse of Concrete and Asphalt Rubble

If encountered during site clearing and/or during preparation activities, construction rubble (i.e., Portland cement concrete and asphalt concrete) may be incorporated in the proposed development. For use as structural fill, the processed material should be crushed to develop a relatively well-graded mixture with a maximum particle size of 3-inch nominal diameter. Concrete rubble should be free of rebar and processed asphalt pavement rubble may be used if mixed with the existing base course (where present). Processed material may be used as structural fill if uniformly mixed with onsite soils in proportion of 1 part processed material to 3 parts soil. For use as pavement base course, crushed material should satisfy

gradation requirements of Section 200-2.4 of the *Standard Specifications for Public Works Construction* (Greenbook), 2021 Edition. Such materials must be free of and segregated from any hazardous materials and/or organic material of any kind.

## 3.2 Foundation Design

Conventional spread footings established in engineered fill or undisturbed natural soils may be used to support the proposed building. Footings should be embedded a minimum 12 inches below the lowest adjacent grade. An average allowable soil bearing pressure of 3,000 pounds per square foot (psf) may be used for footings with a minimum width of 12 inches for continuous footings and 18 inches for isolated footings.

A one-third increase in the bearing value for short duration loading, such as wind or seismic forces may be used. The ultimate bearing capacity can be taken as 9,000 psf, which does not incorporate a factor of safety. A resistance factor of 0.5 should be used for initial bearing capacity evaluation with factored loads.

The recommended bearing values are net values, and the weight of concrete in the mat foundation can be taken as 50 pounds per cubic foot (pcf); the weight of soil backfill can be neglected when determining the downward loads.

The allowable bearing capacity for shallow footings is based on a total static settlement of ½ inch. Differential settlement can be taken as half the total settlement over a horizontal distance of 30 feet.

For static loading, 50 pounds per cubic inch (pci) may be assumed as the modulus of subgrade reaction (*k*). For seismic loading, a *k* value of 150 pci may be assumed.

Since settlement is a function of footing size and contact bearing pressure, differential settlement can be expected between adjacent columns or walls where a large differential loading condition exists. Once developed by the structural engineer, we should review total dead and sustained live loads for each column including plan location and span distance, to evaluate if differential settlements between dissimilarly loaded columns will be tolerable. Excessive differential settlement can be mitigated with the use of reduced bearing pressures, deeper

footing embedment, possibly changing overexcavation schemes and using imported base material under spread footings, or possibly other methods.

Resistance to lateral loads will be provided by a combination of friction between the soil and structure interface and passive pressure acting against the vertical portion of the footings structures. For calculating lateral resistance, a passive pressure of 250 psf per foot of depth to a maximum of 2,500 psf and a frictional coefficient of 0.30 may be used. Note that the passive and frictional coefficients do not include a factor of safety. The frictional resistance and the passive resistance of the soils can be combined without reduction in determining the total lateral resistance.

## 3.3 Slabs-on-Grade

Concrete slabs may be designed using a modulus of subgrade reaction of 100 pci provided the subgrade is prepared as described in Section 3.1. From a geotechnical standpoint, we recommend slab-on-grade be a minimum 5 inches thick with No. 3 rebar placed at the center of the slab at 24 inches on center in each direction. The structural engineer should design the actual thickness and reinforcement based on anticipated loading conditions. Where moisture-sensitive floor coverings or equipment is planned, the slabs should be protected by a minimum 10-mil-thick vapor barrier between the slab and subgrade. A coefficient of friction of 0.35 can be used between the floor slab and the vapor barrier.

Minor cracking of concrete after curing due to drying and shrinkage is normal and should be expected; however, concrete is often aggravated by a high water/cement ratio, high concrete temperature at the time of placement, small nominal aggregate size, and rapid moisture loss due to hot, dry, and/or windy weather conditions during placement and curing. Cracking due to temperature and moisture fluctuations can also be expected. The use of low-slump concrete or low water/cement ratios can reduce the potential for shrinkage cracking. Additionally, our experience indicates that the use of reinforcement in slabs and foundations can generally reduce the potential but not eliminate for concrete cracking.

To reduce the potential for excessive cracking, concrete slabs-on-grade should be provided with construction or weakened plane joints at frequent intervals. Joints should be laid out to form approximately square panels.

## 3.4 Cement Type and Corrosion Protection

Based on the results of laboratory testing, concrete structures in contact with the onsite soil are expected to have moderate exposure to water-soluble sulfates in the soil (Exposure Class S1). Common Type II cement may be used for concrete construction onsite and the concrete should be designed in accordance with CBC 2022 requirements. However, concrete exposed to recycled water should be designed using Type V cement.

Based on our laboratory testing, the onsite soil is considered mildly corrosive to ferrous metals. Ferrous pipe should be avoided by using high-density polyethylene (HDPE) or other non-ferrous pipe when possible. Ferrous pipe, if used, should be protected by polyethylene bags, tap or coatings, di-electric fittings or other means to separate the pipe from onsite soils.

## 3.5 Retaining Walls

Recommended lateral earth pressures are provided as equivalent fluid unit weights, in psf/ft. or pcf. These values do not contain an appreciable factor of safety, so the structural engineer should apply the applicable factors of safety and/or load factors during design.

Onsite soils are likely suitable to be used as retaining wall backfill due to its very low expansion potential, field and laboratory verification are recommended before use. However, site soils can be variable in composition, clast size and expansive characteristics. Should site soil be considered for reuse behind retaining walls, it should be tested to ensure Expansion potential is less than 20 (EI<20). Recommended lateral earth pressures for retaining walls backfilled with sandy soils with drained conditions as shown on Figure 7, *Retaining Wall Backfill and Subdrain Detail* are as follows:

**Table 3 – Retaining Wall Design Earth Pressures**

| Retaining Wall Condition (Level Backfill) | Equivalent Fluid Pressure (pounds-per-cubic-foot)* |
|---|---|
| Active (cantilever) | 35 |
| At-Rest (braced) | 60 |
| Passive Resistance (compacted fill) | 250 |
| Seismic Increment (add to active pressure) | 25 |

*Only for level and drained properly compacted backfill

Walls that are free to rotate or deflect may be designed using active earth pressure. For basement walls or walls that are fixed against rotation, the at-rest pressure should be used. For seismic condition, the pressure should be distributed as an inverted triangular distribution and the dynamic thrust should be applied at a height of 0.6H above the base of the wall.

### 3.5.1 Sliding and Overturning

Total depth of retained earth for design of walls and for uplift resistance, should be measured as the vertical height of the stem below the ground surface at the wall face for stem design, or measured at the heel of the footing for overturning and sliding. A soil unit weight of 120 pcf may be assumed for calculating the actual weight of the soil over the wall footing, if drained, or 60 pcf if submerged, for properly compacted backfill.

### 3.5.2 Drainage

Adequate drainage may be provided by a subdrain system positioned behind the walls. Typically, this system consists of a 4-inch minimum diameter perforated pipe placed near the base of the wall (perforations placed downward). The pipe should be bedded and backfilled with pervious backfill material described in Section 300-3.6 of the *Standard Specifications for Public Works Construction* (Greenbook), 2021 Edition. This pervious backfill should extend at least 2 feet out from the wall and to within 2 feet of the outside finished grade. This pervious backfill and pipe should be wrapped in filter fabric, such as Mirafi 140N or equivalent, placed as described in Section 300-8.1 of the *Standard Specifications for Public Works Construction* (Greenbook), 2021 Edition. The subdrain outlet should be connected to a free-draining outlet or sump.

Miradrain, Geotech Drainage Panels, or Enkadrain drainage geocomposites, or similar, may be used for wall drainage as an alternative to the Class 2 Permeable Material or drain rock backfill, particularly where horizontal space is limited adjacent to shoring (where walls are cast against shoring). These drainage panels should be connected to the perforated drainpipe at the base of the wall.

## 3.6 Paving

To provide support for paving, the subgrade soils should be prepared as recommended in the Section 3.1. Compaction of the subgrade, including trench backfills, to at least 90 percent of the maximum dry density as determined by ASTM Test Method D 1557, and achieving a firm, hard, and unyielding surface will be important for paving support. The preparation of the paving area subgrade should be performed immediately prior to placement of the base course. Proper drainage of the paved areas should be provided since this will reduce moisture infiltration into the subgrade and increase the life of the paving.

### 3.6.1 Asphalt Concrete

The required paving and base thicknesses will depend on the expected wheel loads and volume of traffic (Traffic Index or TI). Assuming that the paving subgrade will consist of engineered fill with an R-value greater than 40, compacted to at least 90 percent of the maximum dry density as determined by ASTM Test Method D 1557 as recommended, the minimum recommended paving thicknesses are presented in the following table. Results of R-value testing on a near surface samples of existing onsite soils indicate a value of 46.

**Table 4 – Asphalt Concrete Pavement Sections**

| Traffic Index | Asphalt Concrete (inches) | Base Course (inches) |
|---|---|---|
| 5 | 3 | 4 |
| 6 | 4 | 4½ |
| 7 | 4 | 7 |
| 8 | 4 | 9½ |
| 9 | 6 | 8½ |

The asphalt paving sections were determined using the Caltrans design method. We can determine the recommended paving and base course thicknesses for other Traffic Indices if required. Careful inspection is recommended to verify that the recommended thicknesses or greater are achieved, and that proper construction procedures are followed.

### 3.6.2 Portland Cement Concrete Paving

We have assumed that onsite soils will have an R-value of at least 45, which will need to be verified after the completion of site grading.

Portland cement concrete (PCC) paving sections were determined in accordance with procedures developed by the Portland Cement Association. Concrete paving sections for a range of Traffic Indices are presented in the following table. We have assumed that the Portland cement concrete will have a compressive strength of at least 4,000 pounds per square inch.

**Table 5 – PCC Pavement Sections**

| Traffic Index | PCC (inches) | Base Course (inches) |
|---|---|---|
| 5 | 5½ | 4 |
| 6 | 6½ | 4 |
| 7 | 7 | 4 |
| 8 | 7½ | 4 |
| 9 | 8 | 4 |

The paving should be provided with control joints or expansion joints at regular intervals no more than 15 feet in each direction. Load transfer devices, such as dowels or keys, are recommended at joints in the paving to reduce possible offsets. The paving sections in the above table have been developed based on the strength of unreinforced concrete. Steel reinforcing may be added to the paving to reduce cracking and to prolong the life of the paving.

### 3.6.3 Base Course

The base course for both asphalt concrete and Portland cement concrete paving should meet the specifications for Class 2 Aggregate Base as defined in Section 26 of the latest edition of the State of California, Department of Transportation, Standard Specifications. Alternatively, the base course could meet the specifications for untreated base as defined in Section 200-2 of the latest edition of the *Standard Specifications for Public Works Construction* (Greenbook), 2021 Edition. The base course should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM Test Method D 1557.

## 3.7 Temporary Excavations

All temporary excavations, including utility trenches, retaining wall excavations, and foundation excavations should be performed in accordance with project plans, specifications, and all OSHA requirements. Excavations 4 feet or deeper should be laid back or shored in accordance with OSHA requirements before personnel are allowed to enter.

No surcharge loads should be permitted within a horizontal distance equal to the height of cut or 5 feet, whichever is greater from the top of the cut, unless the cut is shored appropriately. Excavations that extend below an imaginary plane inclined at 45 degrees below the edge of any adjacent existing site foundation should be properly shored to maintain support of the adjacent structure.

Temporary excavations should be treated in accordance with the State of California version of OSHA excavation regulations, Construction Safety Orders for Excavation General Requirements, Article 6, Section 1541, effective October 1, 1995. The sides of excavations should be shored or sloped in accordance with OSHA regulations. OSHA allows the sides of unbraced excavations, up to a maximum height of 20 feet, to be cut to a ¾H:1V (horizontal:vertical) slope for Type A soils, 1H:1V for Type B soils, and 1½H:1V for Type C soils. Near-surface onsite soils are to be considered Type B soils.

During construction, the soil conditions should be regularly evaluated to verify that conditions are as anticipated. The contractor shall be responsible for providing the "competent person" required by OSHA standards to evaluate soil conditions. Close coordination between the competent person and the geotechnical engineer should be maintained to facilitate construction while providing safe excavations.

## 3.8 Trench Backfill

Utility trenches should be backfilled with compacted fill in accordance with Sections 306-1 and 306-6 of the *Standard Specifications for Public Works Construction* (Greenbook), 2021 Edition. Utility trenches can be backfilled with onsite sandy material free of rubble, debris, organic and oversized material up to (≤) 3-inches in largest dimension. Prior to backfilling trenches, pipes should be bedded in and covered with either:

(1) **Sand:** A uniform, sand material that has a Sand Equivalent (SE) greater-than-or-equal-to (≥) 30, passing the No. 4 U.S. Standard Sieve (or as specified by the pipe manufacturer), water densified in place, or

(2) **CLSM:** Controlled Low Strength Material (CLSM) conforming to Section 201-6 of the *Standard Specifications for Public Works Construction,* (Greenbook), 2021 Edition. CLSM should not be jetted.

Pipe bedding should extend at least 4 inches below the pipeline invert and at least 12 inches over the top of the pipeline. Native and clean fill soils can be used as backfill over the pipe bedding zone, and should be placed in thin lifts, moisture conditioned above optimum, and mechanically compacted to at least 90 percent relative compaction, relative to the ASTM D 1557 laboratory maximum density.

## 3.9 Drainage and Landscaping

Building walls below grade should be waterproofed or at least damp proofed, depending upon the degree of moisture protection desired. Surface drainage should be designed to direct water away from foundations and toward approved drainage devices. Irrigation of landscaping should be controlled to maintain, as much as possible, consistent moisture content sufficient to provide healthy plant growth without overwatering.

## 3.10 Additional Geotechnical Services

Leighton should review the grading plans, foundation plans, and specifications when they are available to verify that the recommendations presented in this report have been properly interpreted and incorporated.

Geotechnical observation and testing should be provided during the following activities:

- Grading and excavation of the site;
- Subgrade Preparation;
- Compaction of all fill materials;
- Utility trench backfilling and compaction;
- Footing excavation and slab-on-grade preparation;
- Pavement subgrade and base preparation;
- Placement of asphalt concrete and/or concrete; and
- When any unusual conditions are encountered.

## 4.0 LIMITATIONS

This geotechnical exploration does not address the potential for encountering hazardous soil at this site. In addition, this report was necessarily based in part upon data obtained from a limited number of observances, site visits, soil samples, tests, analyses, histories of occurrences, spaced subsurface explorations and limited information on historical events and observations. Such information is, by necessity, incomplete. Please also refer ASFE's *Important Information About Your Geotechnical Report* (included at the rear of the text), presenting additional information and limitations regarding geotechnical engineering studies and reports. The nature of many sites is such that differing soil or geologic conditions can be present within small distances and under varying climatic conditions. Changes in subsurface conditions can and do occur over time. Therefore, the findings, conclusions, and recommendations presented in this report are only valid if Leighton Consulting, Inc. has the opportunity to observe subsurface conditions during grading and construction, to confirm that our data are representative for the site. Leighton Consulting, Inc. should also review the construction plans and project specifications, when available, to comment on the geotechnical aspects.

This report was prepared using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical consultants practicing at this time in San Bernardino County. We do not make any warranty, either expressed or implied.

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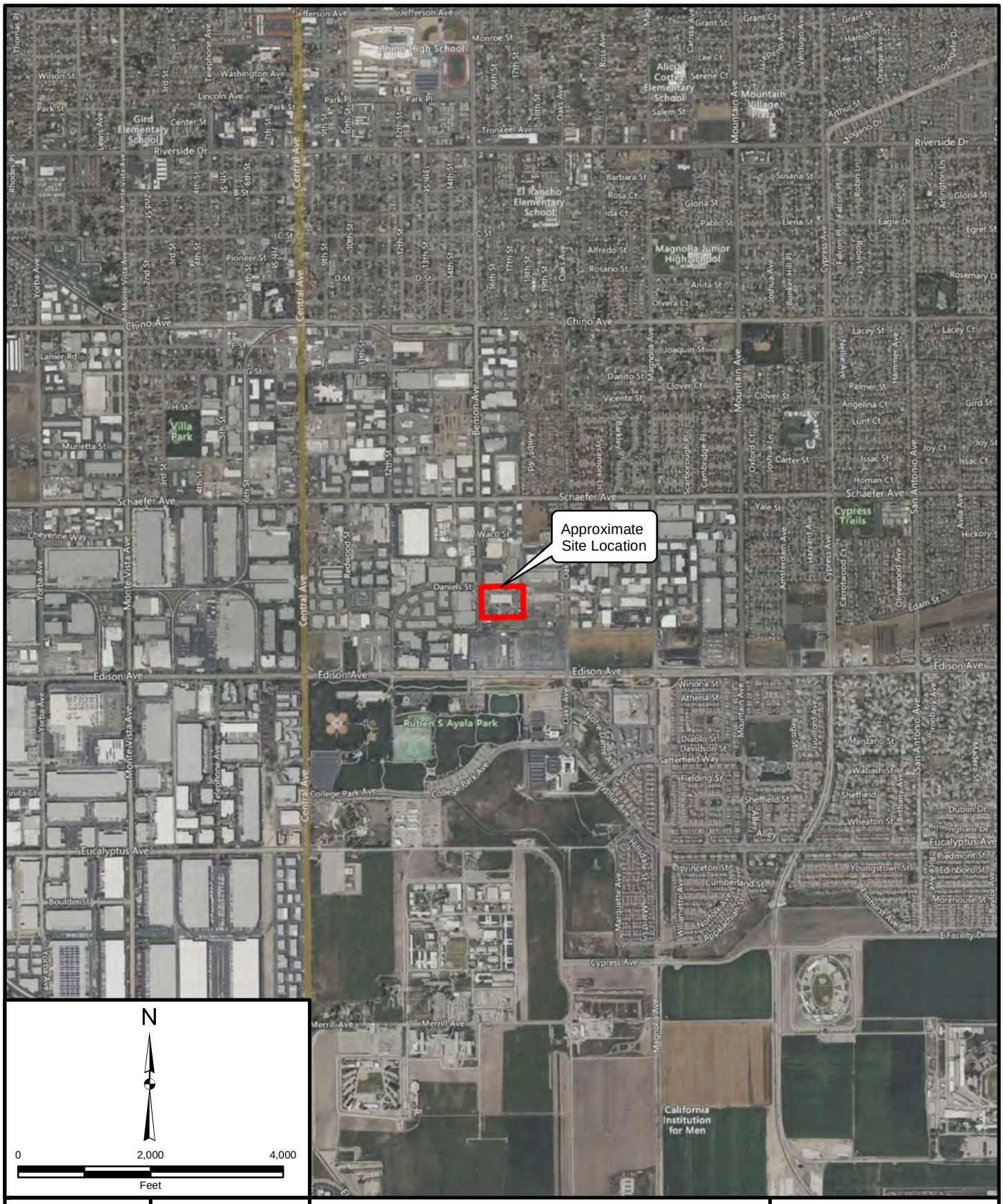
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| | |
|---|---|
| Project: 13807.001 | Eng/Geol: CCK/JMP |
| Scale: 1 " = 2,000 ' | Date: March 2023 |

Reference: © 2023 Microsoft Corporation © 2022 Maxar ©CNES (2022) Distribution Airbus

# SITE LOCATION MAP

Proposed Industrial Building
13925 Benson Avenue
Chino, California

**FIGURE 1**

Leighton

Map Saved as J:\Drafting\13807\001\Maps\13807-001_F01_SLM_2023-03-14.mxd on 3/13/2023 12:28:42 PM Author: KVM (btran)

## LEGEND

**LB-5** — Approximate location of hollow-stem auger boring showing total depth (T.D.) and depth to earth units in feet below existing ground surface (bgs). Groundwater (G.W.) not encountered.

**LP-2** — Approximate location of percolation test boring showing total depth (T.D.) and depth to earth units and depth of percolation test in feet below existing ground surface (bgs). Groundwater (G.W.) not encountered.

**Afu** — Artificial Fill, Undocumented

**Qyf** — Quaternary Age Young Alluvial Fan Deposits

Proposed Building Footprint

Approximate Site Boundary

LB-1
T.D.31.5'
No G.W.
Afu@0-3'
Qyf@3'-T.D.

LB-2
T.D.31.5'
No G.W.
Afu@0-2'
Qyf@2'-T.D.

LB-3
T.D.31.5'
No G.W.
Afu@0-3'
Qyf@3'-T.D.

LB-4
T.D.51.5'
No G.W.
Afu@0-3'
Qyf@3'-T.D.

LB-5
T.D.31.5'
No G.W.
Afu@0-3'
Qyf@3'-T.D.

LP-1
T.D.10'
Afu@0-3'
Qyf@3'-T.D
Perc Test@5-10'.

LP-2
T.D.10'
Afu@0-3'
Qyf@3'-T.D
Perc Test@5-10'.

PROPOSED INDUSTRIAL BUILDING
LOT AREA= 288,367 SF (6.62 AC.)
TOTAL BUILDING AREA= 150,000 SF
FF=144,200 SF (MAX 50% LOT COVERAGE)
MF= 5,800 SF (3.87 %)
B, S1OCCUPANCY/ZONE M2/FAR=0.52 (0.60 MAX)
TYPE III-B/FIRE SPRINKLER/DOCK HIGH/36 FT INT.CLR
INDUSTRIAL USE=138,400 SF/OFFICE=11,600 SF (7.74 %)
REQUIRED PARKING = 101 STALLS
PROVIDED PARKING = 101 STALLS

NOT A PART

BENSON AVENUE (1

Benson Ave

PARKING AREA

OFFICE

20 LOADING DOCK POSITIONS

TRUCK YA

SAN BERNARDINO COUNTY FIRE DEPT ACCESS (26'MIN-REQ'D 30' WIDE IF 2 STORIES HT.)

REQ'D TOTAL 10 TRAILER SPACES
REQ'D 1 TRAILER SPACE/2DH

NOT A PART

PROJECT DATA:

BUILDING CODE:

BUILDING AREAS:

PARKING ANALYSIS:

CONCEPTUAL SITE PLAN
SCALE: 1" = 30'-0"

SITE SURVEY DISCLAIMER:
SITE STUDY WAS COMPLETED WITHOUT THE BENEFIT OF CURRENT ALTA SURVEY
FINAL SITE STUDY SHOULD HAVE LOT BOUNDARY VERIFIED.
ALL CONCEPTUAL SITE PLAN DRAWINGS ARE SUBJECT TO SURVEY CERTIFICATION
APPROVAL BY A CIVIL ENGINEER PRIOR TO CITY CONSTRUCTION DRAWINGS SUBMITTAL.

NORTH

Rexford Industrial

REXFORD INDUSTRIAL REALTY
www.rexfordindustrial.com
11620 WILSHIRE BOULEVARD, 10th FLR
LOS ANGELES, CALIFORNIA 90024
LA (310) 966-1680
OC (714) 696-7775
VC (805) 351-4900
DEVELOPER

REXFORD CONSTRUCTION
GENERAL CONTRACTOR

ARCHITECT STAMP

CLIENT

PROPOSED ONE STORY INDUSTRIAL BUILDING
13925 BENSON AVENUE,
CHINO, CA 91710

PROJECT

| | |
|---|---|
| PROJECT MGR. | DNH |
| PROJECT NO. | 2020 ACQUISITION DEPT REQUEST |
| DATE | JULY 18, 2022 |
| DRAWN BY | TONY |
| SCALE | AS SHOWN |

REVISIONS
PRELIM. SUBMITTAL 07-19-2022

SHEET TITLE
CONCEPTUAL SITE PLAN

SHEET NO.
A1-0

N

0 80 160
Feet

| | |
|---|---|
| Project: 13807.001 | Eng/Geol: CCK/JMP |
| Scale: 1 " = 80 ' | Date: March 2023 |
| Reference: As Shown | |

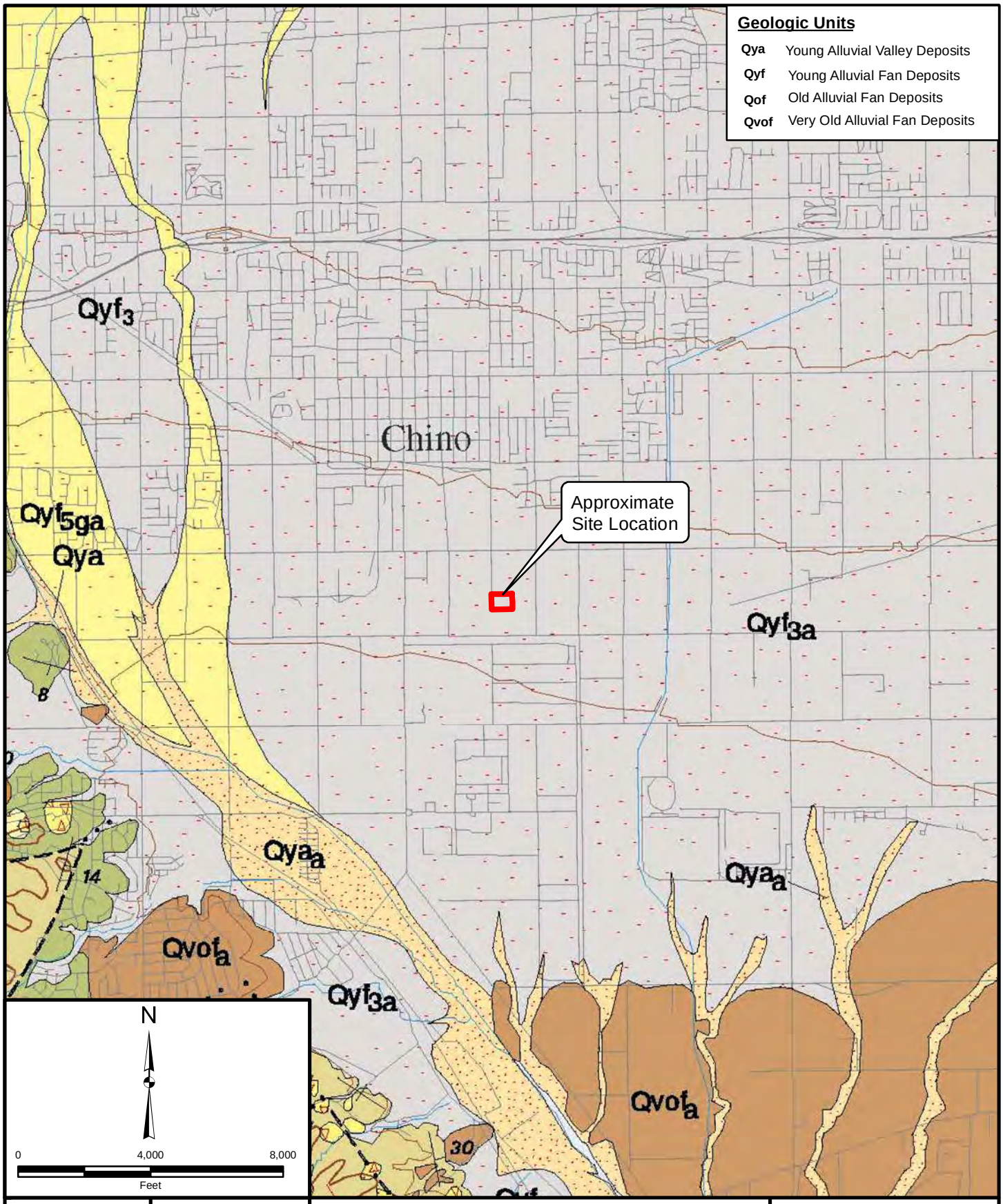
# EXPLORATION LOCATION MAP

Proposed Industrial Building
13925 Benson Avenue
Chino, California

**FIGURE 2**

Leighton

Map Saved as J:\Drafting\13807\001\Maps\13807-001_F02_ELM_2023-03-14.mxd on 3/14/2023 4:24:52 PM Author: KVM (btran)




| | |
|---|---|
| Project: 13807.001 | Eng/Geol: CCK/JMP |
| Scale: 1 " = 4,000 ' | Date: March 2023 |

Reference:
Geologic Map of the San Bernardino and Santa Ana Quadrangles, California
Douglas M. Morton and Fred K. Miller, 2006

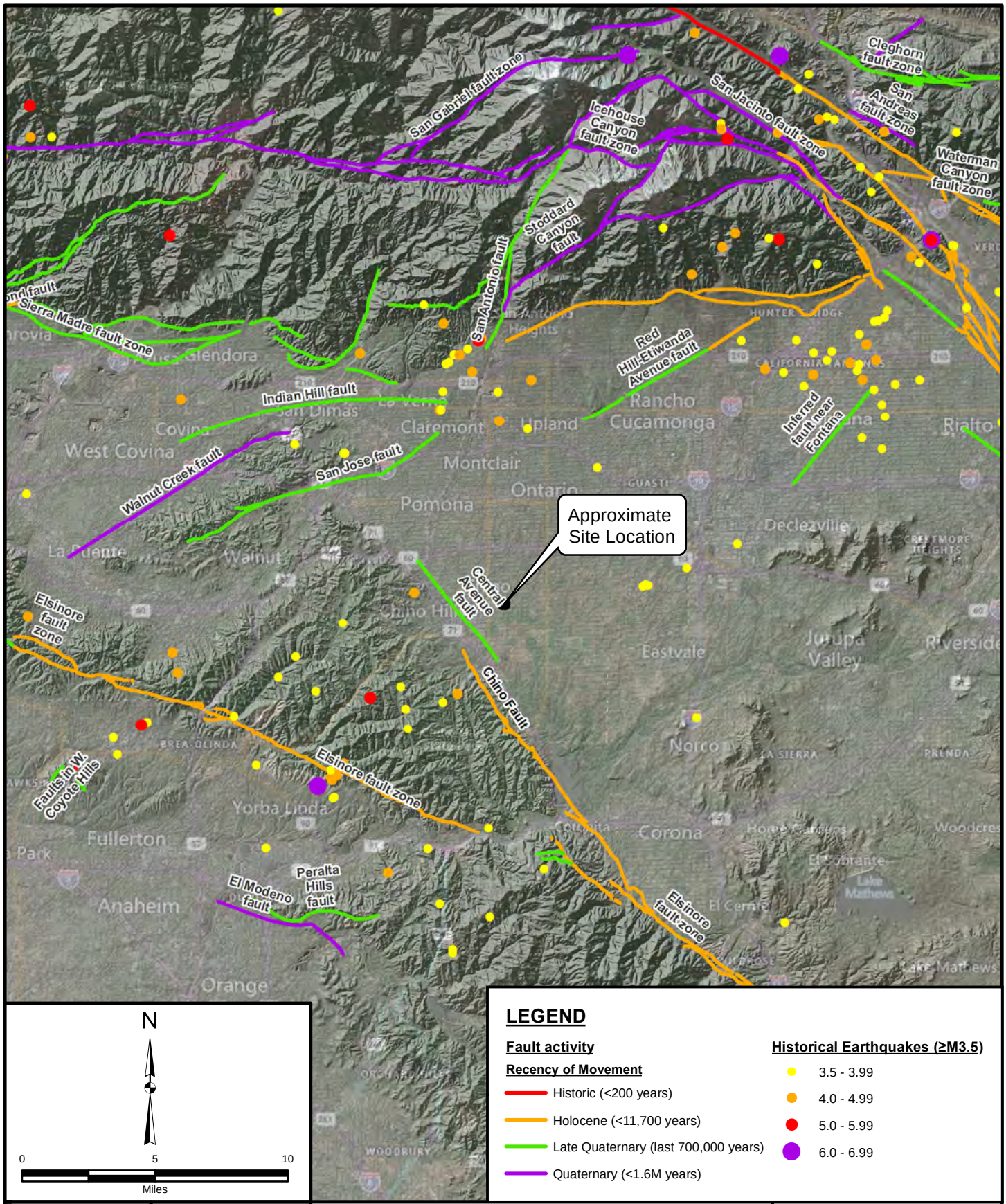
# REGIONAL GEOLOGY MAP

Proposed Industrial Building
13925 Benson Avenue
Chino, California

**FIGURE 3**

Leighton

Map Saved as J:\Drafting\13807\001\Maps\13807-001_F03_RGM_2023-03-14.mxd on 3/13/2023 12:57:06 PM Author: KVM (btran)




## LEGEND

**Fault activity**

**Recency of Movement**

- Historic (<200 years)
- Holocene (<11,700 years)
- Late Quaternary (last 700,000 years)
- Quaternary (<1.6M years)

**Historical Earthquakes (≥M3.5)**

- 3.5 - 3.99
- 4.0 - 4.99
- 5.0 - 5.99
- 6.0 - 6.99

| | |
|---|---|
| Project: 13807.001 | Eng/Geol: CCK/JMP |
| Scale: 1 " = 5 miles | Date: March 2023 |

Basemap Reference: © 2023 Microsoft Corporation
Earthstar Geographics SIO © 2022 TomTom
Seismicity Data Reference: maps.conservation.ca.gov

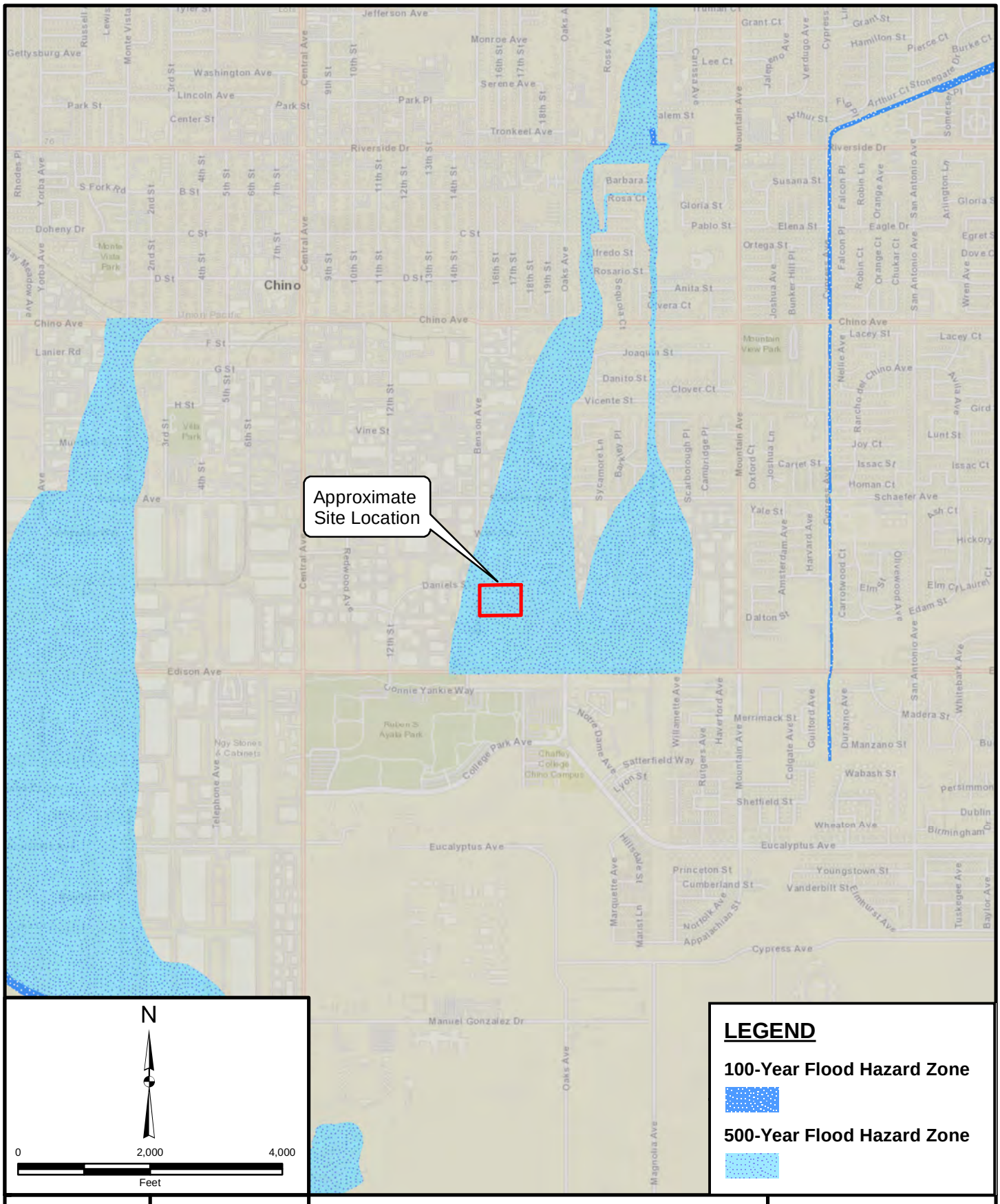
# REGIONAL FAULT AND HISTORICAL SEISMICITY MAP

Proposed Industrial Building
13925 Benson Avenue
Chino, California

**FIGURE 4**

Leighton

Map Saved as J:\Drafting\13807\001\Maps\13807-001_F04_RFHSM_2023-03-17.mxd on 3/17/2023 11:45:34 AM Author: KVM (btran)




| | |
|---|---|
| Project: 13807.001 | Eng/Geol: CCK/JMP |
| Scale: 1 " = 2,000 ' | Date: March 2023 |

Reference: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
FEMA (http://www.fema.gov/index.shtm), DWR (http://www.dwr.ca.gov)

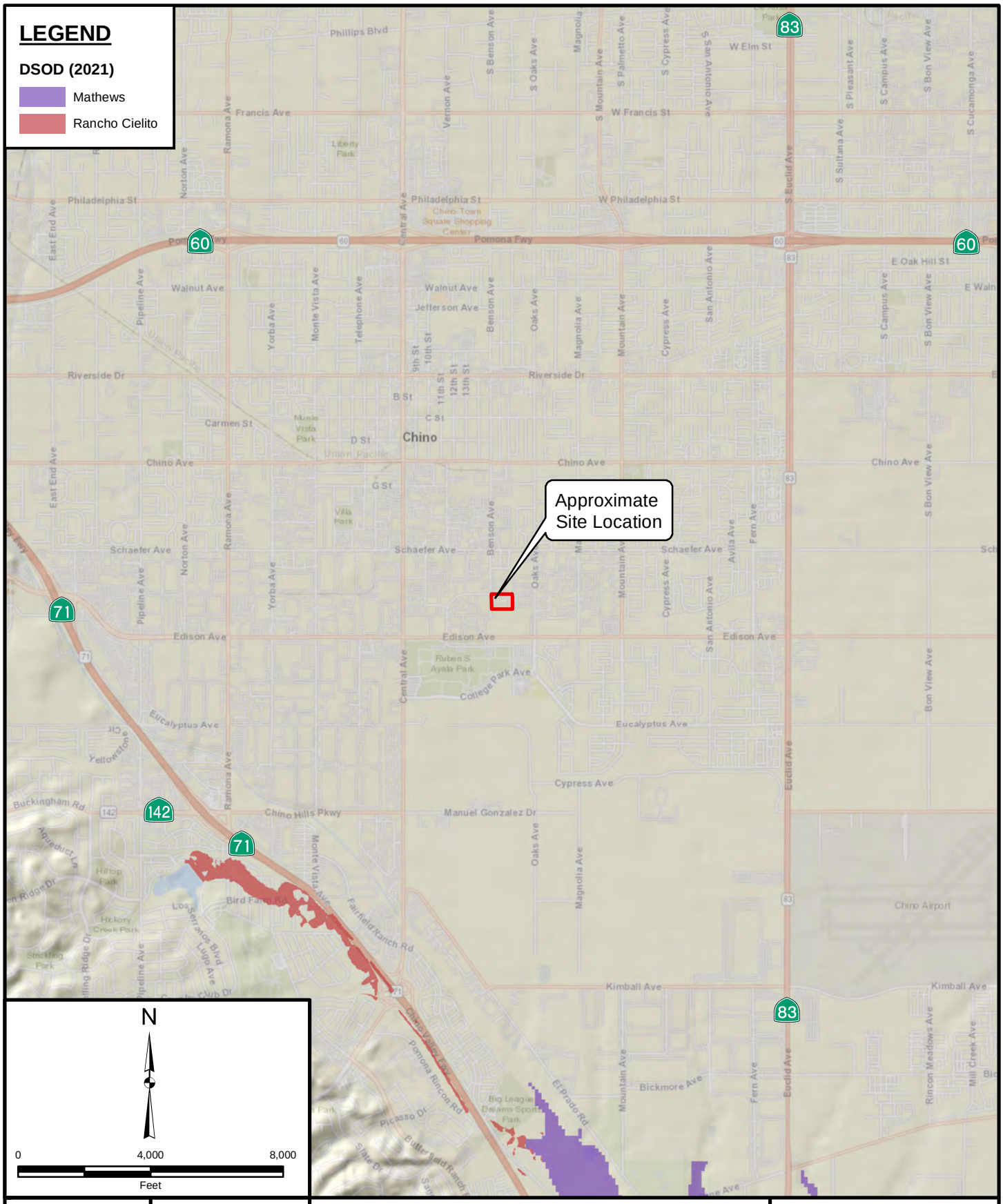
# FLOOD HAZARD ZONE MAP

Proposed Industrial Building
13925 Benson Avenue
Chino, California

**FIGURE 5**

Leighton

Map Saved as J:\Drafting\13807\001\Maps\13807-001_F05_FHZM_2023-03-14.mxd on 3/13/2023 3:33:03 PM Author: KVM (btran)




| | |
|---|---|
| Project: 13807.001 | Eng/Geol: CCK/JMP |
| Scale: 1 " = 4,000 ' | Date: March 2023 |

Base Map: ESRI ArcGIS Online 2023
Reference: Office of Emergency Services (2007),
Dept of Safety of Dams (2021)
National Inventory of Dams, Army Corps of Engrs (2021)

# DAM INUNDATION MAP

Proposed Industrial Building
13925 Benson Avenue
Chino, California

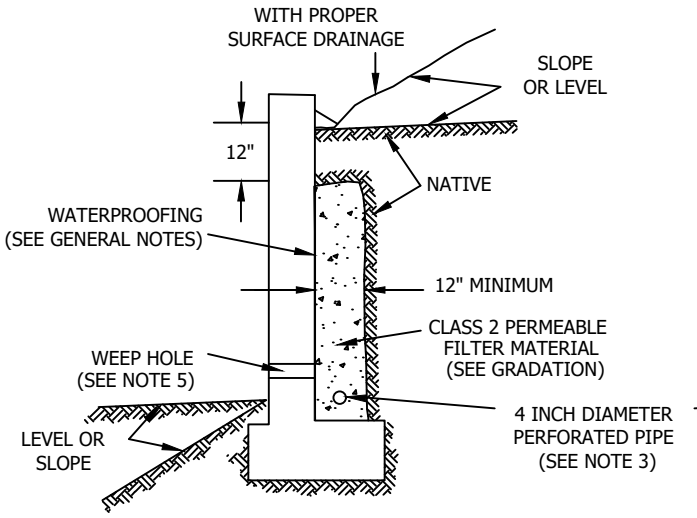
**FIGURE 6**

Leighton

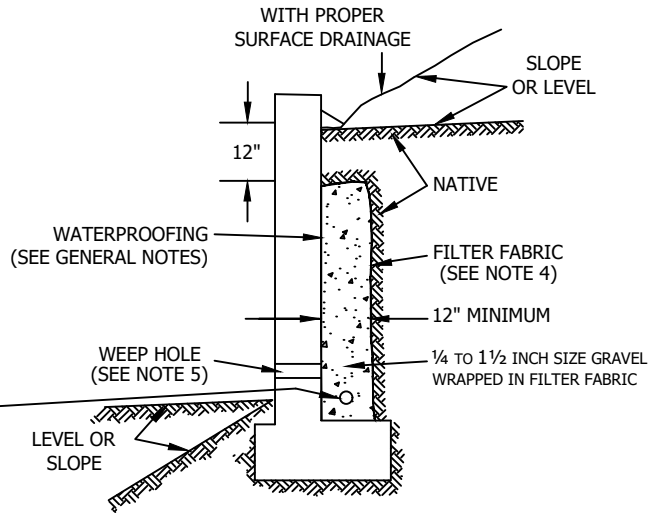
Map Saved as J:\Drafting\13807\001\Maps\13807-001_F06_DIM_2023-03-14.mxd on 3/13/2023 1:07:19 PM Author: KVM (btran)

## SUBDRAIN OPTIONS AND BACKFILL WHEN NATIVE MATERIAL HAS EXPANSION INDEX OF ≤50

OPTION 1: PIPE SURROUNDED WITH CLASS 2 PERMEABLE MATERIAL




OPTION 2: GRAVEL WRAPPED IN FILTER FABRIC




Class 2 Filter Permeable Material Gradation
Per Caltrans Specifications

| Sieve Size | Percent Passing |
|---|---|
| 1" | 100 |
| 3/4" | 90-100 |
| 3/8" | 40-100 |
| No. 4 | 25-40 |
| No. 8 | 18-33 |
| No. 30 | 5-15 |
| No. 50 | 0-7 |
| No. 200 | 0-3 |

GENERAL NOTES:

* Waterproofing should be provided where moisture nuisance problem through the wall is undesirable.
* Water proofing of the walls is not under purview of the geotechnical engineer
* All drains should have a gradient of 1 percent minimum
*Outlet portion of the subdrain should have a 4-inch diameter solid pipe discharged into a suitable disposal area designed by the project engineer. The subdrain pipe should be accessible for maintenance (rodding)
*Other subdrain backfill options are subject to the review by the geotechnical engineer and modification of design parameters.

Notes:
1) Sand should have a sand equivalent of 30 or greater and may be densified by water jetting.
2) 1 Cu. ft. per ft. of 1/4- to 1 1/2-inch size gravel wrapped in filter fabric
3) Pipe type should be ASTM D1527 Acrylonitrile Butadiene Styrene (ABS) SDR35 or ASTM D1785 Polyvinyl Chloride plastic (PVC), Schedule 40, Armco A2000 PVC, or approved equivalent. Pipe should be installed with perforations down. Perforations should be 3/8 inch in diameter placed at the ends of a 120-degree arc in two rows at 3-inch on center (staggered)
4) Filter fabric should be Mirafi 140NC or approved equivalent.
5) Weephole should be 3-inch minimum diameter and provided at 10-foot maximum intervals. If exposure is permitted, weepholes should be located 12 inches above finished grade. If exposure is not permitted such as for a wall adjacent to a sidewalk/curb, a pipe under the sidewalk to be discharged through the curb face or equivalent should be provided. For a basement-type wall, a proper subdrain outlet system should be provided.
6) Retaining wall plans should be reviewed and approved by the geotechnical engineer.
7) Walls over six feet in height are subject to a special review by the geotechnical engineer and modifications to the above requirements.

# RETAINING WALL BACKFILL AND SUBDRAIN DETAIL FOR WALLS 6 FEET OR LESS IN HEIGHT

## WHEN NATIVE MATERIAL HAS EXPANSION INDEX OF ≤50

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FIGURE 7

V:\DRAFTING\TEMPLATES\STANDARD-FIGURES\WALL-STANDARD-FIGURES.DWG (09-02-21 9:07:35AM) Plotted by brian

# APPENDIX A

# EXPLORATION LOGS

# GEOTECHNICAL BORING LOG LB-1

| | | | |
|---|---|---|---|
| **Project No.** | 13807.001 | **Date Drilled** | 2-7-23 |
| **Project** | Rexford Chino Benson Avenue | **Logged By** | MM |
| **Drilling Co.** | Martini Drilling | **Hole Diameter** | 8" |
| **Drilling Method** | Hollow Stem Auger - 140lb - Autohammer - 30" Drop | **Ground Elevation** | 682' |
| **Location** | See Figure 2 - Exploration Location Map | **Sampled By** | MM |

| Elevation Feet | Depth Feet | Graphic Log | Attitudes | Sample No. | Blows Per 6 Inches | Dry Density pcf | Moisture Content, % | Soil Class. (U.S.C.S.) | SOIL DESCRIPTION | Type of Tests |
|---|---|---|---|---|---|---|---|---|---|---|
| | | N S | | | | | | | *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.* | |
| | 0 | | | | | | | SM | @Surface: 3" asphalt concrete, no base | |
| 680 | | | | | | | | | **Undocumented Artificial Fill (Afu)**<br>@3": Silty SAND, dark brown, fine sand, moist | |
| | | | | | | | | SM | **Quaternary Age Young Alluvial Fan Deposits (Qyf)** | |
| | 5 | | | S-1 | 3<br>6<br>7 | | 12 | | @5': Silty SAND, light gray, medium dense, fine sand, moist | |
| 675 | | | | R-2 | 4<br>5<br>5 | 100 | 22 | CL | @7.5': Lean CLAY, light gray, medium stiff, medium plasticity, moist, FeO staining, CaCO3 nodules | |
| | 10 | | | S-3 | 1<br>1<br>1 | | 19 | | @10': Lean CLAY, olive brown, soft, medium plasticity, moist, FeO staining, CaCO3 precipitate and nodules | AL |
| 670 | | | | | | | | | | |
| | 15 | | | R-4 | 3<br>9<br>13 | 117 | 16 | | @15': Lean CLAY, brown, very stiff, medium plasticity, moist, abundant MnO spots | |
| 665 | | | | | | | | | | |
| | 20 | | | S-5 | 2<br>6<br>6 | | 17 | SC | @20': Clayey SAND, yellow brown, medium dense, fine sand, moist, FeO staining, few MnO spots, Lean CLAY in shoe | |
| 660 | | | | | | | | | | |
| | 25 | | | R-6 | 3<br>7<br>14 | 104 | 19 | ML | @25': Sandy SILT, yellow brown, very stiff, fine sand, FeO staining, micaceous | |
| 655 | | | | | | | | | | |
| | 30 | | | | | | | | | |

**SAMPLE TYPES:**
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

**TYPE OF TESTS:**
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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# GEOTECHNICAL BORING LOG LB-1

| | | | |
|---|---|---|---|
| **Project No.** | 13807.001 | **Date Drilled** | 2-7-23 |
| **Project** | Rexford Chino Benson Avenue | **Logged By** | MM |
| **Drilling Co.** | Martini Drilling | **Hole Diameter** | 8" |
| **Drilling Method** | Hollow Stem Auger - 140lb - Autohammer - 30" Drop | **Ground Elevation** | 682' |
| **Location** | See Figure 2 - Exploration Location Map | **Sampled By** | MM |

| Elevation Feet | Depth Feet | Graphic Log (N / S) | Attitudes | Sample No. | Blows Per 6 Inches | Dry Density pcf | Moisture Content, % | Soil Class. (U.S.C.S.) | SOIL DESCRIPTION | Type of Tests |
|---|---|---|---|---|---|---|---|---|---|---|
| | 30 | | | S-7 | 6<br>10<br>12 | | 13 | SM | @30': Silty SAND, yellow brown, dense, fine sand, moist, oxidation throughout | |
| 650 | | | | | | | | | **T.D. 31.5' bgs**<br>**No groundwater encountered during drilling**<br>**Backfilled with soil cuttings and patched with cold-mix asphalt concrete** | |
| | 35 | | | | | | | | | |
| 645 | | | | | | | | | | |
| | 40 | | | | | | | | | |
| 640 | | | | | | | | | | |
| | 45 | | | | | | | | | |
| 635 | | | | | | | | | | |
| | 50 | | | | | | | | | |
| 630 | | | | | | | | | | |
| | 55 | | | | | | | | | |
| 625 | | | | | | | | | | |
| | 60 | | | | | | | | | |

*SOIL DESCRIPTION: This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*

**SAMPLE TYPES:**

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

**TYPE OF TESTS:**

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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# GEOTECHNICAL BORING LOG LB-2

| | | | |
|---|---|---|---|
| **Project No.** | 13807.001 | **Date Drilled** | 2-7-23 |
| **Project** | Rexford Chino Benson Avenue | **Logged By** | MM |
| **Drilling Co.** | Martini Drilling | **Hole Diameter** | 8" |
| **Drilling Method** | Hollow Stem Auger - 140lb - Autohammer - 30" Drop | **Ground Elevation** | 684' |
| **Location** | See Figure 2 - Exploration Location Map | **Sampled By** | MM |

| Elevation Feet | Depth Feet | Graphic Log | Attitudes | Sample No. | Blows Per 6 Inches | Dry Density pcf | Moisture Content, % | Soil Class. (U.S.C.S.) | SOIL DESCRIPTION | Type of Tests |
|---|---|---|---|---|---|---|---|---|---|---|
| | | N S | | | | | | | *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.* | |
| | 0 | | | B-1 | | | | SM | @Surface: 2.5" asphalt concrete, no base<br>**Undocumented Artificial Fill (Afu)**<br>@2.5": Silty SAND, dark brown, fine sand, moist | |
| | | | | | | | | ML | **Quaternary Age Young Alluvial Fan Deposits (Qyf)**<br>@2': SILT w/ Sand, gray brown, moist | |
| 680 | | | | | | | | | | |
| | 5 | | | R-1 | 6<br>14<br>16 | 117 | 10 | SM | @5': Silty SAND, gray brown, medium dense, fine sand, trace fine subangular gravel, moist | |
| | | | | S-2 | 2<br>3<br>4 | | 18 | ML | @7.5': SILT, gray brown, stiff, moist, micaceous, trace MnO spots, few FeO stains | |
| 675 | | | | | | | | | | |
| | 10 | | | R-3 | 4<br>4<br>6 | 104 | 20 | CL | @10': Lean CLAY, gray brown, medium stiff, moist, micaceous, few FeO veins | |
| 670 | | | | | | | | | | |
| | 15 | | | S-4 | 2<br>4<br>7 | | 18 | SC | @15': Clayey SAND, brown, medium dense, medium plasticity, moist, few FeO veins | |
| 665 | | | | | | | | | | |
| | 20 | | | R-5 | 3<br>6<br>9 | 94 | 25 | CL | @20': Lean CLAY, gray brown, very stiff, medium plasticity, moist, laminated, FeO staining along laminations, trace MnO spots | |
| 660 | | | | | | | | | | |
| | 25 | | | S-6 | 2<br>4<br>8 | | 27 | SC | @25': Clayey SAND, gray brown, medium dense, medium plasticity, moist, FeO staining throughout, trace MnO spots | |
| 655 | | | | | | | | | | |
| | 30 | | | | | | | | | |

**SAMPLE TYPES:**

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

**TYPE OF TESTS:**

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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# GEOTECHNICAL BORING LOG LB-2

| | | | |
|---|---|---|---|
| **Project No.** | 13807.001 | **Date Drilled** | 2-7-23 |
| **Project** | Rexford Chino Benson Avenue | **Logged By** | MM |
| **Drilling Co.** | Martini Drilling | **Hole Diameter** | 8" |
| **Drilling Method** | Hollow Stem Auger - 140lb - Autohammer - 30" Drop | **Ground Elevation** | 684' |
| **Location** | See Figure 2 - Exploration Location Map | **Sampled By** | MM |

| Elevation Feet | Depth Feet | Graphic Log (N S) | Attitudes | Sample No. | Blows Per 6 Inches | Dry Density pcf | Moisture Content, % | Soil Class. (U.S.C.S.) | SOIL DESCRIPTION | Type of Tests |
|---|---|---|---|---|---|---|---|---|---|---|
| | 30 | | | R-7 | 3<br>8<br>16 | 112 | 20 | CL | @30': Lean CLAY, gray brown, very stiff, few fine to coarse subrounded gravel, medium plasticity, moist, FeO staining | |
| | | | | | | | | | **T.D. 31.5' bgs**<br>**No groundwater encountered during drilling**<br>**Backfilled with soil cuttings and patched with cold-mix asphalt concrete** | |
| 650 | 35 | | | | | | | | | |
| 645 | 40 | | | | | | | | | |
| 640 | 45 | | | | | | | | | |
| 635 | 50 | | | | | | | | | |
| 630 | 55 | | | | | | | | | |
| 625 | 60 | | | | | | | | | |

**SAMPLE TYPES:**

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

**TYPE OF TESTS:**

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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# GEOTECHNICAL BORING LOG LB-3

| | | | |
|---|---|---|---|
| **Project No.** | 13807.001 | **Date Drilled** | 2-7-23 |
| **Project** | Rexford Chino Benson Avenue | **Logged By** | MM |
| **Drilling Co.** | Martini Drilling | **Hole Diameter** | 8" |
| **Drilling Method** | Hollow Stem Auger - 140lb - Autohammer - 30" Drop | **Ground Elevation** | 683' |
| **Location** | See Figure 2 - Exploration Location Map | **Sampled By** | MM |

| Elevation Feet | Depth Feet | Graphic Log | Attitudes | Sample No. | Blows Per 6 Inches | Dry Density pcf | Moisture Content, % | Soil Class. (U.S.C.S.) | SOIL DESCRIPTION | Type of Tests |
|---|---|---|---|---|---|---|---|---|---|---|
| | | N S | | | | | | | *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.* | |
| | 0 | | | | | | | SM | @Surface: 4" asphalt concrete, no base<br>**Undocumented Artificial Fill (Afu)**<br>@4": Silty SAND, dark brown, fine sand, moist | |
| 680 | | | | | | | | ML | **Quaternary Age Young Alluvial Fan Deposits (Qyf)**<br>@3': SILT, gray brown, moist | |
| | 5 | | | S-1 | 7<br>7<br>7 | | 18 | | @5': SILT, light gray, trace light orange oxidation, very stiff, slightly moist, trace pores | |
| 675 | | | | R-2 | 5<br>9<br>10 | 101 | 13 | | @7.5': Sandy SILT, light gray, very stiff, slightly moist, dark brown silty sand pocket, transitions to light brown Silty SAND w/ depth | |
| | 10 | | | S-3 | 2<br>2<br>3 | | 17 | | @10': SILT, gray brown, medium stiff, moist, FeO staining, micaceous | |
| 670 | | | | | | | | | | |
| | 15 | | | R-4 | 3<br>5<br>7 | 108 | 18 | ML-CL<br>CL | @15': Silty CLAY, brown, stiff, moist, FeO staining, micaceous<br>@16': Lean CLAY, brown, stiff, low-medium plasticity, moist, FeO staining | |
| 665 | | | | | | | | | | |
| | 20 | | | S-5 | 1<br>3<br>6 | | 25 | | @20': Lean CLAY, brown, stiff, low plasticity, moist, FeO staining, micaceous | |
| 660 | | | | | | | | | | |
| | 25 | | | R-6 | 3<br>6<br>12 | 95 | 27 | | @25': Lean CLAY, gray brown, stiff, low plasticity, moist, FeO veins and spots, micaceous | |
| 655 | | | | | | | | | | |
| | 30 | | | | | | | | | |

**SAMPLE TYPES:**

| | |
|---|---|
| B | BULK SAMPLE |
| C | CORE SAMPLE |
| G | GRAB SAMPLE |
| R | RING SAMPLE |
| S | SPLIT SPOON SAMPLE |
| T | TUBE SAMPLE |

**TYPE OF TESTS:**

| | | | | | |
|---|---|---|---|---|---|
| -200 | % FINES PASSING | DS | DIRECT SHEAR | SA | SIEVE ANALYSIS |
| AL | ATTERBERG LIMITS | EI | EXPANSION INDEX | SE | SAND EQUIVALENT |
| CN | CONSOLIDATION | H | HYDROMETER | SG | SPECIFIC GRAVITY |
| CO | COLLAPSE | MD | MAXIMUM DENSITY | UC | UNCONFINED COMPRESSIVE STRENGTH |
| CR | CORROSION | PP | POCKET PENETROMETER | | |
| CU | UNDRAINED TRIAXIAL | RV | R VALUE | | |

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# GEOTECHNICAL BORING LOG LB-3

| | | | |
|---|---|---|---|
| **Project No.** | 13807.001 | **Date Drilled** | 2-7-23 |
| **Project** | Rexford Chino Benson Avenue | **Logged By** | MM |
| **Drilling Co.** | Martini Drilling | **Hole Diameter** | 8" |
| **Drilling Method** | Hollow Stem Auger - 140lb - Autohammer - 30" Drop | **Ground Elevation** | 683' |
| **Location** | See Figure 2 - Exploration Location Map | **Sampled By** | MM |

| Elevation Feet | Depth Feet | Graphic Log (N S) | Attitudes | Sample No. | Blows Per 6 Inches | Dry Density pcf | Moisture Content, % | Soil Class. (U.S.C.S.) | SOIL DESCRIPTION | Type of Tests |
|---|---|---|---|---|---|---|---|---|---|---|
| | 30 | | | S-7 | 1<br>3<br>5 | | 19 | | @30': Lean CLAY, brown, stiff, low plasticity, moist, trace MnO spots | |
| 650 | | | | | | | | | **T.D. 31.5' bgs**<br>**No groundwater encountered during drilling**<br>**Backfilled with soil cuttings and patched with cold-mix asphalt concrete** | |
| | 35 | | | | | | | | | |
| 645 | | | | | | | | | | |
| | 40 | | | | | | | | | |
| 640 | | | | | | | | | | |
| | 45 | | | | | | | | | |
| 635 | | | | | | | | | | |
| | 50 | | | | | | | | | |
| 630 | | | | | | | | | | |
| | 55 | | | | | | | | | |
| 625 | | | | | | | | | | |
| | 60 | | | | | | | | | |

*Soil Description: This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*

**SAMPLE TYPES:**

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

**TYPE OF TESTS:**

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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# GEOTECHNICAL BORING LOG LB-4

| | | | |
|---|---|---|---|
| **Project No.** | 13807.001 | **Date Drilled** | 2-7-23 |
| **Project** | Rexford Chino Benson Avenue | **Logged By** | MM |
| **Drilling Co.** | Martini Drilling | **Hole Diameter** | 8" |
| **Drilling Method** | Hollow Stem Auger - 140lb - Autohammer - 30" Drop | **Ground Elevation** | 681' |
| **Location** | See Figure 2 - Exploration Location Map | **Sampled By** | MM |

| Elevation Feet | Depth Feet | Graphic Log | Attitudes | Sample No. | Blows Per 6 Inches | Dry Density pcf | Moisture Content, % | Soil Class. (U.S.C.S.) | SOIL DESCRIPTION | Type of Tests |
|---|---|---|---|---|---|---|---|---|---|---|
| | | N S | | | | | | | *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.* | |
| 680 | 0 | | | B-1 | | | | SM | @Surface: 3.5" asphalt concrete, no base<br>**Undocumented Artificial Fill (Afu)**<br>@3.5": Silty SAND, very dark yellowish brown, mostly fine sand, moist | MD,EI, DS,CN, RV,CR |
| | | | | | | | | ML | **Quaternary Age Young Alluvial Fan Deposits (Qyf)**<br>@3': Sandy SILT, gray brown, slightly moist to moist | |
| 675 | 5 | | | R-1 | 12<br>13<br>13 | 108 | 17 | | @5': Sandy SILT, brown, very stiff, fine sand, trace fine subrounded gravel and coarse sand, slightly moist | DS,CN |
| | | | | S-2 | 4<br>3<br>2 | | 16 | CL | @7.5': Lean CLAY, gray brown, medium stiff, fine sand, slightly moist, trace oxide veins | |
| | | | | | | | | ML-CL | @8.5': Clayey SILT, gray brown, medium stiff, no plasticity, moist, abundant MnO spotting | |
| 670 | 10 | | | R-3 | 3<br>5<br>8 | 101 | 20 | ML | @10': Sandy SILT, brown, stiff, trace coarse subrounded gravel, no plasticity, moist, micaceous, faint FeO spotting throughout | DS |
| 665 | 15 | | | S-4 | 2<br>3<br>3 | | | CL | @15': Lean CLAY, olive brown, medium stiff, low plasticity, moist, FeO spotting, trace MnO spots | AL |
| 660 | 20 | | | R-5 | 3<br>7<br>12 | 95 | 26 | | @20': Lean CLAY, gray brown, very stiff, low plasticity, moist, FeO spotting/pinpoints | |
| 655 | 25 | | | S-6 | 7<br>9<br>9 | | 9 | SM | @25': Silty SAND, light brown, medium dense, mostly fine sand, trace medium subangular gravel, moist, FeO veining throughout | |
| | 30 | | | | | | | | | |

**SAMPLE TYPES:**

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

**TYPE OF TESTS:**

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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# GEOTECHNICAL BORING LOG LB-4

| | | | |
|---|---|---|---|
| **Project No.** | 13807.001 | **Date Drilled** | 2-7-23 |
| **Project** | Rexford Chino Benson Avenue | **Logged By** | MM |
| **Drilling Co.** | Martini Drilling | **Hole Diameter** | 8" |
| **Drilling Method** | Hollow Stem Auger - 140lb - Autohammer - 30" Drop | **Ground Elevation** | 681' |
| **Location** | See Figure 2 - Exploration Location Map | **Sampled By** | MM |

| Elevation Feet | Depth Feet | Graphic Log (N / S) | Attitudes | Sample No. | Blows Per 6 Inches | Dry Density pcf | Moisture Content, % | Soil Class. (U.S.C.S.) | SOIL DESCRIPTION | Type of Tests |
|---|---|---|---|---|---|---|---|---|---|---|
| | 30 | | | R-7 | 6<br>6<br>12 | 111 | 18 | SC | @30': Clayey Sand, light gray brown, medium dense, mostly fine sand, trace coarse sand, moist, FeO veins, trace MnO spots | |
| 650 | | | | | | | | | | |
| | 35 | | | S-8 | 13<br>25<br>30 | | 5 | SM<br>CL | @35': Silty SAND, light brown, very dense, fine to coarse sand, fine to coarse subangular gravel, moist, FeO staining throughout<br>Transitions to Lean CLAY, light gray brown, laminated, FeO-staining along laminations, moist | |
| 645 | | | | | | | | | | |
| | 40 | | | R-9 | 8<br>14<br>18 | 111 | 10 | SM | @40': Silty SAND, gray brown, medium dense, fine to coarse sand, few fine to coarse gravel, FeO staining, moist, mostly fine grained sand in show w/ laminated Lean CLAY interbedded | |
| 640 | | | | | | | | | | |
| | 45 | | | S-10 | 4<br>8<br>18 | | 32 | CL | @45': Lean CLAY, brown, hard, few silt, trace to few fine sand, low plasticity, moist to very moist, micaceous, trace FeO staining | |
| 635 | | | | | | | | | | |
| | 50 | | | R-11 | 6<br>11<br>12 | 102 | 23 | | @50': Lean CLAY, light gray, very stiff, low plasticity, moist, trace CaCO3 deposits, trace to few FeO spots/veins, trace burrows | |
| 630 | | | | | | | | | | |
| | | | | | | | | | **T.D. 51.5' bgs**<br>**No groundwater encountered during drilling**<br>**Backfilled with soil cuttings and patched with cold-mix asphalt concrete** | |
| | 55 | | | | | | | | | |
| 625 | | | | | | | | | | |
| | 60 | | | | | | | | | |

**SAMPLE TYPES:**

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

**TYPE OF TESTS:**

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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# GEOTECHNICAL BORING LOG LB-5

| | | | |
|---|---|---|---|
| **Project No.** | 13807.001 | **Date Drilled** | 2-7-23 |
| **Project** | Rexford Chino Benson Avenue | **Logged By** | MM |
| **Drilling Co.** | Martini Drilling | **Hole Diameter** | 8" |
| **Drilling Method** | Hollow Stem Auger - 140lb - Autohammer - 30" Drop | **Ground Elevation** | 681' |
| **Location** | See Figure 2 - Exploration Location Map | **Sampled By** | MM |

| Elevation Feet | Depth Feet | Graphic Log (N / S) | Attitudes | Sample No. | Blows Per 6 Inches | Dry Density pcf | Moisture Content, % | Soil Class. (U.S.C.S.) | SOIL DESCRIPTION | Type of Tests |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.* | |
| 680 | 0 | | | B-1 | | | | SM | @Surface: 3" asphalt concrete, no base<br>**Undocumented Artificial Fill (Afu)**<br>@3": Silty SAND, dark brown, fine sand, moist | |
| | | | | | | | | ML | **Quaternary Age Young Alluvial Fan Deposits (Qyf)**<br>@3': Sandy SILT, light gray, fine sand, slightly moist | |
| 675 | 5 | | | R-1 | 6<br>13<br>16 | 113 | 14 | | @5': SILT, light gray, medium dense, little fine sand, slightly moist, CaCO3 nodules | |
| | | | | S-2 | 2<br>3<br>5 | | 20 | CL | @7.5': Lean CLAY, light gray, stiff, slightly moist | |
| 670 | 10 | | | R-3 | 2<br>3<br>7 | 100 | 22 | | @10': Lean CLAY, olive brown, medium stiff, low to medium plasticity, moist, FeO veins | AL,CN |
| 665 | 15 | | | S-4 | push<br>1<br>2 | | 22 | | @15': Lean CLAY, olive brown, soft, medium plasticity, moist, trace FeO veins | AL |
| 660 | 20 | | | R-5 | 2<br>3<br>7 | 94 | 27 | | @20': Lean CLAY, yellow brown, medium stiff, medium plasticity, FeO veins | |
| 655 | 25 | | | S-6 | 4<br>6<br>5 | | 12 | SM | @25': Silty SAND, yellow brown, medium dense, mostly fine sand, FeO staining throughout | |
| | 30 | | | | | | | | | |

**SAMPLE TYPES:**

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

**TYPE OF TESTS:**

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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# GEOTECHNICAL BORING LOG LB-5

| | | | |
|---|---|---|---|
| **Project No.** | 13807.001 | **Date Drilled** | 2-7-23 |
| **Project** | Rexford Chino Benson Avenue | **Logged By** | MM |
| **Drilling Co.** | Martini Drilling | **Hole Diameter** | 8" |
| **Drilling Method** | Hollow Stem Auger - 140lb - Autohammer - 30" Drop | **Ground Elevation** | 681' |
| **Location** | See Figure 2 - Exploration Location Map | **Sampled By** | MM |

| Elevation Feet | Depth Feet | Graphic Log (N S) | Attitudes | Sample No. | Blows Per 6 Inches | Dry Density pcf | Moisture Content, % | Soil Class. (U.S.C.S.) | SOIL DESCRIPTION | Type of Tests |
|---|---|---|---|---|---|---|---|---|---|---|
| 650 | 30 | | | R-7 | 5<br>9<br>17 | 118 | 13 | SC | @30': Clayey SAND, brown, medium dense, fine sand, trace medium to coarse sand, moist | |
| | | | | | | | | | **T.D. 31.5' bgs**<br>**No groundwater encountered during drilling**<br>**Backfilled with soil cuttings and patched with cold-mix asphalt concrete** | |
| 645 | 35 | | | | | | | | | |
| 640 | 40 | | | | | | | | | |
| 635 | 45 | | | | | | | | | |
| 630 | 50 | | | | | | | | | |
| 625 | 55 | | | | | | | | | |
| | 60 | | | | | | | | | |

*SOIL DESCRIPTION: This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*

**SAMPLE TYPES:**
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

**TYPE OF TESTS:**
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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# GEOTECHNICAL BORING LOG LP-1

| | | | |
|---|---|---|---|
| **Project No.** | 13807.001 | **Date Drilled** | 2-7-23 |
| **Project** | Rexford Chino Benson Avenue | **Logged By** | MM |
| **Drilling Co.** | Martini Drilling | **Hole Diameter** | 8" |
| **Drilling Method** | Hollow Stem Auger - 140lb - Autohammer - 30" Drop | **Ground Elevation** | 682' |
| **Location** | See Figure 2 - Exploration Location Map | **Sampled By** | MM |

| Elevation Feet | Depth Feet | Graphic Log | Attitudes | Sample No. | Blows Per 6 Inches | Dry Density pcf | Moisture Content, % | Soil Class. (U.S.C.S.) | SOIL DESCRIPTION | Type of Tests |
|---|---|---|---|---|---|---|---|---|---|---|
| | | N S | | | | | | | *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.* | |
| 680 | 0 | | | | | | | SM | @Surface: 3" asphalt concrete, no base<br>**Undocumented Artificial Fill (Afu)**<br>@3": Silty SAND, dark brown, fine sand, moist | |
| | | | | | | | | ML | **Quaternary Age Young Alluvial Fan Deposits (Qyf)**<br>@3': SILT with sand, light gray, slightly moist | |
| | 5 | | | S-1 | 5<br>6<br>7 | | 13 | | @5': SILT, light gray, very stiff, moist, few fine sand, trace fine gravel | |
| 675 | | | | S-2 | 2<br>2<br>3 | | 17 | | @8': SILT, light gray, medium stiff, moist, few fine sand, abundant FeO veins | |
| | 10 | | | | | | | | **T.D. 10' bgs**<br>**No groundwater encountered during drilling**<br>**Installed temporary test well using 2-inch diameter pipe**<br>**Solid pipe from 0-5 feet bgs and 0.020-inch slotted pipe from 5-10 feet bgs**<br>**No. 3 Monterey SAND placed in annulus from 4-10 feet bgs**<br>**Upon completion of percolation test, removed pipe and backfilled with soil cuttings and patched with cold-mix asphalt concrete** | |
| 670 | | | | | | | | | | |
| | 15 | | | | | | | | | |
| 665 | | | | | | | | | | |
| | 20 | | | | | | | | | |
| 660 | | | | | | | | | | |
| | 25 | | | | | | | | | |
| 655 | | | | | | | | | | |
| | 30 | | | | | | | | | |

**SAMPLE TYPES:**

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

**TYPE OF TESTS:**

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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# GEOTECHNICAL BORING LOG LP-2

| | | | |
|---|---|---|---|
| **Project No.** | 13807.001 | **Date Drilled** | 2-7-23 |
| **Project** | Rexford Chino Benson Avenue | **Logged By** | MM |
| **Drilling Co.** | Martini Drilling | **Hole Diameter** | 8" |
| **Drilling Method** | Hollow Stem Auger - 140lb - Autohammer - 30" Drop | **Ground Elevation** | 682' |
| **Location** | See Figure 2 - Exploration Location Map | **Sampled By** | MM |

| Elevation Feet | Depth Feet | Graphic Log | Attitudes | Sample No. | Blows Per 6 Inches | Dry Density pcf | Moisture Content, % | Soil Class. (U.S.C.S.) | SOIL DESCRIPTION | Type of Tests |
|---|---|---|---|---|---|---|---|---|---|---|
| | | N S | | | | | | | *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.* | |
| 680 | 0 | | | | | | | SM | @Surface: 3" asphalt concrete over 2" base<br>**Undocumented Artificial Fill (Afu)**<br>@3": Silty SAND, dark brown, fine sand | |
| | | | | | | | | ML | **Quaternary Age Young Alluvial Fan Deposits (Qyf)**<br>@3': SILT with sand, light gray, moist | |
| 675 | 5 | | | S-1 | 2<br>4<br>3 | | 18 | CL | @5': Lean CLAY, light gray, stiff, moist, no to low plasticity, trace FeO staining | |
| | | | | S-2 | 2<br>2<br>3 | | 19 | | @8': medium stiff | |
| 670 | 10 | | | | | | | | **T.D. 10' bgs**<br>**No groundwater encountered during drilling**<br>**Installed temporary test well using 2-inch diameter pipe**<br>**Solid pipe from 0-5 feet bgs and 0.020-inch slotted pipe from 5-10 feet bgs**<br>**No. 3 Monterey SAND placed in annulus from 4-10 feet bgs**<br>**Upon completion of percolation test, removed pipe and backfilled with soil cuttings and patched with cold-mix asphalt concrete** | |
| 665 | 15 | | | | | | | | | |
| 660 | 20 | | | | | | | | | |
| 655 | 25 | | | | | | | | | |
| | 30 | | | | | | | | | |

**SAMPLE TYPES:**

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

**TYPE OF TESTS:**

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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# APPENDIX B

# PERCOLATION TEST DATA

## Boring Percolation Test Data Sheet

| | | | |
|---|---|---|---|
| **Project Number:** | 13807.001 | **Test Hole Number:** | LP-1 |
| **Project Name:** | Rexford Benson Chino | **Date Excavated:** | 2/7/2023 |
| **Earth Description:** | Alluvium | **Date Tested:** | 2/8/2023 |
| **Liquid Description:** | Tap water | **Depth of boring (ft):** | 10 |
| **Tested By:** | MM | **Radius of boring (in):** | 4 |
| **Time Interval Standard** | | **Radius of casing (in):** | 1 |
| **Start Time for Pre-Soak:** | 2/7/2023 14:00 | **Length of slotted of casing (ft):** | 5 |
| **Start Time for Standard:** | 7:37 | **Depth to Initial Water Depth (ft):** | 4 |
| **Standard Time Interval Between Readings, mins:** | 30 | **Porosity of Annulus Material, *n* :** | 0.35 |
| | | **Bentonite Plug at Bottom:** | No |

Field Percolation Data - Falling Head Test

| Reading | Time | Time Interval, Δt (min.) | Initial/Final Depth to Water (ft.) | Initial/Final Water Height, $H_0/H_f$ (in.) | Total Water Drop, Δd (in.) | Infiltration Rate (in./hr.) |
|---|---|---|---|---|---|---|
| 1 | 7:37 | 30 | 4.32 | 68.2 | 2.5 | 0.06 |
| | 8:07 | | 4.53 | 65.6 | | |
| 2 | 8:07 | 30 | 4.53 | 65.6 | 3.1 | 0.07 |
| | 8:37 | | 4.79 | 62.5 | | |
| 3 | 8:37 | 30 | 4.79 | 62.5 | 2.5 | 0.06 |
| | 9:07 | | 5.00 | 60.0 | | |
| 4 | 9:07 | 30 | 5.00 | 60.0 | 2.8 | 0.07 |
| | 9:37 | | 5.23 | 57.2 | | |
| 5 | 9:38 | 30 | 5.00 | 60.0 | 3.5 | 0.09 |
| | 10:08 | | 5.29 | 56.5 | | |
| 6 | 10:09 | 30 | 5.00 | 60.0 | 3.4 | 0.09 |
| | 10:39 | | 5.28 | 56.6 | | |
| 7 | 10:40 | 30 | 5.00 | 60.0 | 3.5 | 0.09 |
| | 11:20 | | 5.29 | 56.5 | | |
| 8 | 11:22 | 30 | 5.00 | 60.0 | 3.4 | 0.09 |
| | 11:52 | | 5.28 | 56.6 | | |

Infiltration Rate (I) = Discharge Volume/Surface Area of Test Section/Time Interval

**Measured Infiltration Rate, I (Average of Last 3 Readings) =** **0.09** **in./hr.**

## Boring Percolation Test Data Sheet

| | | | |
|---|---|---|---|
| **Project Number:** | 13807.001 | **Test Hole Number:** | LP-2 |
| **Project Name:** | Rexford Benson Chino | **Date Excavated:** | 2/7/2023 |
| **Earth Description:** | Alluvium | **Date Tested:** | 2/8/2023 |
| **Liquid Description:** | Tap water | **Depth of boring (ft):** | 10 |
| **Tested By:** | MM | **Radius of boring (in):** | 4 |
| **Time Interval Standard** | | **Radius of casing (in):** | 1 |
| **Start Time for Pre-Soak:** | 2/7/2023 14:37 | **Length of slotted of casing (ft):** | 5 |
| **Start Time for Standard:** | 7:12 | **Depth to Initial Water Depth (ft):** | 5 |
| **Standard Time Interval Between Readings, mins:** | 30 | **Porosity of Annulus Material, *n* :** | 0.35 |
| | | **Bentonite Plug at Bottom:** | No |

Field Percolation Data - Falling Head Test

| Reading | Time | Time Interval, Δt (min.) | Initial/Final Depth to Water (ft.) | Initial/Final Water Height, $H_0/H_f$ (in.) | Total Water Drop, Δd (in.) | Infiltration Rate (in./hr.) |
|---|---|---|---|---|---|---|
| 1 | 7:12 | 30 | 5.00 | 60.0 | 1.8 | 0.05 |
| | 7:42 | | 5.15 | 58.2 | | |
| 2 | 7:45 | 30 | 5.00 | 60.0 | 1.8 | 0.05 |
| | 8:15 | | 5.15 | 58.2 | | |
| 3 | 8:17 | 30 | 5.00 | 60.0 | 1.7 | 0.04 |
| | 8:47 | | 5.14 | 58.3 | | |
| 4 | 8:48 | 31 | 5.00 | 60.0 | 1.9 | 0.05 |
| | 9:19 | | 5.16 | 58.1 | | |
| 5 | 9:20 | 30 | 5.00 | 60.0 | 1.8 | 0.05 |
| | 9:50 | | 5.15 | 58.2 | | |
| 6 | 9:51 | 30 | 5.00 | 60.0 | 1.8 | 0.05 |
| | 10:21 | | 5.15 | 58.2 | | |
| 7 | 10:24 | 30 | 5.00 | 60.0 | 1.9 | 0.05 |
| | 10:54 | | 5.16 | 58.1 | | |
| 8 | 10:56 | 30 | 5.00 | 60.0 | 1.8 | 0.05 |
| | 11:26 | | 5.15 | 58.2 | | |

Infiltration Rate (I) = Discharge Volume/Surface Area of Test Section/Time Interval

**Measured Infiltration Rate, I (Average of Last 3 Readings) =** **0.05** **in./hr.**

# APPENDIX C

# LABORATORY TEST RESULTS

# MODIFIED PROCTOR COMPACTION TEST

**ASTM D 1557**

| | | | | | |
|---|---|---|---|---|---|
| Project Name: | Rexford/13925 Benson Ave/Geo | Tested By: | MRV/FLM | Date: | 02/16/23 |
| Project No.: | 13807.001 | Checked By: | M. Vinet | Date: | 03/03/23 |
| Boring No.: | LB-4 | Depth (ft.): | 0 - 5.0 | | |
| Sample No.: | B-1 | | | | |
| Soil Identification: | Silty Sand (SM), Very Dark Yellowish Brown. | | | | |

Preparation Method: [X] Moist [ ] Dry

[X] Mechanical Ram [ ] Manual Ram

**Mold Volume ($ft^3$)** 0.03340 *Ram Weight = 10 lb.; Drop = 18 in.*

| TEST NO. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Wt. Compacted Soil + Mold (g) | 5470 | 5605 | 5645 | 5593 | | |
| Weight of Mold (g) | 3524 | 3524 | 3524 | 3524 | | |
| Net Weight of Soil (g) | 1946 | 2081 | 2121 | 2069 | | |
| Wet Weight of Soil + Cont. (g) | 1255.3 | 1353.0 | 1390.0 | 1342.1 | | |
| Dry Weight of Soil + Cont. (g) | 1191.2 | 1264.5 | 1280.5 | 1220.0 | | |
| Weight of Container (g) | 276.8 | 280.2 | 280.5 | 277.7 | | |
| Moisture Content (%) | 7.0 | 9.0 | 11.0 | 13.0 | | |
| Wet Density (pcf) | 128.4 | 137.4 | 140.0 | 136.6 | | |
| Dry Density (pcf) | 120.0 | 126.0 | 126.2 | 120.9 | | |

**Maximum Dry Density (pcf)** **126.8** **Optimum Moisture Content (%)** **10.0**

## PROCEDURE USED

[X] **Procedure A**
Soil Passing No. 4 (4.75 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
May be used if +#4 is 20% or less

[ ] **Procedure B**
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
Use if +#4 is >20% and +3/8 in. is 20% or less

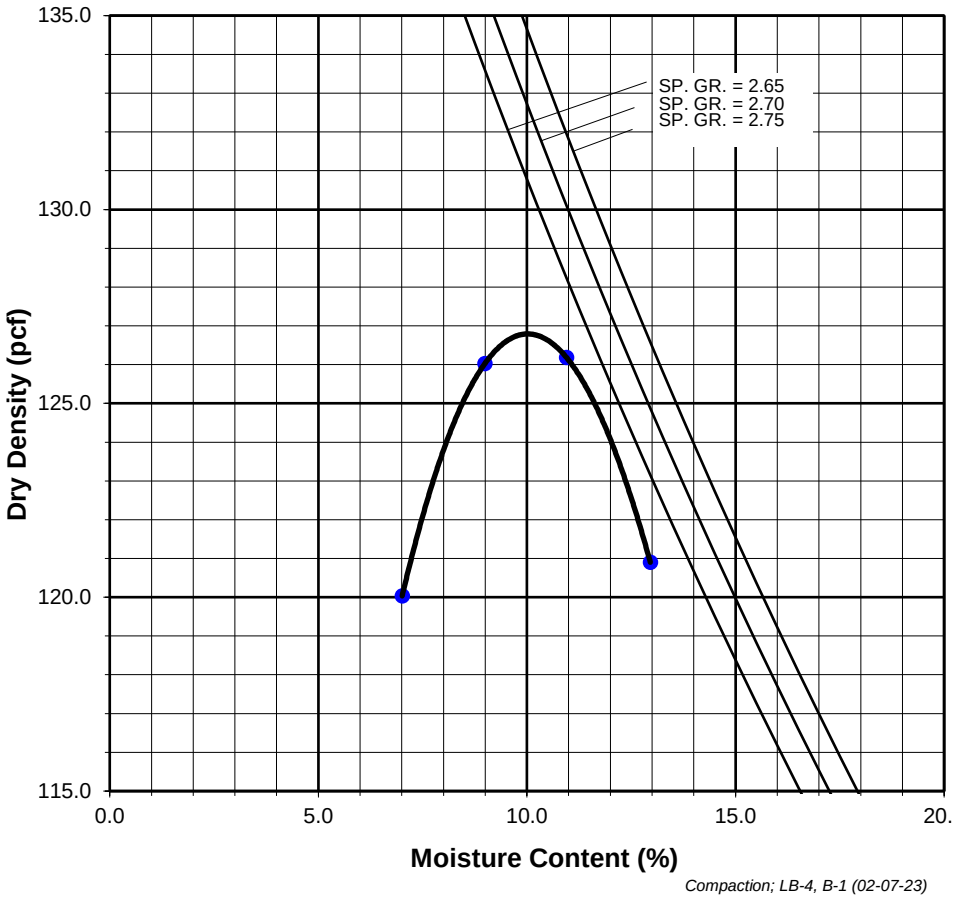
[ ] **Procedure C**
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)
Use if +3/8 in. is >20% and +¾ in. is <30%

**Particle-Size Distribution:**

GR:SA:FI

**Atterberg Limits:**

LL,PL,PI




*Compaction; LB-4, B-1 (02-07-23)*

# EXPANSION INDEX of SOILS

**ASTM D 4829**

| | | | | | |
|---|---|---|---|---|---|
| Project Name: | Rexford/13925 Benson Ave/Geo | Tested By: | M. Vinet | Date: | 2/22/23 |
| Project No. : | 13807.001 | Checked By: | M. Vinet | Date: | 2/23/23 |
| Boring No.: | LB-4 | Depth: | 0 - 5.0 | | |
| Sample No. : | B-1 | Location: | N/A | | |
| Sample Description: | Silty Sand (SM), Very Dark Yellowish Brown. | | | | |

| | |
|---|---|
| Dry Wt. of Soil + Cont. (gm.) | 2512.3 |
| Wt. of Container No. (gm.) | 0.0 |
| Dry Wt. of Soil (gm.) | 2512.3 |
| Weight Soil Retained on #4 Sieve | 22.1 |
| Percent Passing # 4 | 99.1 |

| **MOLDED SPECIMEN** | Before Test | After Test |
|---|---|---|
| Specimen Diameter (in.) | 4.01 | 4.01 |
| Specimen Height (in.) | 1.0000 | 1.0060 |
| Wt. Comp. Soil + Mold (gm.) | 608.0 | 642.0 |
| Wt. of Mold (gm.) | 209.0 | 209.0 |
| Specific Gravity (Assumed) | 2.70 | 2.70 |
| Container No. | 10 | 10 |
| Wet Wt. of Soil + Cont. (gm.) | 350.1 | 642.0 |
| Dry Wt. of Soil + Cont. (gm.) | 324.1 | 364.4 |
| Wt. of Container (gm.) | 50.1 | 209.0 |
| Moisture Content (%) | 9.5 | 18.8 |
| Wet Density (pcf) | 120.4 | 129.8 |
| Dry Density (pcf) | 109.9 | 109.3 |
| Void Ratio | 0.534 | 0.543 |
| Total Porosity | 0.348 | 0.352 |
| Pore Volume (cc) | 72.0 | 73.3 |
| Degree of Saturation (%) [ S meas] | **48.1** | **93.6** |

**SPECIMEN INUNDATION** in distilled water for the period of 24 h or expansion rate < 0.0002 in./h.

| Date | Time | Pressure (psi) | Elapsed Time (min.) | Dial Readings (in.) |
|---|---|---|---|---|
| | | | | |
| 2/22/23 | 9:00 | 1.0 | 0 | 0.5000 |
| 2/22/23 | 9:10 | 1.0 | 10 | 0.5000 |
| | Add Distilled Water to the Specimen | | | |
| 2/23/23 | 8:00 | 1.0 | 1370 | 0.5060 |
| 2/23/23 | 9:00 | 1.0 | 1430 | 0.5060 |

| | | |
|---|---|---|
| Expansion Index (EI meas) = | ((Final Rdg - Initial Rdg) / Initial Thick.) x 1000 | 6.0 |
| Expansion Index ( Report ) = | Nearest Whole Number or Zero (0) if Initial Height is > than Final Height | **6** |

# ATTERBERG LIMITS

**ASTM D 4318**

| | | | | | |
|---|---|---|---|---|---|
| Project Name: | Rexford/13925 Benson Ave/Geo | Tested By: | M. Vinet | Date: | 02/27/23 |
| Project No. : | 13807.001 | Input By: | M. Vinet | Date: | 02/28/23 |
| Boring No.: | LB-1 | Checked By: | M. Vinet | | |
| Sample No.: | S-3 | Depth (ft.) | 10.0 | | |
| Soil Identification: | Lean Clay (CL), Olive Brown. | | | | |

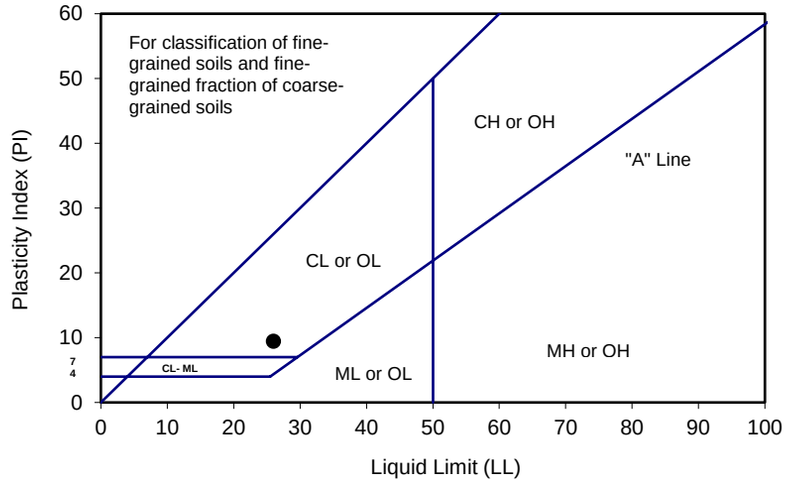
| TEST | PLASTIC LIMIT | | LIQUID LIMIT | | | |
|---|---|---|---|---|---|---|
| NO. | 1 | 2 | 1 | 2 | 3 | 4 |
| Number of Blows [N] | | | 15 | 22 | 31 | |
| Wet Wt. of Soil + Cont. (g) | 21.19 | 21.02 | 23.71 | 24.84 | 27.58 | |
| Dry Wt. of Soil + Cont. (g) | 20.13 | 20.00 | 21.56 | 22.52 | 24.75 | |
| Wt. of Container (g) | 13.77 | 13.79 | 13.67 | 13.69 | 13.65 | |
| Moisture Content (%) [Wn] | 16.67 | 16.43 | 27.25 | 26.27 | 25.50 | |

| | |
|---|---|
| **Liquid Limit** | **26** |
| **Plastic Limit** | **17** |
| **Plasticity Index** | **9** |
| **Classification** | **CL** |

PI at "A" - Line = 0.73(LL-20) 4.38

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



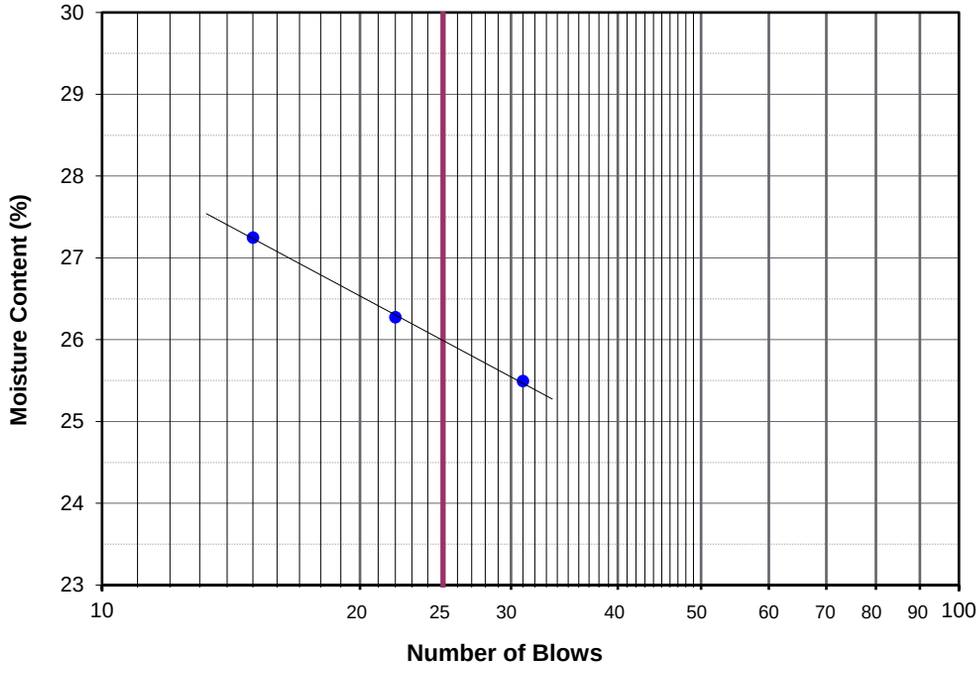

**PROCEDURES USED**

☐ Wet Preparation
Multipoint - Wet

☒ Dry Preparation
Multipoint - Dry

☒ Procedure A
Multipoint Test

☐ Procedure B
One-point Test



# ATTERBERG LIMITS

**ASTM D 4318**

| | | | | | |
|---|---|---|---|---|---|
| Project Name: | Rexford/13925 Benson Ave/Geo | Tested By: | M. Vinet | Date: | 02/27/23 |
| Project No. : | 13807.001 | Input By: | M. Vinet | Date: | 02/28/23 |
| Boring No.: | LB-4 | Checked By: | M. Vinet | | |
| Sample No.: | S-4 | Depth (ft.) | 15.0 | | |
| Soil Identification: | Lean Clay (CL), Olive Brown. | | | | |

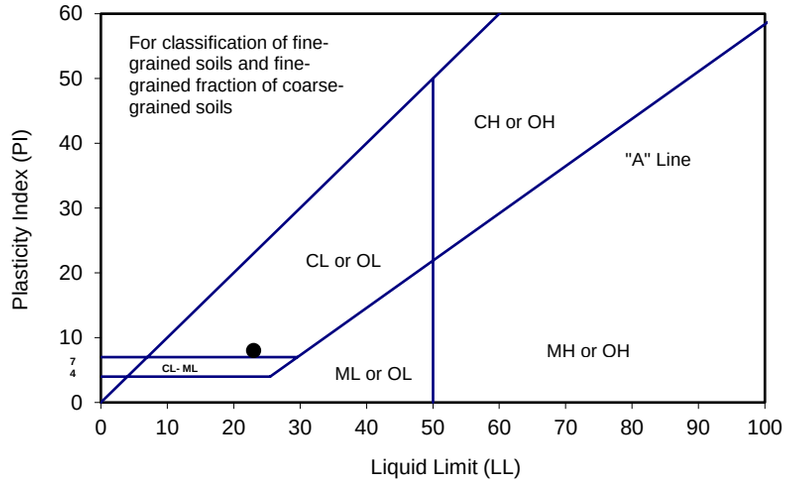
| TEST | PLASTIC LIMIT | | LIQUID LIMIT | | | |
|---|---|---|---|---|---|---|
| NO. | 1 | 2 | 1 | 2 | 3 | 4 |
| Number of Blows [N] | | | 15 | 25 | 35 | |
| Wet Wt. of Soil + Cont. (g) | 23.77 | 21.58 | 25.69 | 25.53 | 28.49 | |
| Dry Wt. of Soil + Cont. (g) | 22.48 | 20.54 | 23.38 | 23.37 | 25.87 | |
| Wt. of Container (g) | 13.76 | 13.66 | 13.67 | 13.78 | 13.75 | |
| Moisture Content (%) [Wn] | 14.79 | 15.12 | 23.79 | 22.52 | 21.62 | |

| | |
|---|---|
| **Liquid Limit** | **23** |
| **Plastic Limit** | **15** |
| **Plasticity Index** | **8** |
| **Classification** | **CL** |

PI at "A" - Line = 0.73(LL-20) 2.19

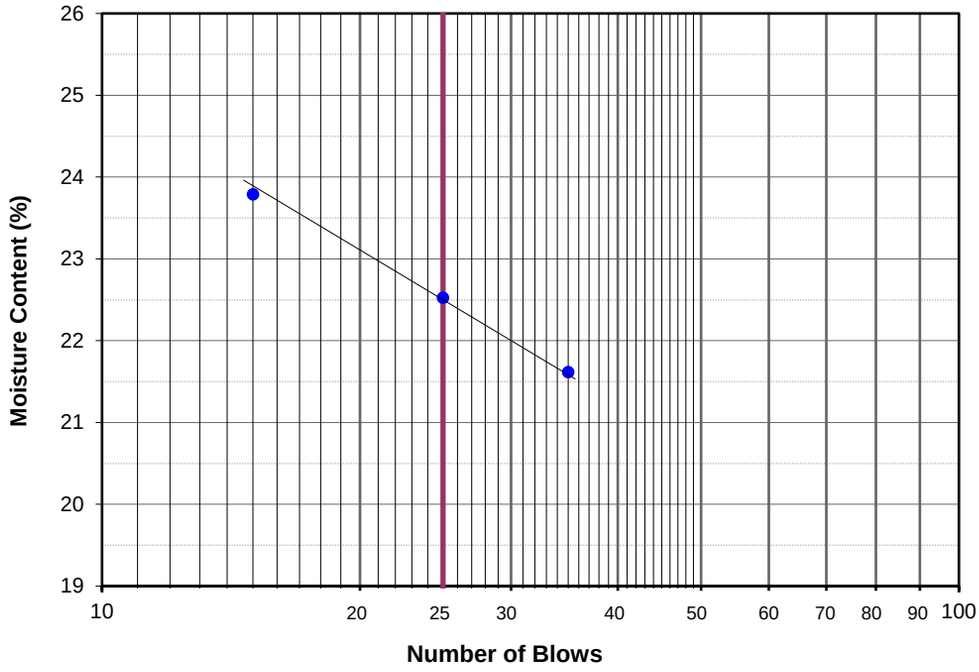
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$




**PROCEDURES USED**

- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



# ATTERBERG LIMITS

**ASTM D 4318**

| | | | | | |
|---|---|---|---|---|---|
| Project Name: | Rexford/13925 Benson Ave/Geo | Tested By: | F. Mina | Date: | 02/22/23 |
| Project No. : | 13807.001 | Input By: | M. Vinet | Date: | 02/28/23 |
| Boring No.: | LB-5 | Checked By: | M. Vinet | | |
| Sample No.: | R-3 | Depth (ft.) | 10.0 | | |
| Soil Identification: | Lean Clay (CL), Olive Brown. | | | | |

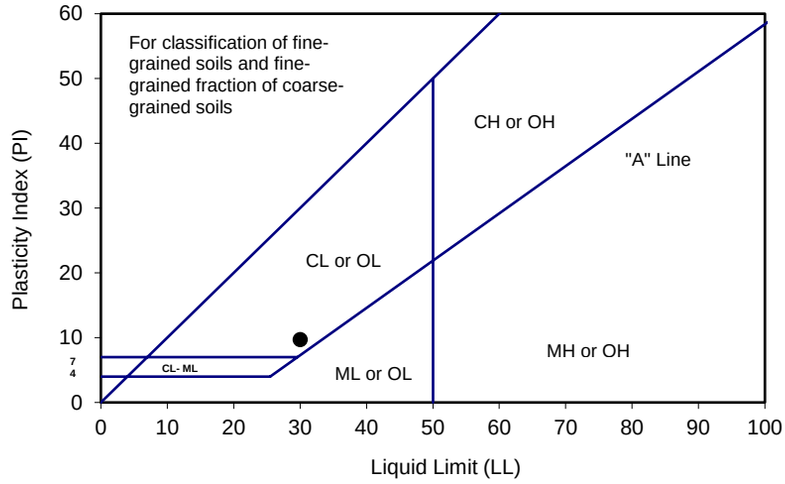
| TEST | PLASTIC LIMIT | | LIQUID LIMIT | | | |
|---|---|---|---|---|---|---|
| NO. | 1 | 2 | 1 | 2 | 3 | 4 |
| Number of Blows [N] | | | 15 | 25 | 35 | |
| Wet Wt. of Soil + Cont. (g) | 28.45 | 21.32 | 22.62 | 21.76 | 24.02 | |
| Dry Wt. of Soil + Cont. (g) | 25.95 | 20.06 | 20.50 | 19.93 | 21.74 | |
| Wt. of Container (g) | 13.76 | 13.77 | 13.70 | 13.74 | 13.76 | |
| Moisture Content (%) [Wn] | 20.51 | 20.03 | 31.18 | 29.56 | 28.57 | |

| | |
|---|---|
| **Liquid Limit** | **30** |
| **Plastic Limit** | **20** |
| **Plasticity Index** | **10** |
| **Classification** | **CL** |

PI at "A" - Line = 0.73(LL-20) 7.3

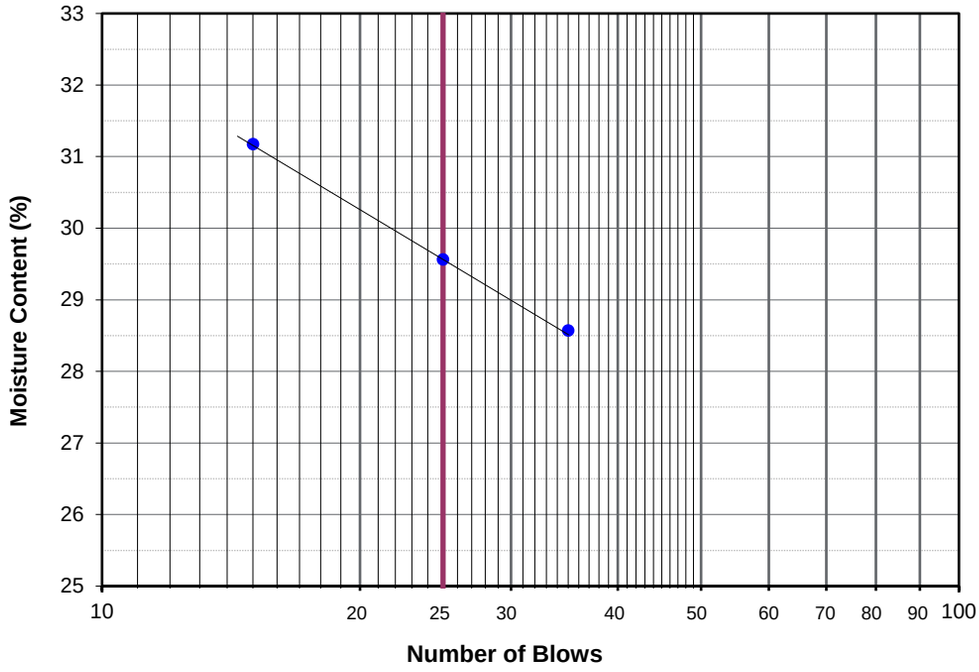
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$




**PROCEDURES USED**

- [ ] Wet Preparation — Multipoint - Wet
- [X] Dry Preparation — Multipoint - Dry
- [X] Procedure A — Multipoint Test
- [ ] Procedure B — One-point Test



# ATTERBERG LIMITS

**ASTM D 4318**

| | | | | | |
|---|---|---|---|---|---|
| Project Name: | Rexford/13925 Benson Ave/Geo | Tested By: | F. Mina | Date: | 02/22/23 |
| Project No. : | 13807.001 | Input By: | M. Vinet | Date: | 02/28/23 |
| Boring No.: | LB-5 | Checked By: | M. Vinet | | |
| Sample No.: | S-4 | Depth (ft.) | 15.0 | | |
| Soil Identification: | Lean Clay (CL), Olive Brown. | | | | |

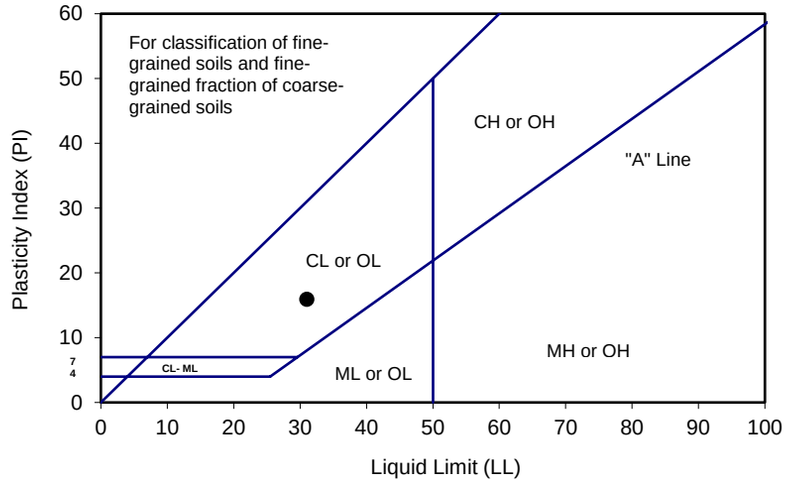
| TEST | PLASTIC LIMIT | | LIQUID LIMIT | | | |
|---|---|---|---|---|---|---|
| NO. | 1 | 2 | 1 | 2 | 3 | 4 |
| Number of Blows [N] | | | 15 | 25 | 35 | |
| Wet Wt. of Soil + Cont. (g) | 23.27 | 26.29 | 22.33 | 21.59 | 23.68 | |
| Dry Wt. of Soil + Cont. (g) | 22.00 | 24.66 | 20.16 | 19.70 | 21.41 | |
| Wt. of Container (g) | 13.67 | 13.73 | 13.71 | 13.66 | 13.75 | |
| Moisture Content (%) [Wn] | 15.25 | 14.91 | 33.64 | 31.29 | 29.63 | |

| | |
|---|---|
| **Liquid Limit** | **31** |
| **Plastic Limit** | **15** |
| **Plasticity Index** | **16** |
| **Classification** | **CL** |

PI at "A" - Line = 0.73(LL-20) 8.03

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



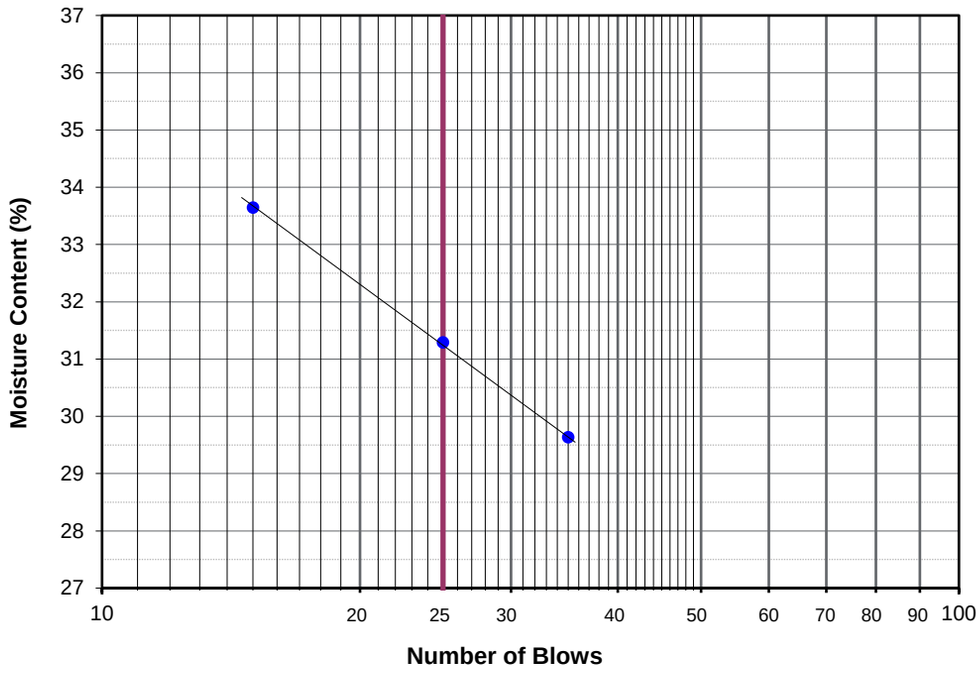

**PROCEDURES USED**

☐ Wet Preparation
Multipoint - Wet

☒ Dry Preparation
Multipoint - Dry

☒ Procedure A
Multipoint Test

☐ Procedure B
One-point Test



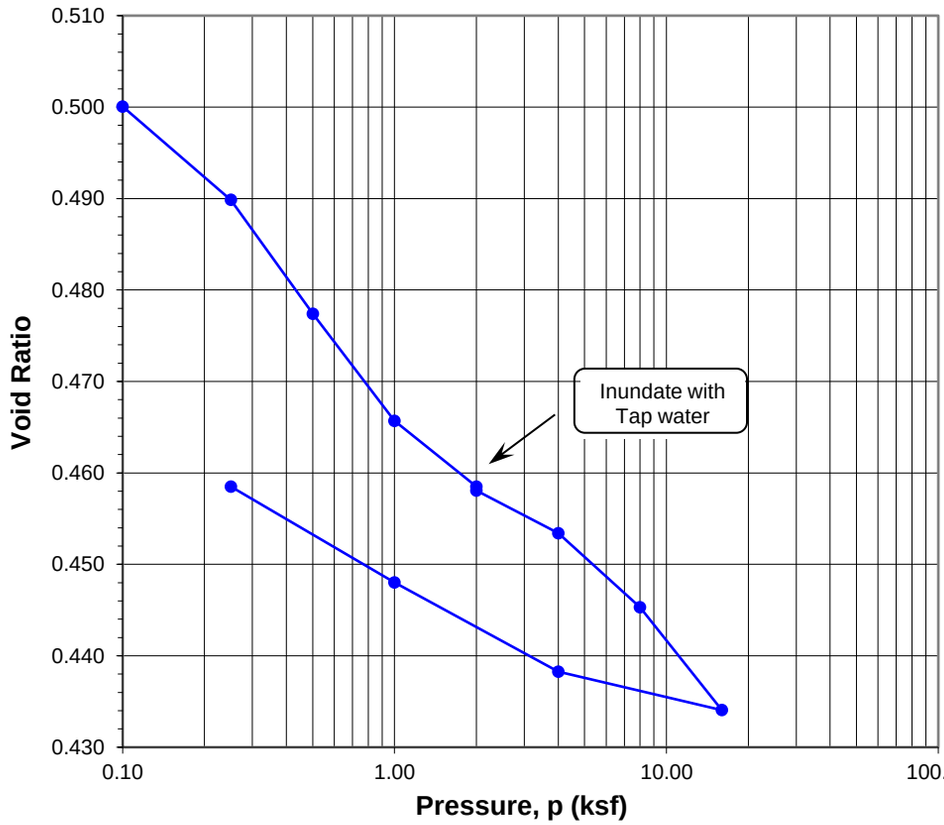
# ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS

**ASTM D 2435**

Project Name: Rexford/13925 Benson Ave/Geo
Project No.: 13807.001
Boring No.: LB-4
Sample No.: B-1
Soil Identification: Silty Sand (SM), Very Dark Yellowish Brown.

Tested By: M. Vinet Date: 02/23/23
Checked By: M. Vinet Date: 03/08/23
Depth (ft.): 0 - 5.0
Sample Type: 90% Remold

| | |
|---|---|
| Sample Diameter (in.): | 2.415 |
| Sample Thickness (in.): | 1.000 |
| Weight of Sample + ring (g): | 194.00 |
| Weight of Ring (g): | 43.21 |
| Height after consol. (in.): | 0.9723 |
| **Before Test** | |
| Wt. of Wet Sample+Cont. (g): | 288.64 |
| Wt. of Dry Sample+Cont. (g): | 262.89 |
| Weight of Container (g): | 32.76 |
| Initial Moisture Content (%) | 11.2 |
| Initial Dry Density (pcf) | 112.8 |
| Initial Saturation (%): | 61 |
| Initial Vertical Reading (in.) | 0.0000 |
| **After Test** | |
| Wt. of Wet Sample+Cont. (g): | 251.27 |
| Wt. of Dry Sample+Cont. (g): | 230.32 |
| Weight of Container (g): | 50.58 |
| Final Moisture Content (%) | 15.34 |
| Final Dry Density (pcf): | 116.8 |
| Final Saturation (%): | 93 |
| Final Vertical Reading (in.) | 0.0310 |
| Specific Gravity (assumed): | 2.71 |
| Water Density (pcf): | 62.43 |

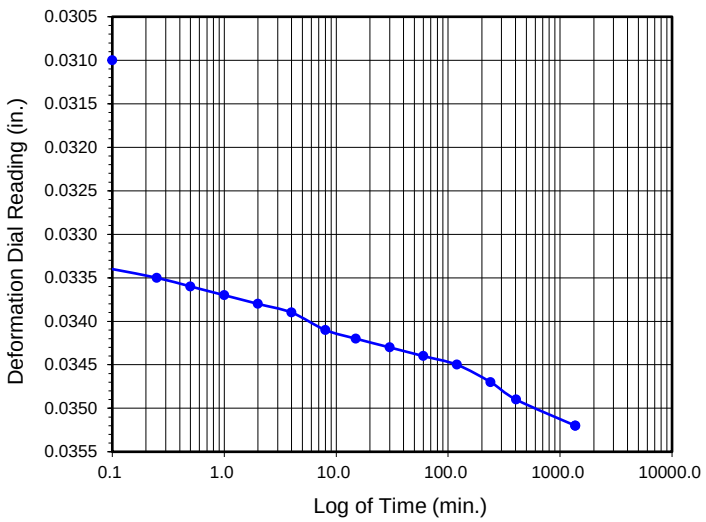


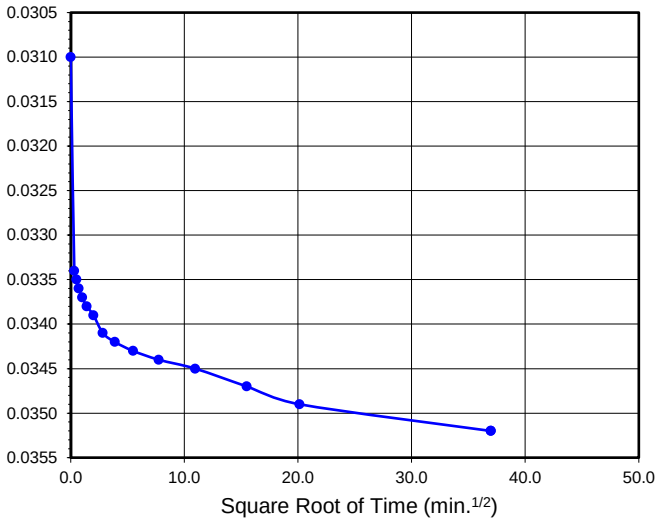

| Pressure (p) (ksf) | Final Reading (in.) | Apparent Thickness (in.) | Load Compliance (%) | Deformation % of Sample Thickness | Void Ratio | Corrected Deformation (%) |
|---|---|---|---|---|---|---|
| 0.10 | 0.0000 | 1.0000 | 0.00 | 0.00 | 0.500 | 0.00 |
| 0.25 | 0.0072 | 0.9928 | 0.04 | 0.72 | 0.490 | 0.68 |
| 0.50 | 0.0160 | 0.9840 | 0.09 | 1.60 | 0.477 | 1.51 |
| 1.00 | 0.0248 | 0.9752 | 0.19 | 2.48 | 0.466 | 2.29 |
| 2.00 | 0.0296 | 0.9704 | 0.19 | 2.96 | 0.459 | 2.77 |
| 2.00 | 0.0310 | 0.9690 | 0.30 | 3.10 | 0.458 | 2.80 |
| 4.00 | 0.0352 | 0.9648 | 0.41 | 3.52 | 0.453 | 3.11 |
| 8.00 | 0.0420 | 0.9580 | 0.55 | 4.20 | 0.445 | 3.65 |
| 16.00 | 0.0512 | 0.9488 | 0.72 | 5.12 | 0.434 | 4.40 |
| 4.00 | 0.0468 | 0.9532 | 0.56 | 4.68 | 0.438 | 4.12 |
| 1.00 | 0.0391 | 0.9609 | 0.44 | 3.91 | 0.448 | 3.47 |
| 0.25 | 0.0310 | 0.9690 | 0.33 | 3.10 | 0.459 | 2.77 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

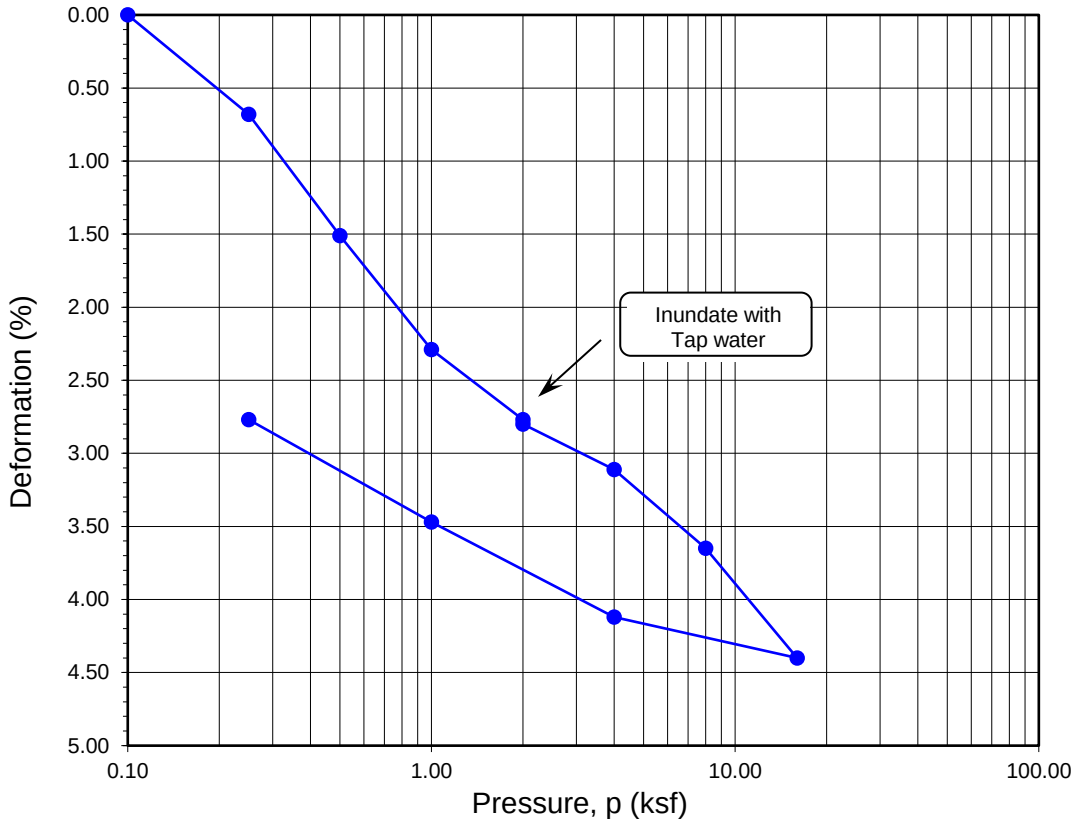
Time Readings @ 4.0 ksf

| Date | Time | Elapsed Time (min) | Square Root of Time | Dial Rdgs. (in.) |
|---|---|---|---|---|
| 3/3/23 | 8:15:00 | 0.0 | 0.0 | 0.0310 |
| 3/3/23 | 8:15:06 | 0.1 | 0.3 | 0.0334 |
| 3/3/23 | 8:15:15 | 0.2 | 0.5 | 0.0335 |
| 3/3/23 | 8:15:30 | 0.5 | 0.7 | 0.0336 |
| 3/3/23 | 8:16:00 | 1.0 | 1.0 | 0.0337 |
| 3/3/23 | 8:17:00 | 2.0 | 1.4 | 0.0338 |
| 3/3/23 | 8:19:00 | 4.0 | 2.0 | 0.0339 |
| 3/3/23 | 8:23:00 | 8.0 | 2.8 | 0.0341 |
| 3/3/23 | 8:30:00 | 15.0 | 3.9 | 0.0342 |
| 3/3/23 | 8:45:00 | 30.0 | 5.5 | 0.0343 |
| 3/3/23 | 9:15:00 | 60.0 | 7.7 | 0.0344 |
| 3/3/23 | 10:15:00 | 120.0 | 11.0 | 0.0345 |
| 3/3/23 | 12:15:00 | 240.0 | 15.5 | 0.0347 |
| 3/3/23 | 15:00:00 | 405.0 | 20.1 | 0.0349 |
| 3/4/23 | 7:03:00 | 1368.0 | 37.0 | 0.0352 |
| 3/4/23 | 7:03:00 | 1368.0 | 37.0 | 0.0352 |

Time Readings @ 4.0 ksf




| Boring No. | Sample No. | Depth (ft.) | Moisture Content (%) | | Dry Density (pcf) | | Void Ratio | | Degree of Saturation (%) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Initial | Final | Initial | Final | Initial | Final | Initial | Final |
| **LB-4** | **B-1** | **0 - 5.0** | **11.2** | **15.3** | **112.8** | **116.8** | **0.500** | **0.459** | **61** | **93** |

Soil Identification: Silty Sand (SM), Very Dark Yellowish Brown.

Leighton

**ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS**
**ASTM D 2435**

Project No.: 13807.001

Rexford/13925 Benson Ave/Geo

03-23

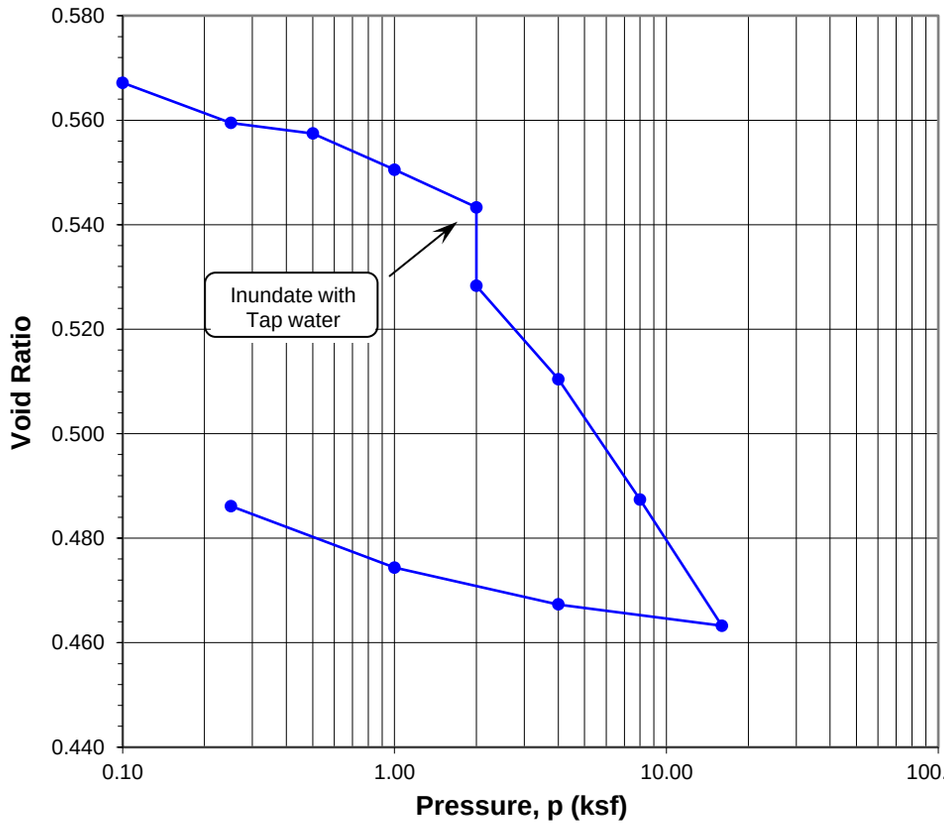
# ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS

**ASTM D 2435**

Project Name: Rexford/13925 Benson Ave/Geo
Project No.: 13807.001
Boring No.: LB-4
Sample No.: R-1
Soil Identification: Sandy Silt s(ML), Brown.

Tested By: M. Vinet Date: 02/22/23
Checked By: M. Vinet Date: 03/08/23
Depth (ft.): 5.0
Sample Type: Ring

| | |
|---|---|
| Sample Diameter (in.): | 2.415 |
| Sample Thickness (in.): | 1.000 |
| Weight of Sample + ring (g): | 197.43 |
| Weight of Ring (g): | 45.36 |
| Height after consol. (in.): | 0.9483 |
| **Before Test** | |
| Wt. of Wet Sample+Cont. (g): | 192.22 |
| Wt. of Dry Sample+Cont. (g): | 171.43 |
| Weight of Container (g): | 50.20 |
| Initial Moisture Content (%) | 17.1 |
| Initial Dry Density (pcf) | 108.0 |
| Initial Saturation (%): | 82 |
| Initial Vertical Reading (in.) | 0.0000 |
| **After Test** | |
| Wt. of Wet Sample+Cont. (g): | 249.18 |
| Wt. of Dry Sample+Cont. (g): | 226.95 |
| Weight of Container (g): | 49.80 |
| Final Moisture Content (%) | 16.87 |
| Final Dry Density (pcf): | 115.6 |
| Final Saturation (%): | 99 |
| Final Vertical Reading (in.) | 0.0550 |
| Specific Gravity (assumed): | 2.71 |
| Water Density (pcf): | 62.43 |

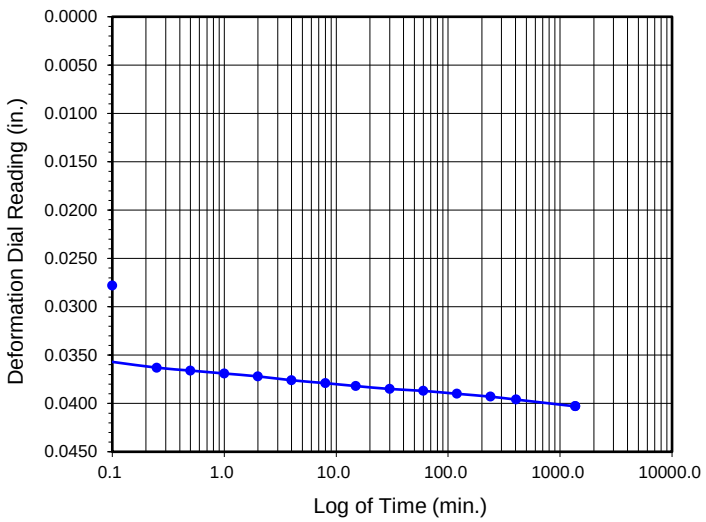


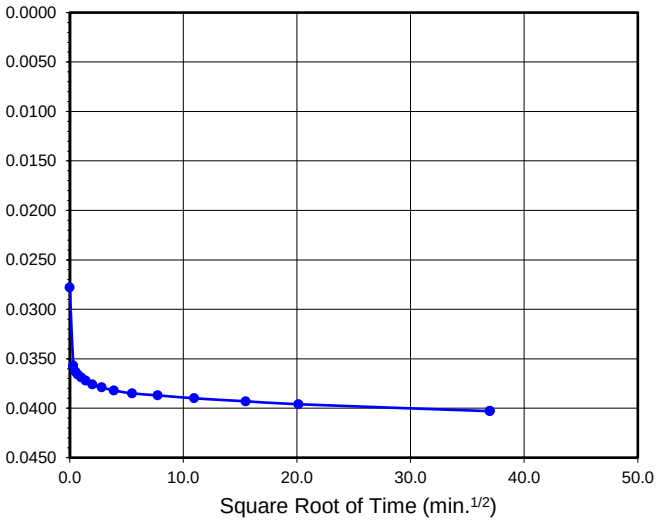

| Pressure (p) (ksf) | Final Reading (in.) | Apparent Thickness (in.) | Load Compliance (%) | Deformation % of Sample Thickness | Void Ratio | Corrected Deformation (%) |
|---|---|---|---|---|---|---|
| 0.10 | 0.0000 | 1.0000 | 0.00 | 0.00 | 0.567 | 0.00 |
| 0.25 | 0.0053 | 0.9947 | 0.04 | 0.53 | 0.559 | 0.49 |
| 0.50 | 0.0071 | 0.9929 | 0.09 | 0.71 | 0.557 | 0.62 |
| 1.00 | 0.0125 | 0.9875 | 0.19 | 1.25 | 0.551 | 1.06 |
| 2.00 | 0.0171 | 0.9829 | 0.19 | 1.71 | 0.543 | 1.52 |
| 2.00 | 0.0278 | 0.9722 | 0.30 | 2.78 | 0.528 | 2.48 |
| 4.00 | 0.0403 | 0.9597 | 0.41 | 4.03 | 0.510 | 3.62 |
| 8.00 | 0.0564 | 0.9436 | 0.55 | 5.64 | 0.487 | 5.09 |
| 16.00 | 0.0735 | 0.9265 | 0.72 | 7.35 | 0.463 | 6.63 |
| 4.00 | 0.0693 | 0.9307 | 0.56 | 6.93 | 0.467 | 6.37 |
| 1.00 | 0.0636 | 0.9364 | 0.44 | 6.36 | 0.474 | 5.92 |
| 0.25 | 0.0550 | 0.9450 | 0.33 | 5.50 | 0.486 | 5.17 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

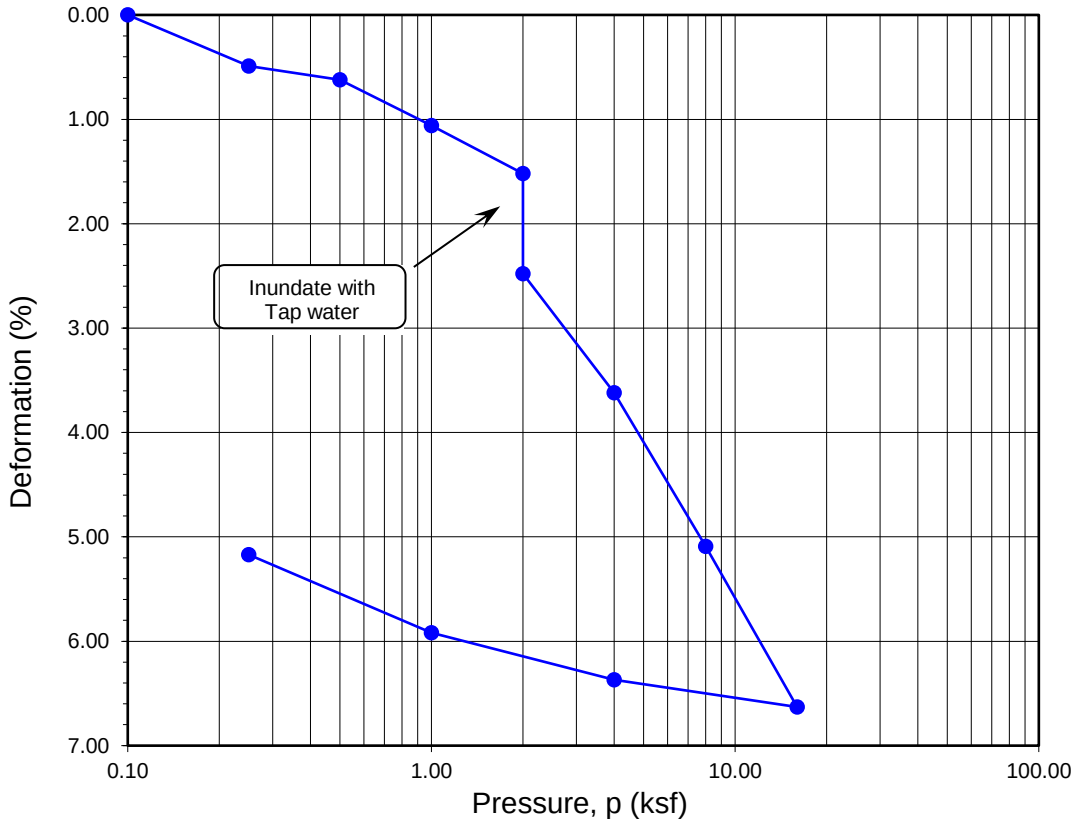
Time Readings @ 4.0 ksf

| Date | Time | Elapsed Time (min) | Square Root of Time | Dial Rdgs. (in.) |
|---|---|---|---|---|
| 3/2/23 | 8:15:00 | 0.0 | 0.0 | 0.0278 |
| 3/2/23 | 8:15:06 | 0.1 | 0.3 | 0.0357 |
| 3/2/23 | 8:15:15 | 0.2 | 0.5 | 0.0363 |
| 3/2/23 | 8:15:30 | 0.5 | 0.7 | 0.0366 |
| 3/2/23 | 8:16:00 | 1.0 | 1.0 | 0.0369 |
| 3/2/23 | 8:17:00 | 2.0 | 1.4 | 0.0372 |
| 3/2/23 | 8:19:00 | 4.0 | 2.0 | 0.0376 |
| 3/2/23 | 8:23:00 | 8.0 | 2.8 | 0.0379 |
| 3/2/23 | 8:30:00 | 15.0 | 3.9 | 0.0382 |
| 3/2/23 | 8:45:00 | 30.0 | 5.5 | 0.0385 |
| 3/2/23 | 9:15:00 | 60.0 | 7.7 | 0.0387 |
| 3/2/23 | 10:15:00 | 120.0 | 11.0 | 0.0390 |
| 3/2/23 | 12:15:00 | 240.0 | 15.5 | 0.0393 |
| 3/2/23 | 15:00:00 | 405.0 | 20.1 | 0.0396 |
| 3/3/23 | 7:03:00 | 1368.0 | 37.0 | 0.0403 |
| 3/3/23 | 7:03:00 | 1368.0 | 37.0 | 0.0403 |

Time Readings @ 4.0 ksf




| Boring No. | Sample No. | Depth (ft.) | Moisture Content (%) | | Dry Density (pcf) | | Void Ratio | | Degree of Saturation (%) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Initial | Final | Initial | Final | Initial | Final | Initial | Final |
| **LB-4** | **R-1** | **5** | **17.1** | **16.9** | **108.0** | **115.6** | **0.567** | **0.486** | **82** | **99** |

Soil Identification: Sandy Silt s(ML), Brown.

Leighton

**ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS**
**ASTM D 2435**

Project No.: 13807.001

Rexford/13925 Benson Ave/Geo

03-23

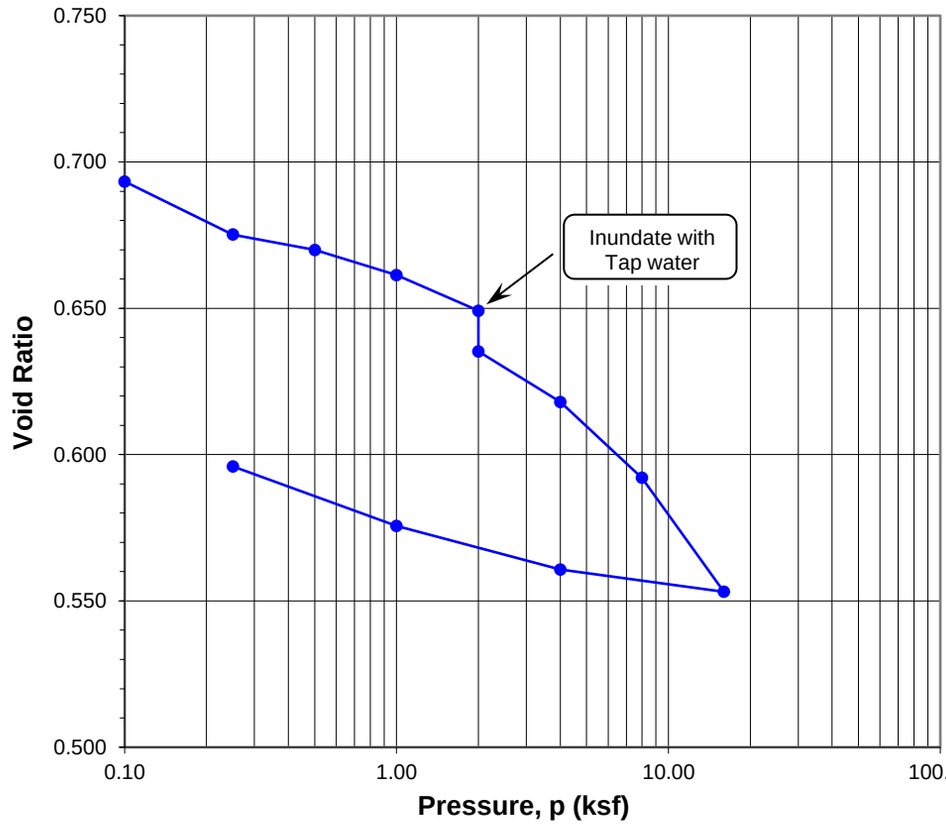
# ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS

**ASTM D 2435**

Project Name: Rexford/13925 Benson Ave/Geo
Project No.: 13807.001
Boring No.: LB-5
Sample No.: R-3
Soil Identification: Lean Clay (CL), Olive Gray.

Tested By: M. Vinet Date: 02/23/23
Checked By: M. Vinet Date: 03/08/23
Depth (ft.): 10.0
Sample Type: Ring

| | |
|---|---|
| Sample Diameter (in.): | 2.415 |
| Sample Thickness (in.): | 1.000 |
| Weight of Sample + ring (g): | 190.71 |
| Weight of Ring (g): | 44.21 |
| Height after consol. (in.): | 0.9425 |
| **Before Test** | |
| Wt. of Wet Sample+Cont. (g): | 350.41 |
| Wt. of Dry Sample+Cont. (g): | 296.42 |
| Weight of Container (g): | 50.38 |
| Initial Moisture Content (%) | 21.9 |
| Initial Dry Density (pcf) | 99.9 |
| Initial Saturation (%): | 86 |
| Initial Vertical Reading (in.) | 0.0000 |
| **After Test** | |
| Wt. of Wet Sample+Cont. (g): | 239.70 |
| Wt. of Dry Sample+Cont. (g): | 211.25 |
| Weight of Container (g): | 49.80 |
| Final Moisture Content (%) | 24.27 |
| Final Dry Density (pcf): | 103.5 |
| Final Saturation (%): | 103 |
| Final Vertical Reading (in.) | 0.0608 |
| Specific Gravity (assumed): | 2.71 |
| Water Density (pcf): | 62.43 |

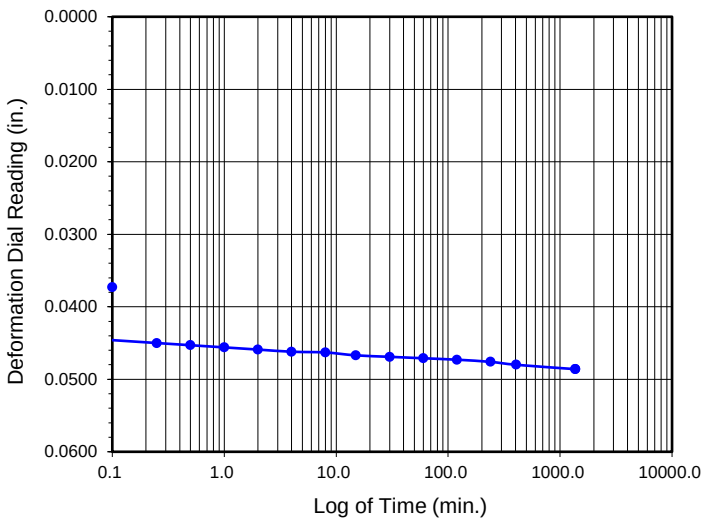


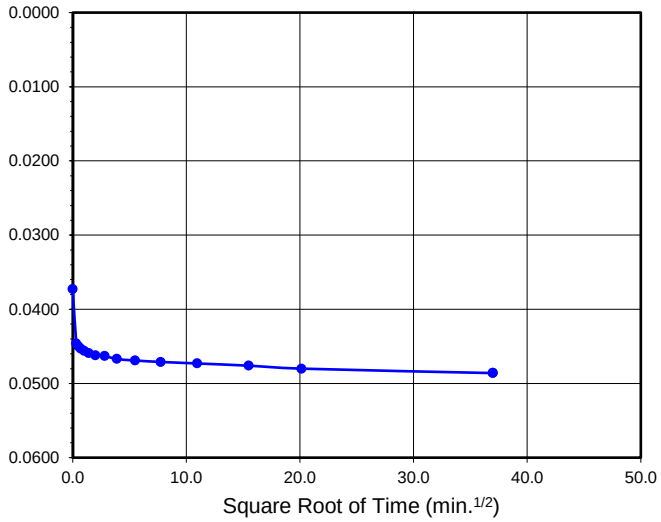

| Pressure (p) (ksf) | Final Reading (in.) | Apparent Thickness (in.) | Load Compliance (%) | Deformation % of Sample Thickness | Void Ratio | Corrected Deformation (%) |
|---|---|---|---|---|---|---|
| 0.10 | 0.0000 | 1.0000 | 0.00 | 0.00 | 0.693 | 0.00 |
| 0.25 | 0.0111 | 0.9889 | 0.04 | 1.11 | 0.675 | 1.07 |
| 0.50 | 0.0147 | 0.9853 | 0.09 | 1.47 | 0.670 | 1.38 |
| 1.00 | 0.0208 | 0.9792 | 0.19 | 2.08 | 0.661 | 1.89 |
| 2.00 | 0.0280 | 0.9720 | 0.19 | 2.80 | 0.649 | 2.61 |
| 2.00 | 0.0373 | 0.9627 | 0.30 | 3.73 | 0.635 | 3.43 |
| 4.00 | 0.0486 | 0.9514 | 0.41 | 4.86 | 0.618 | 4.45 |
| 8.00 | 0.0653 | 0.9347 | 0.55 | 6.53 | 0.592 | 5.98 |
| 16.00 | 0.0900 | 0.9100 | 0.72 | 9.00 | 0.553 | 8.28 |
| 4.00 | 0.0839 | 0.9161 | 0.56 | 8.39 | 0.561 | 7.83 |
| 1.00 | 0.0739 | 0.9261 | 0.44 | 7.39 | 0.576 | 6.95 |
| 0.25 | 0.0608 | 0.9392 | 0.33 | 6.08 | 0.596 | 5.75 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

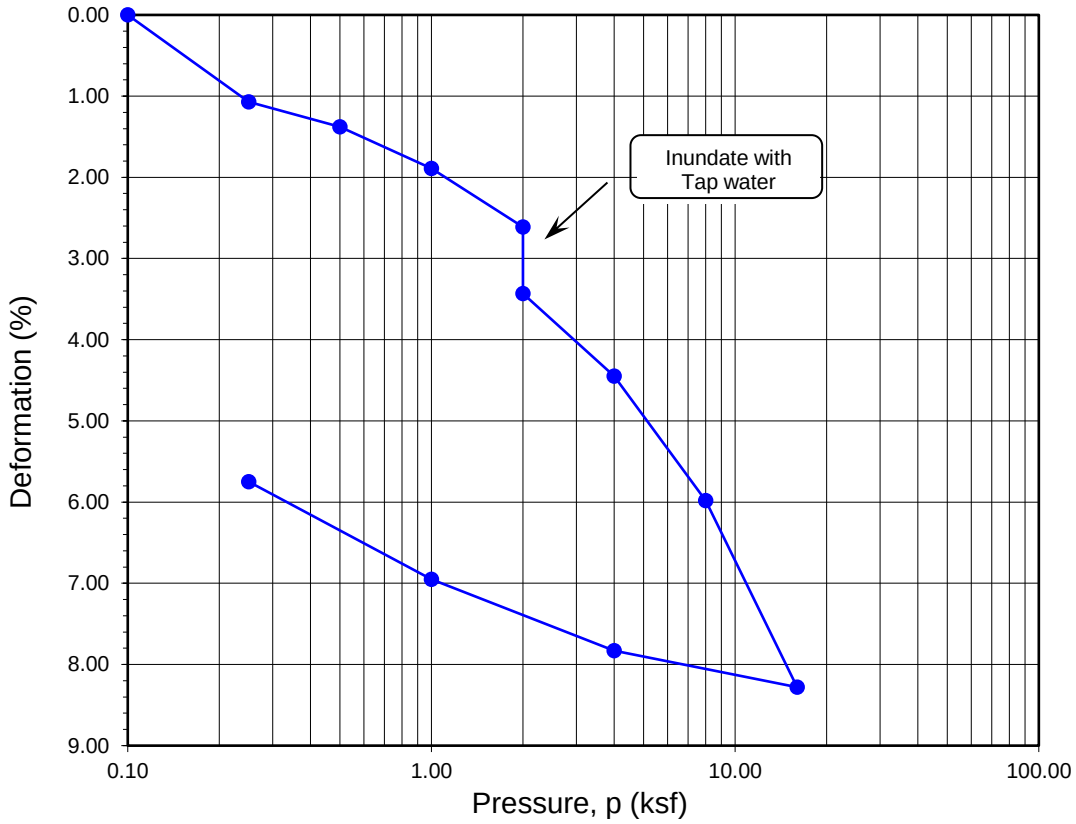
Time Readings @ 4.0 ksf

| Date | Time | Elapsed Time (min) | Square Root of Time | Dial Rdgs. (in.) |
|---|---|---|---|---|
| 3/6/23 | 8:15:00 | 0.0 | 0.0 | 0.0373 |
| 3/6/23 | 8:15:06 | 0.1 | 0.3 | 0.0446 |
| 3/6/23 | 8:15:15 | 0.2 | 0.5 | 0.0450 |
| 3/6/23 | 8:15:30 | 0.5 | 0.7 | 0.0453 |
| 3/6/23 | 8:16:00 | 1.0 | 1.0 | 0.0456 |
| 3/6/23 | 8:17:00 | 2.0 | 1.4 | 0.0459 |
| 3/6/23 | 8:19:00 | 4.0 | 2.0 | 0.0462 |
| 3/6/23 | 8:23:00 | 8.0 | 2.8 | 0.0463 |
| 3/6/23 | 8:30:00 | 15.0 | 3.9 | 0.0467 |
| 3/6/23 | 8:45:00 | 30.0 | 5.5 | 0.0469 |
| 3/6/23 | 9:15:00 | 60.0 | 7.7 | 0.0471 |
| 3/6/23 | 10:15:00 | 120.0 | 11.0 | 0.0473 |
| 3/6/23 | 12:15:00 | 240.0 | 15.5 | 0.0476 |
| 3/6/23 | 15:00:00 | 405.0 | 20.1 | 0.0480 |
| 3/7/23 | 7:03:00 | 1368.0 | 37.0 | 0.0486 |
| 3/7/23 | 7:03:00 | 1368.0 | 37.0 | 0.0486 |

Time Readings @ 4.0 ksf




| Boring No. | Sample No. | Depth (ft.) | Moisture Content (%) | | Dry Density (pcf) | | Void Ratio | | Degree of Saturation (%) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Initial | Final | Initial | Final | Initial | Final | Initial | Final |
| **LB-5** | **R-3** | **10** | **21.9** | **24.3** | **99.9** | **103.5** | **0.693** | **0.596** | **86** | **103** |

Soil Identification: Lean Clay (CL), Olive Gray.

Leighton

**ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS**
**ASTM D 2435**

Project No.: 13807.001

Rexford/13925 Benson Ave/Geo

03-23

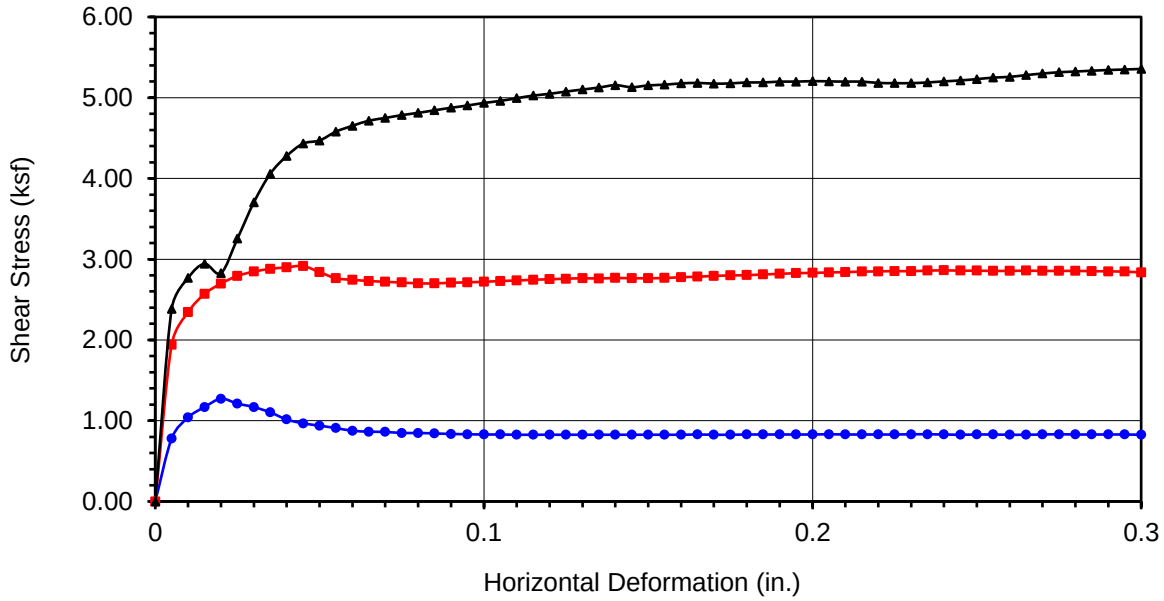
# DIRECT SHEAR TEST

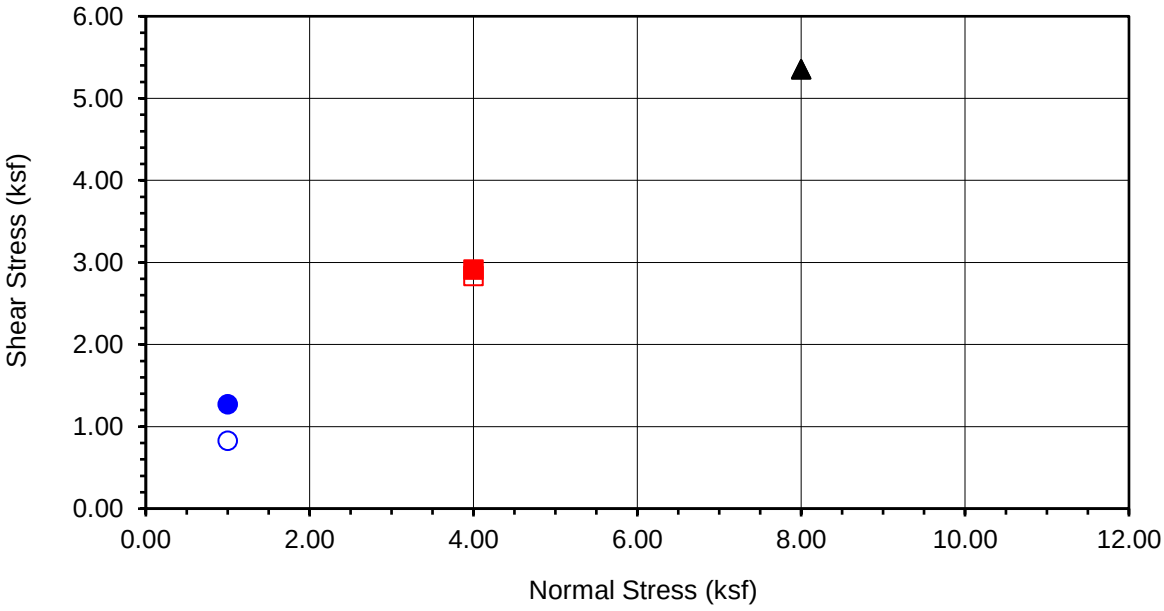
**Consolidated Drained - ASTM D 3080**

| | | | | | |
|---|---|---|---|---|---|
| Project Name: | Rexford/13925 Benson Ave/Geo | Tested By: | M. Vinet | Date: | 02/23/23 |
| Project No.: | 13807.001 | Checked By: | M. Vinet | Date: | 03/03/23 |
| Boring No.: | LB-4 | Sample Type: | 90% Remold | | |
| Sample No.: | B-1 | Depth (ft.): | 0 - 5.0 | | |

Soil Identification: Silty Sand (SM), Very Dark Yellowish Brown.

| | | | |
|---|---|---|---|
| Sample Diameter(in): | 2.415 | 2.415 | 2.415 |
| Sample Thickness(in.): | 1.000 | 1.000 | 1.000 |
| Weight of Sample + ring(gm): | 193.01 | 197.16 | 196.23 |
| Weight of Ring(gm): | 41.80 | 45.52 | 45.84 |
| **Before Shearing** | | | |
| Weight of Wet Sample+Cont.(gm): | 288.64 | 288.64 | 288.64 |
| Weight of Dry Sample+Cont.(gm): | 262.89 | 262.89 | 262.89 |
| Weight of Container(gm): | 32.76 | 32.76 | 32.76 |
| Vertical Rdg.(in): Initial | 0.0000 | 0.2500 | 0.2500 |
| Vertical Rdg.(in): Final | -0.0014 | 0.2624 | 0.2756 |
| **After Shearing** | | | |
| Weight of Wet Sample+Cont.(gm): | 209.45 | 210.53 | 208.40 |
| Weight of Dry Sample+Cont.(gm): | 185.68 | 186.34 | 184.32 |
| Weight of Container(gm): | 50.22 | 50.39 | 49.83 |
| Specific Gravity (Assumed): | 2.70 | 2.70 | 2.70 |
| Water Density(pcf): | 62.43 | 62.43 | 62.43 |




| | |
|---|---|
| **Boring No.** | **LB-4** |
| **Sample No.** | **B-1** |
| **Depth (ft)** | **0 - 5.0** |
| Sample Type: 90% Remold | |
| Soil Identification: Silty Sand (SM), Very Dark Yellowish Brown. | |

| Normal Stress (kip/ft²) | 1.000 | 4.000 | 8.000 |
|---|---|---|---|
| Peak Shear Stress (kip/ft²) | ● 1.272 | ■ 2.915 | ▲ 5.356 |
| Shear Stress @ End of Test (ksf) | ○ 0.826 | □ 2.836 | △ 5.356 |
| Deformation Rate (in./min.) | 0.0033 | 0.0033 | 0.0033 |
| Initial Sample Height (in.) | 1.000 | 1.000 | 1.000 |
| Diameter (in.) | 2.415 | 2.415 | 2.415 |
| Initial Moisture Content (%) | 11.19 | 11.19 | 11.19 |
| Dry Density (pcf) | 113.1 | 113.4 | 112.5 |
| Saturation (%) | 61.6 | 62.1 | 60.6 |
| Soil Height Before Shearing (in.) | 0.9986 | 0.9876 | 0.9744 |
| Final Moisture Content (%) | 17.5 | 17.8 | 17.9 |

Leighton

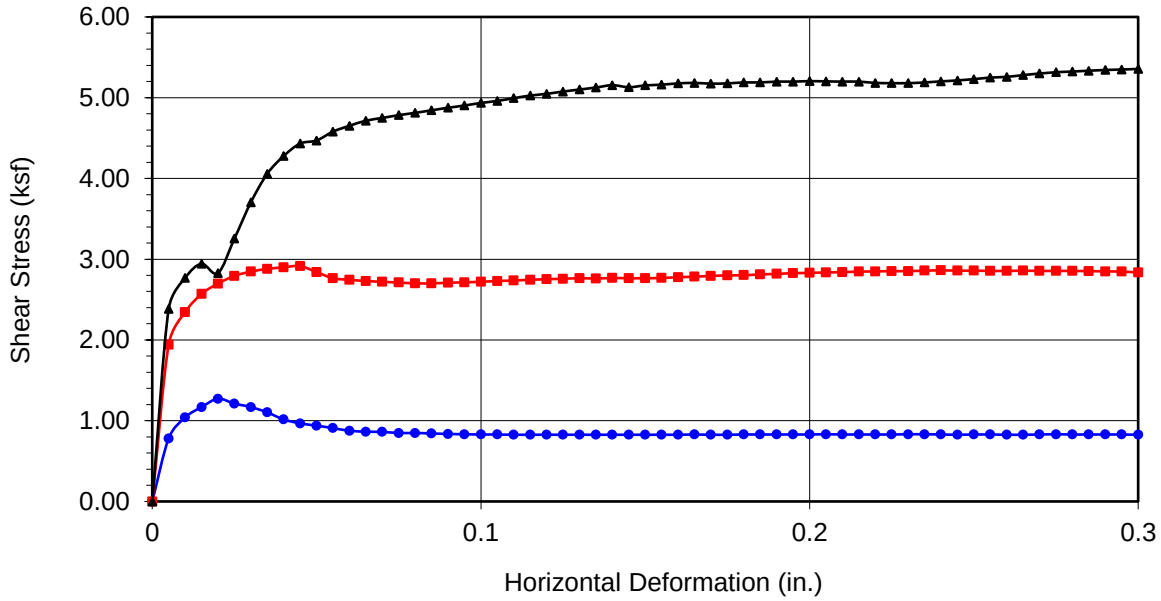
**DIRECT SHEAR TEST RESULTS**

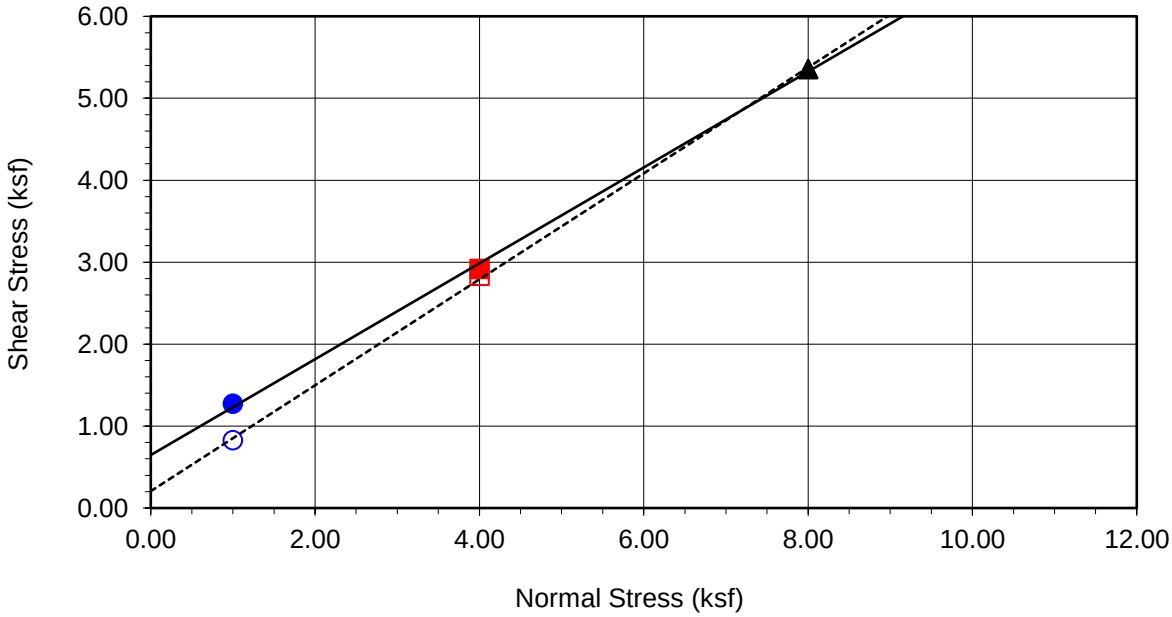
**Consolidated Drained - ASTM D 3080**

Project No.: 13807.001

Rexford/13925 Benson Ave/Geo

02-23




| | |
|---|---|
| **Boring No.** | **LB-4** |
| **Sample No.** | **B-1** |
| **Depth (ft)** | **0 - 5.0** |
| Sample Type: | 90% Remold |
| Soil Identification: | Silty Sand (SM), Very Dark Yellowish Brown. |

**Strength Parameters**

| | C (psf) | $\phi$ (°) |
|---|---|---|
| Peak | 647 | 30 |
| Ultimate | 206 | 33 |

| Normal Stress (kip/ft²) | 1.000 | 4.000 | 8.000 |
|---|---|---|---|
| Peak Shear Stress (kip/ft²) | ● 1.272 | ■ 2.915 | ▲ 5.356 |
| Shear Stress @ End of Test (ksf) | ○ 0.826 | □ 2.836 | △ 5.356 |
| Deformation Rate (in./min.) | 0.0033 | 0.0033 | 0.0033 |
| Initial Sample Height (in.) | 1.000 | 1.000 | 1.000 |
| Diameter (in.) | 2.415 | 2.415 | 2.415 |
| Initial Moisture Content (%) | 11.19 | 11.19 | 11.19 |
| Dry Density (pcf) | 113.1 | 113.4 | 112.5 |
| Saturation (%) | 61.6 | 62.1 | 60.6 |
| Soil Height Before Shearing (in.) | 0.9986 | 0.9876 | 0.9744 |
| Final Moisture Content (%) | 17.5 | 17.8 | 17.9 |

Leighton

**DIRECT SHEAR TEST RESULTS**

**Consolidated Drained - ASTM D 3080**

Project No.: 13807.001

Rexford/13925 Benson Ave/Geo

02-23

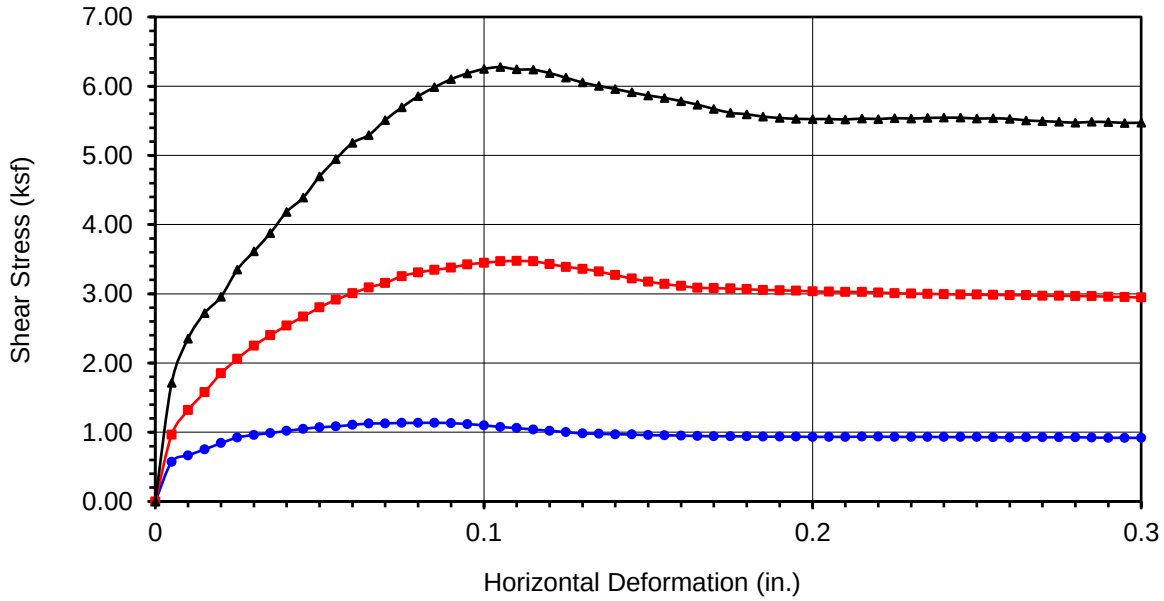
# DIRECT SHEAR TEST

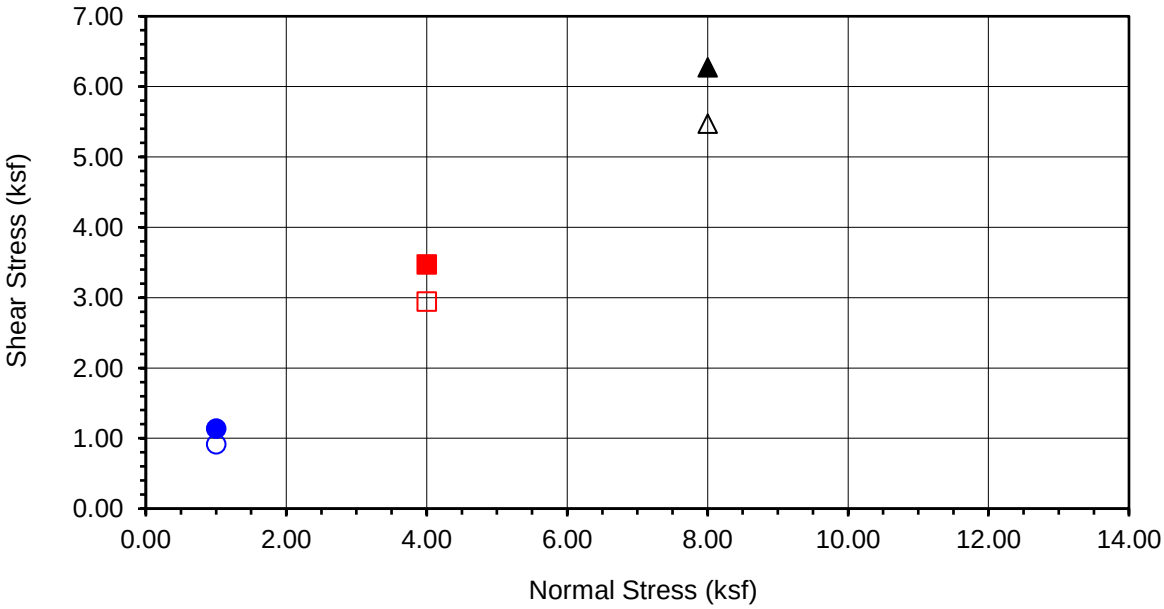
**Consolidated Drained - ASTM D 3080**

| | | | | | |
|---|---|---|---|---|---|
| Project Name: | Rexford/13925 Benson Ave/Geo | Tested By: | M. Vinet | Date: | 02/22/23 |
| Project No.: | 13807.001 | Checked By: | M. Vinet | Date: | 03/03/23 |
| Boring No.: | LB-4 | Sample Type: | Ring | | |
| Sample No.: | R-1 | Depth (ft.): | 5.0 | | |

Soil Identification: Sandy Silt s(ML), Brown.

| | | | |
|---|---|---|---|
| Sample Diameter(in): | 2.415 | 2.415 | 2.415 |
| Sample Thickness(in.): | 1.000 | 1.000 | 1.000 |
| Weight of Sample + ring(gm): | 188.23 | 194.86 | 206.87 |
| Weight of Ring(gm): | 44.50 | 46.07 | 54.46 |
| **Before Shearing** | | | |
| Weight of Wet Sample+Cont.(gm): | 192.22 | 192.22 | 192.22 |
| Weight of Dry Sample+Cont.(gm): | 171.43 | 171.43 | 171.43 |
| Weight of Container(gm): | 50.20 | 50.20 | 50.20 |
| Vertical Rdg.(in): Initial | 0.0000 | 0.2500 | 0.2500 |
| Vertical Rdg.(in): Final | -0.0078 | 0.2784 | 0.2842 |
| **After Shearing** | | | |
| Weight of Wet Sample+Cont.(gm): | 198.30 | 200.79 | 206.13 |
| Weight of Dry Sample+Cont.(gm): | 173.27 | 177.48 | 184.49 |
| Weight of Container(gm): | 51.25 | 50.69 | 51.48 |
| Specific Gravity (Assumed): | 2.70 | 2.70 | 2.70 |
| Water Density(pcf): | 62.43 | 62.43 | 62.43 |




| | |
|---|---|
| **Boring No.** | **LB-4** |
| **Sample No.** | **R-1** |
| **Depth (ft)** | **5** |
| Sample Type: Ring | |
| Soil Identification: Sandy Silt s(ML), Brown. | |

| Normal Stress (kip/ft²) | 1.000 | 4.000 | 8.000 |
|---|---|---|---|
| Peak Shear Stress (kip/ft²) | ● 1.137 | ■ 3.474 | ▲ 6.276 |
| Shear Stress @ End of Test (ksf) | ○ 0.917 | □ 2.946 | △ 5.472 |
| Deformation Rate (in./min.) | 0.0025 | 0.0025 | 0.0025 |
| Initial Sample Height (in.) | 1.000 | 1.000 | 1.000 |
| Diameter (in.) | 2.415 | 2.415 | 2.415 |
| Initial Moisture Content (%) | 17.15 | 17.15 | 17.15 |
| Dry Density (pcf) | 102.0 | 105.6 | 108.2 |
| Saturation (%) | 71.0 | 77.7 | 83.0 |
| Soil Height Before Shearing (in.) | 0.9922 | 0.9716 | 0.9658 |
| Final Moisture Content (%) | 20.5 | 18.4 | 16.3 |

Leighton

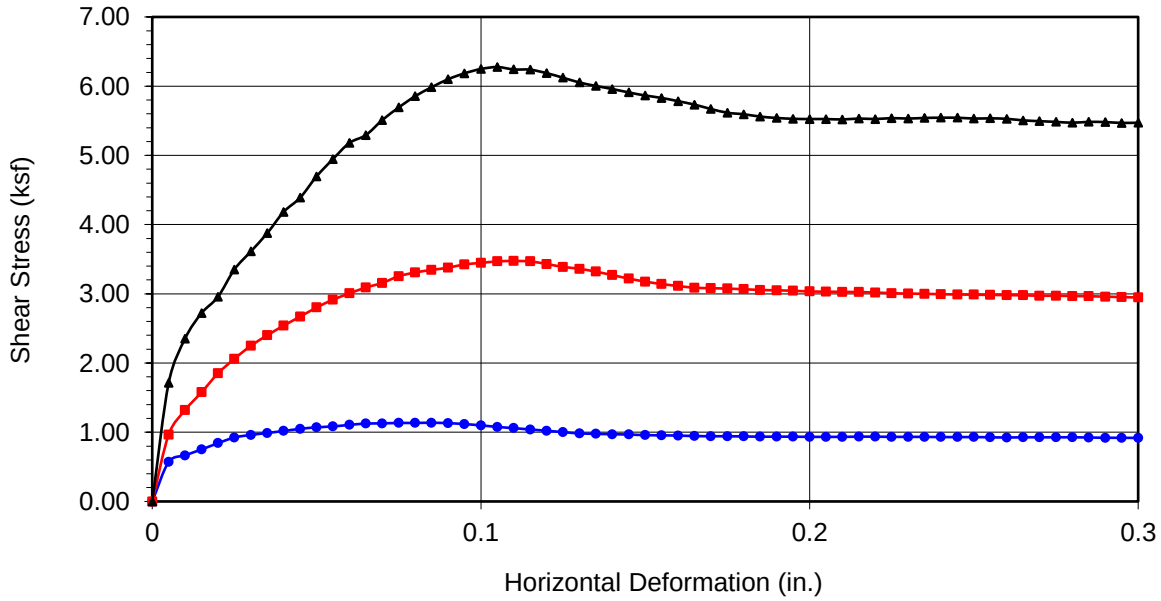
**DIRECT SHEAR TEST RESULTS**

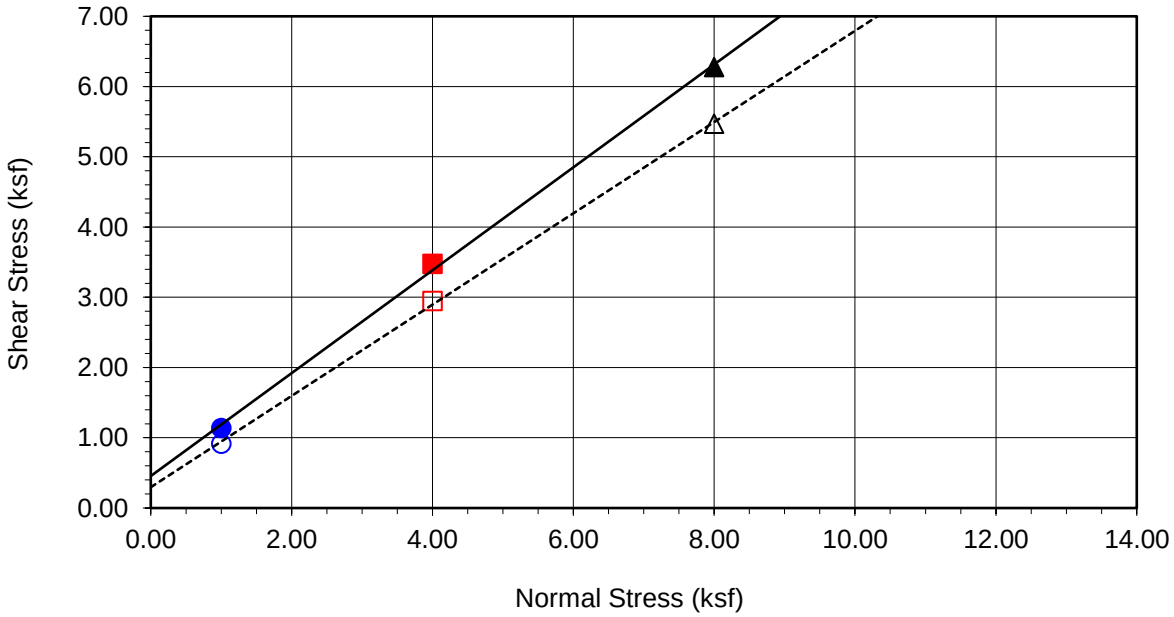
**Consolidated Drained - ASTM D 3080**

Project No.: 13807.001

Rexford/13925 Benson Ave/Geo

02-23




| | |
|---|---|
| **Boring No.** | **LB-4** |
| **Sample No.** | **R-1** |
| **Depth (ft)** | **5** |
| Sample Type: | Ring |
| Soil Identification: | Sandy Silt s(ML), Brown. |

**Strength Parameters**

| | C (psf) | $\phi$ (°) |
|---|---|---|
| Peak | 456 | 36 |
| Ultimate | 296 | 33 |

| Normal Stress (kip/ft²) | 1.000 | 4.000 | 8.000 |
|---|---|---|---|
| Peak Shear Stress (kip/ft²) | ● 1.137 | ■ 3.474 | ▲ 6.276 |
| Shear Stress @ End of Test (ksf) | ○ 0.917 | □ 2.946 | △ 5.472 |
| Deformation Rate (in./min.) | 0.0025 | 0.0025 | 0.0025 |
| Initial Sample Height (in.) | 1.000 | 1.000 | 1.000 |
| Diameter (in.) | 2.415 | 2.415 | 2.415 |
| Initial Moisture Content (%) | 17.15 | 17.15 | 17.15 |
| Dry Density (pcf) | 102.0 | 105.6 | 108.2 |
| Saturation (%) | 71.0 | 77.7 | 83.0 |
| Soil Height Before Shearing (in.) | 0.9922 | 0.9716 | 0.9658 |
| Final Moisture Content (%) | 20.5 | 18.4 | 16.3 |

Leighton

**DIRECT SHEAR TEST RESULTS**

**Consolidated Drained - ASTM D 3080**

Project No.: 13807.001

Rexford/13925 Benson Ave/Geo

02-23

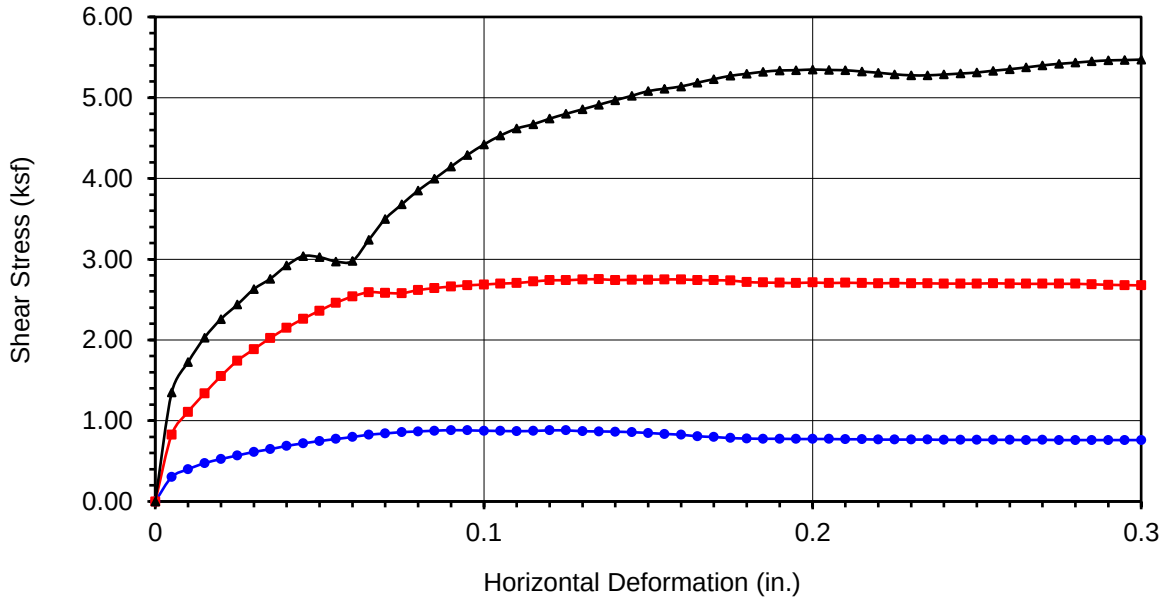
# DIRECT SHEAR TEST

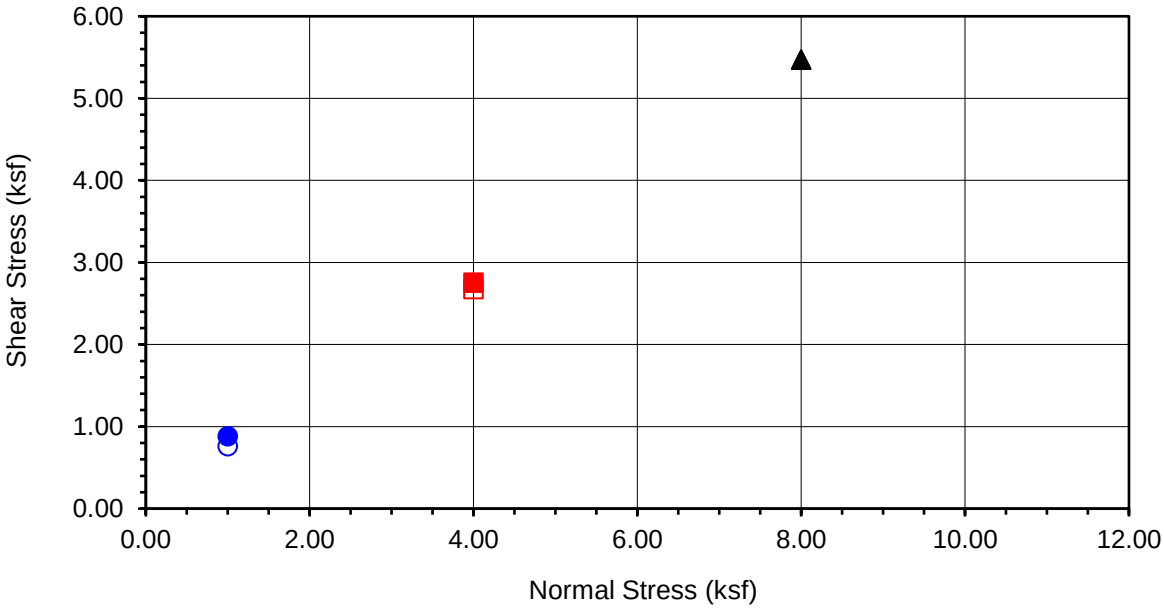
**Consolidated Drained - ASTM D 3080**

| | | | | | |
|---|---|---|---|---|---|
| Project Name: | Rexford/13925 Benson Ave/Geo | Tested By: | M. Vinet | Date: | 02/23/23 |
| Project No.: | 13807.001 | Checked By: | M. Vinet | Date: | 03/03/23 |
| Boring No.: | LB-4 | Sample Type: | Ring | | |
| Sample No.: | R-3 | Depth (ft.): | 10.0 | | |

Soil Identification: Sandy Silt s(ML), Brown.

| | | | |
|---|---|---|---|
| Sample Diameter(in): | 2.415 | 2.415 | 2.415 |
| Sample Thickness(in.): | 1.000 | 1.000 | 1.000 |
| Weight of Sample + ring(gm): | 186.56 | 191.96 | 195.26 |
| Weight of Ring(gm): | 37.67 | 43.91 | 45.66 |
| **Before Shearing** | | | |
| Weight of Wet Sample+Cont.(gm): | 185.26 | 185.26 | 185.26 |
| Weight of Dry Sample+Cont.(gm): | 162.56 | 162.56 | 162.56 |
| Weight of Container(gm): | 50.56 | 50.56 | 50.56 |
| Vertical Rdg.(in): Initial | 0.0000 | 0.2500 | 0.2500 |
| Vertical Rdg.(in): Final | -0.0061 | 0.2828 | 0.3004 |
| **After Shearing** | | | |
| Weight of Wet Sample+Cont.(gm): | 201.66 | 198.77 | 200.73 |
| Weight of Dry Sample+Cont.(gm): | 171.88 | 170.22 | 172.32 |
| Weight of Container(gm): | 50.59 | 50.55 | 49.79 |
| Specific Gravity (Assumed): | 2.70 | 2.70 | 2.70 |
| Water Density(pcf): | 62.43 | 62.43 | 62.43 |




| | |
|---|---|
| **Boring No.** | **LB-4** |
| **Sample No.** | **R-3** |
| **Depth (ft)** | **10** |
| Sample Type: | |
| Ring | |
| Soil Identification: | |
| Sandy Silt s(ML), Brown. | |

| Normal Stress (kip/ft²) | 1.000 | 4.000 | 8.000 |
|---|---|---|---|
| Peak Shear Stress (kip/ft²) | ● 0.883 | ■ 2.752 | ▲ 5.472 |
| Shear Stress @ End of Test (ksf) | ○ 0.760 | □ 2.676 | △ 5.472 |
| Deformation Rate (in./min.) | 0.0025 | 0.0025 | 0.0025 |
| Initial Sample Height (in.) | 1.000 | 1.000 | 1.000 |
| Diameter (in.) | 2.415 | 2.415 | 2.415 |
| Initial Moisture Content (%) | 20.27 | 20.27 | 20.27 |
| Dry Density (pcf) | 103.0 | 102.4 | 103.4 |
| Saturation (%) | 85.9 | 84.6 | 86.9 |
| Soil Height Before Shearing (in.) | 0.9939 | 0.9672 | 0.9496 |
| Final Moisture Content (%) | 24.6 | 23.9 | 23.2 |

Leighton

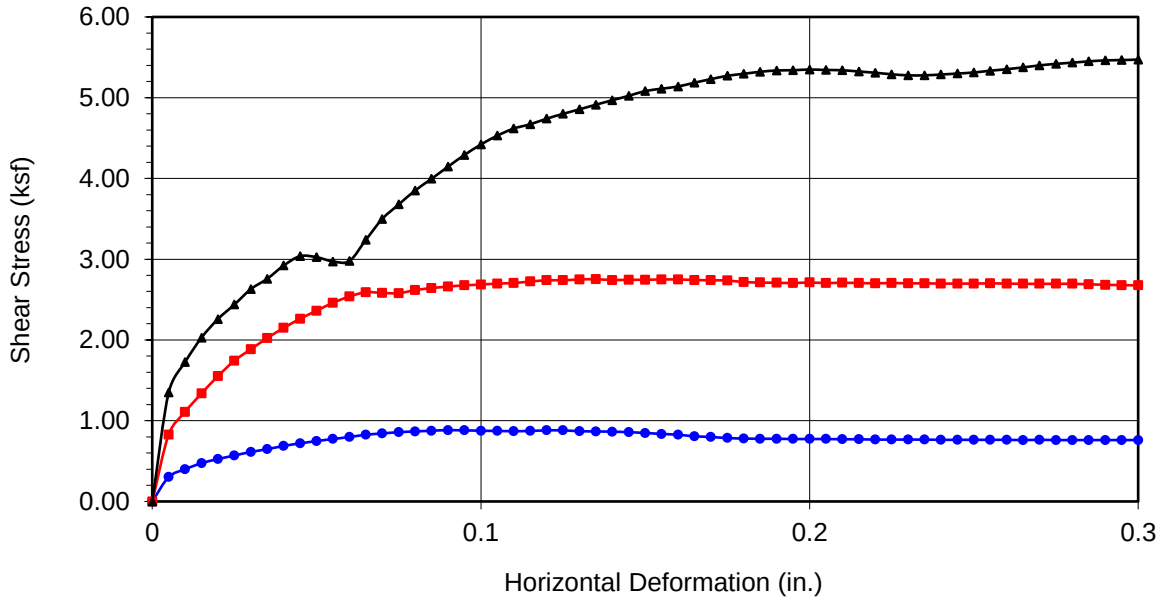
**DIRECT SHEAR TEST RESULTS**

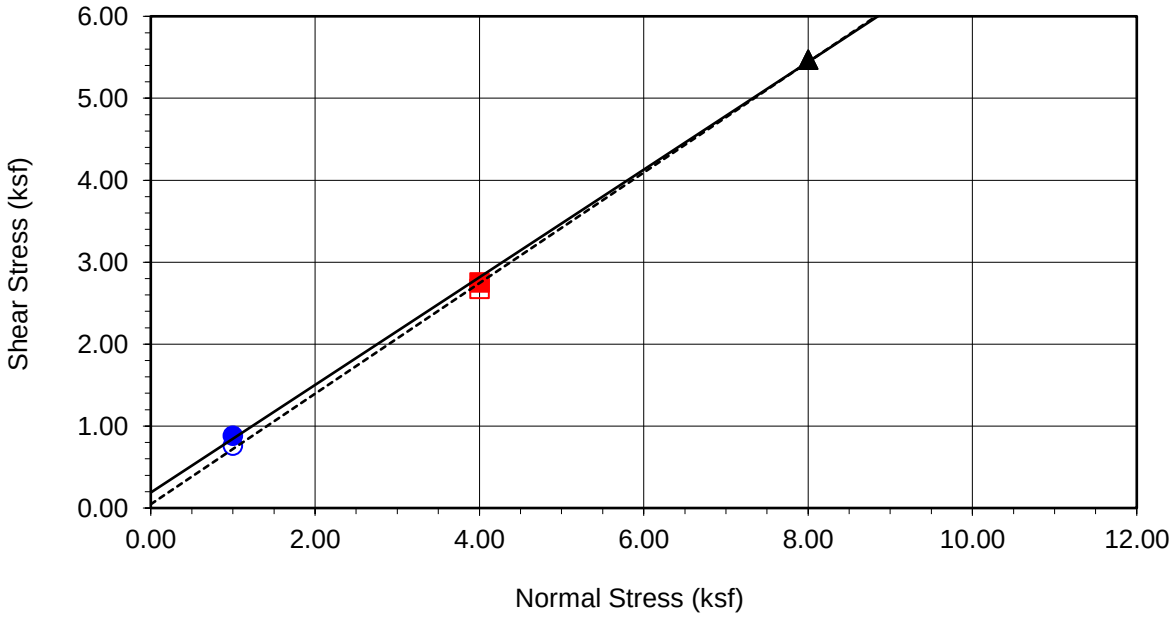
**Consolidated Drained - ASTM D 3080**

Project No.: 13807.001

Rexford/13925 Benson Ave/Geo

02-23




| | |
|---|---|
| **Boring No.** | **LB-4** |
| **Sample No.** | **R-3** |
| **Depth (ft)** | **10** |
| Sample Type: | Ring |
| Soil Identification: Sandy Silt s(ML), Brown. | |

**Strength Parameters**

| | C (psf) | $\phi$ (°) |
|---|---|---|
| Peak | 189 | 33 |
| Ultimate | 46 | 34 |

| Normal Stress (kip/ft²) | 1.000 | 4.000 | 8.000 |
|---|---|---|---|
| Peak Shear Stress (kip/ft²) | ● 0.883 | ■ 2.752 | ▲ 5.472 |
| Shear Stress @ End of Test (ksf) | ○ 0.760 | □ 2.676 | △ 5.472 |
| Deformation Rate (in./min.) | 0.0025 | 0.0025 | 0.0025 |
| Initial Sample Height (in.) | 1.000 | 1.000 | 1.000 |
| Diameter (in.) | 2.415 | 2.415 | 2.415 |
| Initial Moisture Content (%) | 20.27 | 20.27 | 20.27 |
| Dry Density (pcf) | 103.0 | 102.4 | 103.4 |
| Saturation (%) | 85.9 | 84.6 | 86.9 |
| Soil Height Before Shearing (in.) | 0.9939 | 0.9672 | 0.9496 |
| Final Moisture Content (%) | 24.6 | 23.9 | 23.2 |

Leighton

**DIRECT SHEAR TEST RESULTS**

**Consolidated Drained - ASTM D 3080**

Project No.: 13807.001

Rexford/13925 Benson Ave/Geo

02-23

# TESTS for SULFATE CONTENT
# CHLORIDE CONTENT and pH of SOILS

Project Name: Rexford/13925 Benson Ave/Geo  Tested By : M. Vinet  Date: 02/27/23

Project No. : 13807.001  Checked By: M. Vinet  Date: 03/03/23

| | | | | |
|---|---|---|---|---|
| Boring No. | LB-4 | | | |
| Sample No. | B-1 | | | |
| Sample Depth (ft) | 0 - 5.0 | | | |
| Soil Identification: | Silty Sand (SM) | | | |
| Wet Weight of Soil + Container (g) | 100.00 | | | |
| Dry Weight of Soil + Container (g) | 100.00 | | | |
| Weight of Container (g) | 0.00 | | | |
| Moisture Content (%) | 0.00 | | | |
| Weight of Soaked Soil (g) | 100.00 | | | |

**SULFATE CONTENT, DOT California Test 417, Part II**

| | | | | |
|---|---|---|---|---|
| Beaker No. | 1 | | | |
| Crucible No. | 1 | | | |
| Furnace Temperature (°C) | 850 | | | |
| Time In / Time Out | Timer | | | |
| Duration of Combustion (min) | 45 | | | |
| Wt. of Crucible + Residue (g) | 25.0399 | | | |
| Wt. of Crucible (g) | 25.0361 | | | |
| Wt. of Residue (g) (A) | 0.0038 | | | |
| PPM of Sulfate (A) x 41150 | 156.37 | | | |
| **PPM of Sulfate, Dry Weight Basis** | **156** | | | |

**CHLORIDE CONTENT, DOT California Test 422**

| | | | | |
|---|---|---|---|---|
| ml of Extract For Titration (B) | 30 | | | |
| ml of AgNO3 Soln. Used in Titration (C) | 0.6 | | | |
| PPM of Chloride (C -0.2) * 100 * 30 / B | 40 | | | |
| **PPM of Chloride, Dry Wt. Basis** | **40** | | | |

**pH TEST, DOT California Test 643**

| | | | | |
|---|---|---|---|---|
| **pH Value** | **7.80** | | | |
| **Temperature °C** | 21.0 | | | |

# SOIL RESISTIVITY TEST

## DOT CA TEST 643

Project Name: Rexford/13925 Benson Ave/Geo
Project No. : 13807.001
Boring No.: LB-4
Sample No. : B-1
Soil Identification:* Silty Sand (SM)

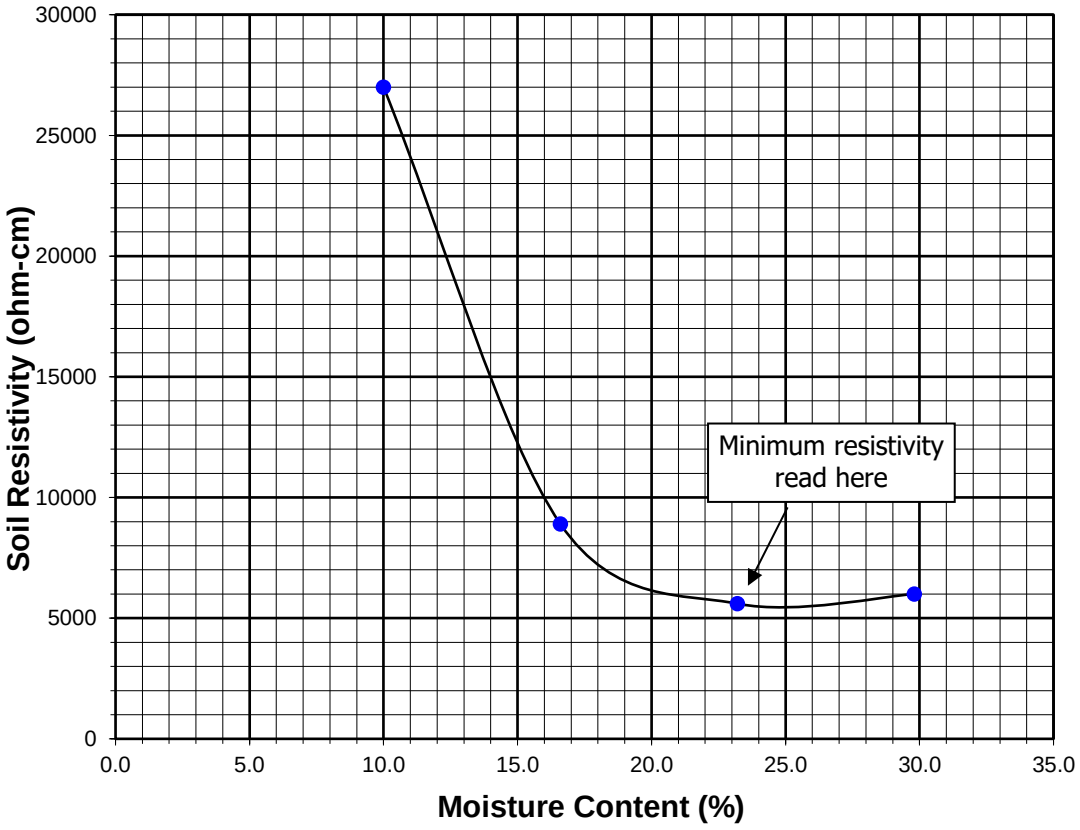
Tested By : M. Vinet Date: 02/28/23
Checked By: M. Vinet Date: 03/03/23
Depth (ft.) : 0 - 5.0

*California Test 643 requires soil specimens to consist only of portions of samples passing through the No. 8 US Standard Sieve before resistivity testing. Therefore, this test method may not be representative for coarser materials.

| Specimen No. | Water Added (ml) (Wa) | Adjusted Moisture Content (MC) | Resistance Reading (ohm) | Soil Resistivity (ohm-cm) |
|---|---|---|---|---|
| 1 | 50 | 10.00 | 27000 | 27000 |
| 2 | 83 | 16.60 | 8900 | 8900 |
| 3 | 116 | 23.20 | 5600 | 5600 |
| 4 | 149 | 29.80 | 6000 | 6000 |
| 5 | | | | |

| | |
|---|---|
| Moisture Content (%) (MCi) | 0.00 |
| Wet Wt. of Soil + Cont. (g) | 100.00 |
| Dry Wt. of Soil + Cont. (g) | 100.00 |
| Wt. of Container (g) | 0.00 |
| Container No. | A |
| Initial Soil Wt. (g) (Wt) | 500.00 |
| Box Constant | 1.000 |
| MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100 | |

| Min. Resistivity (ohm-cm) | Moisture Content (%) | Sulfate Content (ppm) | Chloride Content (ppm) | Soil pH | |
|---|---|---|---|---|---|
| | | | | pH | Temp. (°C) |
| DOT CA Test 643 | | DOT CA Test 417 Part II | DOT CA Test 422 | DOT CA Test 643 | |
| **5600** | **23.2** | **156** | **40** | **7.80** | **21.0** |



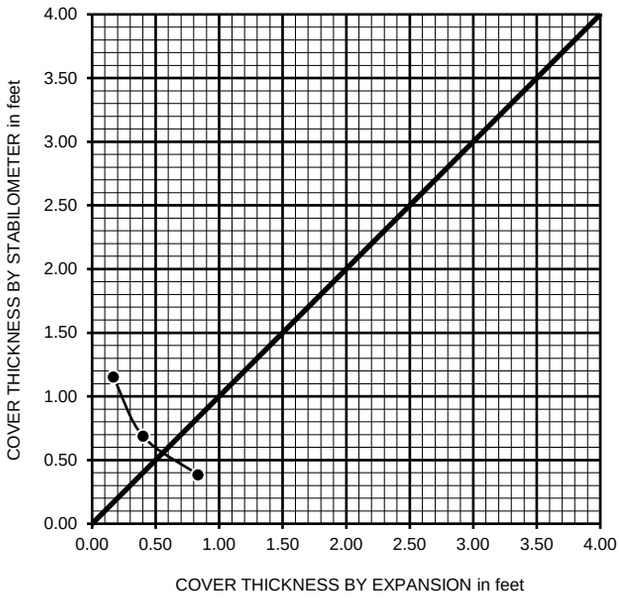
# R-VALUE TEST RESULTS
**DOT CA Test 301**

| | | | |
|---|---|---|---|
| PROJECT NAME: | Rexford/13925 Benson Ave/Geo | PROJECT NUMBER: | 13807.001 |
| BORING NUMBER: | LB-4 | DEPTH (FT.): | 0 - 5.0 |
| SAMPLE NUMBER: | B-1 | TECHNICIAN: | F. Mina |
| SAMPLE DESCRIPTION: | Silty Sand (SM), Very Dark Yellowish Brown. | DATE COMPLETED: | 2/28/2023 |

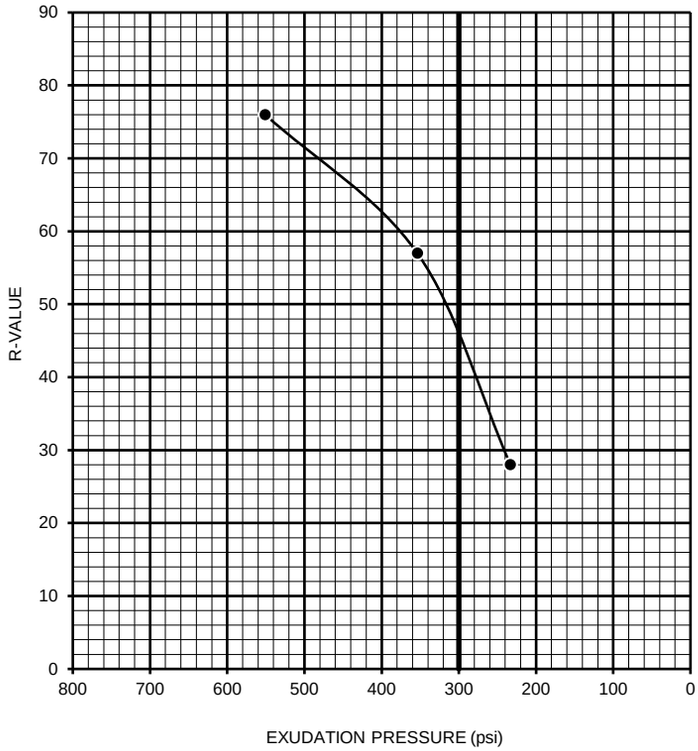
| TEST SPECIMEN | a | b | c |
|---|---|---|---|
| MOISTURE AT COMPACTION % | 11.0 | 12.0 | 13.0 |
| HEIGHT OF SAMPLE, Inches | 2.49 | 2.51 | 2.55 |
| DRY DENSITY, pcf | 112.7 | 112.3 | 110.9 |
| COMPACTOR PRESSURE, psi | 250 | 225 | 200 |
| EXUDATION PRESSURE, psi | 551 | 354 | 233 |
| EXPANSION, Inches x 10exp-4 | 25 | 12 | 5 |
| STABILITY Ph 2,000 lbs (160 psi) | 23 | 45 | 90 |
| TURNS DISPLACEMENT | 4.61 | 4.77 | 4.90 |
| R-VALUE UNCORRECTED | 76 | 57 | 28 |
| R-VALUE CORRECTED | 76 | 57 | 28 |

| DESIGN CALCULATION DATA | a | b | c |
|---|---|---|---|
| GRAVEL EQUIVALENT FACTOR | 1.0 | 1.0 | 1.0 |
| TRAFFIC INDEX | 5.0 | 5.0 | 5.0 |
| STABILOMETER THICKNESS, ft. | 0.38 | 0.69 | 1.15 |
| EXPANSION PRESSURE THICKNESS, ft. | 0.83 | 0.40 | 0.17 |

EXPANSION PRESSURE CHART




EXUDATION PRESSURE CHART




| | |
|---|---|
| R-VALUE BY EXPANSION: | 66 |
| R-VALUE BY EXUDATION: | 46 |
| EQUILIBRIUM R-VALUE: | 46 |

# APPENDIX D

# EARTHWORK AND GRADING GUIDE SPECIFICATIONS

APPENDIX D

LEIGHTON CONSULTING, INC.
EARTHWORK AND GRADING GUIDE SPECIFICATIONS

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# D-1.0 GENERAL

## D-1.1 Intent

These Earthwork and Grading Guide Specifications are for grading and earthwork shown on the current, approved grading plan(s) and/or indicated in the Leighton Consulting, Inc. geotechnical report(s). These Guide Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the project-specific recommendations in the geotechnical report shall supersede these Guide Specifications. Leighton Consulting, Inc. shall provide geotechnical observation and testing during earthwork and grading. Based on these observations and tests, Leighton Consulting, Inc. may provide new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

## D-1.2 Role of Leighton Consulting, Inc.

Prior to commencement of earthwork and grading, Leighton Consulting, Inc. shall meet with the earthwork contractor to review the earthwork contractor's work plan, to schedule sufficient personnel to perform the appropriate level of observation, mapping and compaction testing. During earthwork and grading, Leighton Consulting, Inc. shall observe, map, and document subsurface exposures to verify geotechnical design assumptions. If observed conditions are found to be significantly different than the interpreted assumptions during the design phase, Leighton Consulting, Inc. shall inform the owner, recommend appropriate changes in design to accommodate these observed conditions, and notify the review agency where required. Subsurface areas to be geotechnically observed, mapped, elevations recorded, and/or tested include (1) natural ground after clearing to receiving fill but before fill is placed, (2) bottoms of all "remedial removal" areas, (3) all key bottoms, and (4) benches made on sloping ground to receive fill.

Leighton Consulting, Inc. shall observe moisture-conditioning and processing of the subgrade and fill materials, and perform relative compaction testing of fill to determine the attained relative compaction. Leighton Consulting, Inc. shall provide *Daily Field Reports* to the owner and the Contractor on a routine and frequent basis.

## D-1.3 The Earthwork Contractor

The earthwork contractor (Contractor) shall be qualified, experienced and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Guide Specifications prior to commencement of grading. The Contractor shall be solely

responsible for performing grading and backfilling in accordance with the current, approved plans and specifications.

The Contractor shall inform the owner and Leighton Consulting, Inc. of changes in work schedules at least one working day in advance of such changes so that appropriate observations and tests can be planned and accomplished. The Contractor shall not assume that Leighton Consulting, Inc. is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish earthwork and grading in accordance with the applicable grading codes and agency ordinances, these Guide Specifications, and recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of Leighton Consulting, Inc., unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, adverse weather, etc., are resulting in a quality of work less than required in these specifications, Leighton Consulting, Inc. shall reject the work and may recommend to the owner that earthwork and grading be stopped until unsatisfactory condition(s) are rectified.

## D-2.0 PREPARATION OF AREAS TO BE FILLED

### D-2.1 Clearing and Grubbing

Vegetation, such as brush, grass, roots and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies and Leighton Consulting, Inc.. Care should be taken not to encroach upon or otherwise damage native and/or historic trees designated by the Owner or appropriate agencies to remain. Pavements, flatwork or other construction should not extend under the “drip line” of designated trees to remain.

Leighton Consulting, Inc. shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 3 percent of organic materials (by dry weight: ASTM D 2974). Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area. As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage

of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed.

## D-2.2 Processing

Existing ground that has been declared satisfactory for support of fill, by Leighton Consulting, Inc., shall be scarified to a minimum depth of 6 inches (15 cm). Existing ground that is not satisfactory shall be over-excavated as specified in the following Section D-2.3. Scarification shall continue until soils are broken down and free of large clay lumps or clods and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction.

## D-2.3 Overexcavation

In addition to removals and over-excavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be over-excavated to competent ground as evaluated by Leighton Consulting, Inc. during grading. All undocumented fill soils under proposed structure footprints should be excavated

## D-2.4 Benching

Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), (>20 percent grade) the ground shall be stepped or benched. The lowest bench or key shall be a minimum of 15 feet (4.5 m) wide and at least 2 feet (0.6 m) deep, into competent material as evaluated by Leighton Consulting, Inc.. Other benches shall be excavated a minimum height of 4 feet (1.2 m) into competent material or as otherwise recommended by Leighton Consulting, Inc.. Fill placed on ground sloping flatter than 5:1 (horizontal to vertical units), (<20 percent grade) shall also be benched or otherwise over-excavated to provide a flat subgrade for the fill.

## D-2.5 Evaluation/Acceptance of Fill Areas

All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by Leighton Consulting, Inc. as suitable to receive fill. The Contractor shall obtain a written acceptance (*Daily Field Report*) from Leighton Consulting, Inc. prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys and benches.

## D-3.0 FILL MATERIAL

### D-3.1 Fill Quality

Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by Leighton Consulting, Inc. prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to Leighton Consulting, Inc. or mixed with other soils to achieve satisfactory fill material.

### D-3.2 Oversize

Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 6 inches (15 cm), shall not be buried or placed in fill unless location, materials and placement methods are specifically accepted by Leighton Consulting, Inc.. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 feet (3 m) measured vertically from finish grade, or within 2 feet (0.61 m) of future utilities or underground construction.

### D-3.3 Import

If importing of fill material is required for grading, proposed import material shall meet the requirements of Section D-3.1, and be free of hazardous materials ("contaminants") and rock larger than 3-inches (8 cm) in largest dimension. All import soils shall have an Expansion Index (EI) of 20 or less and a sulfate content no greater than (≤) 500 parts-per-million (ppm). A representative sample of a potential import source shall be given to Leighton Consulting, Inc. at least four full working days before importing begins, so that suitability of this import material can be determined and appropriate tests performed.

## D-4.0 FILL PLACEMENT AND COMPACTION

### D-4.1 Fill Layers

Approved fill material shall be placed in areas prepared to receive fill, as described in Section D-2.0, above, in near-horizontal layers not exceeding 8 inches (20 cm) in loose thickness. Leighton Consulting, Inc. may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers, and only if the building officials with the appropriate jurisdiction approve. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

### D-4.2 Fill Moisture Conditioning

Fill soils shall be watered, dried back, blended and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM) Test Method D 1557.

### D-4.3 Compaction of Fill

After each layer has been moisture-conditioned, mixed, and evenly spread, each layer shall be uniformly compacted to not-less-than (≥) 90 percent of the maximum dry density as determined by ASTM Test Method D 1557. In some cases, structural fill may be specified (see project-specific geotechnical report) to be uniformly compacted to at-least (≥) 95 percent of the ASTM D 1557 modified Proctor laboratory maximum dry density. For fills thicker than (>) 15 feet (4.5 m), the portion of fill deeper than 15 feet below proposed finish grade shall be compacted to 95 percent of the ASTM D 1557 laboratory maximum density. Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

### D-4.4 Compaction of Fill Slopes

In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by back rolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet (1 to 1.2 m) in fill elevation, or by other methods producing satisfactory results acceptable to Leighton Consulting, Inc.. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of the ASTM D 1557 laboratory maximum density.

### D-4.5 Compaction Testing

Field-tests for moisture content and relative compaction of the fill soils shall be performed by Leighton Consulting, Inc.. Location and frequency of tests shall be at our field representative(s) discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

### D-4.6 Compaction Test Locations

Leighton Consulting, Inc. shall document the approximate elevation and horizontal coordinates of each density test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that Leighton

Consulting, Inc. can determine the test locations with sufficient accuracy. Adequate grade stakes shall be provided.

## D-5.0 EXCAVATION

Excavations, as well as over-excavation for remedial purposes, shall be evaluated by Leighton Consulting, Inc. during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by Leighton Consulting, Inc. based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, then observed and reviewed by Leighton Consulting, Inc. prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by Leighton Consulting, Inc..

## D-6.0 TRENCH BACKFILLS

### D-6.1 Safety

The Contractor shall follow all OSHA and Cal/OSHA requirements for safety of trench excavations. Work should be performed in accordance with Article 6 of the *California Construction Safety Orders*, 2009 Edition or more current (see also: http://www.dir.ca.gov/title8/sb4a6.html ).

### D-6.2 Bedding and Backfill

All utility trench bedding and backfill shall be performed in accordance with applicable provisions of the 2018 Edition of the *Standard Specifications for Public Works Construction* (Green Book). Bedding material shall have a Sand Equivalent greater than 30 (SE>30). Bedding shall be placed to 1-foot (0.3 m) over the top of the conduit, and densified by jetting in areas of granular soils, if allowed by the permitting agency. Otherwise, the pipe-bedding zone should be backfilled with Controlled Low Strength Material (CLSM) consisting of at least one sack of Portland cement per cubic-yard of sand, and conforming to Section 201-6 of the 2018 Edition of the *Standard Specifications for Public Works Construction* (Green Book). Backfill over the bedding zone shall be placed and densified mechanically to a minimum of 90 percent of relative compaction (ASTM D 1557) from 1 foot (0.3 m) above the top of the conduit to the surface. Backfill above the pipe zone shall **not** be jetted. Jetting of the bedding around the conduits shall be observed by Leighton Consulting, Inc. and backfill above the pipe zone (bedding) shall be observed and tested by Leighton Consulting, Inc..

### D-6.3 Lift Thickness

Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to Leighton Consulting, Inc. that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method, and only if the building officials with the appropriate jurisdiction approve.

# APPENDIX B

NOAA Precipitation Depth, Supporting Calculations

**NOAA Atlas 14, Volume 6, Version 2**
**Location name: Chino, California, USA***
**Latitude: 34.0005°, Longitude: -117.6793°**
**Elevation: 685 ft****
* source: ESRI Maps
** source: USGS

**POINT PRECIPITATION FREQUENCY ESTIMATES**

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

## PF tabular

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

| Duration | Average recurrence interval (years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 | 1000 |
| 5-min | 0.116 (0.097-0.140) | 0.151 (0.126-0.183) | 0.198 (0.165-0.240) | 0.237 (0.196-0.291) | 0.292 (0.233-0.370) | 0.335 (0.261-0.435) | 0.380 (0.289-0.506) | 0.427 (0.315-0.586) | 0.493 (0.348-0.706) | 0.585 (0.398-0.868) |
| 10-min | 0.166 (0.138-0.201) | 0.216 (0.180-0.262) | 0.284 (0.236-0.345) | 0.340 (0.281-0.417) | 0.419 (0.333-0.531) | 0.481 (0.374-0.623) | 0.545 (0.414-0.725) | 0.613 (0.452-0.839) | 0.707 (0.499-1.01) | 0.839 (0.571-1.24) |
| 15-min | 0.201 (0.167-0.242) | 0.261 (0.218-0.317) | 0.343 (0.286-0.417) | 0.411 (0.339-0.504) | 0.506 (0.403-0.642) | 0.581 (0.453-0.754) | 0.659 (0.500-0.877) | 0.741 (0.546-1.02) | 0.855 (0.603-1.22) | 1.01 (0.691-1.50) |
| 30-min | 0.301 (0.251-0.364) | 0.393 (0.327-0.475) | 0.515 (0.429-0.626) | 0.618 (0.509-0.757) | 0.760 (0.605-0.964) | 0.873 (0.680-1.13) | 0.990 (0.751-1.32) | 1.11 (0.820-1.52) | 1.28 (0.906-1.84) | 1.52 (1.04-2.26) |
| 60-min | 0.452 (0.378-0.547) | 0.589 (0.492-0.713) | 0.774 (0.643-0.939) | 0.927 (0.765-1.14) | 1.14 (0.909-1.45) | 1.31 (1.02-1.70) | 1.48 (1.13-1.98) | 1.67 (1.23-2.29) | 1.93 (1.36-2.76) | 2.29 (1.56-3.39) |
| 2-hr | 0.680 (0.568-0.822) | 0.889 (0.741-1.08) | 1.16 (0.962-1.40) | 1.37 (1.13-1.68) | 1.65 (1.32-2.10) | 1.86 (1.45-2.42) | 2.08 (1.58-2.76) | 2.29 (1.69-3.14) | 2.58 (1.82-3.69) | 2.79 (1.90-4.14) |
| 3-hr | 0.863 (0.721-1.04) | 1.13 (0.940-1.36) | 1.46 (1.22-1.77) | 1.72 (1.42-2.11) | 2.07 (1.65-2.62) | 2.32 (1.81-3.01) | 2.57 (1.95-3.42) | 2.82 (2.08-3.87) | 3.15 (2.22-4.51) | 3.40 (2.31-5.04) |
| 6-hr | 1.19 (0.994-1.44) | 1.55 (1.30-1.88) | 2.00 (1.67-2.43) | 2.36 (1.94-2.89) | 2.81 (2.24-3.57) | 3.15 (2.45-4.08) | 3.48 (2.64-4.62) | 3.80 (2.80-5.20) | 4.22 (2.98-6.04) | 4.53 (3.08-6.72) |
| 12-hr | 1.56 (1.30-1.89) | 2.04 (1.70-2.47) | 2.64 (2.19-3.20) | 3.11 (2.57-3.81) | 3.74 (2.98-4.74) | 4.20 (3.27-5.45) | 4.66 (3.54-6.20) | 5.12 (3.77-7.01) | 5.72 (4.04-8.19) | 6.18 (4.20-9.16) |
| 24-hr | 2.02 (1.78-2.32) | 2.64 (2.33-3.05) | 3.45 (3.04-4.00) | 4.12 (3.60-4.80) | 5.01 (4.24-6.04) | 5.69 (4.72-7.00) | 6.39 (5.17-8.05) | 7.10 (5.59-9.19) | 8.06 (6.10-10.9) | 8.80 (6.44-12.3) |
| 2-day | 2.42 (2.15-2.80) | 3.24 (2.86-3.74) | 4.33 (3.82-5.02) | 5.25 (4.59-6.12) | 6.52 (5.52-7.86) | 7.53 (6.25-9.27) | 8.58 (6.95-10.8) | 9.69 (7.63-12.5) | 11.2 (8.50-15.1) | 12.5 (9.11-17.4) |
| 3-day | 2.60 (2.30-3.00) | 3.53 (3.12-4.07) | 4.78 (4.22-5.54) | 5.85 (5.11-6.82) | 7.35 (6.22-8.86) | 8.55 (7.09-10.5) | 9.82 (7.95-12.4) | 11.2 (8.80-14.5) | 13.1 (9.89-17.6) | 14.6 (10.7-20.4) |
| 4-day | 2.82 (2.50-3.26) | 3.86 (3.41-4.45) | 5.26 (4.63-6.08) | 6.44 (5.63-7.51) | 8.10 (6.86-9.76) | 9.43 (7.82-11.6) | 10.8 (8.76-13.6) | 12.3 (9.69-15.9) | 14.4 (10.9-19.4) | 16.0 (11.7-22.4) |
| 7-day | 3.22 (2.85-3.71) | 4.40 (3.89-5.08) | 5.98 (5.28-6.93) | 7.29 (6.38-8.51) | 9.10 (7.70-11.0) | 10.5 (8.72-12.9) | 12.0 (9.69-15.1) | 13.5 (10.6-17.5) | 15.6 (11.8-21.0) | 17.2 (12.6-24.0) |
| 10-day | 3.53 (3.12-4.07) | 4.84 (4.28-5.59) | 6.56 (5.78-7.60) | 7.97 (6.97-9.30) | 9.90 (8.38-11.9) | 11.4 (9.45-14.0) | 12.9 (10.5-16.3) | 14.5 (11.4-18.8) | 16.6 (12.6-22.4) | 18.3 (13.4-25.5) |
| 20-day | 4.28 (3.79-4.94) | 5.93 (5.24-6.85) | 8.11 (7.15-9.39) | 9.90 (8.66-11.6) | 12.3 (10.4-14.9) | 14.2 (11.8-17.5) | 16.2 (13.1-20.4) | 18.2 (14.3-23.5) | 20.9 (15.8-28.2) | 23.0 (16.8-32.1) |
| 30-day | 5.13 (4.54-5.92) | 7.14 (6.31-8.24) | 9.84 (8.67-11.4) | 12.1 (10.6-14.1) | 15.2 (12.9-18.3) | 17.6 (14.6-21.7) | 20.2 (16.3-25.4) | 22.8 (18.0-29.6) | 26.5 (20.1-35.8) | 29.4 (21.5-41.0) |
| 45-day | 6.07 (5.37-7.00) | 8.44 (7.46-9.74) | 11.7 (10.3-13.5) | 14.5 (12.7-16.9) | 18.4 (15.6-22.2) | 21.6 (18.0-26.6) | 25.0 (20.3-31.5) | 28.7 (22.6-37.1) | 33.8 (25.6-45.6) | 38.0 (27.8-53.0) |
| 60-day | 6.98 (6.18-8.05) | 9.63 (8.51-11.1) | 13.4 (11.8-15.5) | 16.6 (14.6-19.4) | 21.4 (18.1-25.8) | 25.4 (21.1-31.2) | 29.7 (24.0-37.4) | 34.3 (27.1-44.5) | 41.1 (31.1-55.5) | 46.8 (34.2-65.3) |

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

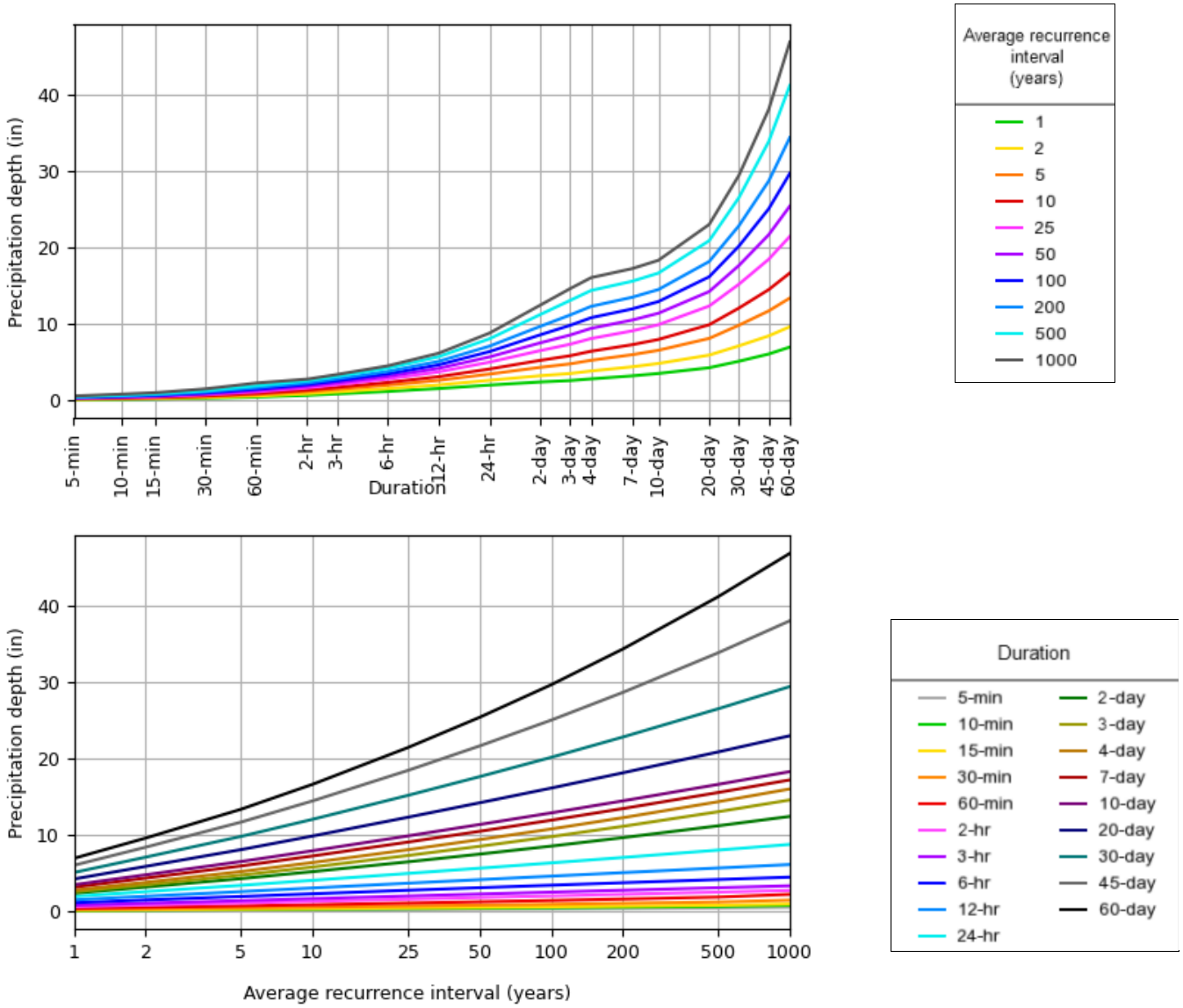
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper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

Please refer to NOAA Atlas 14 document for more information.

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## PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 34.0005°, Longitude: -117.6793°




NOAA Atlas 14, Volume 6, Version 2 Created (GMT): Mon Jun 5 20:25:54 2023

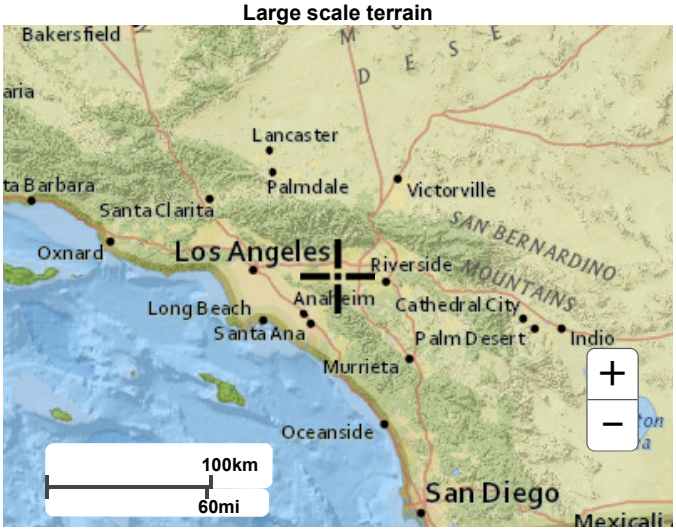
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## Maps & aerials

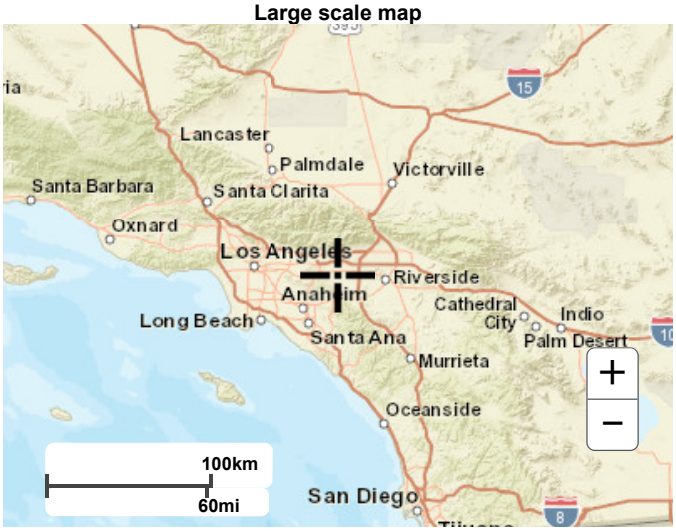
**Small scale terrain**




**Large scale terrain**




**Large scale map**




**Large scale aerial**

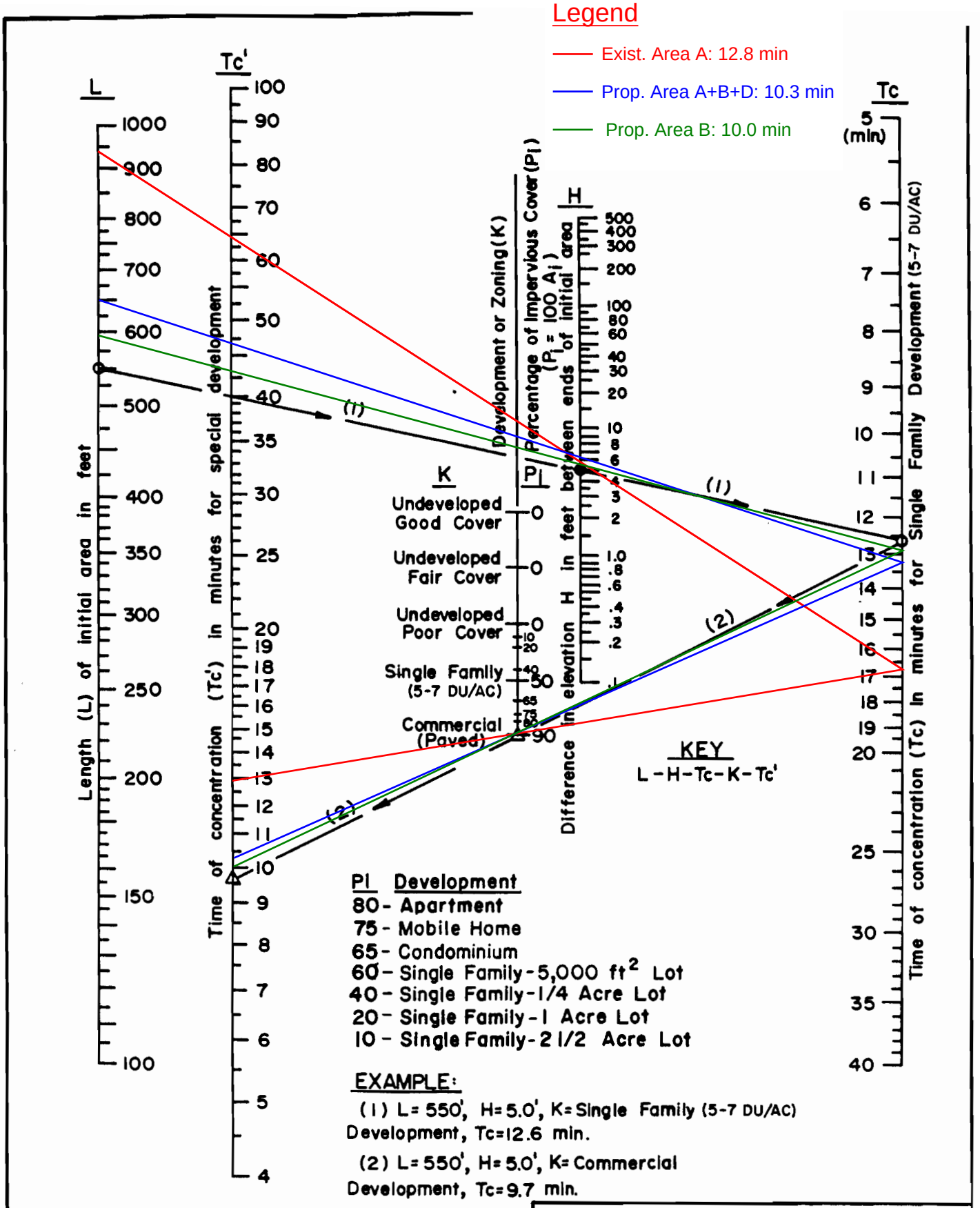



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National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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# SAN BERNARDINO COUNTY
## HYDROLOGY MANUAL

## TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

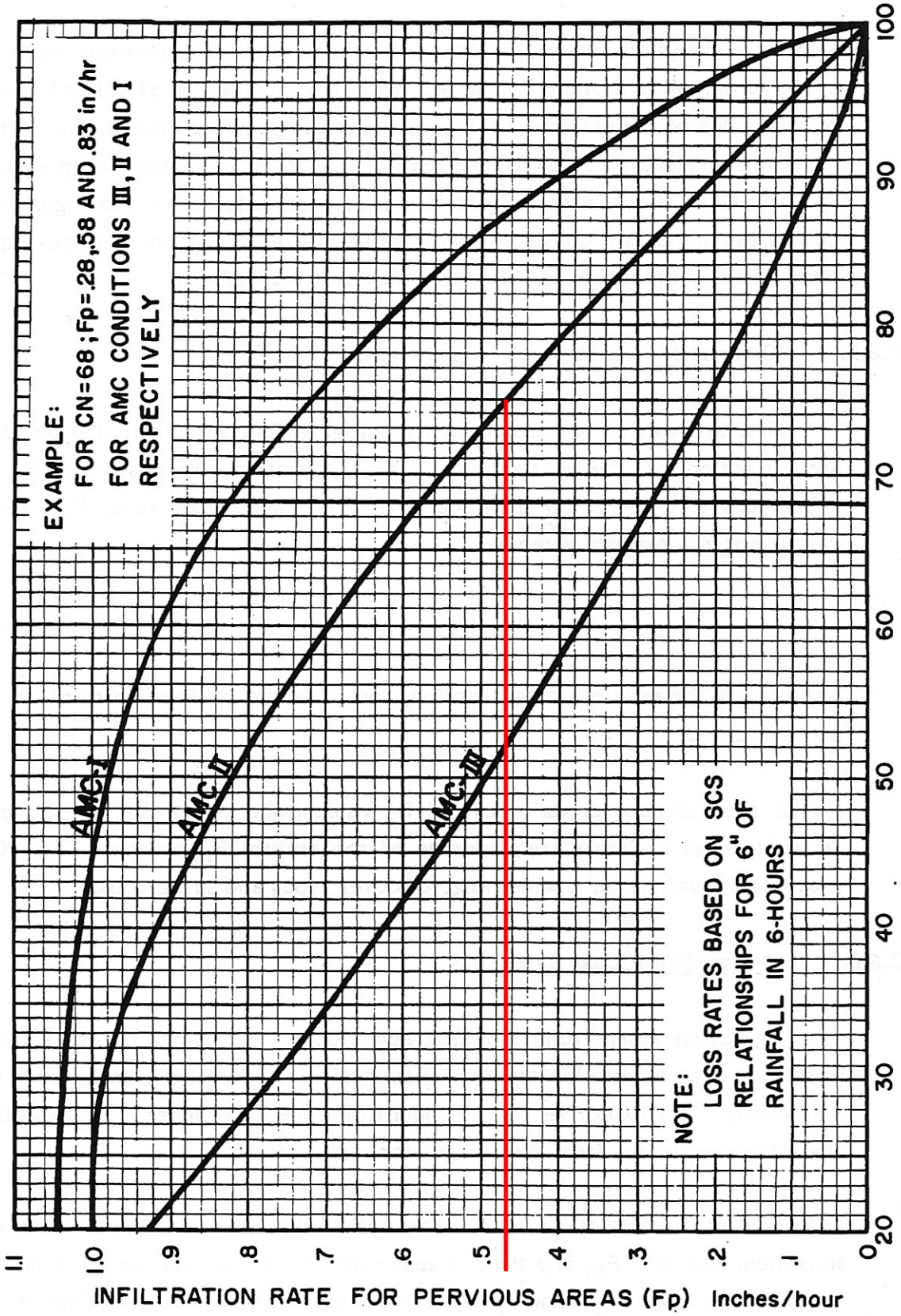
## Curve (1) Numbers of Hydrologic Soil-Cover Complexes For Pervious Areas-AMC II

| Cover Type (3) | Quality of Cover (2) | Soil Group A | B | C | D |
|---|---|---|---|---|---|
| **NATURAL COVERS -** | | | | | |
| Barren (Rockland, eroded and graded land) | | 78 | 86 | 91 | 93 |
| Chaparral, Broadleaf (Manzonita, ceanothus and scrub oak) | Poor | 53 | 70 | 80 | 85 |
| | Fair | 40 | 63 | 75 | 81 |
| | Good | 31 | 57 | 71 | 78 |
| Chaparral, Narrowleaf (Chamise and redshank) | Poor | 71 | 82 | 88 | 91 |
| | Fair | 55 | 72 | 81 | 86 |
| Grass, Annual or Perennial | Poor | 67 | 78 | 86 | 89 |
| | Fair | 50 | 69 | 79 | 84 |
| | Good | 38 | 61 | 74 | 80 |
| Meadows or Cienegas (Areas with seasonally high water table, principal vegetation is sod forming grass) | Poor | 63 | 77 | 85 | 88 |
| | Fair | 51 | 70 | 80 | 84 |
| | Good | 30 | 58 | 71 | 78 |
| Open Brush (Soft wood shrubs - buckwheat, sage, etc.) | Poor | 62 | 76 | 84 | 88 |
| | Fair | 46 | 66 | 77 | 83 |
| | Good | 41 | 63 | 75 | 81 |
| Woodland (Coniferous or broadleaf trees predominate. Canopy density is at least 50 percent.) | Poor | 45 | 66 | 77 | 83 |
| | Fair | 36 | 60 | 73 | 79 |
| | Good | 25 | 55 | 70 | 77 |
| Woodland, Grass (Coniferous or broadleaf trees with canopy density from 20 to 50 percent) | Poor | 57 | 73 | 82 | 86 |
| | Fair | 44 | 65 | 77 | 82 |
| | Good | 33 | 58 | 72 | 79 |
| **URBAN COVERS -** | | | | | |
| Residential or Commercial Landscaping (Lawn, shrubs, etc.) | Good | 32 | 56 | 69 | 75 |
| Turf (Irrigated and mowed grass) | Poor | 58 | 74 | 83 | 87 |
| | Fair | 44 | 65 | 77 | 82 |
| | Good | 33 | 58 | 72 | 79 |
| **AGRICULTURAL COVERS -** | | | | | |
| Fallow (Land plowed but not tilled or seeded) | | 77 | 86 | 91 | 94 |

**SAN BERNARDINO COUNTY**
**HYDROLOGY MANUAL**

**CURVE NUMBERS FOR PERVIOUS AREAS**

Figure C-3 (1 of 2)




**SAN BERNARDINO COUNTY**
**HYDROLOGY MANUAL**

**INFILTRATION RATE FOR PERVIOUS AREAS VERSUS SCS CURVE NUMBERS**

# DCV CALCULATIONS

Bioretention with Underdrain/Planter Box Calcs (Table 5-6):

| Area | $P_{DESIGN}$ | $SA_{INF}$ | $T_{FILL}$ (hr) | $SA_{PONDED}$ | $D_{PONDED}$ | $SA_{SOIL}$ | $D_{SOIL}$ | $N_{SOIL}$ | $SA_{GRAVEL}$ | $D_{GRAVEL}$ | $N_{GRAVEL}$ | $V_{BIOTREATED}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 2.5 | 1,621 | 3 | 1,621 | 1.50 | 1,621 | 3.00 | 40% | 1,621 | 1.50 | 40% | 5,147 |
| B | 2.5 | 4,652 | 3 | 4,652 | 1.50 | 4,652 | 2.00 | 40% | 4,652 | 1.50 | 40% | 12,909 |
| C | 2.5 | 956 | 3 | 956 | 0.50 | 956 | 2.00 | 40% | 956 | 1.50 | 40% | 2,175 |
| Total: | | 7,229 | | | | | | | | | | 20,231 |

Min. Eff. Area Required for LID BMPs to Demonstrate Infeasibility (Table 5-7):

| Class | Site Area | Bldg Area | FAR | % Req'd | Min. Eff. Area | Eff. $Area_{DESIGN}$ |
|---|---|---|---|---|---|---|
| Redev. | 289,056 | 139,689 | 2.1 | 2.50% | 7,226 | 7,229 |

Additional Volume for Modular Wetlands

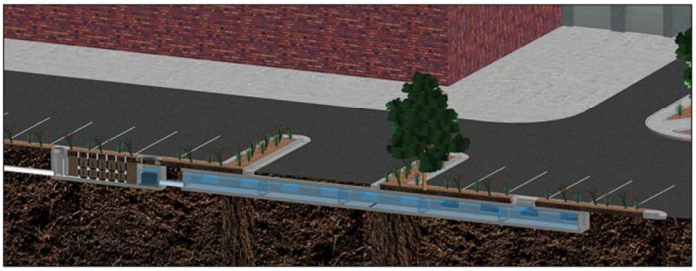
| Area | DCV | Remaining DCV | Unit | Unit Volume | Check | Pipe D (ft) | LF Req'd | LF Provided | Treatment V | Total V |
|---|---|---|---|---|---|---|---|---|---|---|
| B | | 9,054 | MWS-L-8-8 | 10,072 | Sufficient | 4 | 721 | 775 | 9,111 | 9,741 |
| D | | 1,559 | MWS-L-4-4 | 2,280 | Sufficient | 4 | 125 | 170 | 1,598 | 2,137 |



## Flow Based Sizing

The MWS Linear can be used in stand alone applications to meet treatment flow requirements. Since the MWS Linear is the only biofiltration system that can accept inflow pipes several feet below the surface it can be used not only in decentralized design applications but also as a large central end-of-the-line application for maximum feasibility.

| Model # | Dimensions | WetlandMEDIA Surface Area | Treatment Flow Rate (cfs) |
|---|---|---|---|
| MWS-L-4-4 | 4′ x 4′ | 23 sq. ft. | 0.052 |
| MWS-L-4-6 | 4′ x 6′ | 32 sq. ft. | 0.073 |
| MWS-L-4-8 | 4′ x 8′ | 50 sq. ft. | 0.115 |
| MWS-L-4-13 | 4′ x 13′ | 63 sq. ft. | 0.144 |
| MWS-L-4-15 | 4′ x 15′ | 76 sq. ft. | 0.175 |
| MWS-L-4-17 | 4′ x 17′ | 90 sq. ft. | 0.206 |
| MWS-L-4-19 | 4′ x 19′ | 103 sq. ft. | 0.237 |
| MWS-L-4-21 | 4′ x 21′ | 117 sq. ft. | 0.268 |
| MWS-L-6-8 | 7′ x 9′ | 64 sq. ft. | 0.147 |
| MWS-L-8-8 | 8′ x 8′ | 100 sq. ft. | 0.230 |
| MWS-L-8-12 | 8′ x 12′ | 151 sq. ft. | 0.346 |
| MWS-L-8-16 | 8′ x 16′ | 201 sq. ft. | 0.462 |
| MWS-L-8-20 | 9′ x 21′ | 252 sq. ft. | 0.577 |
| MWS-L-8-24 | 9′ x 25′ | 302 sq. ft. | 0.693 |



## Volume Based Sizing

Many states require treatment of a water quality volume and do not offer the option of flow based design. The MWS Linear and its unique horizontal flow makes it the only biofilter that can be used in volume based design installed downstream of ponds, detention basins, and underground storage systems.

| Model # | Treatment Capacity (cu. ft.) @ 24-Hour Drain Down | Treatment Capacity (cu. ft.) @ 48-Hour Drain Down |
|---|---|---|
| MWS-L-4-4 | 1140 | 2280 |
| MWS-L-4-6 | 1600 | 3200 |
| MWS-L-4-8 | 2518 | 5036 |
| MWS-L-4-13 | 3131 | 6261 |
| MWS-L-4-15 | 3811 | 7623 |
| MWS-L-4-17 | 4492 | 8984 |
| MWS-L-4-19 | 5172 | 10345 |
| MWS-L-4-21 | 5853 | 11706 |
| MWS-L-6-8 | 3191 | 6382 |
| MWS-L-8-8 | 5036 | 10072 |
| MWS-L-8-12 | 7554 | 15109 |
| MWS-L-8-16 | 10073 | 20145 |
| MWS-L-8-20 | 12560 | 25120 |
| MWS-L-8-24 | 15108 | 30216 |

# HMOD CALCULATIONS

```
******************************************************************************
          NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                    AND LOW LOSS FRACTION ESTIMATIONS
==============================================================================
         (C) Copyright 1989-2015 Advanced Engineering Software (aes)
             Ver. 22.0  Release Date: 07/01/2015  License ID 1510

                           Analysis prepared by:

                           DRC Engineering, Inc.
                      160 South Old Springs Road, Suite 210
                             Anaheim Hills, CA 92808
                                  714-685-6860

******************************************************************************
------------------------------------------------------------------------------

 Problem Descriptions:
  AREA A
  EXISTING CONDITION
  2 YEAR
==============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC I:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     2.64 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA     NUMBER    Fp(in./hr.)    YIELD
         1          6.64        9.30       75.(AMC II)     0.720       0.833

    TOTAL AREA (Acres) =      6.64

    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.067

    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.167
==============================================================================
```

```
**************************************************************************
                    SMALL AREA UNIT HYDROGRAPH MODEL
==========================================================================
         (C) Copyright 1989-2015 Advanced Engineering Software (aes)
             Ver. 22.0  Release Date: 07/01/2015  License ID 1510

                          Analysis prepared by:

                          DRC Engineering, Inc.
                    160 South Old Springs Road, Suite 210
                           Anaheim Hills, CA 92808
                                714-685-6860

**************************************************************************
--------------------------------------------------------------------------

 Problem Descriptions:
  AREA A
  EXISTING CONDITION
  2 YEAR
--------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =    6.64
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.067
    LOW LOSS FRACTION = 0.167
    TIME OF CONCENTRATION(MIN.) = 12.80
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =   2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.15
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.39
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.59
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  1.13
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.55
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  2.64

--------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     1.10
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.36

**************************************************************************
  TIME     VOLUME       Q    0.        2.5       5.0       7.5      10.0
 (HOURS)    (AF)      (CFS)
--------------------------------------------------------------------------
  0.21      0.0019      0.21  Q         .         .         .         .
  0.43      0.0056      0.21  Q         .         .         .         .
```

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0.64 | 0.0093 | 0.21 | Q | . | . | . | . |
| 0.85 | 0.0131 | 0.22 | Q | . | . | . | . |
| 1.07 | 0.0170 | 0.22 | Q | . | . | . | . |
| 1.28 | 0.0208 | 0.22 | Q | . | . | . | . |
| 1.49 | 0.0247 | 0.22 | Q | . | . | . | . |
| 1.71 | 0.0286 | 0.22 | Q | . | . | . | . |
| 1.92 | 0.0326 | 0.23 | Q | . | . | . | . |
| 2.13 | 0.0366 | 0.23 | Q | . | . | . | . |
| 2.35 | 0.0406 | 0.23 | Q | . | . | . | . |
| 2.56 | 0.0447 | 0.23 | Q | . | . | . | . |
| 2.77 | 0.0488 | 0.23 | Q | . | . | . | . |
| 2.99 | 0.0530 | 0.24 | Q | . | . | . | . |
| 3.20 | 0.0572 | 0.24 | Q | . | . | . | . |
| 3.41 | 0.0614 | 0.24 | Q | . | . | . | . |
| 3.63 | 0.0657 | 0.24 | Q | . | . | . | . |
| 3.84 | 0.0700 | 0.25 | Q | . | . | . | . |
| 4.05 | 0.0744 | 0.25 | Q | . | . | . | . |
| 4.27 | 0.0788 | 0.25 | .Q | . | . | . | . |
| 4.48 | 0.0833 | 0.25 | .Q | . | . | . | . |
| 4.69 | 0.0878 | 0.26 | .Q | . | . | . | . |
| 4.91 | 0.0924 | 0.26 | .Q | . | . | . | . |
| 5.12 | 0.0970 | 0.26 | .Q | . | . | . | . |
| 5.33 | 0.1017 | 0.27 | .Q | . | . | . | . |
| 5.55 | 0.1065 | 0.27 | .Q | . | . | . | . |
| 5.76 | 0.1113 | 0.27 | .Q | . | . | . | . |
| 5.97 | 0.1161 | 0.28 | .Q | . | . | . | . |
| 6.19 | 0.1211 | 0.28 | .Q | . | . | . | . |
| 6.40 | 0.1260 | 0.29 | .Q | . | . | . | . |
| 6.61 | 0.1311 | 0.29 | .Q | . | . | . | . |
| 6.83 | 0.1362 | 0.29 | .Q | . | . | . | . |
| 7.04 | 0.1414 | 0.30 | .Q | . | . | . | . |
| 7.25 | 0.1467 | 0.30 | .Q | . | . | . | . |
| 7.47 | 0.1521 | 0.31 | .Q | . | . | . | . |
| 7.68 | 0.1575 | 0.31 | .Q | . | . | . | . |
| 7.89 | 0.1630 | 0.31 | .Q | . | . | . | . |
| 8.11 | 0.1686 | 0.32 | .Q | . | . | . | . |
| 8.32 | 0.1743 | 0.33 | .Q | . | . | . | . |
| 8.53 | 0.1801 | 0.33 | .Q | . | . | . | . |
| 8.75 | 0.1860 | 0.34 | .Q | . | . | . | . |
| 8.96 | 0.1920 | 0.34 | .Q | . | . | . | . |
| 9.17 | 0.1981 | 0.35 | .Q | . | . | . | . |
| 9.39 | 0.2044 | 0.36 | .Q | . | . | . | . |
| 9.60 | 0.2107 | 0.36 | .Q | . | . | . | . |
| 9.81 | 0.2172 | 0.37 | .Q | . | . | . | . |
| 10.03 | 0.2238 | 0.38 | .Q | . | . | . | . |
| 10.24 | 0.2305 | 0.39 | .Q | . | . | . | . |
| 10.45 | 0.2375 | 0.39 | .Q | . | . | . | . |
| 10.67 | 0.2445 | 0.41 | .Q | . | . | . | . |
| 10.88 | 0.2518 | 0.41 | .Q | . | . | . | . |
| 11.09 | 0.2592 | 0.43 | .Q | . | . | . | . |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 11.31 | 0.2668 | 0.44 | .Q | . | . | . | . |
| 11.52 | 0.2746 | 0.45 | .Q | . | . | . | . |
| 11.73 | 0.2827 | 0.46 | .Q | . | . | . | . |
| 11.95 | 0.2910 | 0.48 | .Q | . | . | . | . |
| 12.16 | 0.2996 | 0.50 | . Q | . | . | . | . |
| 12.37 | 0.3094 | 0.61 | . Q | . | . | . | . |
| 12.59 | 0.3202 | 0.62 | . Q | . | . | . | . |
| 12.80 | 0.3313 | 0.65 | . Q | . | . | . | . |
| 13.01 | 0.3428 | 0.66 | . Q | . | . | . | . |
| 13.23 | 0.3548 | 0.70 | . Q | . | . | . | . |
| 13.44 | 0.3673 | 0.72 | . Q | . | . | . | . |
| 13.65 | 0.3803 | 0.76 | . Q | . | . | . | . |
| 13.87 | 0.3939 | 0.78 | . Q | . | . | . | . |
| 14.08 | 0.4083 | 0.86 | . Q | . | . | . | . |
| 14.29 | 0.4258 | 1.13 | . Q | . | . | . | . |
| 14.51 | 0.4464 | 1.20 | . Q | . | . | . | . |
| 14.72 | 0.4680 | 1.25 | . Q | . | . | . | . |
| 14.93 | 0.4911 | 1.36 | . Q | . | . | . | . |
| 15.15 | 0.5157 | 1.43 | . Q | . | . | . | . |
| 15.36 | 0.5427 | 1.63 | . Q | . | . | . | . |
| 15.57 | 0.5728 | 1.78 | . Q | . | . | . | . |
| 15.79 | 0.6080 | 2.22 | . Q | . | . | . | . |
| 16.00 | 0.6514 | 2.70 | . Q | . | . | . | . |
| 16.21 | 0.7329 | 6.54 | . | . | . Q | . | . |
| 16.43 | 0.8079 | 1.98 | . Q | . | . | . | . |
| 16.64 | 0.8388 | 1.52 | . Q | . | . | . | . |
| 16.85 | 0.8636 | 1.30 | . Q | . | . | . | . |
| 17.07 | 0.8854 | 1.16 | . Q | . | . | . | . |
| 17.28 | 0.9028 | 0.81 | . Q | . | . | . | . |
| 17.49 | 0.9164 | 0.74 | . Q | . | . | . | . |
| 17.71 | 0.9289 | 0.68 | . Q | . | . | . | . |
| 17.92 | 0.9405 | 0.63 | . Q | . | . | . | . |
| 18.13 | 0.9513 | 0.59 | . Q | . | . | . | . |
| 18.35 | 0.9606 | 0.47 | .Q | . | . | . | . |
| 18.56 | 0.9687 | 0.44 | .Q | . | . | . | . |
| 18.77 | 0.9763 | 0.42 | .Q | . | . | . | . |
| 18.99 | 0.9836 | 0.40 | .Q | . | . | . | . |
| 19.20 | 0.9905 | 0.38 | .Q | . | . | . | . |
| 19.41 | 0.9971 | 0.37 | .Q | . | . | . | . |
| 19.63 | 1.0034 | 0.35 | .Q | . | . | . | . |
| 19.84 | 1.0096 | 0.34 | .Q | . | . | . | . |
| 20.05 | 1.0155 | 0.33 | .Q | . | . | . | . |
| 20.27 | 1.0212 | 0.32 | .Q | . | . | . | . |
| 20.48 | 1.0267 | 0.31 | .Q | . | . | . | . |
| 20.69 | 1.0320 | 0.30 | .Q | . | . | . | . |
| 20.91 | 1.0372 | 0.29 | .Q | . | . | . | . |
| 21.12 | 1.0423 | 0.28 | .Q | . | . | . | . |
| 21.33 | 1.0472 | 0.28 | .Q | . | . | . | . |
| 21.55 | 1.0520 | 0.27 | .Q | . | . | . | . |
| 21.76 | 1.0567 | 0.26 | .Q | . | . | . | . |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 21.97 | 1.0613 | 0.26 | .Q | . | . | . | . |
| 22.19 | 1.0657 | 0.25 | .Q | . | . | . | . |
| 22.40 | 1.0701 | 0.25 | Q | . | . | . | . |
| 22.61 | 1.0744 | 0.24 | Q | . | . | . | . |
| 22.83 | 1.0786 | 0.24 | Q | . | . | . | . |
| 23.04 | 1.0827 | 0.23 | Q | . | . | . | . |
| 23.25 | 1.0868 | 0.23 | Q | . | . | . | . |
| 23.47 | 1.0907 | 0.22 | Q | . | . | . | . |
| 23.68 | 1.0946 | 0.22 | Q | . | . | . | . |
| 23.89 | 1.0984 | 0.22 | Q | . | . | . | . |
| 24.11 | 1.1022 | 0.21 | Q | . | . | . | . |
| 24.32 | 1.1041 | 0.00 | Q | . | . | . | . |

TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
(Note: 100% of Peak Flow Rate estimate assumed to have
an instantaneous time duration)

| Percentile of Estimated Peak Flow Rate | Duration (minutes) |
|---|---|
| 0% | 1446.4 |
| 10% | 294.4 |
| 20% | 115.2 |
| 30% | 51.2 |
| 40% | 25.6 |
| 50% | 12.8 |
| 60% | 12.8 |
| 70% | 12.8 |
| 80% | 12.8 |
| 90% | 12.8 |

```
*****************************************************************************
          NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                    AND LOW LOSS FRACTION ESTIMATIONS
=============================================================================
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                           Analysis prepared by:

                           DRC Engineering, Inc.
                      160 South Old Springs Road, Suite 210
                             Anaheim Hills, CA 92808
                                  714-685-6860

*****************************************************************************
-----------------------------------------------------------------------------

 Problem Descriptions:
  AREA A
  PROPOSED CONDITION
  2 YEAR
=============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC I:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     2.64 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA     NUMBER    Fp(in./hr.)    YIELD
         1          2.22       22.80       75.(AMC II)     0.720       0.717

    TOTAL AREA (Acres) =      2.22

    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.164

    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.283
=============================================================================
```

```
**************************************************************************
                    SMALL AREA UNIT HYDROGRAPH MODEL
==========================================================================
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             Ver. 22.0  Release Date: 07/01/2015  License ID 1510

                          Analysis prepared by:

                          DRC Engineering, Inc.
                    160 South Old Springs Road, Suite 210
                           Anaheim Hills, CA 92808
                                714-685-6860

**************************************************************************
--------------------------------------------------------------------------

 Problem Descriptions:
  AREA A
  PROPOSED CONDITION
  2 YEAR
--------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =    2.22
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.164
    LOW LOSS FRACTION = 0.283
    TIME OF CONCENTRATION(MIN.) = 10.30
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =   2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.15
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.39
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.59
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  1.13
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.55
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  2.64

--------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     0.32
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.17

**************************************************************************
  TIME     VOLUME       Q    0.        2.5       5.0       7.5      10.0
 (HOURS)    (AF)      (CFS)
--------------------------------------------------------------------------
  0.03      0.0000      0.00  Q         .         .         .         .
  0.21      0.0004      0.06  Q         .         .         .         .
```

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0.38 | 0.0013 | 0.06 | Q | . | . | . | . |
| 0.55 | 0.0022 | 0.06 | Q | . | . | . | . |
| 0.72 | 0.0030 | 0.06 | Q | . | . | . | . |
| 0.89 | 0.0039 | 0.06 | Q | . | . | . | . |
| 1.06 | 0.0048 | 0.06 | Q | . | . | . | . |
| 1.24 | 0.0057 | 0.06 | Q | . | . | . | . |
| 1.41 | 0.0066 | 0.06 | Q | . | . | . | . |
| 1.58 | 0.0075 | 0.06 | Q | . | . | . | . |
| 1.75 | 0.0084 | 0.06 | Q | . | . | . | . |
| 1.92 | 0.0093 | 0.07 | Q | . | . | . | . |
| 2.09 | 0.0103 | 0.07 | Q | . | . | . | . |
| 2.27 | 0.0112 | 0.07 | Q | . | . | . | . |
| 2.44 | 0.0121 | 0.07 | Q | . | . | . | . |
| 2.61 | 0.0131 | 0.07 | Q | . | . | . | . |
| 2.78 | 0.0140 | 0.07 | Q | . | . | . | . |
| 2.95 | 0.0150 | 0.07 | Q | . | . | . | . |
| 3.12 | 0.0160 | 0.07 | Q | . | . | . | . |
| 3.30 | 0.0170 | 0.07 | Q | . | . | . | . |
| 3.47 | 0.0180 | 0.07 | Q | . | . | . | . |
| 3.64 | 0.0189 | 0.07 | Q | . | . | . | . |
| 3.81 | 0.0199 | 0.07 | Q | . | . | . | . |
| 3.98 | 0.0210 | 0.07 | Q | . | . | . | . |
| 4.15 | 0.0220 | 0.07 | Q | . | . | . | . |
| 4.33 | 0.0230 | 0.07 | Q | . | . | . | . |
| 4.50 | 0.0241 | 0.07 | Q | . | . | . | . |
| 4.67 | 0.0251 | 0.07 | Q | . | . | . | . |
| 4.84 | 0.0262 | 0.08 | Q | . | . | . | . |
| 5.01 | 0.0272 | 0.08 | Q | . | . | . | . |
| 5.18 | 0.0283 | 0.08 | Q | . | . | . | . |
| 5.36 | 0.0294 | 0.08 | Q | . | . | . | . |
| 5.53 | 0.0305 | 0.08 | Q | . | . | . | . |
| 5.70 | 0.0316 | 0.08 | Q | . | . | . | . |
| 5.87 | 0.0327 | 0.08 | Q | . | . | . | . |
| 6.04 | 0.0339 | 0.08 | Q | . | . | . | . |
| 6.21 | 0.0350 | 0.08 | Q | . | . | . | . |
| 6.39 | 0.0362 | 0.08 | Q | . | . | . | . |
| 6.56 | 0.0373 | 0.08 | Q | . | . | . | . |
| 6.73 | 0.0385 | 0.08 | Q | . | . | . | . |
| 6.90 | 0.0397 | 0.09 | Q | . | . | . | . |
| 7.07 | 0.0409 | 0.09 | Q | . | . | . | . |
| 7.24 | 0.0422 | 0.09 | Q | . | . | . | . |
| 7.42 | 0.0434 | 0.09 | Q | . | . | . | . |
| 7.59 | 0.0447 | 0.09 | Q | . | . | . | . |
| 7.76 | 0.0459 | 0.09 | Q | . | . | . | . |
| 7.93 | 0.0472 | 0.09 | Q | . | . | . | . |
| 8.10 | 0.0485 | 0.09 | Q | . | . | . | . |
| 8.27 | 0.0498 | 0.09 | Q | . | . | . | . |
| 8.45 | 0.0512 | 0.09 | Q | . | . | . | . |
| 8.62 | 0.0525 | 0.10 | Q | . | . | . | . |
| 8.79 | 0.0539 | 0.10 | Q | . | . | . | . |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 8.96 | 0.0553 | 0.10 | Q | . | . | . | . |
| 9.13 | 0.0567 | 0.10 | Q | . | . | . | . |
| 9.30 | 0.0582 | 0.10 | Q | . | . | . | . |
| 9.48 | 0.0596 | 0.10 | Q | . | . | . | . |
| 9.65 | 0.0611 | 0.11 | Q | . | . | . | . |
| 9.82 | 0.0626 | 0.11 | Q | . | . | . | . |
| 9.99 | 0.0642 | 0.11 | Q | . | . | . | . |
| 10.16 | 0.0657 | 0.11 | Q | . | . | . | . |
| 10.34 | 0.0673 | 0.11 | Q | . | . | . | . |
| 10.51 | 0.0689 | 0.11 | Q | . | . | . | . |
| 10.68 | 0.0706 | 0.12 | Q | . | . | . | . |
| 10.85 | 0.0723 | 0.12 | Q | . | . | . | . |
| 11.02 | 0.0740 | 0.12 | Q | . | . | . | . |
| 11.19 | 0.0757 | 0.12 | Q | . | . | . | . |
| 11.37 | 0.0775 | 0.13 | Q | . | . | . | . |
| 11.54 | 0.0793 | 0.13 | Q | . | . | . | . |
| 11.71 | 0.0812 | 0.13 | Q | . | . | . | . |
| 11.88 | 0.0831 | 0.14 | Q | . | . | . | . |
| 12.05 | 0.0851 | 0.14 | Q | . | . | . | . |
| 12.22 | 0.0873 | 0.17 | Q | . | . | . | . |
| 12.40 | 0.0897 | 0.18 | Q | . | . | . | . |
| 12.57 | 0.0922 | 0.18 | Q | . | . | . | . |
| 12.74 | 0.0948 | 0.19 | Q | . | . | . | . |
| 12.91 | 0.0975 | 0.19 | Q | . | . | . | . |
| 13.08 | 0.1002 | 0.20 | Q | . | . | . | . |
| 13.25 | 0.1030 | 0.20 | Q | . | . | . | . |
| 13.43 | 0.1059 | 0.21 | Q | . | . | . | . |
| 13.60 | 0.1089 | 0.21 | Q | . | . | . | . |
| 13.77 | 0.1120 | 0.23 | Q | . | . | . | . |
| 13.94 | 0.1153 | 0.23 | Q | . | . | . | . |
| 14.11 | 0.1189 | 0.28 | .Q | . | . | . | . |
| 14.28 | 0.1232 | 0.33 | .Q | . | . | . | . |
| 14.45 | 0.1280 | 0.34 | .Q | . | . | . | . |
| 14.63 | 0.1329 | 0.35 | .Q | . | . | . | . |
| 14.80 | 0.1382 | 0.38 | .Q | . | . | . | . |
| 14.97 | 0.1436 | 0.39 | .Q | . | . | . | . |
| 15.14 | 0.1495 | 0.43 | .Q | . | . | . | . |
| 15.31 | 0.1557 | 0.45 | .Q | . | . | . | . |
| 15.48 | 0.1626 | 0.52 | . Q | . | . | . | . |
| 15.66 | 0.1702 | 0.56 | . Q | . | . | . | . |
| 15.83 | 0.1788 | 0.65 | . Q | . | . | . | . |
| 16.00 | 0.1892 | 0.82 | .  Q | . | . | . | . |
| 16.17 | 0.2109 | 2.24 | .  Q | . | . | . | . |
| 16.34 | 0.2312 | 0.62 | . Q | . | . | . | . |
| 16.52 | 0.2390 | 0.48 | .Q | . | . | . | . |
| 16.69 | 0.2453 | 0.41 | .Q | . | . | . | . |
| 16.86 | 0.2508 | 0.37 | .Q | . | . | . | . |
| 17.03 | 0.2558 | 0.34 | .Q | . | . | . | . |
| 17.20 | 0.2599 | 0.24 | Q | . | . | . | . |
| 17.37 | 0.2631 | 0.22 | Q | . | . | . | . |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 17.55 | 0.2661 | 0.20 | Q | . | . | . | . |
| 17.72 | 0.2690 | 0.19 | Q | . | . | . | . |
| 17.89 | 0.2716 | 0.18 | Q | . | . | . | . |
| 18.06 | 0.2741 | 0.17 | Q | . | . | . | . |
| 18.23 | 0.2763 | 0.14 | Q | . | . | . | . |
| 18.40 | 0.2782 | 0.13 | Q | . | . | . | . |
| 18.58 | 0.2801 | 0.13 | Q | . | . | . | . |
| 18.75 | 0.2818 | 0.12 | Q | . | . | . | . |
| 18.92 | 0.2835 | 0.12 | Q | . | . | . | . |
| 19.09 | 0.2851 | 0.11 | Q | . | . | . | . |
| 19.26 | 0.2867 | 0.11 | Q | . | . | . | . |
| 19.43 | 0.2882 | 0.10 | Q | . | . | . | . |
| 19.61 | 0.2897 | 0.10 | Q | . | . | . | . |
| 19.78 | 0.2911 | 0.10 | Q | . | . | . | . |
| 19.95 | 0.2925 | 0.10 | Q | . | . | . | . |
| 20.12 | 0.2938 | 0.09 | Q | . | . | . | . |
| 20.29 | 0.2951 | 0.09 | Q | . | . | . | . |
| 20.46 | 0.2964 | 0.09 | Q | . | . | . | . |
| 20.64 | 0.2976 | 0.09 | Q | . | . | . | . |
| 20.81 | 0.2988 | 0.08 | Q | . | . | . | . |
| 20.98 | 0.3000 | 0.08 | Q | . | . | . | . |
| 21.15 | 0.3012 | 0.08 | Q | . | . | . | . |
| 21.32 | 0.3023 | 0.08 | Q | . | . | . | . |
| 21.49 | 0.3034 | 0.08 | Q | . | . | . | . |
| 21.67 | 0.3045 | 0.08 | Q | . | . | . | . |
| 21.84 | 0.3056 | 0.07 | Q | . | . | . | . |
| 22.01 | 0.3066 | 0.07 | Q | . | . | . | . |
| 22.18 | 0.3076 | 0.07 | Q | . | . | . | . |
| 22.35 | 0.3087 | 0.07 | Q | . | . | . | . |
| 22.52 | 0.3097 | 0.07 | Q | . | . | . | . |
| 22.69 | 0.3106 | 0.07 | Q | . | . | . | . |
| 22.87 | 0.3116 | 0.07 | Q | . | . | . | . |
| 23.04 | 0.3125 | 0.07 | Q | . | . | . | . |
| 23.21 | 0.3135 | 0.07 | Q | . | . | . | . |
| 23.38 | 0.3144 | 0.06 | Q | . | . | . | . |
| 23.55 | 0.3153 | 0.06 | Q | . | . | . | . |
| 23.73 | 0.3162 | 0.06 | Q | . | . | . | . |
| 23.90 | 0.3171 | 0.06 | Q | . | . | . | . |
| 24.07 | 0.3180 | 0.06 | Q | . | . | . | . |
| 24.24 | 0.3184 | 0.00 | Q | . | . | . | . |

---

TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
(Note: 100% of Peak Flow Rate estimate assumed to have
an instantaneous time duration)

| Percentile of Estimated Peak Flow Rate | Duration (minutes) |
|---|---|
| 0% | 1442.0 |

| | |
|---|---|
| 10% | 216.3 |
| 20% | 82.4 |
| 30% | 20.6 |
| 40% | 10.3 |
| 50% | 10.3 |
| 60% | 10.3 |
| 70% | 10.3 |
| 80% | 10.3 |
| 90% | 10.3 |

```
*************************************************************************
          NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                    AND LOW LOSS FRACTION ESTIMATIONS
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                          Analysis prepared by:

                          DRC Engineering, Inc.
                    160 South Old Springs Road, Suite 210
                          Anaheim Hills, CA 92808
                               714-685-6860

*************************************************************************
-------------------------------------------------------------------------

 Problem Descriptions:
  AREA B
  PROPOSED CONDITION
  2 YEAR
=========================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC I:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     2.64 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA     NUMBER    Fp(in./hr.)    YIELD
         1          4.42        5.30       75.(AMC II)     0.720       0.867

    TOTAL AREA (Acres) =      4.42

    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.038

    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.133
=========================================================================
```

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**************************************************************************
                    SMALL AREA UNIT HYDROGRAPH MODEL
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                          Analysis prepared by:

                          DRC Engineering, Inc.
                    160 South Old Springs Road, Suite 210
                           Anaheim Hills, CA 92808
                                714-685-6860

**************************************************************************
--------------------------------------------------------------------------

 Problem Descriptions:
  AREA B
  PROPOSED CONDITION
  2 YEAR
--------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =    4.42
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.038
    LOW LOSS FRACTION = 0.133
    TIME OF CONCENTRATION(MIN.) = 10.00
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =   2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.15
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.39
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.59
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  1.13
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.55
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  2.64

--------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     0.77
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.21

**************************************************************************
  TIME     VOLUME       Q    0.        2.5       5.0       7.5      10.0
 (HOURS)    (AF)      (CFS)
--------------------------------------------------------------------------
  0.17      0.0010      0.15  Q         .         .         .         .
  0.33      0.0030      0.15  Q         .         .         .         .
```

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0.50 | 0.0051 | 0.15 | Q | . | . | . | . |
| 0.67 | 0.0071 | 0.15 | Q | . | . | . | . |
| 0.83 | 0.0091 | 0.15 | Q | . | . | . | . |
| 1.00 | 0.0112 | 0.15 | Q | . | . | . | . |
| 1.17 | 0.0133 | 0.15 | Q | . | . | . | . |
| 1.33 | 0.0154 | 0.15 | Q | . | . | . | . |
| 1.50 | 0.0175 | 0.15 | Q | . | . | . | . |
| 1.67 | 0.0196 | 0.15 | Q | . | . | . | . |
| 1.83 | 0.0218 | 0.16 | Q | . | . | . | . |
| 2.00 | 0.0239 | 0.16 | Q | . | . | . | . |
| 2.17 | 0.0261 | 0.16 | Q | . | . | . | . |
| 2.33 | 0.0283 | 0.16 | Q | . | . | . | . |
| 2.50 | 0.0305 | 0.16 | Q | . | . | . | . |
| 2.67 | 0.0327 | 0.16 | Q | . | . | . | . |
| 2.83 | 0.0350 | 0.16 | Q | . | . | . | . |
| 3.00 | 0.0372 | 0.16 | Q | . | . | . | . |
| 3.17 | 0.0395 | 0.17 | Q | . | . | . | . |
| 3.33 | 0.0418 | 0.17 | Q | . | . | . | . |
| 3.50 | 0.0441 | 0.17 | Q | . | . | . | . |
| 3.67 | 0.0464 | 0.17 | Q | . | . | . | . |
| 3.83 | 0.0488 | 0.17 | Q | . | . | . | . |
| 4.00 | 0.0512 | 0.17 | Q | . | . | . | . |
| 4.17 | 0.0536 | 0.17 | Q | . | . | . | . |
| 4.33 | 0.0560 | 0.18 | Q | . | . | . | . |
| 4.50 | 0.0584 | 0.18 | Q | . | . | . | . |
| 4.67 | 0.0609 | 0.18 | Q | . | . | . | . |
| 4.83 | 0.0633 | 0.18 | Q | . | . | . | . |
| 5.00 | 0.0658 | 0.18 | Q | . | . | . | . |
| 5.17 | 0.0683 | 0.18 | Q | . | . | . | . |
| 5.33 | 0.0709 | 0.19 | Q | . | . | . | . |
| 5.50 | 0.0735 | 0.19 | Q | . | . | . | . |
| 5.67 | 0.0761 | 0.19 | Q | . | . | . | . |
| 5.83 | 0.0787 | 0.19 | Q | . | . | . | . |
| 6.00 | 0.0813 | 0.19 | Q | . | . | . | . |
| 6.17 | 0.0840 | 0.20 | Q | . | . | . | . |
| 6.33 | 0.0867 | 0.20 | Q | . | . | . | . |
| 6.50 | 0.0894 | 0.20 | Q | . | . | . | . |
| 6.67 | 0.0922 | 0.20 | Q | . | . | . | . |
| 6.83 | 0.0950 | 0.20 | Q | . | . | . | . |
| 7.00 | 0.0978 | 0.21 | Q | . | . | . | . |
| 7.17 | 0.1006 | 0.21 | Q | . | . | . | . |
| 7.33 | 0.1035 | 0.21 | Q | . | . | . | . |
| 7.50 | 0.1064 | 0.21 | Q | . | . | . | . |
| 7.67 | 0.1094 | 0.22 | Q | . | . | . | . |
| 7.83 | 0.1124 | 0.22 | Q | . | . | . | . |
| 8.00 | 0.1154 | 0.22 | Q | . | . | . | . |
| 8.17 | 0.1185 | 0.22 | Q | . | . | . | . |
| 8.33 | 0.1216 | 0.23 | Q | . | . | . | . |
| 8.50 | 0.1247 | 0.23 | Q | . | . | . | . |
| 8.67 | 0.1279 | 0.23 | Q | . | . | . | . |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 8.83 | 0.1311 | 0.24 | Q | . | . | . | . |
| 9.00 | 0.1344 | 0.24 | Q | . | . | . | . |
| 9.17 | 0.1377 | 0.24 | Q | . | . | . | . |
| 9.33 | 0.1411 | 0.25 | Q | . | . | . | . |
| 9.50 | 0.1445 | 0.25 | .Q | . | . | . | . |
| 9.67 | 0.1480 | 0.25 | .Q | . | . | . | . |
| 9.83 | 0.1515 | 0.26 | .Q | . | . | . | . |
| 10.00 | 0.1551 | 0.26 | .Q | . | . | . | . |
| 10.17 | 0.1588 | 0.27 | .Q | . | . | . | . |
| 10.33 | 0.1625 | 0.27 | .Q | . | . | . | . |
| 10.50 | 0.1663 | 0.28 | .Q | . | . | . | . |
| 10.67 | 0.1701 | 0.28 | .Q | . | . | . | . |
| 10.83 | 0.1740 | 0.29 | .Q | . | . | . | . |
| 11.00 | 0.1780 | 0.29 | .Q | . | . | . | . |
| 11.17 | 0.1821 | 0.30 | .Q | . | . | . | . |
| 11.33 | 0.1863 | 0.30 | .Q | . | . | . | . |
| 11.50 | 0.1906 | 0.31 | .Q | . | . | . | . |
| 11.67 | 0.1949 | 0.32 | .Q | . | . | . | . |
| 11.83 | 0.1994 | 0.33 | .Q | . | . | . | . |
| 12.00 | 0.2039 | 0.33 | .Q | . | . | . | . |
| 12.17 | 0.2090 | 0.41 | .Q | . | . | . | . |
| 12.33 | 0.2147 | 0.42 | .Q | . | . | . | . |
| 12.50 | 0.2205 | 0.43 | .Q | . | . | . | . |
| 12.67 | 0.2265 | 0.44 | .Q | . | . | . | . |
| 12.83 | 0.2326 | 0.45 | .Q | . | . | . | . |
| 13.00 | 0.2389 | 0.46 | .Q | . | . | . | . |
| 13.17 | 0.2454 | 0.48 | .Q | . | . | . | . |
| 13.33 | 0.2521 | 0.49 | .Q | . | . | . | . |
| 13.50 | 0.2590 | 0.51 | . Q | . | . | . | . |
| 13.67 | 0.2661 | 0.52 | . Q | . | . | . | . |
| 13.83 | 0.2736 | 0.55 | . Q | . | . | . | . |
| 14.00 | 0.2813 | 0.57 | . Q | . | . | . | . |
| 14.17 | 0.2905 | 0.78 | .  Q | . | . | . | . |
| 14.33 | 0.3014 | 0.80 | .  Q | . | . | . | . |
| 14.50 | 0.3126 | 0.84 | .  Q | . | . | . | . |
| 14.67 | 0.3244 | 0.86 | .  Q | . | . | . | . |
| 14.83 | 0.3367 | 0.92 | .  Q | . | . | . | . |
| 15.00 | 0.3496 | 0.96 | .  Q | . | . | . | . |
| 15.17 | 0.3635 | 1.05 | .   Q | . | . | . | . |
| 15.33 | 0.3784 | 1.12 | .   Q | . | . | . | . |
| 15.50 | 0.3951 | 1.30 | .    Q | . | . | . | . |
| 15.67 | 0.4139 | 1.42 | .    Q | . | . | . | . |
| 15.83 | 0.4351 | 1.66 | .     Q | . | . | . | . |
| 16.00 | 0.4614 | 2.17 | .       Q | . | . | . | . |
| 16.17 | 0.5110 | 5.03 | .         | . | Q | . | . |
| 16.33 | 0.5566 | 1.59 | .     Q | . | . | . | . |
| 16.50 | 0.5758 | 1.19 | .   Q | . | . | . | . |
| 16.67 | 0.5909 | 1.00 | .  Q | . | . | . | . |
| 16.83 | 0.6039 | 0.89 | .  Q | . | . | . | . |
| 17.00 | 0.6157 | 0.82 | .  Q | . | . | . | . |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 17.17 | 0.6254 | 0.58 | . Q | . | . | . | . |
| 17.33 | 0.6331 | 0.54 | . Q | . | . | . | . |
| 17.50 | 0.6402 | 0.50 | . Q | . | . | . | . |
| 17.67 | 0.6469 | 0.47 | .Q | . | . | . | . |
| 17.83 | 0.6532 | 0.44 | .Q | . | . | . | . |
| 18.00 | 0.6592 | 0.42 | .Q | . | . | . | . |
| 18.17 | 0.6644 | 0.34 | .Q | . | . | . | . |
| 18.33 | 0.6690 | 0.32 | .Q | . | . | . | . |
| 18.50 | 0.6734 | 0.31 | .Q | . | . | . | . |
| 18.67 | 0.6775 | 0.30 | .Q | . | . | . | . |
| 18.83 | 0.6815 | 0.28 | .Q | . | . | . | . |
| 19.00 | 0.6854 | 0.27 | .Q | . | . | . | . |
| 19.17 | 0.6891 | 0.27 | .Q | . | . | . | . |
| 19.33 | 0.6927 | 0.26 | .Q | . | . | . | . |
| 19.50 | 0.6962 | 0.25 | Q | . | . | . | . |
| 19.67 | 0.6995 | 0.24 | Q | . | . | . | . |
| 19.83 | 0.7028 | 0.23 | Q | . | . | . | . |
| 20.00 | 0.7060 | 0.23 | Q | . | . | . | . |
| 20.17 | 0.7091 | 0.22 | Q | . | . | . | . |
| 20.33 | 0.7121 | 0.22 | Q | . | . | . | . |
| 20.50 | 0.7151 | 0.21 | Q | . | . | . | . |
| 20.67 | 0.7180 | 0.21 | Q | . | . | . | . |
| 20.83 | 0.7208 | 0.20 | Q | . | . | . | . |
| 21.00 | 0.7235 | 0.20 | Q | . | . | . | . |
| 21.17 | 0.7262 | 0.19 | Q | . | . | . | . |
| 21.33 | 0.7289 | 0.19 | Q | . | . | . | . |
| 21.50 | 0.7315 | 0.19 | Q | . | . | . | . |
| 21.67 | 0.7340 | 0.18 | Q | . | . | . | . |
| 21.83 | 0.7365 | 0.18 | Q | . | . | . | . |
| 22.00 | 0.7390 | 0.18 | Q | . | . | . | . |
| 22.17 | 0.7414 | 0.17 | Q | . | . | . | . |
| 22.33 | 0.7438 | 0.17 | Q | . | . | . | . |
| 22.50 | 0.7461 | 0.17 | Q | . | . | . | . |
| 22.67 | 0.7484 | 0.17 | Q | . | . | . | . |
| 22.83 | 0.7506 | 0.16 | Q | . | . | . | . |
| 23.00 | 0.7529 | 0.16 | Q | . | . | . | . |
| 23.17 | 0.7551 | 0.16 | Q | . | . | . | . |
| 23.33 | 0.7572 | 0.16 | Q | . | . | . | . |
| 23.50 | 0.7593 | 0.15 | Q | . | . | . | . |
| 23.67 | 0.7614 | 0.15 | Q | . | . | . | . |
| 23.83 | 0.7635 | 0.15 | Q | . | . | . | . |
| 24.00 | 0.7656 | 0.15 | Q | . | . | . | . |
| 24.17 | 0.7666 | 0.00 | Q | . | . | . | . |

---

TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
(Note: 100% of Peak Flow Rate estimate assumed to have
an instantaneous time duration)

Percentile of Estimated Duration

| Peak Flow Rate | (minutes) |
|---|---|
| 0% | 1440.0 |
| 10% | 240.0 |
| 20% | 90.0 |
| 30% | 40.0 |
| 40% | 20.0 |
| 50% | 10.0 |
| 60% | 10.0 |
| 70% | 10.0 |
| 80% | 10.0 |
| 90% | 10.0 |

# Hydraflow Table of Contents





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# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020.4

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Manual | 2.240 | 5 | 970 | 13,899 | ------ | ------ | ------ | Area A |
| 2 | Reservoir | 2.194 | 5 | 970 | 12,296 | 1 | 675.84 | 2,036 | Detention 1 Outflow |
| 3 | Manual | 5.030 | 5 | 970 | 33,429 | ------ | ------ | ------ | Area B |
| 4 | Reservoir | 2.373 | 5 | 980 | 33,423 | 3 | 673.43 | 3,441 | Basin B Outflow |
| 5 | Reservoir | 2.382 | 5 | 980 | 24,357 | 4 | 674.87 | 9,568 | Detention 2 Outflow |

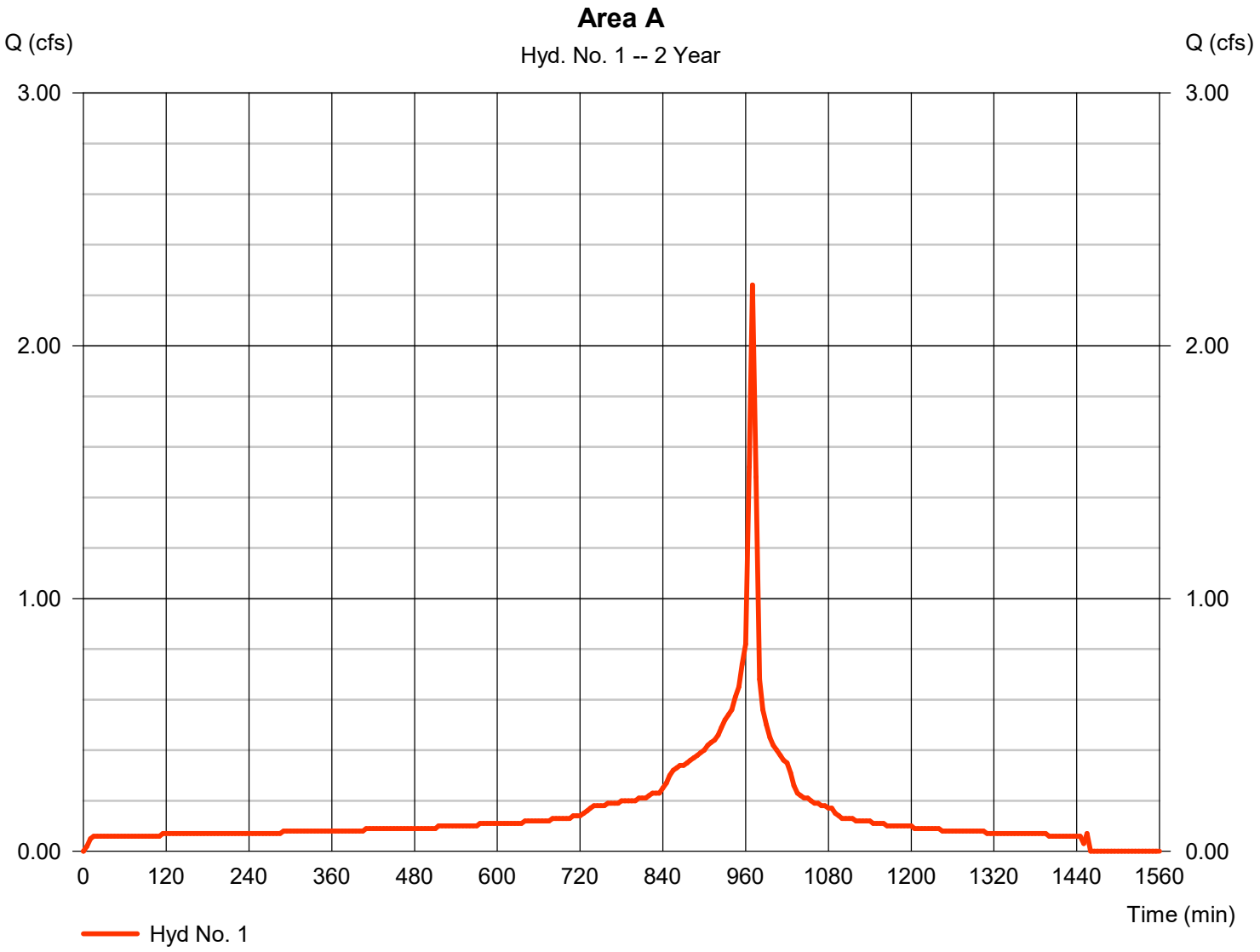
# Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020.4 Thursday, 09 / 14 / 2023

## Hyd. No. 1

Area A

| | | | |
|---|---|---|---|
| Hydrograph type | = Manual | Peak discharge | = 2.240 cfs |
| Storm frequency | = 2 yrs | Time to peak | = 970 min |
| Time interval | = 5 min | Hyd. volume | = 13,899 cuft |



# Hydrograph Report

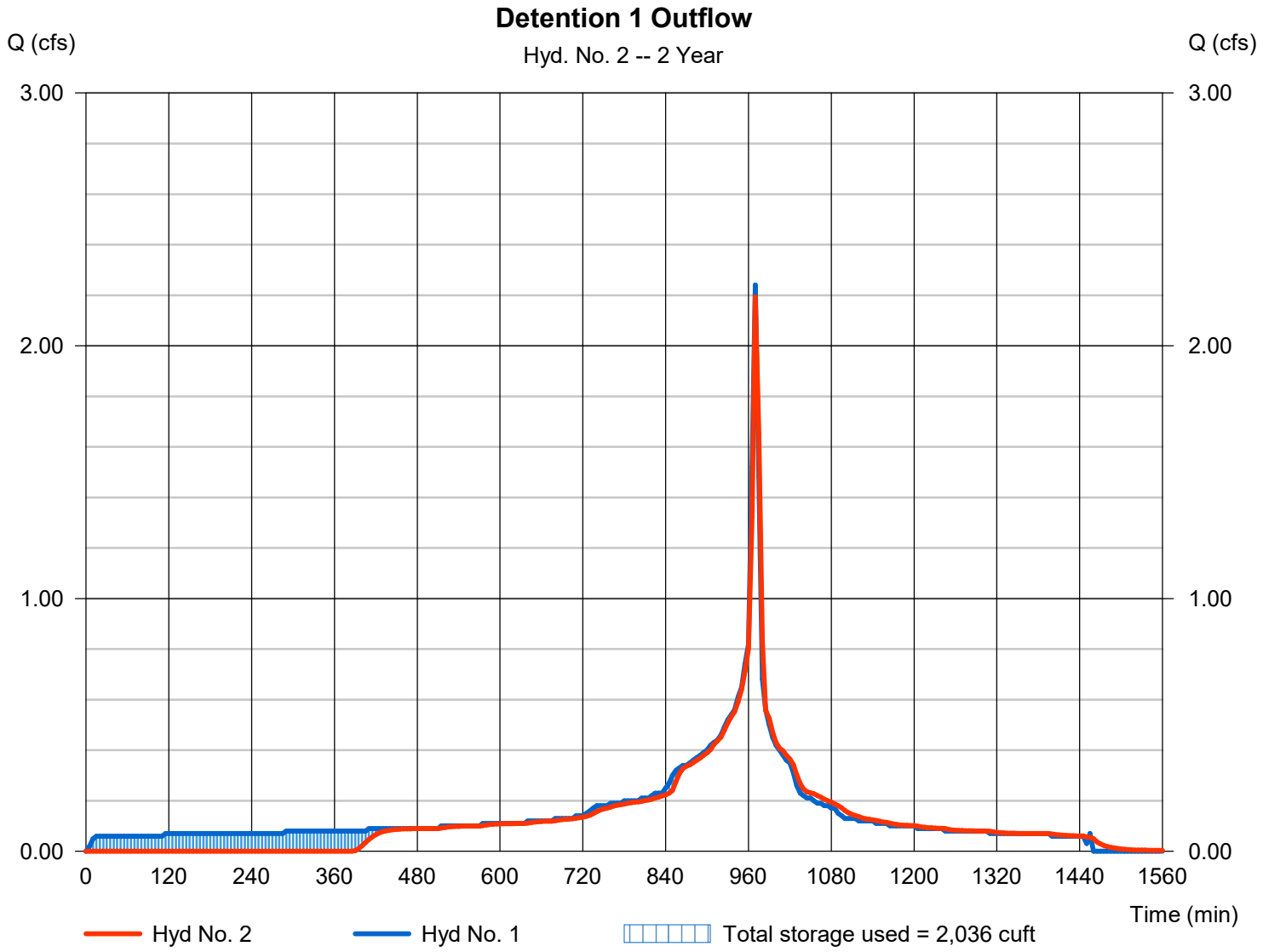


## Hyd. No. 2

Detention 1 Outflow

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Reservoir | Peak discharge | = | 2.194 cfs |
| Storm frequency | = | 2 yrs | Time to peak | = | 970 min |
| Time interval | = | 5 min | Hyd. volume | = | 12,296 cuft |
| Inflow hyd. No. | = | 1 - Area A | Max. Elevation | = | 675.84 ft |
| Reservoir name | = | Detention 1 | Max. Storage | = | 2,036 cuft |

Storage Indication method used.



# Pond Report



## Pond No. 3 - Detention 1

### Pond Data

**UG Chambers -**Invert elev. = 672.20 ft, Rise x Span = 4.00 x 4.00 ft, Barrel Len = 85.00 ft, No. Barrels = 2, Slope = 0.00%, Headers = No

### Stage / Storage Table

| Stage (ft) | Elevation (ft) | Contour area (sqft) | Incr. Storage (cuft) | Total storage (cuft) |
|---|---|---|---|---|
| 0.00 | 672.20 | n/a | 0 | 0 |
| 0.40 | 672.60 | n/a | 111 | 111 |
| 0.80 | 673.00 | n/a | 193 | 304 |
| 1.20 | 673.40 | n/a | 235 | 539 |
| 1.60 | 673.80 | n/a | 259 | 798 |
| 2.00 | 674.20 | n/a | 270 | 1,069 |
| 2.40 | 674.60 | n/a | 270 | 1,339 |
| 2.80 | 675.00 | n/a | 259 | 1,598 |
| 3.20 | 675.40 | n/a | 235 | 1,833 |
| 3.60 | 675.80 | n/a | 193 | 2,026 |
| 4.00 | 676.20 | n/a | 111 | 2,137 |

### Culvert / Orifice Structures

| | [A] | [B] | [C] | [PrfRsr] |
|---|---|---|---|---|
| **Rise (in)** | = 6.00 | Inactive | 0.00 | 0.00 |
| **Span (in)** | = 6.00 | 0.00 | 0.00 | 0.00 |
| **No. Barrels** | = 1 | 0 | 0 | 0 |
| **Invert El. (ft)** | = 675.00 | 0.00 | 0.00 | 0.00 |
| **Length (ft)** | = 10.00 | 0.00 | 0.00 | 0.00 |
| **Slope (%)** | = 0.50 | 0.00 | 0.00 | n/a |
| **N-Value** | = .013 | .013 | .013 | n/a |
| **Orifice Coeff.** | = 0.60 | 0.60 | 0.60 | 0.60 |
| **Multi-Stage** | = n/a | No | No | No |

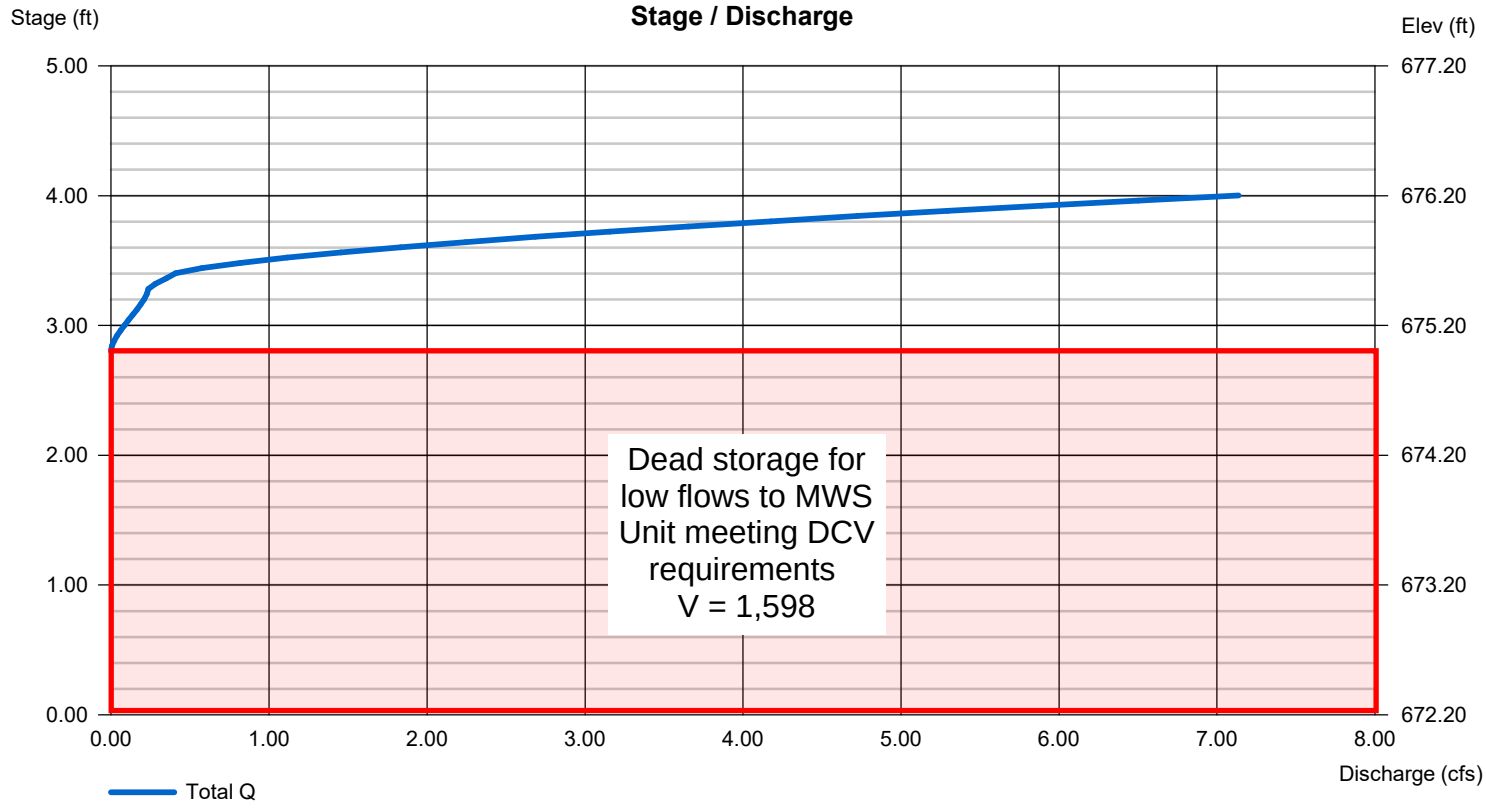
### Weir Structures

| | [A] | [B] | [C] | [D] |
|---|---|---|---|---|
| **Crest Len (ft)** | = 4.00 | 0.00 | 0.00 | 0.00 |
| **Crest El. (ft)** | = 675.60 | 0.00 | 0.00 | 0.00 |
| **Weir Coeff.** | = 3.33 | 3.33 | 3.33 | 3.33 |
| **Weir Type** | = Rect | --- | --- | --- |
| **Multi-Stage** | = No | No | No | No |

**Exfil.(in/hr)** = 0.000 (by Wet area)

**TW Elev. (ft)** = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



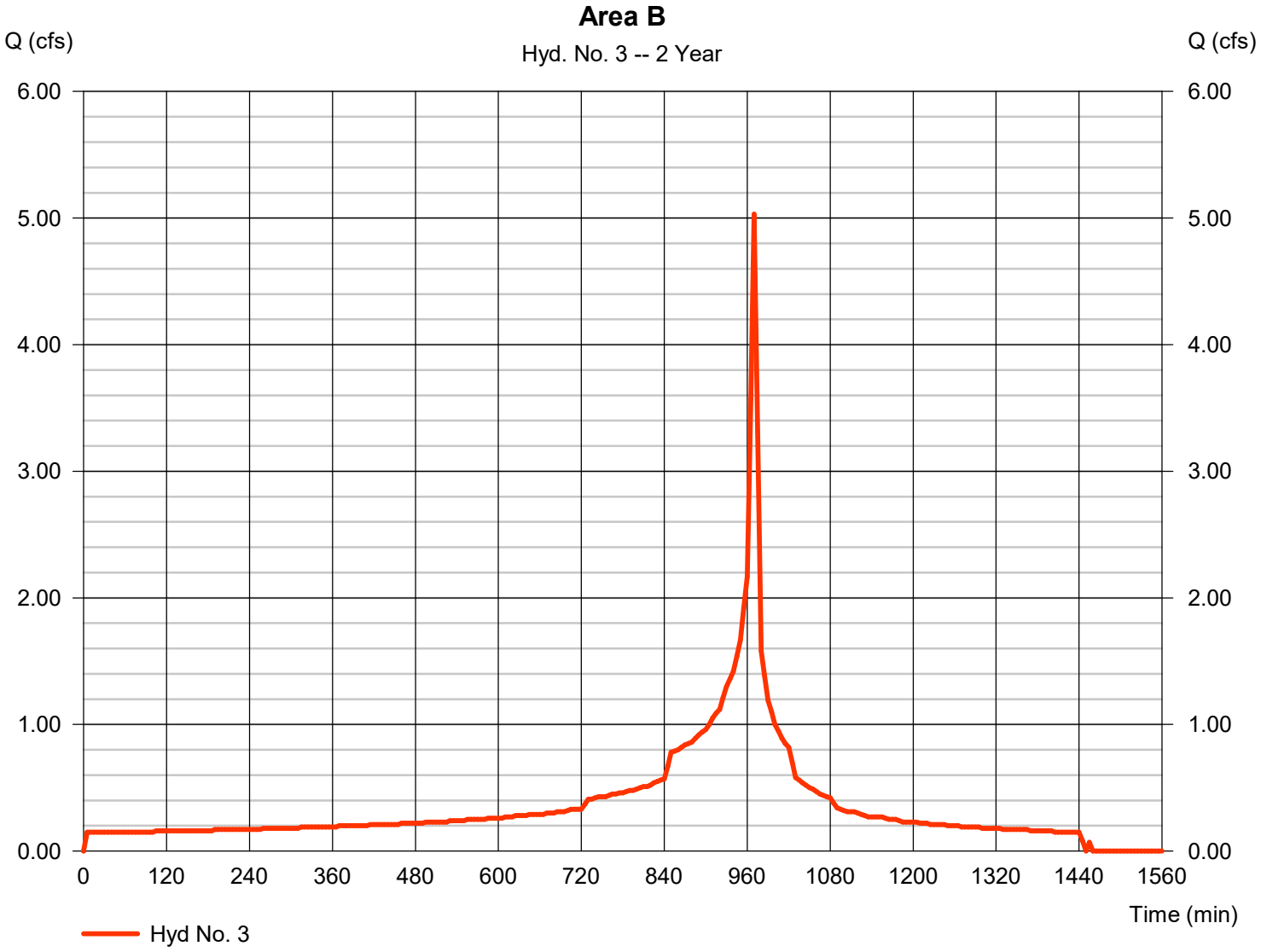
# Hydrograph Report



## Hyd. No. 3

Area B

| | | | |
|---|---|---|---|
| Hydrograph type | = Manual | Peak discharge | = 5.030 cfs |
| Storm frequency | = 2 yrs | Time to peak | = 970 min |
| Time interval | = 5 min | Hyd. volume | = 33,429 cuft |



# Hydrograph Report

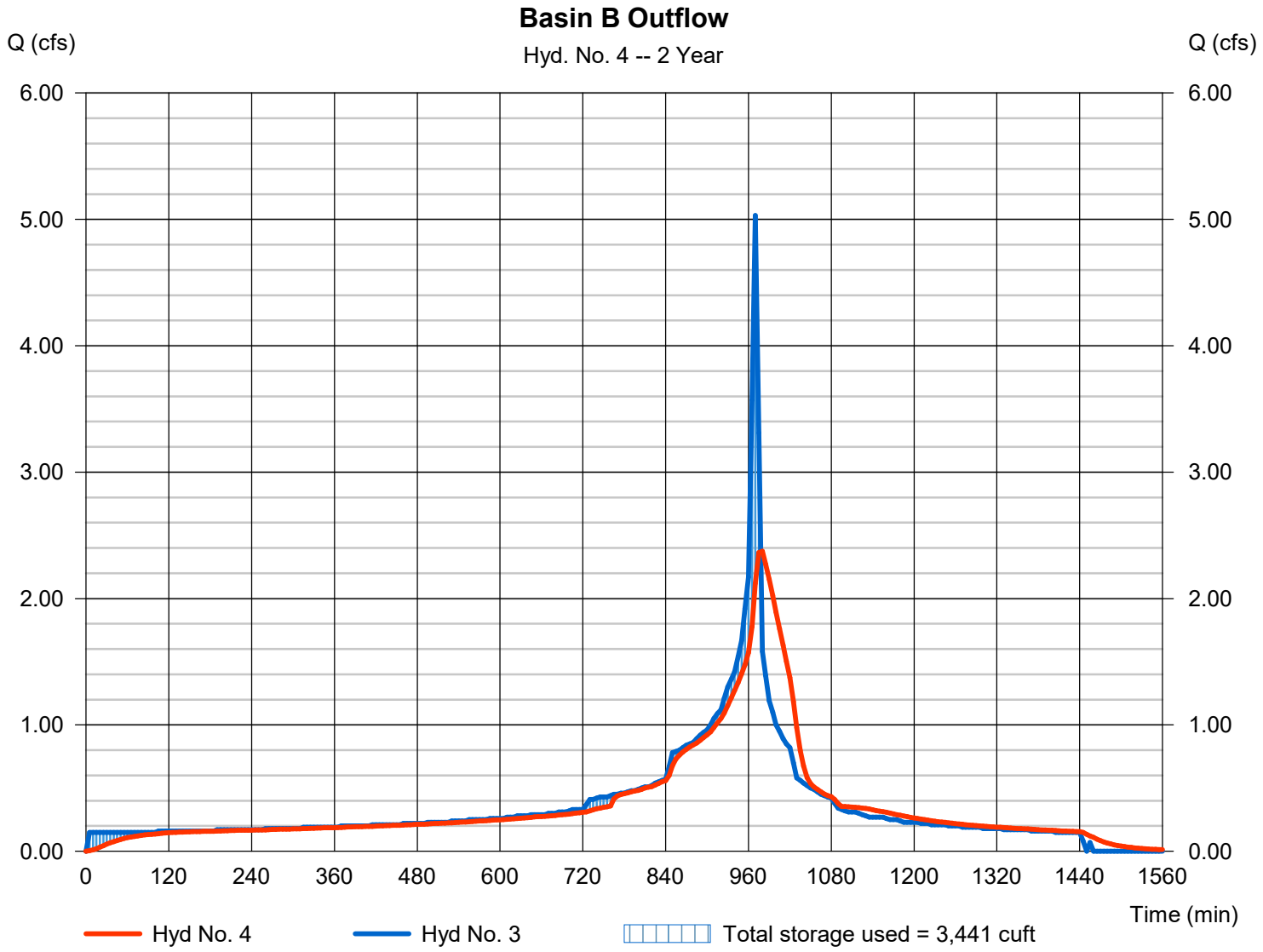


## Hyd. No. 4

Basin B Outflow

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Reservoir | Peak discharge | = | 2.373 cfs |
| Storm frequency | = | 2 yrs | Time to peak | = | 980 min |
| Time interval | = | 5 min | Hyd. volume | = | 33,423 cuft |
| Inflow hyd. No. | = | 3 - Area B | Max. Elevation | = | 673.43 ft |
| Reservoir name | = | Basin B | Max. Storage | = | 3,441 cuft |

Storage Indication method used.



# Pond Report



## Pond No. 2 - Basin B

### Pond Data

**Pond storage is based on user-defined values.**

### Stage / Storage Table

| Stage (ft) | Elevation (ft) | Contour area (sqft) | Incr. Storage (cuft) | Total storage (cuft) |
|---|---|---|---|---|
| 0.00 | 671.80 | n/a | 0 | 0 |
| 0.50 | 672.30 | n/a | 942 | 942 |
| 1.00 | 672.80 | n/a | 942 | 1,884 |
| 1.50 | 673.30 | n/a | 943 | 2,827 |
| 2.00 | 673.80 | n/a | 942 | 3,769 |
| 2.50 | 674.30 | n/a | 942 | 4,711 |
| 3.00 | 674.80 | n/a | 942 | 5,653 |
| 3.50 | 675.30 | n/a | 2,356 | 8,009 |
| 4.00 | 675.80 | n/a | 2,355 | 10,364 |
| 4.50 | 676.30 | n/a | 2,356 | 12,720 |
| 5.00 | 676.80 | n/a | 2,355 | 15,075 |
| 5.50 | 677.30 | n/a | 2,355 | 17,430 |

### Culvert / Orifice Structures

| | [A] | [B] | [C] | [PrfRsr] |
|---|---|---|---|---|
| **Rise (in)** | = 6.00 | 2.00 | 2.00 | 0.00 |
| **Span (in)** | = 6.00 | 2.00 | 2.00 | 0.00 |
| **No. Barrels** | = 2 | 9 | 9 | 0 |
| **Invert El. (ft)** | = 671.80 | 676.30 | 676.30 | 0.00 |
| **Length (ft)** | = 1.00 | 1.00 | 1.00 | 0.00 |
| **Slope (%)** | = 2.00 | 2.00 | 2.00 | n/a |
| **N-Value** | = .013 | .013 | .013 | n/a |
| **Orifice Coeff.** | = 0.60 | 0.60 | 0.60 | 0.60 |
| **Multi-Stage** | = n/a | No | No | No |

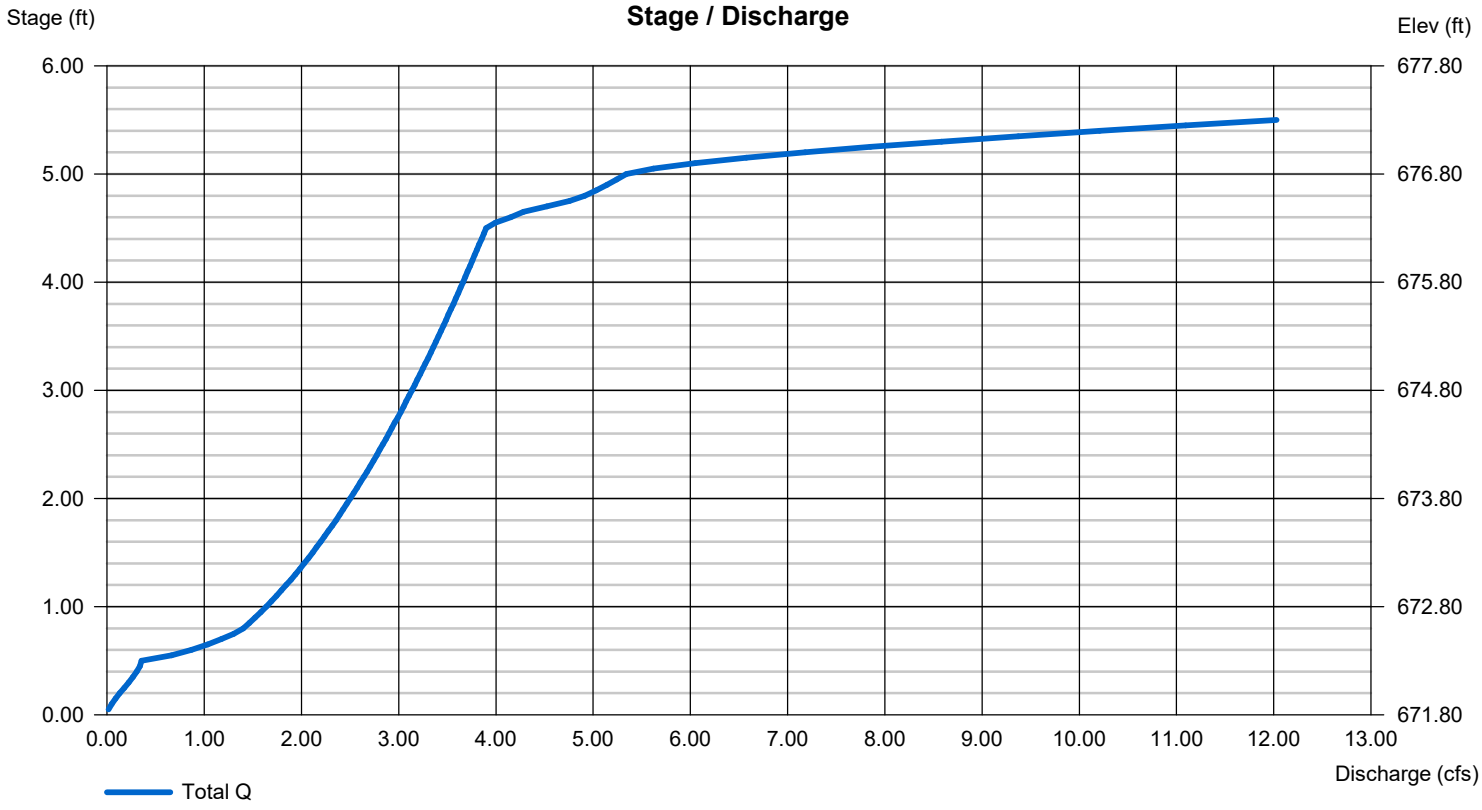
### Weir Structures

| | [A] | [B] | [C] | [D] |
|---|---|---|---|---|
| **Crest Len (ft)** | = 2.50 | 2.50 | 0.00 | 0.00 |
| **Crest El. (ft)** | = 676.80 | 676.80 | 0.00 | 0.00 |
| **Weir Coeff.** | = 3.33 | 3.33 | 3.33 | 3.33 |
| **Weir Type** | = Rect | Rect | --- | --- |
| **Multi-Stage** | = No | No | No | No |

**Exfil.(in/hr)** = 0.000 (by Wet area)

**TW Elev. (ft)** = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



## Basin B Stage-Storage Volume

| | |
|---|---|
| Gravel/Media H | 3.5 |
| Pond H | 2 |
| Width | 10.83 |
| Length | 435 |

| Stage | Height | Porosity | Inc. Volume | Total Volume |
|---|---|---|---|---|
| 671.80 | 0.00 | 40% | 0 | 0 |
| 672.30 | 0.50 | 40% | 942 | 942 |
| 672.80 | 1.00 | 40% | 942 | 1884 |
| 673.30 | 1.50 | 40% | 942 | 2827 |
| 673.80 | 2.00 | 40% | 942 | 3769 |
| 674.30 | 2.50 | 40% | 942 | 4711 |
| 674.80 | 3.00 | 40% | 942 | 5653 |
| 675.30 | 3.50 | 100% | 2356 | 8009 |
| 675.80 | 4.00 | 100% | 2356 | 10364 |
| 676.30 | 4.50 | 100% | 2356 | 12720 |
| 676.80 | 5.00 | 100% | 2356 | 15075 |
| 677.30 | 5.50 | 100% | 2356 | 17431 |

# Hydrograph Report

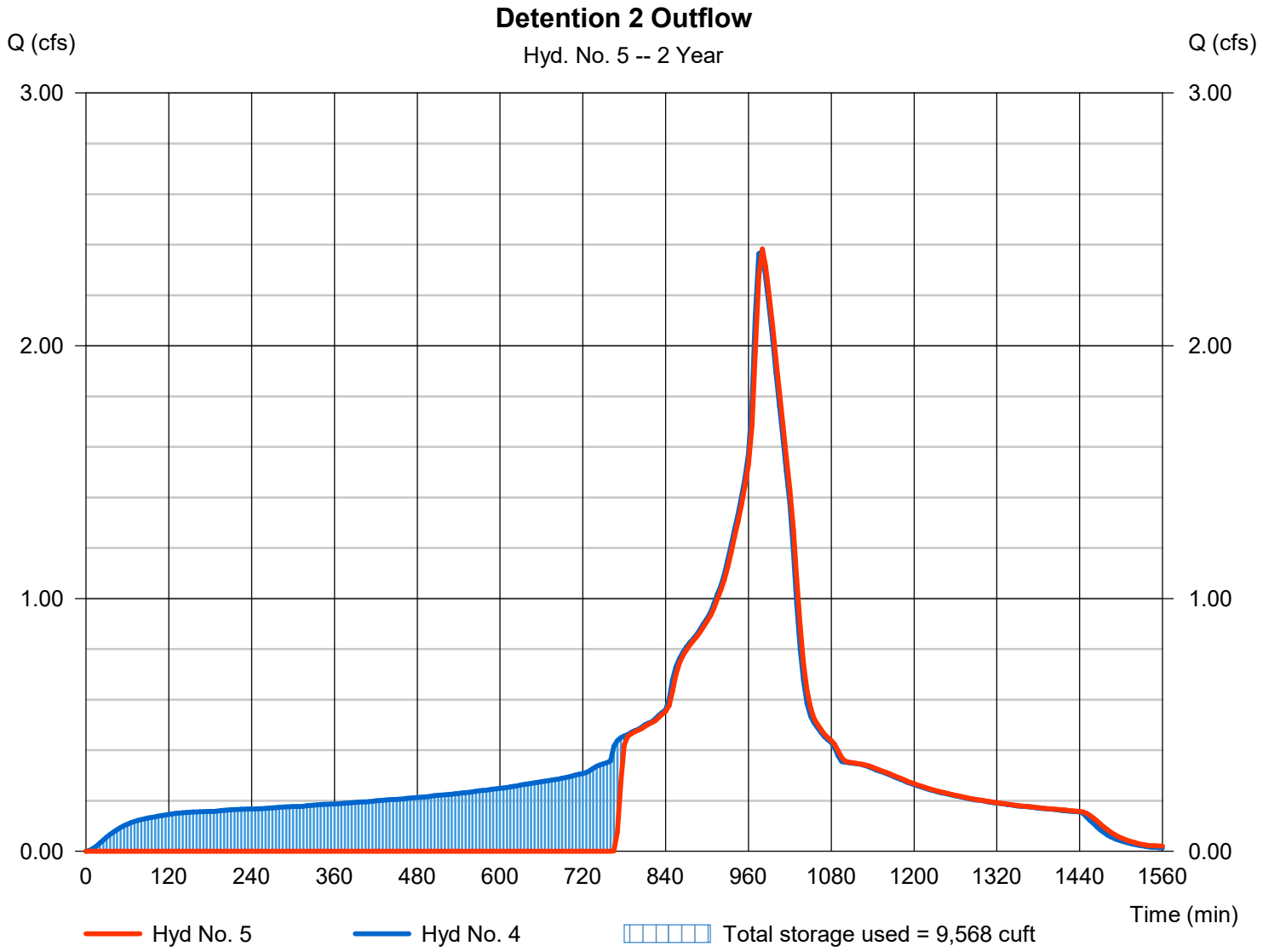


## Hyd. No. 5

Detention 2 Outflow

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Reservoir | Peak discharge | = | 2.382 cfs |
| Storm frequency | = | 2 yrs | Time to peak | = | 980 min |
| Time interval | = | 5 min | Hyd. volume | = | 24,357 cuft |
| Inflow hyd. No. | = | 4 - Basin B Outflow | Max. Elevation | = | 674.87 ft |
| Reservoir name | = | Detention 2 | Max. Storage | = | 9,568 cuft |

Storage Indication method used.



# Pond Report



## Pond No. 4 - Detention 2

### Pond Data

**UG Chambers -**Invert elev. = 671.20 ft, Rise x Span = 4.00 x 4.00 ft, Barrel Len = 155.00 ft, No. Barrels = 5, Slope = 0.00%, Headers = No

### Stage / Storage Table

| Stage (ft) | Elevation (ft) | Contour area (sqft) | Incr. Storage (cuft) | Total storage (cuft) |
|---|---|---|---|---|
| 0.00 | 671.20 | n/a | 0 | 0 |
| 0.40 | 671.60 | n/a | 504 | 504 |
| 0.80 | 672.00 | n/a | 880 | 1,384 |
| 1.20 | 672.40 | n/a | 1,073 | 2,457 |
| 1.60 | 672.80 | n/a | 1,182 | 3,639 |
| 2.00 | 673.20 | n/a | 1,233 | 4,872 |
| 2.40 | 673.60 | n/a | 1,233 | 6,105 |
| 2.80 | 674.00 | n/a | 1,182 | 7,287 |
| 3.20 | 674.40 | n/a | 1,072 | 8,358 |
| 3.60 | 674.80 | n/a | 879 | 9,238 |
| 4.00 | 675.20 | n/a | 503 | 9,741 |

### Culvert / Orifice Structures

| | [A] | [B] | [C] | [PrfRsr] |
|---|---|---|---|---|
| **Rise (in)** | = 0.00 | Inactive | 0.00 | 0.00 |
| **Span (in)** | = 0.00 | 0.00 | 0.00 | 0.00 |
| **No. Barrels** | = 0 | 0 | 0 | 0 |
| **Invert El. (ft)** | = 0.00 | 0.00 | 0.00 | 0.00 |
| **Length (ft)** | = 0.00 | 0.00 | 0.00 | 0.00 |
| **Slope (%)** | = 0.00 | 0.00 | 0.00 | n/a |
| **N-Value** | = .013 | .013 | .013 | n/a |
| **Orifice Coeff.** | = 0.60 | 0.60 | 0.60 | 0.60 |
| **Multi-Stage** | = n/a | No | No | No |

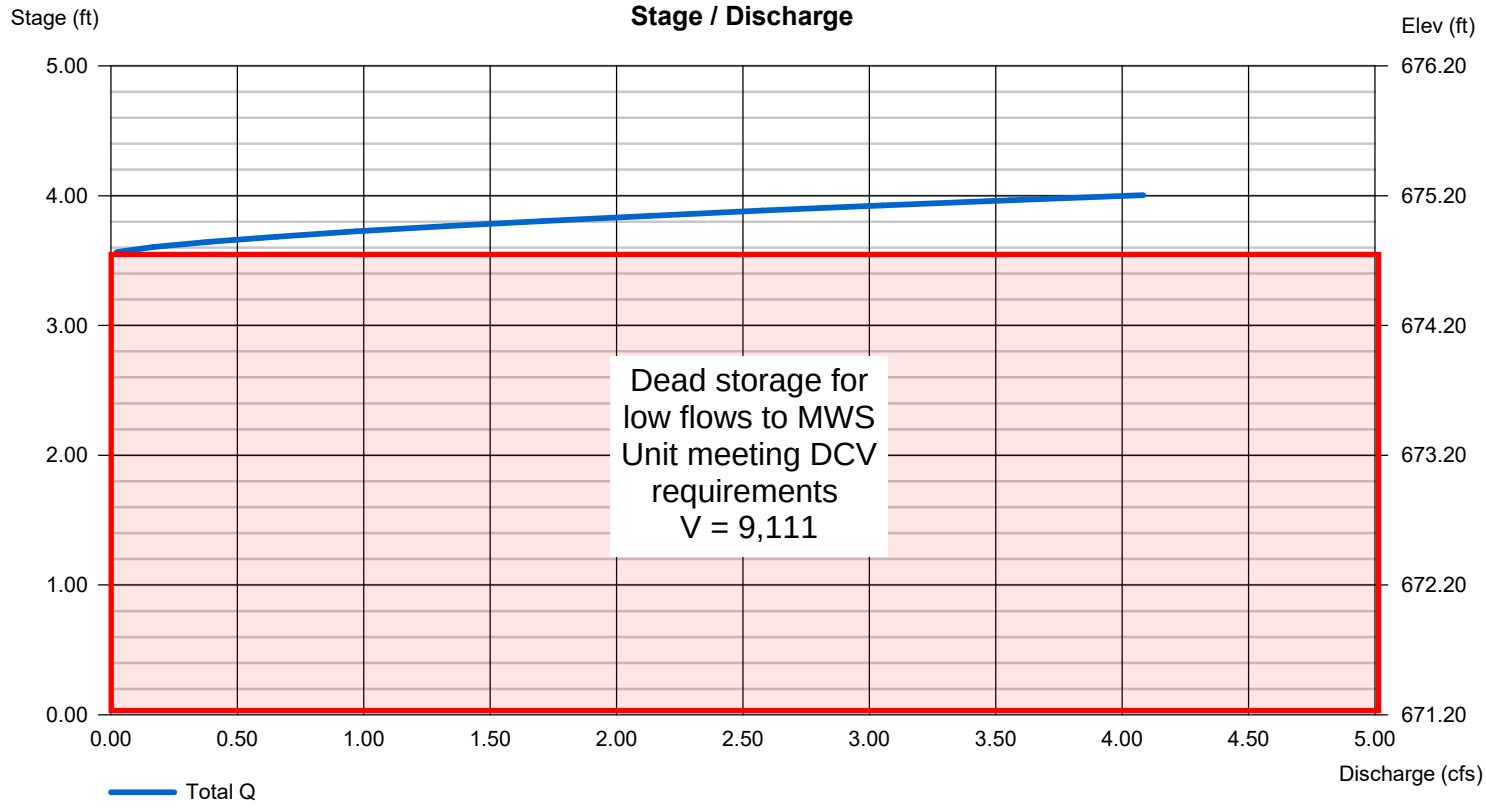
### Weir Structures

| | [A] | [B] | [C] | [D] |
|---|---|---|---|---|
| **Crest Len (ft)** | = 4.00 | 0.00 | 0.00 | 0.00 |
| **Crest El. (ft)** | = 674.75 | 0.00 | 0.00 | 0.00 |
| **Weir Coeff.** | = 3.33 | 3.33 | 3.33 | 3.33 |
| **Weir Type** | = Rect | --- | --- | --- |
| **Multi-Stage** | = No | No | No | No |

**Exfil.(in/hr)** = 0.000 (by Wet area)

**TW Elev. (ft)** = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



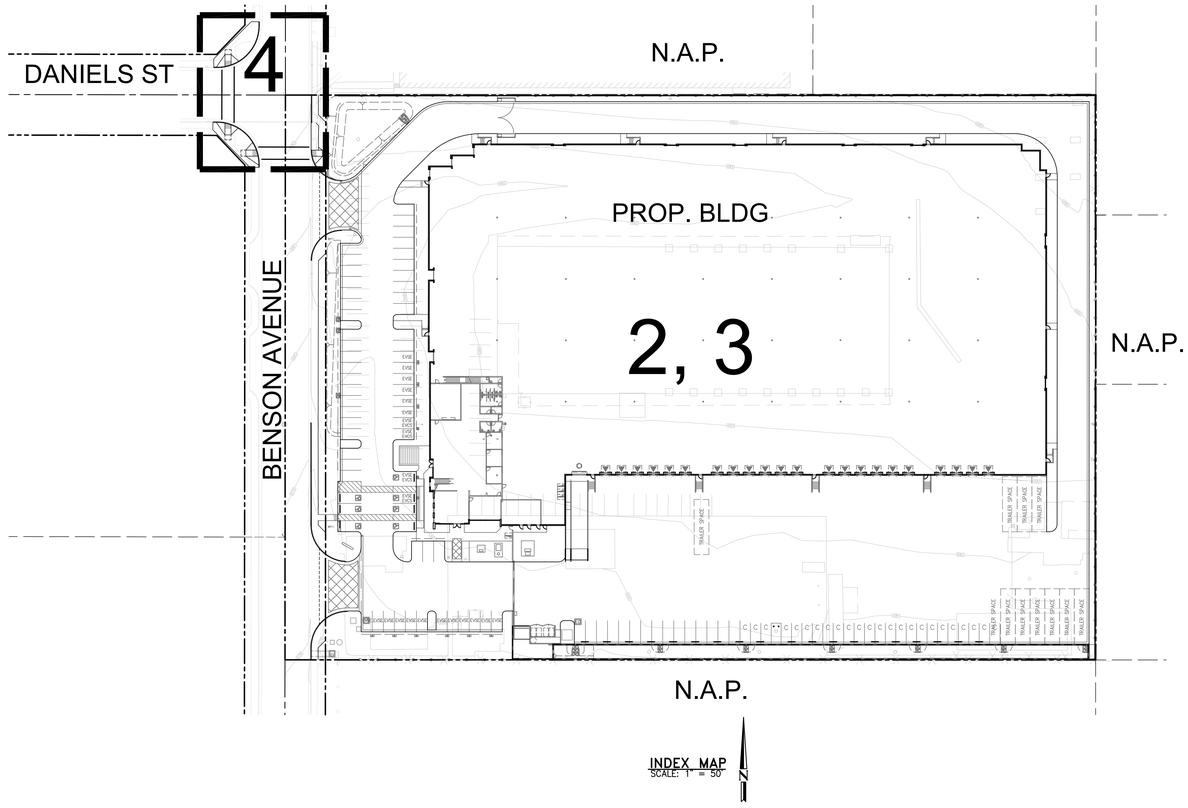
| HMOD Mitigation Results: | |
|---|---|
| Exist: | 2yr Peak Flow (cfs) |
| A | 6.54 |
| Total: | 6.54 |
| | |
| Prop: | 2yr Peak Flow (cfs) |
| A + C + D | 2.19 |
| B | 2.38 |
| Total: | 4.57 |

# APPENDIX C

Conceptual Grading Plan & Conceptual Utility Plan for Reference

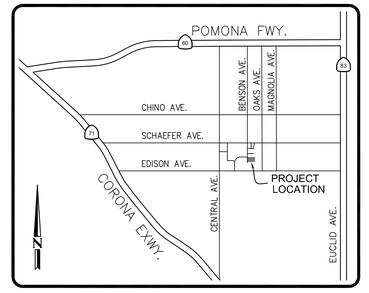
# CONCEPTUAL SITE IMPROVEMENT PLANS
# FOR
# REXFORD INDUSTRIAL
## IN THE CITY OF CHINO

NOT FOR CONSTRUCTION




INDEX MAP
SCALE: 1" = 50'

| SHEET INDEX | |
|---|---|
| SHEET NO. | DESCRIPTION |
| 1 | TITLE SHEET |
| 2 | CONCEPTUAL GRADING PLAN |
| 3 | CONCEPTUAL UTILITY PLAN |
| 4 | SECTIONS |




VICINITY MAP
NOT TO SCALE

## SITE INFORMATION
GROSS ACREAGE: ±6.98 ACRES NET ACREAGE

## ASSESSORS PARCEL NUMBER
1021-211-02

## OWNER/DEVELOPER
**REXFORD INDUSTRIAL REALITY AND MANAGEMENT, INC.**
11620 WILSHIRE BOULEVARD, 10TH FLR
LOS ANGELES, CALIFORNIA 90024

TEL. (310) 696-1680
CONTACT PERSON: COREY GUERRERO

## CIVIL ENGINEER
**DRC ENGINEERING, INC.**
160 SOUTH OLD SPRINGS ROAD,
SUITE 210
ANAHEIM HILLS, CA 92808
(714) 685-6860
CONTACT PERSON: RENÉ VARGA

## SOILS ENGINEER
**LEIGHTON CONSULTING, INC.**
2600 MICHELSON DRIVE,
SUITE 400
IRVINE, CALIFORNIA 92612
(866) LEIGHTON
REFERENCE REPORT NO. 13807.001
REPORT DATE: 03/17/23
CONTACT PERSON: CARL KIM

## LEGEND

| | |
|---|---|
| | ACCESSIBLE PATH OF TRAVEL |
| | RIGHT-OF-WAY/PROPERTY LINE |
| | CENTERLINE |
| | SAWCUT LINE |
| 000 | EX. CONTOUR |
| 000 | PROP. CONTOUR |
| | PROP. SIDEWALK |
| | EX. STORM DRAIN LINE |
| SS | EX. SEWER LINE |
| SL | EX. STREET LIGHT LINE |
| E | EX. ELECTRIC LINE |
| G | EX. GAS LINE |
| W | EX. WATER LINE |
| | EX. RETAINING WALL |
| | PROP. RETAINING WALL |
| | PROP. STORM DRAIN LINE |
| | PROP. CURB |
| | PROP. FENCE PER ARCH'S PLAN |
| GB | GRADE BREAK |
| R | RIDGELINE |
| | PROP. SEWER SAMPLE BOX |
| GI | PROP. SEWER GI |
| | PROP. SEWER CO |
| | PROP. SD CB |
| | PROP. PUMP BOX |
| | PROP. MWS |
| | RUNOFF FLOW ARROW |

## ABBREVIATIONS

| | |
|---|---|
| ARCH | = ARCHITECT |
| BLDG | = BUILDING |
| BOT | = BOTTOM |
| ℄ | = CENTER LINE |
| E | = ELECTRIC LINE |
| ELEV | = ELEVATION |
| ENC. | = ENCLOSURE |
| EQPT. | = EQUIPMENT |
| EX. | = EXISTING |
| FL/℄ | = FLOW LINE |
| FG | = FINISHED GRADE |
| FS | = FINISH SURFACE |
| G | = GAS |
| GB | = GRADE BREAK |
| GI | = GREASE INTERCEPTOR |
| HDPE | = HIGH-DENSITY POLYETHYLENE |
| HP | = HIGH POINT |
| INV | = INVERT |
| N.A.P | = NOT A PART |
| PA | = PLANTER AREA |
| P | = PROPERTY LINE |
| PM | = PARCEL MAP |
| PROP. | = PROPOSED |
| PVC | = POLYVINYL CHLORIDE |
| R | = RIDGELINE |
| RD | = ROOF DRAIN |
| R/W | = RIGHT OF WAY |
| S | = SEWER |
| SD | = STORM DRAIN |
| TC | = TOP OF CURB |
| TELE | = TELEPHONE LINE |
| TG | = TOP OF GRATE |
| TYP. | = TYPICAL |
| W | = WATER |

## LEGAL DESCRIPTION

THE LAND REFERRED TO HEREIN BELOW IS SITUATED IN THE CITY OF CHINO, IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, AND IS DESCRIBED AS FOLLOWS:

LOT 24, SECTION 13, TOWNSHIP 2 SOUTH, RANGE 8 WEST, SAN BERNARDINO BASE AND MERIDIAN, IN THE CITY OF CHINO, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, ACCORDING TO THE MAP OF SUBDIVISION OF PART OF RANCHO SANTA ANA DEL CHINO, IN THE CITY OF CHINO, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, AS PER PLAT RECORDED IN BOOK 6, PAGE 15 OF MAPS, RECORDS OF SAID COUNTY.

EXCEPTING THEREFROM THE SOUTH 200 FEET OF LOT 24.

## UTILITIES:

**GAS: THE GAS CO.**
1981 W LUNGONIA AVE.
REDLANDS, CA 92374
RUDY YBARRA (900) 613-1529

**TELEPHONE: FRONTIER**
1400 E. PHILIPS BLVD.
POMONA, CA 91766
RAUL CHAVEZ (909) 488-8875

**CABLE: TIME WARNER**
7337 CENTRAL AVENUE, 2ND FLOOR
RIVERSIDE, CA 92504
DAVID ROMERO (951) 343-5101;

**SEWER: CITY OF CHINO, PUBLIC WORKS ENGINEERING DIVISION - SEWER SECTION**
13220 CENTRAL AVENUE
CITY OF CHINO, CA 91708-0667
GEORGE DE STAFANO, (909) 334-3444

**FIRE DEPARTMENT: CHINO VALLEY FIRE DISTRICT**
14011 CITY CENTER DRIVE
CHINO HILLS, CA 91709
(909) 902-5280

**ELECTRIC: SOUTHERN CALIFORNIA EDISON**
1351 EST FRANCIS STREET
ONTARIO, CA 91761
(909) 930-8591

**WATER DISTRIBUTION: CITY OF CHINO, PUBLIC WORKS DEPARTMENT, ENGINEERING DIVISION - WATER SECTION**
13220 CENTRAL AVENUE
CHINO, CA 91708-0667
GILBERT ALDACO, WATER UTILITIES SUPERVISOR (909) 334-3425
PETE VICARIO, ASSISTANT WATER UTILITIES SUPERVISOR (909) 334-3444

## CERTIFICATION OF PLANS & INFORMATION

I HEREBY CERTIFY THAT THE PLANS AND INFORMATION PROVIDED PRESENT ALL OF THE DATA AND INFORMATION REQUIRED BY THE "MINIMUM REQUIRED INFORMATION CHECKLIST," AND THAT THE FACTS, STATEMENTS AND INFORMATION PRESENTED ARE TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF. FURTHERMORE, I UNDERSTAND THAT FAILURE TO PROVIDE THE PLANS AND INFORMATION REQUIRED BY THIS CHECKLIST MAY RESULT IN THIS APPLICATION NOT BEING ACCEPTED AS COMPLETE FOR FILING AND/OR PROCESSING.

PREPARER'S SIGNATURE: _____ DATE: 11/29/23

NAME (PRINT): LAWRENCE GATES PHONE: 714-685-6860

ADDRESS: 160 S OLD SPRINGS RD, STE. 210 CITY: ANAHEIM HILLS STATE: CA ZIP: 92808

## WQMP NOTES:

1. 1. DETERMINE AND PROVIDE THE PRE AND POST DEVELOPMENT PERVIOUS AND IMPERVIOUS AREAS CREATED BY THE PROPOSED DEVELOPMENT.

| | |
|---|---|
| PRE DEVELOPMENT | |
| IMPERVIOUS AREA 6.03 ACRES, | PERCENT IMPERVIOUS 90.7 % |
| PERVIOUS AREA 0.61 ACRES, | PERCENT PERVIOUS 9.3 % |
| POST DEVELOPMENT | |
| IMPERVIOUS AREA 5.64 ACRES, | PERCENT IMPERVIOUS 84.9 % |
| PERVIOUS AREA 0.74 ACRES, | PERCENT PERVIOUS 11.1 % |

2. ANY MODIFICATIONS TO THE APPROVED WQMP PLAN MUST BE RESUBMITTED TO THE CITY OF CHINO DEPARTMENT OF PUBLIC WORKS.
3. A COPY OF THE APPROVED WQMP PLAN MUST BE IN THE POSSESSION OF A RESPONSIBLE PERSON AND AVAILABLE AT THE SITE AT ALL TIMES.
4. ALL STRUCTURAL BMP'S SHALL BE ACCESSIBLE FOR INSPECTION AND MAINTENANCE.
5. PRIOR TO COMMENCEMENT OF ANY WORK WITHIN THE ROAD RIGHT OF WAY AND/OR CONNECTION TO CITY MAINTAINED STORM DRAIN, AN ENCROACHMENT PERMIT FROM PUBLIC WORKS IS REQUIRED.

## EXISTING UNDERGROUND STRUCTURES NOTE:

THE EXISTENCE AND LOCATION OF ANY UNDERGROUND UTILITY PIPES, CONDUITS, OR STRUCTURES SHOWN ON THESE PLANS ARE OBTAINED BY A SEARCH OF THE AVAILABLE RECORDS, TO THE BEST OF OUR KNOWLEDGE, THERE ARE NO EXISTING UTILITIES EXCEPT AS SHOWN ON THESE PLANS. THE CONTRACTOR IS REQUIRED TO TAKE DUE PRECAUTIONARY MEASURES TO PROTECT THE UTILITIES SHOWN AND ANY OTHER LINES NOT OF RECORD OR NOT SHOWN ON THESE DRAWINGS. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO NOTIFY THE OWNERS OF THE UTILITIES OR STRUCTURES CONCERNED BEFORE STARTING WORK. CONTRACTOR FURTHER ASSUMES ALL LIABILITY AND RESPONSIBILITY FOR THE UNDERGROUND UTILITY PIPES, CONDUITS, OR STRUCTURES SHOWN OR NOT SHOWN ON THESE DRAWINGS.

## WATER CONNECTION NOTE:

FOR ANY NEW WATER CONNECTION THAT REQUIRES THE USE OF A TEE TO AN EXISTING ASBESTOS CEMENT PIPE (ACP), CONTRACTOR SHALL BE REQUIRED TO REPLACE A COMPLETE SECTION OF ACP FROM JOINT TO JOINT (A TOTAL OF 13 LINEAR FEET). WATERPIPE MATERIAL USED SHALL BE APPROVED BY THE CITY. NO PARTIAL OR SMALL CUTS INTO THE ACP SHALL BE ALLOWED.

## FIRE PROTECTION NOTE:

ONSITE FIRE PROTECTION WATER IMPROVEMENTS SHALL BE SUBMITTED TO AND REVIEWED BY THE CHINO VALLEY FIRE DISTRICT. ALL FIRE PROTECTION SYSTEM WORK SHALL BE COMPLETED UNDER A SEPARATE PERMIT.

## EARTHWORK QUANTITY ESTIMATE:

| | CUT (CY) | FILL (CY) |
|---|---|---|
| RAW | 15,762 | 558 |
| EXPORT | 15,204 | |

EARTHWORK NOTES:

- EARTHWORK QUANTITIES SHOWN ARE BASED UPON:
  - A PROPOSED BUILDING STRUCTURAL SLAB THICKNESS OF 6"
  - PROPOSED PAVEMENT SECTION OF 7"
  - PROPOSED PAVEMENT SECTION AND SLAB ARE SIMILAR TO EXISTING PAVEMENT AND SLAB
- CONTRACTOR IS RESPONSIBLE FOR OBTAINING THEIR OWN EARTHWORK NUMBERS FOR PRICING/CONTRACT PURPOSES.
- EARTHWORK VALUES DO NOT ACCOUNT FOR POTENTIAL SCARIFYING AND REMOVALS OF EXISTING ON-SITE IMPROVEMENTS/ORGANIC MATERIALS.
- DOES NOT INCLUDE SPOILS.

**BASIS OF BEARINGS:**
*THE BEARING OF N 89°59'57" W ALONG THE CENTERLINE OF SCHAEFER AVENUE PER PARCEL MAP NO. 5169, PMB 57/13-14, IN THE CITY OF CHINO, COUNTRY OF SAN BERNARDINO, STATE OF CALIFORNIA WAS USED AS THE BASIS OF BEARINGS FOR THIS SURVEY.*

DATE ISSUED: 12/8/23

REGISTERED PROFESSIONAL ENGINEER LAWRENCE MITCHELL GATES No. 45715 Exp. 12-31-24 CIVIL STATE OF CALIFORNIA

DIGALERT — DIAL BEFORE YOU DIG — TWO WORKING DAYS BEFORE YOU DIG — TOLL FREE 1-800-227-2600

| PREPARED BY | |
|---|---|
| FIRM: | DRC ENGINEERING, INC. |
| ADDRESS: | 160 SOUTH OLD SPRINGS ROAD, STE 210 |
| | ANAHEIM HILLS, CA. 92808 |
| TELEPHONE: (714)685-6860 | FAX: (714)685-6801 |
| 45715 | |
| SIGNATURE RCE | DATE |

| REVISIONS | MADE BY | MADE DATE | APPROVED BY | APPROVED DATE |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |

**BENCH MARK DATA**
NO. 141/61 ELEV. 674.9730 LOCATION: A 2 1/2" BRASS DISK STAMPED "141/61" REST 6-01", IN THE TOP OF CURB 1' SOUTH OF A CATCH BASIN AT THE NORTHWEST INTERSECTION OF MAGNOLIA AVENUE AND EDISON AVENUE
VERTICAL DATUM: NGVD 29

**REFERENCE DRAWINGS**

| REVIEWED BY STAFF | BY | DATE | CITY ENGINEER'S STAFF | BY | DATE |
|---|---|---|---|---|---|
| WATER: | | | DRAWN: | | |
| SEWER: | | | DESIGNED: | | |
| FIRE: | | | CHECKED: | | |
| PLANNING: | | | RECOMMENDED: | | |
| TRAFFIC: | | | | | |
| SERVICES: | | | | | |

APPROVED BY:
CITY ENGINEER
DATE: _____

CITY OF CHINO ENGINEERING DIVISION
REXFORD INDUSTRIAL, 13925 BENSON AVENUE, CHINO CA
CONCEPTUAL SITE IMPROVEMENT PLAN
TITLE SHEET

PROJECT NO. PL23-0091
SHEET 1 OF 4
DRAWING NO.

EXTERNAL REFERENCES: 23464xmod1 23-646 4th Site 23464x101 23464x100 23464g100
FILENAME: M:\2023\23-646 Rexford Chino 13925 Benson\GI\23646g101 CS.dwg, LAST SAVED ON: Nov 29 2023 1:59pm PLOTTED BY: DREW, ON: Dec 06 2023 9:14am, DFD.

NOT FOR CONSTRUCTION

BENSON AVE.

FF=683.38

FF=682.04

0.5% FLOOR SLOPE

504.0'

269.2'

SEE DETAIL 'A' ON SHEET 4

EX. 6' SCE EASEMENT TO BE VACATED

BIORETENTION BASIN A 679.7TOP 677.7BOT

BIORETENTION BASIN C 679.7TOP 678.7BOT

PROP. BATTERY STORAGE 681.83FF

PROP. TRANSFORMER

TRAILER SPACE

PROTECT IN PLACE EX. OFFSITE WALL

PROTECT EX. ONSITE WALL

BIORETENTION BASIN B 677.3 TOP OF POND 671.8 BOT OF BOX

PUMP & VALVE BOX

MH WITH OPENING TO U-CHANNEL

N.A.P.

SEE SHEET 4 FOR TYPICAL SECTIONS

## GRADING CONSTRUCTION NOTES:

1. CONSTRUCT 6" CURB
2. CONSTRUCT 6" CURB & GUTTER
3. CONSTRUCT 3"AC/4"AB PAVEMENT SECTION
4. CONSTRUCT 7"PCC/4"AB PAVEMENT SECTION
5. CONSTRUCT 4" PCC SIDEWALK
6. CONSTRUCT 3' RIBBON GUTTER
7. CONSTRUCT 18" WIDE U-CHANNEL
8. CONSTRUCT TRASH ENCLOSURE PER ARCHITECTURAL PLANS
9. CONSTRUCT ADA RAMP W/ TRUNCATED DOMES PER CITY STD. 1112
10. CONSTRUCT RETAINING WALL
11. CONSTRUCT 2' WIDE CURB CUT
12. CONSTRUCT BIORETENTION BASIN WITH INTERIOR DRAINS
13. CONSTRUCT RIP RAP
14. CONSTRUCT MOUNTABLE 6" CURB
15. CONSTRUCT 10.83'X435.00'X7.10' BIORETENTION BOX WITH INTEGRATED RETAINING WALL & HANDRAIL & CURB & GUTTER WITH 2' WIDE CURB OPENINGS AT 70' INTERVALS PER DETAIL ON SHEET 4
16. CONSTRUCT INDUSTRIAL/COMMERCIAL DRIVEWAY PER CITY OF CHINO STANDARD 250
17. CONSTRUCT 8" CURB & GUTTER
18. CONSTRUCT 48" WIDE U-CHANNEL
19. CONSTRUCT 48" WIDE PARKWAY DRAIN

GRAPHIC SCALE: 1"=20'

**BASIS OF BEARINGS:**
*THE BEARING OF N 89°59'57" W ALONG THE CENTERLINE OF SCHAEFER AVENUE PER PARCEL MAP NO. 5169, PMB 57/13-14, IN THE CITY OF CHINO, COUNTRY OF SAN BERNARDINO, STATE OF CALIFORNIA WAS USED AS THE BASIS OF BEARINGS FOR THIS SURVEY.*

DATE ISSUED: 12/8/23

LAWRENCE MITCHELL EWALD No. 45715 Exp. 12-31-24 CIVIL STATE OF CALIFORNIA

DIGALERT DIAL BEFORE YOU DIG TOLL FREE 1-800-227-2600 TWO WORKING DAYS BEFORE YOU DIG

| PREPARED BY | |
|---|---|
| FIRM: | DRC ENGINEERING, INC. |
| ADDRESS: | 160 SOUTH OLD SPRINGS ROAD, STE 210 |
| | ANAHEIM HILLS, CA. 92808 |
| TELEPHONE: (714)685-6860 | FAX: (714)685-6801 |
| 45715 | |
| SIGNATURE RCE | DATE |

| REVISIONS | MADE BY | MADE DATE | APPROVED BY | APPROVED DATE |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |

**BENCH MARK DATA**
NO. 141/61 ELEV. 674.9730 LOCATION: A 2 1/2" BRASS DISK STAMPED "141/61" REST 6-01", IN THE TOP OF CURB 1' SOUTH OF A CATCH BASIN AT THE NORTHWEST INTERSECTION OF MAGNOLIA AVENUE AND EDISON AVENUE
VERTICAL DATUM: NGVD 29

**REFERENCE DRAWINGS**

| REVIEWED BY STAFF | BY | DATE |
|---|---|---|
| WATER: | | |
| SEWER: | | |
| FIRE: | | |
| PLANNING: | | |
| TRAFFIC: | | |
| SERVICES: | | |

| CITY ENGINEER'S STAFF | BY | DATE |
|---|---|---|
| DRAWN: | | |
| DESIGNED: | | |
| CHECKED: | | |
| RECOMMENDED: | | |

APPROVED BY:

CITY ENGINEER

DATE:

# CITY OF CHINO ENGINEERING DIVISION
## REXFORD INDUSTRIAL, 13925 BENSON AVENUE, CHINO CA
## CONCEPTUAL SITE IMPROVEMENT PLAN
### CONCEPTUAL GRADING PLAN

PROJECT NO. PL23-0091
SHEET 2 OF 4
DRAWING NO.

EXTERNAL REFERENCES: 25646xr01 25646x101 25646xr03 25646xr04 25646xr05 25646xr06 25646xr07 25646xr08 25646xr09 25646xr10 25646xr11 25646xr12 25646xr13 25646xr14 25646xr15 25646xr16 25646xr17 25646xr18 25646xr19 25646xr20 25646xr21 25646xr22 25646xr23 25646xr24 25646xr25 25646xr26 25646xr27 25646xr28 25646xr29 25646xr30 25646xr31 25646xr32 25646xr33 25646xr34 25646xr35 25646xr36 25646xr37 25646xr38 25646xr39 25646xr40 25646xr41 25646xr42 25646xr43 25646xr44 25646xr45 25646xr46 25646xr47 25646xr48 25646xr49 25646xr50 25646xr51 25646xr52 25646xr53 25646xr54 25646xr55 25646xr56 25646xr57 25646xr58 25646xr59 25646xr60 25646xr61 25646xr62 25646xr63 25646xr64 25646xr65 25646xr66 25646xr67 25646xr68 25646xr69 25646xr70 25646xr71 25646xr72 25646xr73 25646xr74 25646xr75 25646xr76 25646xr77 25646xr78 25646xr79 25646xr80 25646xr81 25646xr82 25646xr83 25646xr84 25646xr85 25646xr86 25646xr87 25646xr88 25646xr89 25646xr90 25646xr91 25646xr92 25646xr93 25646xr94 25646xr95 25646xr96 25646xr97 25646xr98 25646xr99 25646xr100 25646xr101 25646xr102 25646xr103 25646xr104 25646xr105 25646xr106 25646xr107 25646xr108 25646xr109 25646xr110 25646xr111 25646xr112 25646xr113 25646xr114 25646xr115 25646xr116 25646xr117 25646xr118 25646xr119 25646xr120 25646xr121 25646xr122 25646xr123 25646xr124 25646xr125 25646xr126 25646xr127 25646xr128 25646xr129 25646xr130 25646xr131 25646xr132 25646xr133 25646xr134 25646xr135 25646xr136 25646xr137 25646xr138 25646xr139 25646xr140 25646xr141 25646xr142 25646xr143 25646xr144 25646xr145 25646xr146 25646xr147 25646xr148 25646xr149 25646xr150 25646xr151 25646xr152 25646xr153 25646xr154 25646xr155 25646xr156 25646xr157 25646xr158 25646xr159 25646xr160 25646xr161 25646xr162 25646xr163 25646xr164 25646xr165 25646xr166 25646xr167 25646xr168 25646xr169 25646xr170 25646xr171 25646xr172 25646xr173 25646xr174 25646xr175 25646xr176 25646xr177 25646xr178 25646xr179 25646xr180 25646xr181 25646xr182 25646xr183 25646xr184 25646xr185 25646xr186 25646xr187 25646xr188 25646xr189 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FILENAME: M:\2022\23-646 Rexford Chino 13925 Benson\CC\25646xg102 CC.dwg

NOT FOR CONSTRUCTION

EX. 4" PUBLIC GAS LINE
EX. PUBLIC ELECTRIC LINE
EX. 30" PUBLIC STORM DRAIN LINE
EX. 4" PUBLIC GAS LINE
EX. PUBLIC SD CATCH BASIN
SEE DETAIL 'A' ON SHEET 4
BIORETENTION BASIN A 79.7TOP, 77.7BOT
679.2 TG 673.70 INV
EX. 6" PUBLIC SEWER LINE
EX. 6" PUBLIC RECLAIMED WATER LINE
EX. 8" PUBLIC WATER LINE
BENSON AVE.
BIORETENTION BASIN C 679.7TOP 678.7BOT
679.2 TG 674.4 INV
680.1 RIM 674.5 INV
(679.5) RIM 673.4 INV IN-W (673.2) INV IN-N (673.1) INV OUT-S
681.5 RIM 675.6 INV
679.5 TG 676.5 INV
679.5 TG 676.5 INV
677.8 RIM WEIR 672.0 INV-N,S 671.9 INV-E,W
678.2 RIM 671.8 INV-E 671.3 INV-W
678.7 RIM 678.0 INV-W 668.8 INV-N,S
677.8 INV-4" 677.8 INV
(678.3) TC 677.6 INV (677.6) FL
678.8 RIM 677.8 INV-W 669.1 INV-E 669.0 INV-N
PROP. U-CHANNEL & PKWY DRAIN
672.2 INV
672.5 INV
678.1 TC 673.1 INV
677.7 RIM 670.9 INV-S 670.3 INV-N
677.5 RIM WEIR 671.2 INV-W 671.1 INV-S,E
676.8 TG 672.3 INV
676.8 TG 672.3 INV
676.8 TG 672.3 INV
671.7 INV
PROP. BATTERY STORAGE
PROP. TRANSFORMER
EX. 6' SCE EASEMENT TO BE VACATED
EX. RIBBON GUTTER TO BE REMOVED
0.5% FLOOR SLOPE
FF=683.38
FF=682.04
BIORETENTION BASIN B 677.3 TOP OF POND 671.8 BOT OF BOX
BIORETENTION BASIN B 677.3 TOP OF POND 671.8 BOT OF BOX
N.A.P.
PUBLIC
PRIVATE
R/W
S=0.005
S=0.020
S=0.056
S=0.160
S=0.180
S=0.003
S=0.009
S=0.017
S=0.030

## STORM DRAIN CONSTRUCTION NOTES:

30 CONNECT TO BACK OF EXISTING CURB INLET CATCH BASIN
31 INSTALL 4" PVC STORM DRAIN PIPE
32 INSTALL 8" PVC STORM DRAIN PIPE
33 INSTALL 12" HDPE STORM DRAIN PIPE
34 INSTALL 18" HDPE STORM DRAIN PIPE
35 INSTALL 48" HDPE STORM DRAIN PIPE
36 INSTALL 48" STORM DRAIN MANHOLE WITH WEIR & ORIFICE DIVERSION PLATE
37 INSTALL 48" STORM DRAIN MANHOLE
38 INSTALL 12"X12" DROP INLET
39 INSTALL 30" RISER INLET
40 INSTALL 3.5' WIDE CURB INLET
41 INSTALL IRRIGATED CONTECH MWS-L-4-4 UNIT
42 INSTALL IRRIGATED CONTECH MWS-L-8-8 UNIT
43 INSTALL PUMP STATION & VALVE BOX PER PLUMBING PLANS

## FIRE WATER CONSTRUCTION NOTES:

60 CONNECT TO EXISTING WATER LINE
61 INSTALL 6" PVC FIRE WATER LINE
62 INSTALL 8" PVC FIRE WATER LINE
63 INSTALL 8" DOUBLE CHECK DETECTOR ASSEMBLY
64 INSTALL FIRE DEPARTMENT CONNECTION
65 INSTALL POST INDICATOR VALVE
66 INSTALL 6" FIRE HYDRANT WITH GATE VALVE

## WATER CONSTRUCTION NOTES:

80 CONNECT TO EXISTING WATER LINE
81 INSTALL 2" IRRIGATION LINE
82 INSTALL 2" IRRIGATION METER
83 INSTALL 2" DOMESTIC WATER LINE
84 INSTALL 2" DOMESTIC WATER METER
85 INSTALL 2" REDUCED PRESSURE ASSEMBLY

## SEWER CONSTRUCTION NOTES:

90 CONNECT TO EXISTING 10"SEWER MAIN (INVERT ELEVATION TO BE FIELD VERIFIED)
91 INSTALL 6" SEWER LINE
92 INSTALL SEWER CLEANOUT
93 INSTALL 48" SEWER MONITORING MANHOLE PER CITY OF CHINO STD. 527
94 INSTALL SAMPLING WYE CLEANOUT PER CITY OF CHINO STD. 527

**BASIS OF BEARINGS:**
*THE BEARING OF N 89°59'57" W ALONG THE CENTERLINE OF SCHAEFER AVENUE PER PARCEL MAP NO. 5169, PMB 57/13-14, IN THE CITY OF CHINO, COUNTRY OF SAN BERNARDINO, STATE OF CALIFORNIA WAS USED AS THE BASIS OF BEARINGS FOR THIS SURVEY.*

N

20' 0' 20' 40' 60'
GRAPHIC SCALE: 1"=20'

**DATE ISSUED: 12/8/23**

REGISTERED PROFESSIONAL ENGINEER LAWRENCE MITCHELL GILLES No. 45715 Exp. 12-31-24 CIVIL STATE OF CALIFORNIA

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|---|---|---|
| FIRM: | DRC ENGINEERING, INC. | |
| ADDRESS: | 160 SOUTH OLD SPRINGS ROAD, STE 210 | |
| | ANAHEIM HILLS, CA. 92808 | |
| TELEPHONE: (714)685-6860 | FAX: (714)685-6801 | |
| 45715 | | |
| SIGNATURE | RCE | DATE |

| REVISIONS | MADE BY | MADE DATE | APPROVED BY | APPROVED DATE |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |

**BENCH MARK DATA**
NO. 141/61 ELEV. 674.9730 LOCATION: A 2 1/2" BRASS DISK STAMPED "141/61" REST 6-01", IN THE TOP OF CURB 1' SOUTH OF A CATCH BASIN AT THE NORTHWEST INTERSECTION OF MAGNOLIA AVENUE AND EDISON AVENUE
VERTICAL DATUM: NGVD 29

**REFERENCE DRAWINGS**

| REVIEWED BY STAFF | BY | DATE |
|---|---|---|
| WATER: | | |
| SEWER: | | |
| FIRE: | | |
| PLANNING: | | |
| TRAFFIC: | | |
| SERVICES: | | |

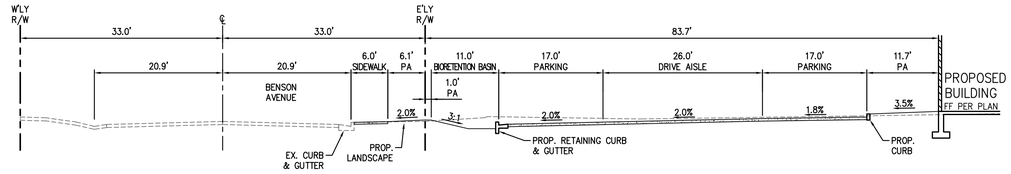
| CITY ENGINEER'S STAFF | BY | DATE |
|---|---|---|
| DRAWN: | | |
| DESIGNED: | | |
| CHECKED: | | |
| RECOMMENDED: | | |

**APPROVED BY:**
CITY ENGINEER
DATE:

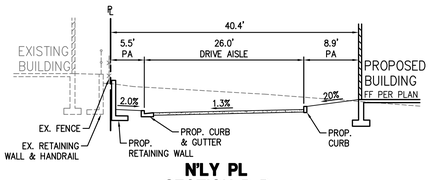
# CITY OF CHINO ENGINEERING DIVISION
## REXFORD INDUSTRIAL, 13925 BENSON AVENUE, CHINO CA
## CONCEPTUAL SITE IMPROVEMENT PLAN
### CONCEPTUAL UTILITY PLAN

PROJECT NO. PL23-0091
SHEET 3 OF 4
DRAWING NO.

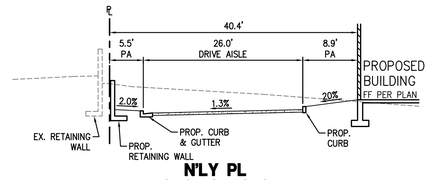
EXTERNAL REFERENCES: 23646xc01 23-646 AS Site 23646x101 23646x100 23646x101 23646x101
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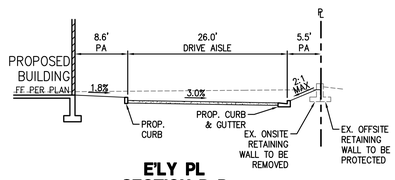

**BENSON AVE.**
**SECTION A-A**
SCALE: 1"=10'



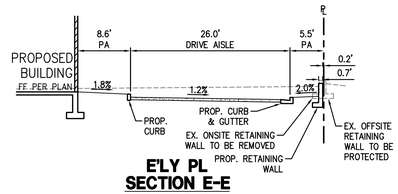

**N'LY PL**
**SECTION B-B**
SCALE: 1"=10'



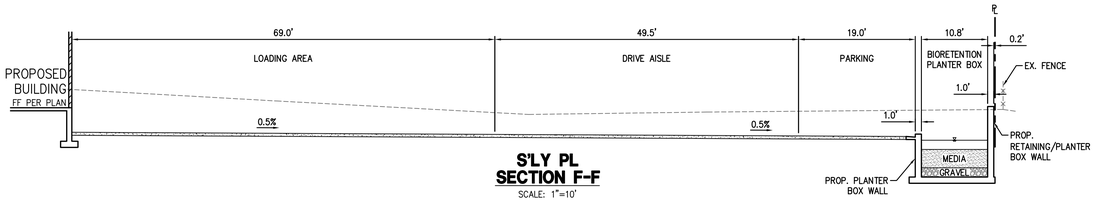

**N'LY PL**
**SECTION C-C**
SCALE: 1"=10'




**E'LY PL**
**SECTION D-D**
SCALE: 1"=10'

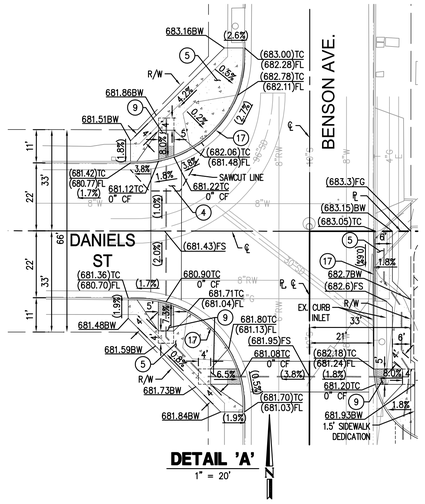



**E'LY PL**
**SECTION E-E**
SCALE: 1"=10'




**S'LY PL**
**SECTION F-F**
SCALE: 1"=10'

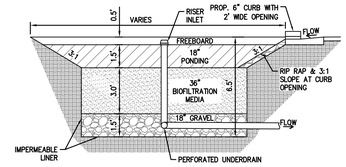
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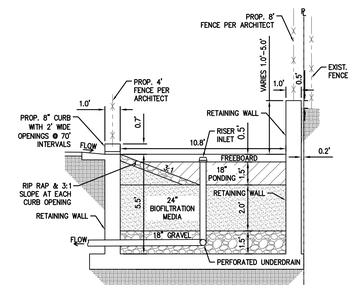

**DETAIL 'A'**
1" = 20'

## GRADING CONSTRUCTION NOTES:

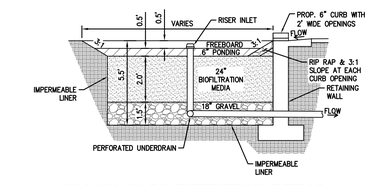
- (4) CONSTRUCT 7"PCC/4"AB PAVEMENT SECTION
- (5) CONSTRUCT 4" PCC SIDEWALK
- (9) CONSTRUCT ADA RAMP W/ TRUNCATED DOMES PER CITY STD. 1112
- (17) CONSTRUCT 8" CURB & GUTTER




(12) **'BASIN A' BIORETENTION DETAIL**
N.T.S.




(15) **'BASIN B' PLANTER BOX DETAIL**
N.T.S.




(12) **'BASIN C' BIORETENTION DETAIL**
N.T.S.

NOT FOR CONSTRUCTION

EXTERNAL REFERENCES: 2346xmod1 2346x101 23-646 Alt Site 2346x101 2346x102 2346x103 2346x104 Sections.dwg, LAST SAVED ON: Dec 06 2023 3:40pm PLOTTED BY: GREN, ON: Dec 06 2023 3:42pm CTC
FILENAME: M:\2023\23-646 Rexford Chino 13925 Benson\05\2346x104 Sections.dwg

REGISTERED PROFESSIONAL ENGINEER — LAWRENCE MITCHELL CIVIL — No. 45715 — Exp. 12-31-24 — CIVIL — STATE OF CALIFORNIA

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| PREPARED BY | | REVISIONS | MADE BY | MADE DATE | APPROVED BY | APPROVED DATE |
|---|---|---|---|---|---|---|
| FIRM: | DRC ENGINEERING, INC. | 1 | | | | |
| ADDRESS: | 160 SOUTH OLD SPRINGS ROAD, STE 210 ANAHEIM HILLS, CA. 92808 | 2 | | | | |
| TELEPHONE: | (714)685-6860 FAX: (714)685-6801 | 3 | | | | |
| | 45715 | 4 | | | | |
| | SIGNATURE RCE DATE | 5 | | | | |

**BENCH MARK DATA**
NO. 141/61 ELEV. 674.9730 LOCATION: A 2 1/2" BRASS DISK STAMPED "141/61" REST 6-01", IN THE TOP OF CURB 1' SOUTH OF A CATCH BASIN AT THE NORTHWEST INTERSECTION OF MAGNOLIA AVENUE AND EDISON AVENUE
VERTICAL DATUM: NGVD 29

**REFERENCE DRAWINGS**

| REVIEWED BY STAFF | BY | DATE | CITY ENGINEER'S STAFF | BY | DATE |
|---|---|---|---|---|---|
| WATER: | | | DRAWN: | | |
| SEWER: | | | DESIGNED: | | |
| FIRE: | | | CHECKED: | | |
| PLANNING: | | | RECOMMENDED: | | |
| TRAFFIC: | | | | | |
| SERVICES: | | | | | |

**APPROVED BY:**
CITY ENGINEER
DATE: _____

**DATE ISSUED: 12/8/23**

# CITY OF CHINO ENGINEERING DIVISION
## REXFORD INDUSTRIAL, 13925 BENSON AVENUE, CHINO CA
## CONCEPTUAL SITE IMPROVEMENT PLAN
## SECTIONS

PROJECT NO. PL23-0091
SHEET 4 OF 4
DRAWING NO.

# APPENDIX D

Hydrology Report

# PRELIMINARY DRAINAGE REPORT

FOR

## Rexford Industrial

**13925 Benson Avenue**

**Chino, CA**

*Prepared for Owner/Developer:*


**Rexford Industrial Realty and Management**
**555 Anton Blvd. Suite 910**
**Costa Mesa, CA 92626**
**(310) 601-7319**
**Contact: Randall Hooper**


*Prepared By:*


**DRC ENGINEERING, INC.**
**160 S. Old Springs Road, Suite 210**
**Anaheim Hills, CA 92808**
**(714) 685-6860**
**Contact: Drew Gates**





Drew Gates RCE#94249 Exp. 12-31-2024

December 8, 2023

DRC Job No. 23-646

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| Section II | Hydrology Methodology |
| Section III | Project Description<br>Existing Site Conditions<br>Proposed Site Conditions |
| Section IV | Conclusion |
| Appendix A | Background Information<br>Vicinity Map<br>NOAA Precipitation Depth<br>NOAA Precipitation Intensity |
| Appendix B | Hydrology Maps<br>Existing Hydrology Map<br>Proposed Hydrology Map<br>Proposed Hydrology Subarea Map |
| Appendix C | Hydrology ToC “Plate D.4” Determination<br>Existing Condition<br>Proposed Condition |
| Appendix D | 10-year & 100-year Small Area Unit Hydrographs<br>Existing Condition<br>Proposed Condition |
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| Appendix H | Geotech Report & Infiltration Testing |
| Appendix I | FEMA Firmette Flood Zone Map |
| Appendix J | Preliminary Pump Specifications |

## Introduction

The following hydrology study has been prepared for the development of the industrial property to be situated at 13925 Benson Avenue in the City of Chino in San Bernardino County, California. The subject site is approximately 6.64 acres and the general location of the site is illustrated on the Vicinity Map included in Appendix A of this report.

## Hydrology Methodology

For both the existing and proposed conditions, the peak storm discharge and runoff volumes for the drainage areas were calculated using the SB County Hydrology Manual. Plate D-4 “Time of Concentration Nomograph for Initial Subarea” from the Hydrology Manual was used to calculate the time of concentration (ToC) for the 10-year and 100-year storm events in both the proposed and existing site conditions. The Small Unit Area Hydrograph Method for San Bernardino, using AES Software (Ratscx), was used to generate hydrographs for the 10-year and 100-year storm events. To determine the 10-year and 100-year precipitation depth and intensity, the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Point Precipitation Frequency Estimates web-page was used. The stage-storage discharge method, using the Civil3d Hydraflow Hydrograph software, was used to design the proposed detention BMPs to attenuate and release the peak flows for the site. Civil3d Hydraflow utilizes the following equations:

- Detention Pond Routing: Inflow – Outflow = ds / dt
- Underground Chambers: V = (L / 6) * (A1 + 4M + A2)
- Weirs: Q = Weir Coefficient * Length * H^1.5
- Culverts/Orifices: Q = Co * A * SQRT [ (2 * g * H) / k ] * Nb
    - Co - Orifice Coefficient
    - A - Culvert/Orifice Area
    - g - Gravity
    - H - Distance between water surface and centroid of the culvert barrel
    - k - 1
    - Nb - Number of barrels

## Hydraulic Methodology

For the proposed conditions, the peak storm discharge for the drainage subareas were calculated using the San Bernardino County Hydrology Manual. The Rational Method Equation (1978 April), AES Software (Ratscx), was used to calculate the peak flows for the 10-year and 100-year storm events in the proposed condition. The peak flows were used to determine the hydraulic capacity of the proposed drainage improvements. Onsite proposed storm drain lines were sized to meet or exceed the design sizes generated by the AES software. The onsite storm drain curb inlet, grate inlets, and riser inlets were sized using the weir equation. Bentley FlowMaster v8.1 was used to determine the capacity of the curb cut openings and determine the velocity through the curb cut openings for sizing of the rip-rap improvements. The San Diego County Hydrology Design Manual was used to calculate the sizing and dimensions of the rip-rap improvements.

## Project Description

**Existing Site Conditions:**

Currently, the existing site is approximately 6.64 acres of industrial land. The site is mostly impervious with minimal commercial vegetation. Preliminary infiltration testing was performed by Leighton & Associates and presented in the geotechnical investigation attached in Appendix H. Per the investigation, the soil on the project site matches the characteristics of hydrologic soil class D and does not infiltrate.

Presently, the site sheet flows from the northeast corner to the southwest driveway at "Ex. Discharge 1". Refer to the "Existing Hydrology Map" in Appendix B for an illustration of the existing drainage patterns. The peak flows and runoff volumes were determined from the Small Unit Area Hydrograph results. All calculations can be found in Appendices C-E of this report. The following table summarizes the data and results for the 10-year and 100-year storm event in the existing condition.

**EXISTING STORM SUMMARY**

| Drainage Area | Acreage (AC) | 10-Year Flowrate (CFS) | 100-Year Flowrate (CFS) | Discharge Location |
|---|---|---|---|---|
| **A** | 6.64 | 10.80 | 17.47 | Ex. Discharge 1 |
| **Total:** | 6.64 | 10.80 | 17.47 | |

**Proposed Site Conditions:**

The proposed development will consist of the demolition of the existing 43,940 sf industrial warehouse and construction of a 129,600 sf industrial warehouse. Accompanying the building is the development of associated paved parking areas, drive aisles, loading docks, concrete hardscape, retaining/screen walls, and curbing. The remaining portion of the site will be commercial landscaping. There are two proposed aboveground bioretention pond basins (Basin A & C), one proposed bioretention planter box (Basin B), and two proposed underground detention chambers (Detention 1 & 2).

The majority of the site drains to Basin B and then to Detention 2 at the south side of the site. The northerly surface runoff sheet flows to the proposed curb and gutter into Basin A and then to Detention 1 at the southwest corner of the site. The westerly surface runoff sheet flows to the proposed curb and gutter and either to Basin C and then to Detention 1 or directly to Detention 1.

Basin's A & C were not included in the calculations for hydrology detention due to the minimal relative volume and stage-storage discharge reduction that would result in negligible effects on the overall drainage condition. The proposed condition was analyzed as two areas tributary to either Detention 1 (DMA A) or Detention 2 (DMA B). Both detention fields outlet to the manhole with side opening and bubble-up to the u-channel and parkway drain at the southwest corner of the site (Discharge 1). The low flows and residual stormwater runoff will route from the manhole to the proposed pump unit and be

pumped to the u-channel. Refer to the "Proposed Hydrology Map" in Appendix B for an illustration of the proposed areas and to Appendix J for the proposed pump preliminary specifications. The following table summarizes the results for the 10-year and 100-year storm event in the proposed condition prior to mitigation.

**PROPOSED STORM SUMMARY PRE-DETENTION**

| Drainage Area | Acreage (AC) | 10-Year Flowrate (CFS) | 100-Year Flowrate (CFS) | Discharge Location |
|---|---|---|---|---|
| **A** | 2.22 | 3.88 | 6.41 | Pr. Discharge 1 |
| **B** | 4.42 | 8.17 | 13.09 | Pr. Discharge 1 |
| **Total:** | 6.64 | 12.05 | 19.50 | |

For drainage area A, the proposed onsite storm drain system is designed to collect the runoff from Basin A, Basin C, and curb inlets/drop inlets and convey the runoff to the proposed Detention 1 prior to being released by a control structure manhole with a weir to the manhole with side opening and will either bubble-up or pump up to the u-channel and parkway drain at the southwest corner of the site (Discharge 1). This curb face outlet will match the existing drainage pattern for the project site. For drainage area B, the proposed onsite storm drain system is designed to collect the runoff in the planter box Basin B and through to Detention 2 prior to being released by a control structure manhole with a weir to the manhole with side opening and will either bubble-up or pump up to the u-channel and parkway drain (See Appendix E for the stage-storage discharge results of the runoff from Area B routing through Basin B and then through Detention 2 for the fully mitigated peak flow). The bioretention planter box Basin C and detention fields Detention 1 & 2 have been sized to reduce the peak flows for discharge of the 10-year and 100-year storm events below the existing condition. The following table summarizes the results for the 10-year and 100-year storm event in the proposed condition post-mitigation.

**PROPOSED STORM SUMMARY POST-DETENTION**

| Drainage Area | Acreage (AC) | 10-Year Flowrate (CFS) | 100-Year Flowrate (CFS) | Discharge Location |
|---|---|---|---|---|
| **A** | 2.22 | 3.86 | 6.36 | Pr. Discharge 1 |
| **B** | 4.42 | 3.24 | 3.92 | Pr. Discharge 1 |
| **Total:** | 6.64 | 7.10 | 10.28 | |

The proposed drainage areas were divided into subareas for hydraulic analysis of the individual drainage improvements, refer to the "Proposed Hydrology Subarea Map" in Appendix B for an illustration of the proposed subareas. The onsite storm drain pipe network meets or exceeds the minimum pipe design sizing generated by the Rational Method report in Appendix F. The curb inlet, grate inlets, and riser inlets are adequately sized to convey the 100-year storm event peak discharge without ponding above the adjacent curb face or pond freeboard limit, refer to Appendix G for the calculations.

The proposed curb cut openings were hydraulically evaluated as rectangular channels in the Bentley FlowMaster program. For the subareas with multiple curb cuts handling similar runoff, the peak discharge was determined by the rational method using one overall subarea and then a rectangular channel with a width equal to the sum of the curb cut openings was modeled in FlowMaster. The resulting normal depth in the openings did not exceed the curb height. The model also calculated the velocity of the runoff to the basins for determination of the rip-rap sizing. For the non-erosive runoff with a velocity below 6.0 feet/second, rip-rap is not required to protect the basin slopes. To be conservative, rip-rap is proposed at these locations at a reduced length based on the geometric conditions. Full rip-rap is provided for the locations of runoff greater than 6.0 feet/second. Refer to Appendix G for the rip-rap calculations.

## Conclusion

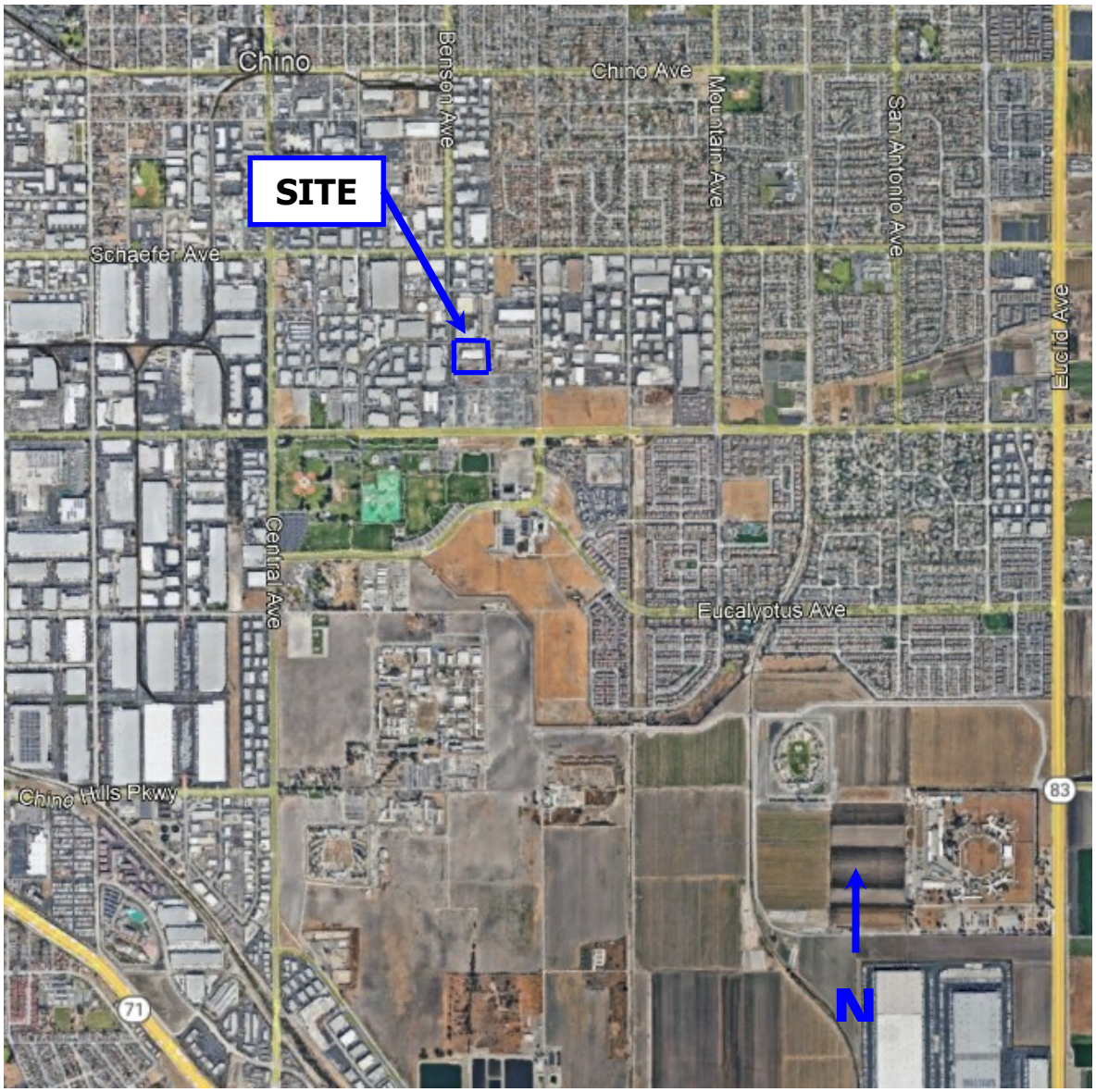
The proposed aboveground bioretention planter box and underground detention fields are sized to reduce the proposed 10-year and 100-year storm flowrates to below the existing 10-year and 100-year peak flowrates. Proposed low flows will discharge through pump discharge to the u-channel and parkway drain and then ultimately to the curb and gutter in Benson Ave. The proposed high flows will bubble-up in the proposed manhole with side opening to the u-channel and parkway drain and then ultimately to the curb and gutter in Benson Ave. at the south end of the project site at a peak flow of 10.28 CFS. The proposed drainage improvements are adequately sized to convey the 100-year runoff with ponding less than the curb face adjacent to the improvements. The proposed site is also designed to ensure a secondary overland release path for the surface runoff that is below the proposed building finished floor and below the adjacent properties, allowing for safe discharge of a storm event greater than the design storm. Offsite surface runoff tributary to the site was determined to be negligible. Due to the site reducing peak flows to below the existing condition and the proposed drainage improvements adequately conveying the design storm runoff, the proposed development will not pose any flood dangers to any downstream or upstream drainage facilities and properties.

# APPENDIX A

## Background Information

Vicinity Map
NOAA Precipitation Depth
NOAA Precipitation Intensity

# Vicinity Map



**NOAA Atlas 14, Volume 6, Version 2**
**Location name: Chino, California, USA***
**Latitude: 34.0005°, Longitude: -117.6793°**
**Elevation: 685 ft****
* source: ESRI Maps
** source: USGS

**POINT PRECIPITATION FREQUENCY ESTIMATES**

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

## PF tabular

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

| Duration | Average recurrence interval (years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 | 1000 |
| 5-min | 0.116 (0.097-0.140) | 0.151 (0.126-0.183) | 0.198 (0.165-0.240) | 0.237 (0.196-0.291) | 0.292 (0.233-0.370) | 0.335 (0.261-0.435) | 0.380 (0.289-0.506) | 0.427 (0.315-0.586) | 0.493 (0.348-0.706) | 0.585 (0.398-0.868) |
| 10-min | 0.166 (0.138-0.201) | 0.216 (0.180-0.262) | 0.284 (0.236-0.345) | 0.340 (0.281-0.417) | 0.419 (0.333-0.531) | 0.481 (0.374-0.623) | 0.545 (0.414-0.725) | 0.613 (0.452-0.839) | 0.707 (0.499-1.01) | 0.839 (0.571-1.24) |
| 15-min | 0.201 (0.167-0.242) | 0.261 (0.218-0.317) | 0.343 (0.286-0.417) | 0.411 (0.339-0.504) | 0.506 (0.403-0.642) | 0.581 (0.453-0.754) | 0.659 (0.500-0.877) | 0.741 (0.546-1.02) | 0.855 (0.603-1.22) | 1.01 (0.691-1.50) |
| 30-min | 0.301 (0.251-0.364) | 0.393 (0.327-0.475) | 0.515 (0.429-0.626) | 0.618 (0.509-0.757) | 0.760 (0.605-0.964) | 0.873 (0.680-1.13) | 0.990 (0.751-1.32) | 1.11 (0.820-1.52) | 1.28 (0.906-1.84) | 1.52 (1.04-2.26) |
| 60-min | 0.452 (0.378-0.547) | 0.589 (0.492-0.713) | 0.774 (0.643-0.939) | 0.927 (0.765-1.14) | 1.14 (0.909-1.45) | 1.31 (1.02-1.70) | 1.48 (1.13-1.98) | 1.67 (1.23-2.29) | 1.93 (1.36-2.76) | 2.29 (1.56-3.39) |
| 2-hr | 0.680 (0.568-0.822) | 0.889 (0.741-1.08) | 1.16 (0.962-1.40) | 1.37 (1.13-1.68) | 1.65 (1.32-2.10) | 1.86 (1.45-2.42) | 2.08 (1.58-2.76) | 2.29 (1.69-3.14) | 2.58 (1.82-3.69) | 2.79 (1.90-4.14) |
| 3-hr | 0.863 (0.721-1.04) | 1.13 (0.940-1.36) | 1.46 (1.22-1.77) | 1.72 (1.42-2.11) | 2.07 (1.65-2.62) | 2.32 (1.81-3.01) | 2.57 (1.95-3.42) | 2.82 (2.08-3.87) | 3.15 (2.22-4.51) | 3.40 (2.31-5.04) |
| 6-hr | 1.19 (0.994-1.44) | 1.55 (1.30-1.88) | 2.00 (1.67-2.43) | 2.36 (1.94-2.89) | 2.81 (2.24-3.57) | 3.15 (2.45-4.08) | 3.48 (2.64-4.62) | 3.80 (2.80-5.20) | 4.22 (2.98-6.04) | 4.53 (3.08-6.72) |
| 12-hr | 1.56 (1.30-1.89) | 2.04 (1.70-2.47) | 2.64 (2.19-3.20) | 3.11 (2.57-3.81) | 3.74 (2.98-4.74) | 4.20 (3.27-5.45) | 4.66 (3.54-6.20) | 5.12 (3.77-7.01) | 5.72 (4.04-8.19) | 6.18 (4.20-9.16) |
| 24-hr | 2.02 (1.78-2.32) | 2.64 (2.33-3.05) | 3.45 (3.04-4.00) | 4.12 (3.60-4.80) | 5.01 (4.24-6.04) | 5.69 (4.72-7.00) | 6.39 (5.17-8.05) | 7.10 (5.59-9.19) | 8.06 (6.10-10.9) | 8.80 (6.44-12.3) |
| 2-day | 2.42 (2.15-2.80) | 3.24 (2.86-3.74) | 4.33 (3.82-5.02) | 5.25 (4.59-6.12) | 6.52 (5.52-7.86) | 7.53 (6.25-9.27) | 8.58 (6.95-10.8) | 9.69 (7.63-12.5) | 11.2 (8.50-15.1) | 12.5 (9.11-17.4) |
| 3-day | 2.60 (2.30-3.00) | 3.53 (3.12-4.07) | 4.78 (4.22-5.54) | 5.85 (5.11-6.82) | 7.35 (6.22-8.86) | 8.55 (7.09-10.5) | 9.82 (7.95-12.4) | 11.2 (8.80-14.5) | 13.1 (9.89-17.6) | 14.6 (10.7-20.4) |
| 4-day | 2.82 (2.50-3.26) | 3.86 (3.41-4.45) | 5.26 (4.63-6.08) | 6.44 (5.63-7.51) | 8.10 (6.86-9.76) | 9.43 (7.82-11.6) | 10.8 (8.76-13.6) | 12.3 (9.69-15.9) | 14.4 (10.9-19.4) | 16.0 (11.7-22.4) |
| 7-day | 3.22 (2.85-3.71) | 4.40 (3.89-5.08) | 5.98 (5.28-6.93) | 7.29 (6.38-8.51) | 9.10 (7.70-11.0) | 10.5 (8.72-12.9) | 12.0 (9.69-15.1) | 13.5 (10.6-17.5) | 15.6 (11.8-21.0) | 17.2 (12.6-24.0) |
| 10-day | 3.53 (3.12-4.07) | 4.84 (4.28-5.59) | 6.56 (5.78-7.60) | 7.97 (6.97-9.30) | 9.90 (8.38-11.9) | 11.4 (9.45-14.0) | 12.9 (10.5-16.3) | 14.5 (11.4-18.8) | 16.6 (12.6-22.4) | 18.3 (13.4-25.5) |
| 20-day | 4.28 (3.79-4.94) | 5.93 (5.24-6.85) | 8.11 (7.15-9.39) | 9.90 (8.66-11.6) | 12.3 (10.4-14.9) | 14.2 (11.8-17.5) | 16.2 (13.1-20.4) | 18.2 (14.3-23.5) | 20.9 (15.8-28.2) | 23.0 (16.8-32.1) |
| 30-day | 5.13 (4.54-5.92) | 7.14 (6.31-8.24) | 9.84 (8.67-11.4) | 12.1 (10.6-14.1) | 15.2 (12.9-18.3) | 17.6 (14.6-21.7) | 20.2 (16.3-25.4) | 22.8 (18.0-29.6) | 26.5 (20.1-35.8) | 29.4 (21.5-41.0) |
| 45-day | 6.07 (5.37-7.00) | 8.44 (7.46-9.74) | 11.7 (10.3-13.5) | 14.5 (12.7-16.9) | 18.4 (15.6-22.2) | 21.6 (18.0-26.6) | 25.0 (20.3-31.5) | 28.7 (22.6-37.1) | 33.8 (25.6-45.6) | 38.0 (27.8-53.0) |
| 60-day | 6.98 (6.18-8.05) | 9.63 (8.51-11.1) | 13.4 (11.8-15.5) | 16.6 (14.6-19.4) | 21.4 (18.1-25.8) | 25.4 (21.1-31.2) | 29.7 (24.0-37.4) | 34.3 (27.1-44.5) | 41.1 (31.1-55.5) | 46.8 (34.2-65.3) |

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

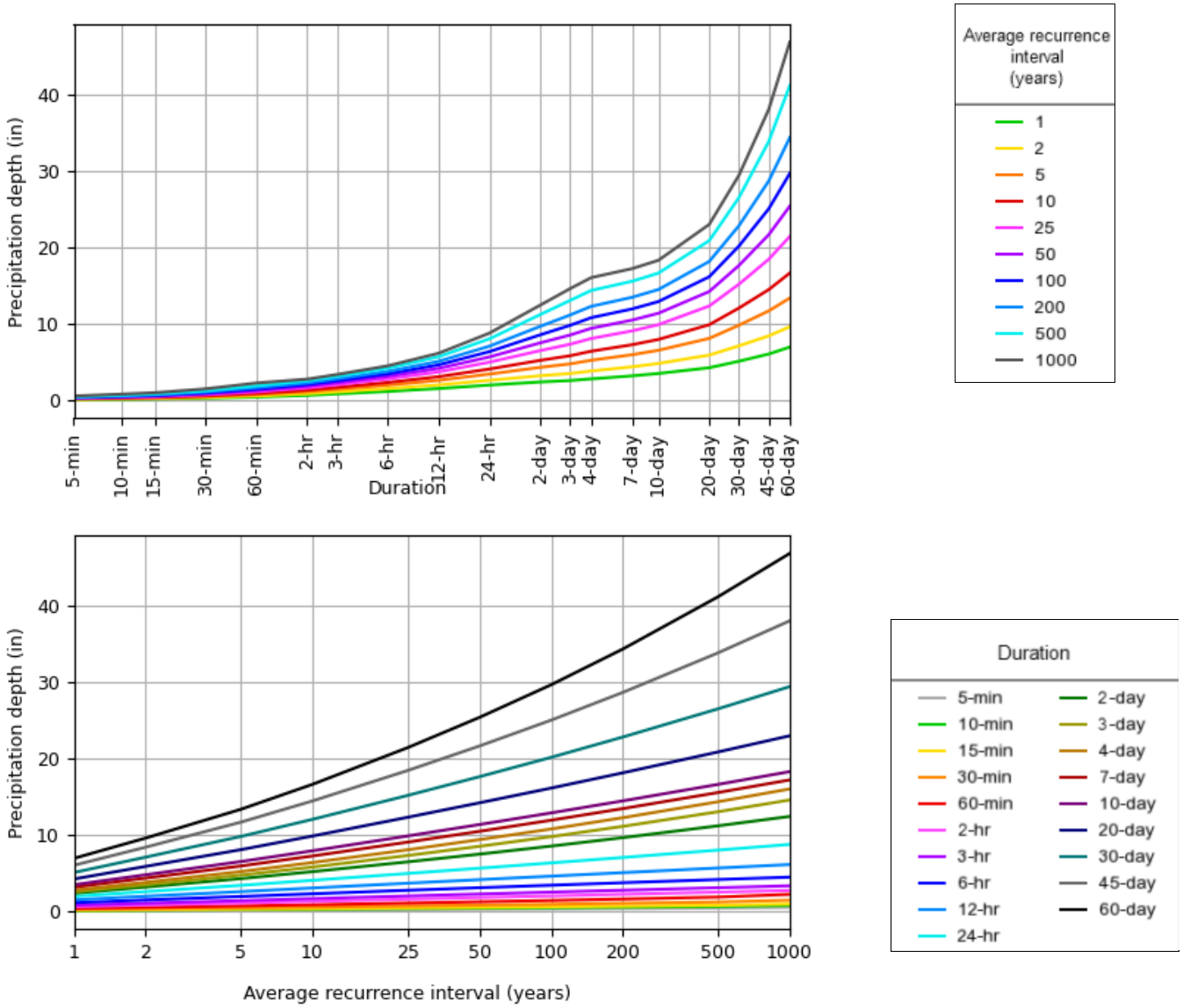
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper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

Please refer to NOAA Atlas 14 document for more information.

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## PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 34.0005°, Longitude: -117.6793°




NOAA Atlas 14, Volume 6, Version 2 Created (GMT): Mon Jun 5 20:25:54 2023

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## Maps & aerials

**Small scale terrain**

**NOAA Atlas 14, Volume 6, Version 2**
**Location name: Chino, California, USA***
**Latitude: 34.0005°, Longitude: -117.6793°**
**Elevation: 685 ft****
* source: ESRI Maps
** source: USGS

**POINT PRECIPITATION FREQUENCY ESTIMATES**

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

## PF tabular

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

| Duration | Average recurrence interval (years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 | 1000 |
| 5-min | 1.39 (1.16-1.68) | 1.81 (1.51-2.20) | 2.38 (1.98-2.88) | 2.84 (2.35-3.49) | 3.50 (2.80-4.44) | 4.02 (3.13-5.22) | 4.56 (3.47-6.07) | 5.12 (3.78-7.03) | 5.92 (4.18-8.47) | 7.02 (4.78-10.4) |
| 10-min | 0.996 (0.828-1.21) | 1.30 (1.08-1.57) | 1.70 (1.42-2.07) | 2.04 (1.69-2.50) | 2.51 (2.00-3.19) | 2.89 (2.24-3.74) | 3.27 (2.48-4.35) | 3.68 (2.71-5.03) | 4.24 (2.99-6.07) | 5.03 (3.43-7.46) |
| 15-min | 0.804 (0.668-0.968) | 1.04 (0.872-1.27) | 1.37 (1.14-1.67) | 1.64 (1.36-2.02) | 2.02 (1.61-2.57) | 2.32 (1.81-3.02) | 2.64 (2.00-3.51) | 2.96 (2.18-4.06) | 3.42 (2.41-4.89) | 4.06 (2.76-6.02) |
| 30-min | 0.602 (0.502-0.728) | 0.786 (0.654-0.950) | 1.03 (0.858-1.25) | 1.24 (1.02-1.51) | 1.52 (1.21-1.93) | 1.75 (1.36-2.26) | 1.98 (1.50-2.63) | 2.23 (1.64-3.05) | 2.57 (1.81-3.67) | 3.05 (2.07-4.52) |
| 60-min | 0.452 (0.378-0.547) | 0.589 (0.492-0.713) | 0.774 (0.643-0.939) | 0.927 (0.765-1.14) | 1.14 (0.909-1.45) | 1.31 (1.02-1.70) | 1.48 (1.13-1.98) | 1.67 (1.23-2.29) | 1.93 (1.36-2.76) | 2.29 (1.56-3.39) |
| 2-hr | 0.340 (0.284-0.411) | 0.444 (0.370-0.538) | 0.578 (0.481-0.701) | 0.684 (0.564-0.838) | 0.826 (0.658-1.05) | 0.932 (0.726-1.21) | 1.04 (0.788-1.38) | 1.15 (0.845-1.57) | 1.29 (0.909-1.84) | 1.40 (0.950-2.07) |
| 3-hr | 0.287 (0.240-0.347) | 0.375 (0.313-0.454) | 0.486 (0.404-0.590) | 0.573 (0.473-0.702) | 0.687 (0.548-0.872) | 0.772 (0.602-1.00) | 0.856 (0.650-1.14) | 0.940 (0.692-1.29) | 1.05 (0.740-1.50) | 1.13 (0.770-1.68) |
| 6-hr | 0.198 (0.165-0.240) | 0.259 (0.216-0.313) | 0.334 (0.278-0.406) | 0.393 (0.324-0.482) | 0.469 (0.374-0.596) | 0.525 (0.409-0.681) | 0.580 (0.440-0.772) | 0.634 (0.467-0.869) | 0.704 (0.497-1.01) | 0.756 (0.515-1.12) |
| 12-hr | 0.129 (0.108-0.156) | 0.169 (0.141-0.204) | 0.218 (0.182-0.265) | 0.258 (0.212-0.316) | 0.310 (0.246-0.393) | 0.348 (0.271-0.452) | 0.386 (0.293-0.514) | 0.424 (0.313-0.581) | 0.474 (0.335-0.679) | 0.512 (0.349-0.760) |
| 24-hr | 0.084 (0.074-0.096) | 0.110 (0.097-0.127) | 0.143 (0.126-0.166) | 0.171 (0.149-0.200) | 0.208 (0.176-0.251) | 0.237 (0.196-0.291) | 0.266 (0.215-0.335) | 0.295 (0.233-0.383) | 0.335 (0.254-0.453) | 0.366 (0.268-0.511) |
| 2-day | 0.050 (0.044-0.058) | 0.067 (0.059-0.077) | 0.090 (0.079-0.104) | 0.109 (0.095-0.127) | 0.135 (0.115-0.163) | 0.156 (0.130-0.193) | 0.178 (0.144-0.225) | 0.201 (0.159-0.261) | 0.233 (0.176-0.315) | 0.259 (0.189-0.362) |
| 3-day | 0.036 (0.032-0.041) | 0.048 (0.043-0.056) | 0.066 (0.058-0.076) | 0.081 (0.071-0.094) | 0.102 (0.086-0.123) | 0.118 (0.098-0.146) | 0.136 (0.110-0.171) | 0.155 (0.122-0.200) | 0.181 (0.137-0.244) | 0.202 (0.148-0.283) |
| 4-day | 0.029 (0.026-0.033) | 0.040 (0.035-0.046) | 0.054 (0.048-0.063) | 0.067 (0.058-0.078) | 0.084 (0.071-0.101) | 0.098 (0.081-0.120) | 0.112 (0.091-0.141) | 0.128 (0.100-0.165) | 0.149 (0.113-0.201) | 0.167 (0.122-0.233) |
| 7-day | 0.019 (0.016-0.022) | 0.026 (0.023-0.030) | 0.035 (0.031-0.041) | 0.043 (0.037-0.050) | 0.054 (0.045-0.065) | 0.062 (0.051-0.076) | 0.071 (0.057-0.089) | 0.080 (0.063-0.103) | 0.092 (0.070-0.125) | 0.102 (0.075-0.143) |
| 10-day | 0.014 (0.013-0.016) | 0.020 (0.017-0.023) | 0.027 (0.024-0.031) | 0.033 (0.029-0.038) | 0.041 (0.034-0.049) | 0.047 (0.039-0.058) | 0.053 (0.043-0.067) | 0.060 (0.047-0.078) | 0.069 (0.052-0.093) | 0.076 (0.055-0.106) |
| 20-day | 0.008 (0.007-0.010) | 0.012 (0.010-0.014) | 0.016 (0.014-0.019) | 0.020 (0.018-0.024) | 0.025 (0.021-0.030) | 0.029 (0.024-0.036) | 0.033 (0.027-0.042) | 0.037 (0.029-0.048) | 0.043 (0.032-0.058) | 0.047 (0.035-0.066) |
| 30-day | 0.007 (0.006-0.008) | 0.009 (0.008-0.011) | 0.013 (0.012-0.015) | 0.016 (0.014-0.019) | 0.021 (0.017-0.025) | 0.024 (0.020-0.030) | 0.028 (0.022-0.035) | 0.031 (0.024-0.041) | 0.036 (0.027-0.049) | 0.040 (0.029-0.056) |
| 45-day | 0.005 (0.004-0.006) | 0.007 (0.006-0.009) | 0.010 (0.009-0.012) | 0.013 (0.011-0.015) | 0.017 (0.014-0.020) | 0.020 (0.016-0.024) | 0.023 (0.018-0.029) | 0.026 (0.020-0.034) | 0.031 (0.023-0.042) | 0.035 (0.025-0.049) |
| 60-day | 0.004 (0.004-0.005) | 0.006 (0.005-0.007) | 0.009 (0.008-0.010) | 0.011 (0.010-0.013) | 0.014 (0.012-0.017) | 0.017 (0.014-0.021) | 0.020 (0.016-0.025) | 0.023 (0.018-0.030) | 0.028 (0.021-0.038) | 0.032 (0.023-0.045) |

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

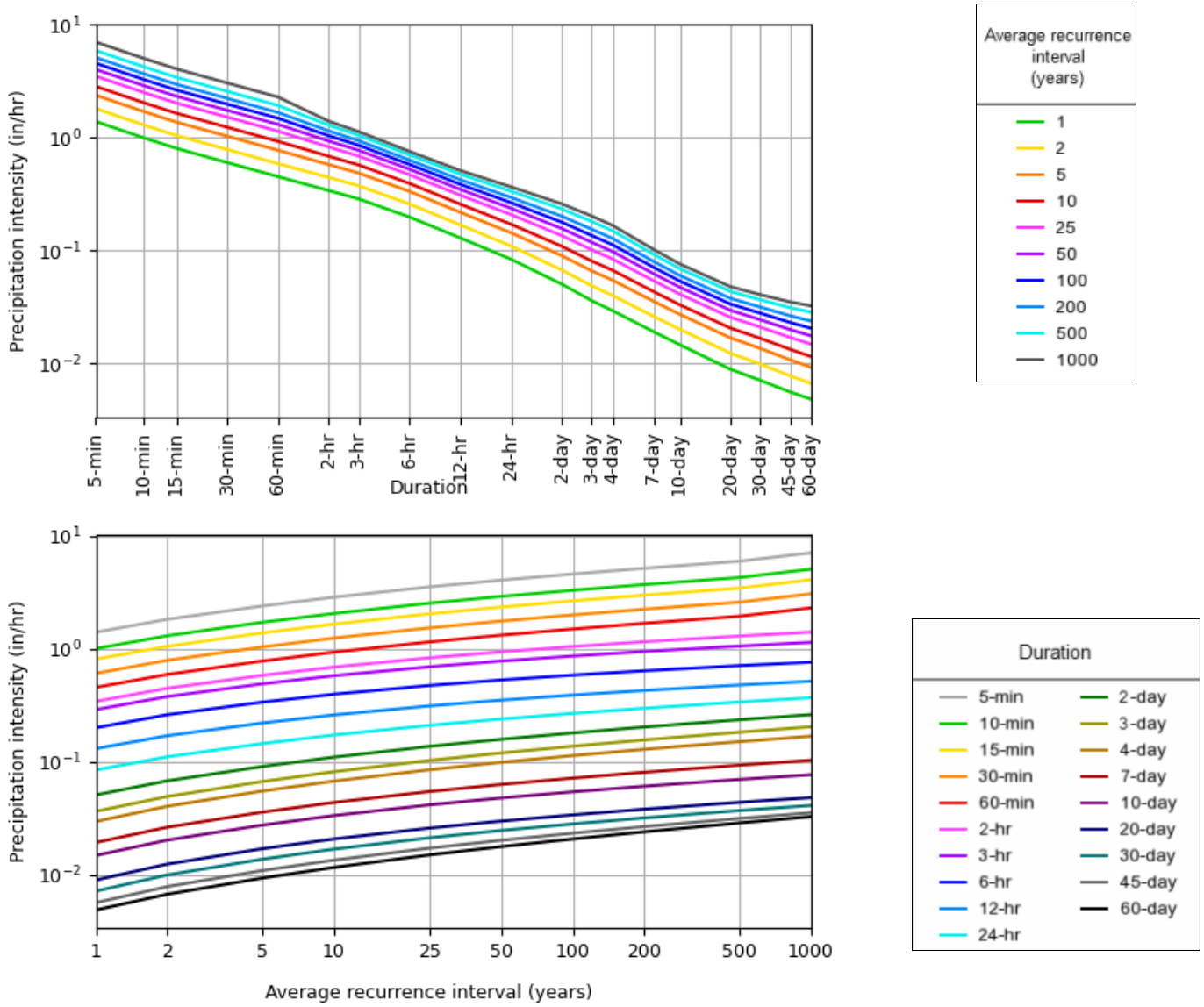
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper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

Please refer to NOAA Atlas 14 document for more information.

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## PF graphical

PDS-based intensity-duration-frequency (IDF) curves
Latitude: 34.0005°, Longitude: -117.6793°




NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Wed Dec 6 21:45:52 2023

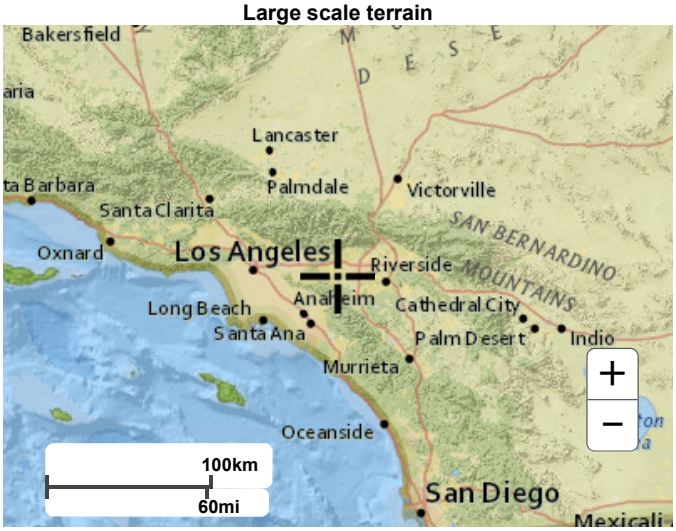
Back to Top

## Maps & aerials

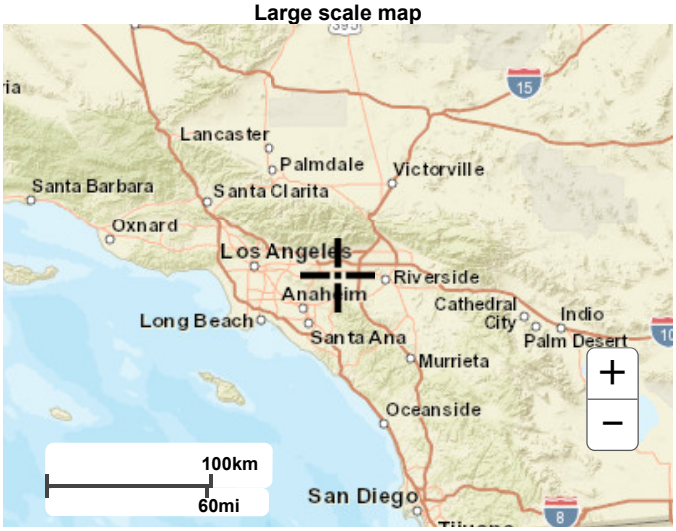
**Small scale terrain**




**Large scale terrain**




**Large scale map**




**Large scale aerial**




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

Disclaimer

# APPENDIX B

## Hydrology Maps

Existing Hydrology Map
Proposed Hydrology Map
Proposed Hydrology Subarea Map

APN: 1021-121-11

APN: 1021-121-07

DANIELS ST

BENSON AVE

APN: 1021-121-05

APN: 1021-211-05

APN: 1021-211-06

APN: 1021-211-02

APN: 1021-211-01

R/W

℄

℄

℄

℄

℄

℄

L=942.0'

100 EL=685.7

EL=680.0
101
$Q_{10}$=10.80
$Q_{100}$=17.47 CFS
EX. DISCHARGE 1

A
6.64
91.3% IMPERVIOUS
8.7% PERVIOUS

## LEGEND

- DMA BOUNDARY
- SUBAREA BOUNDARY
- X / XXX — SUBAREA / SUBAREA ACREAGE
- DIRECTION OF RUNOFF
- LANDSCAPE AREA
- DRAINAGE FLOWPATH

N

30' 0' 30' 60' 90'

GRAPHIC SCALE: 1"=30'


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DRC Engineering, Inc.
Civil Engineering/Land Surveying/Land Planning
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Suite 210
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714-685-6860
DREW J. GATES
R.C.E. 94249
12/8/23
DATE


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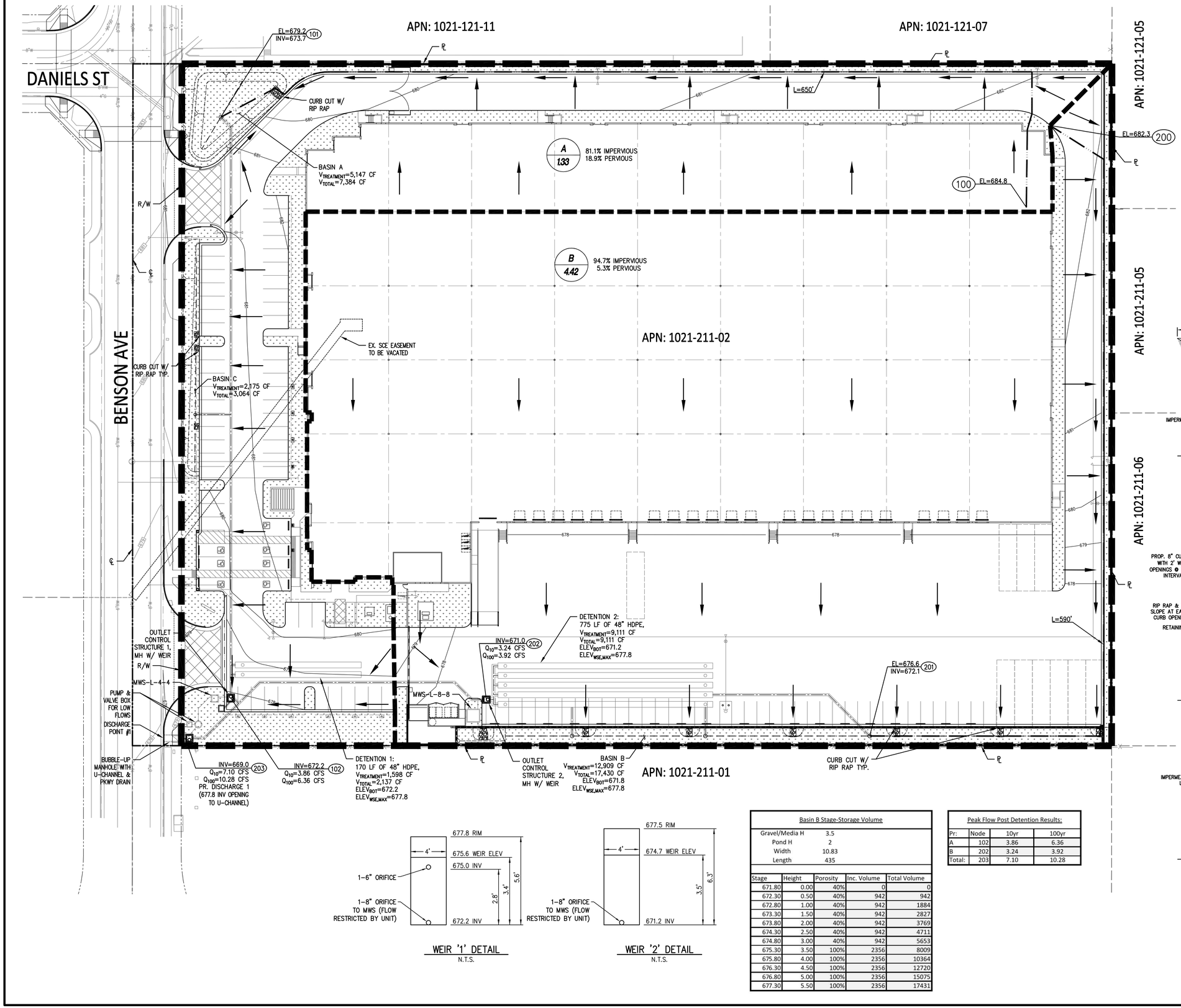
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|---|---|---|
| | | |

PROJECT: REXFORD INDUSTRIAL
13925 BENSON AVENUE
CHINO, CA

DRAWING NAME: EXISTING HYDROLOGY MAP

| | |
|---|---|
| ISSUE: | HYDROLOGY |
| DATE: | 12/8/23 |
| CHECKED: DG | DRAWN: AS |
| DRAWING FILE: | 23646exhm |
| PROJECT NO.: | 23-646 |
| SHEET NUMBER: | 1 |
| OF | 1 SHEETS |
| SCALE: | AS SHOWN |

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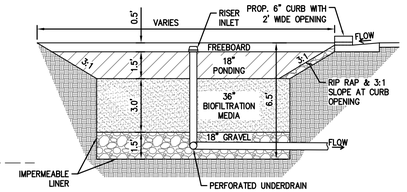



## LEGEND

- DMA BOUNDARY
- SUBAREA BOUNDARY
- SUBAREA (X)
- SUBAREA ACREAGE (XXX)
- DIRECTION OF RUNOFF
- LANDSCAPE AREA
- STORM DRAIN FLOW ARROW / STORM DRAIN LINE
- OUTLET CONTROL STRUCTURE MANHOLE (WEIR PLATE / WEIR PLATE)
- 2' WIDE CURB CUT OPENING W/ RIP RAP ON SLOPE
- DRAINAGE FLOWPATH

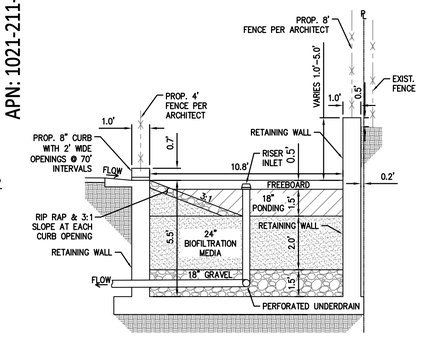
## PROPOSED ZONING

M2 (INDUSTRIAL GENERAL)



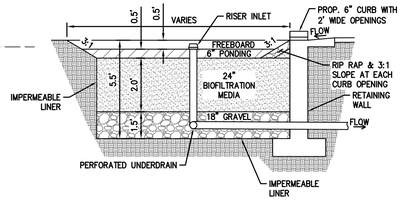

## 'BASIN A' BIORETENTION DETAIL

N.T.S.




## 'BASIN B' PLANTER BOX DETAIL

N.T.S.




## 'BASIN C' BIORETENTION DETAIL

N.T.S.




## WEIR '1' DETAIL

N.T.S.

## WEIR '2' DETAIL

N.T.S.

Basin B Stage-Storage Volume

| | |
|---|---|
| Gravel/Media H | 3.5 |
| Pond H | 2 |
| Width | 10.83 |
| Length | 435 |

| Stage | Height | Porosity | Inc. Volume | Total Volume |
|---|---|---|---|---|
| 671.80 | 0.00 | 40% | 0 | 0 |
| 672.30 | 0.50 | 40% | 942 | 942 |
| 672.80 | 1.00 | 40% | 942 | 1884 |
| 673.30 | 1.50 | 40% | 942 | 2827 |
| 673.80 | 2.00 | 40% | 942 | 3769 |
| 674.30 | 2.50 | 40% | 942 | 4711 |
| 674.80 | 3.00 | 40% | 942 | 5653 |
| 675.30 | 3.50 | 100% | 2356 | 8009 |
| 675.80 | 4.00 | 100% | 2356 | 10364 |
| 676.30 | 4.50 | 100% | 2356 | 12720 |
| 676.80 | 5.00 | 100% | 2356 | 15075 |
| 677.30 | 5.50 | 100% | 2356 | 17431 |

Peak Flow Post Detention Results:

| Pr: | Node | 10yr | 100yr |
|---|---|---|---|
| A | 102 | 3.86 | 6.36 |
| B | 202 | 3.24 | 3.92 |
| Total: | 203 | 7.10 | 10.28 |

N

30' 0' 30' 60' 90'

GRAPHIC SCALE: 1"=30'


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DREW J. GATES
R.C.E. 94249
12/8/23
DATE


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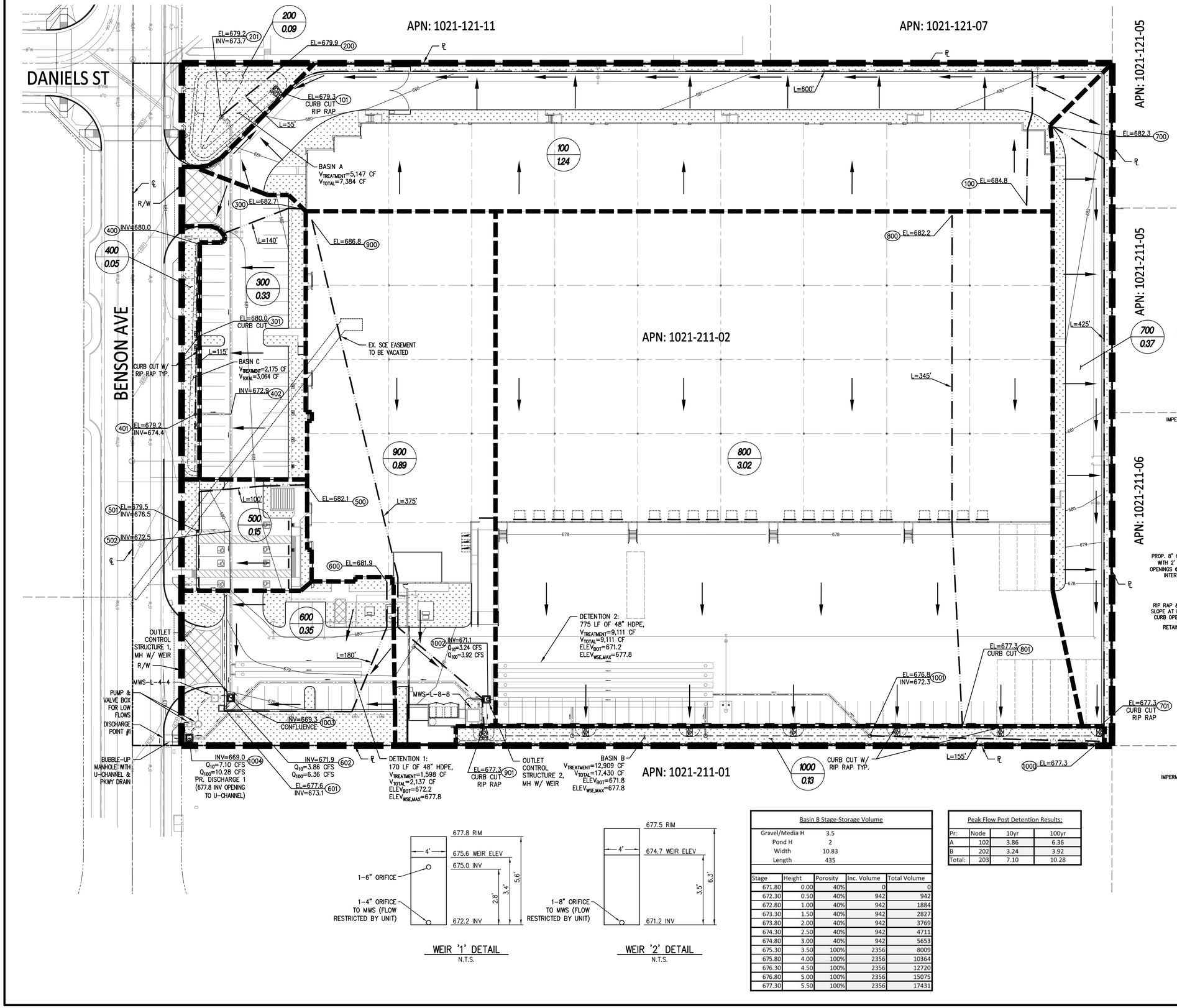
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|---|---|---|
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PROJECT: REXFORD INDUSTRIAL
13925 BENSON AVENUE
CHINO, CA

DRAWING NAME: PROPOSED HYDROLOGY MAP

| | |
|---|---|
| ISSUE: | HYDROLOGY |
| DATE: | 12/8/23 |
| CHECKED: DG | DRAWN: AS |
| DRAWING FILE: | 23646prhm |
| PROJECT NO.: | 23-646 |
| SHEET NUMBER: | 1 |
| OF | 1 SHEETS |
| SCALE: | AS SHOWN |

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Basin B Stage-Storage Volume

| | |
|---|---|
| Gravel/Media H | 3.5 |
| Pond H | 2 |
| Width | 10.83 |
| Length | 435 |

| Stage | Height | Porosity | Inc. Volume | Total Volume |
|---|---|---|---|---|
| 671.80 | 0.00 | 40% | 0 | 0 |
| 672.30 | 0.50 | 40% | 942 | 942 |
| 672.80 | 1.00 | 40% | 942 | 1884 |
| 673.30 | 1.50 | 40% | 942 | 2827 |
| 673.80 | 2.00 | 40% | 942 | 3769 |
| 674.30 | 2.50 | 40% | 942 | 4711 |
| 674.80 | 3.00 | 40% | 942 | 5653 |
| 675.30 | 3.50 | 100% | 2356 | 8009 |
| 675.80 | 4.00 | 100% | 2356 | 10364 |
| 676.30 | 4.50 | 100% | 2356 | 12720 |
| 676.80 | 5.00 | 100% | 2356 | 15075 |
| 677.30 | 5.50 | 100% | 2356 | 17431 |

Peak Flow Post Detention Results:

| Pr: | Node | 10yr | 100yr |
|---|---|---|---|
| A | 102 | 3.86 | 6.36 |
| B | 202 | 3.24 | 3.92 |
| Total: | 203 | 7.10 | 10.28 |


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Civil Engineering/Land Surveying/Land Planning
R.C.E. 94249
DREW J. GATES


12/8/23 DATE

NOT FOR CONSTRUCTION

NO: REVISION: DATE:

PROJECT: REXFORD INDUSTRIAL
13925 BENSON AVENUE
CHINO, CA

DRAWING NAME: PROPOSED SUBAREA MAP

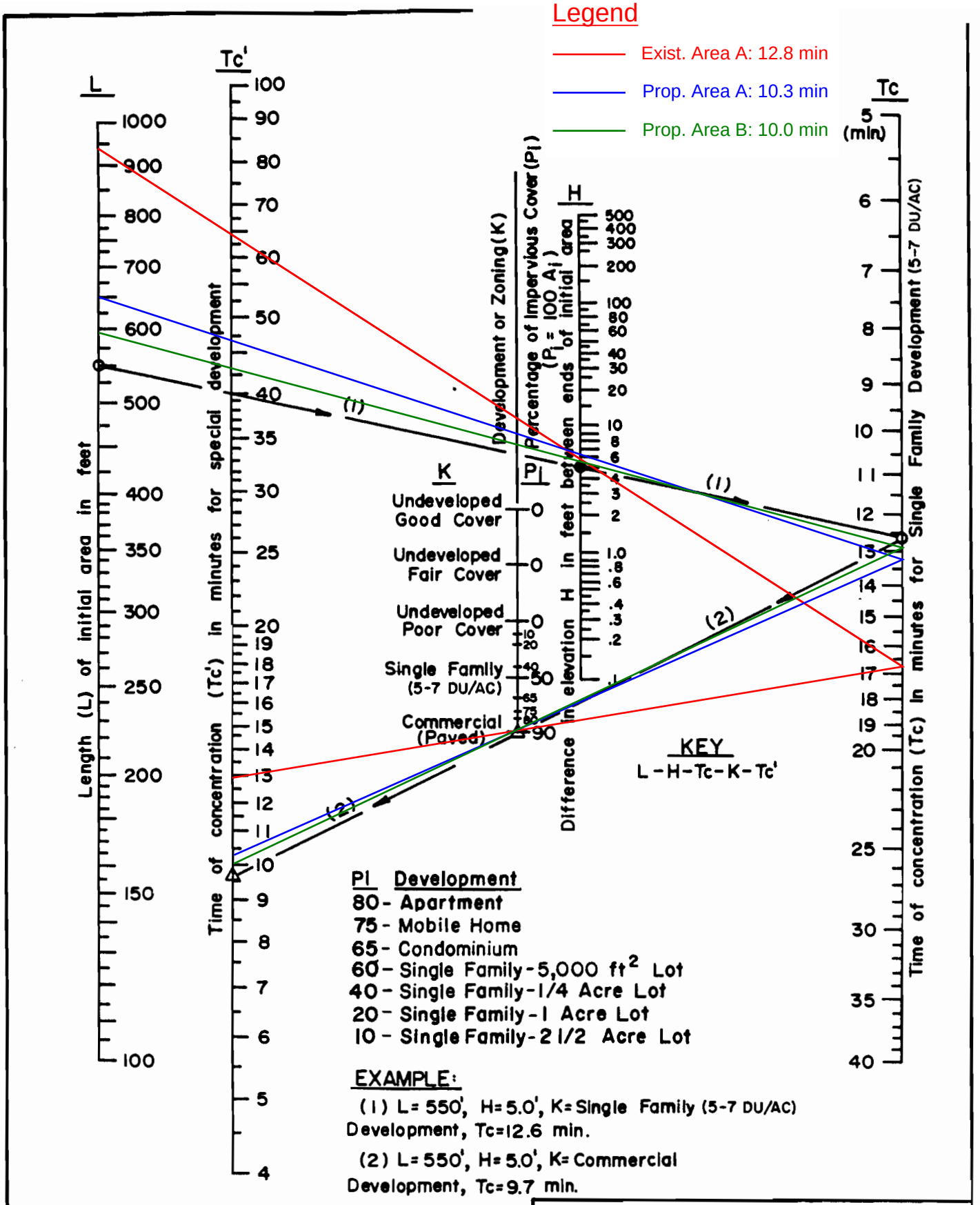
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DATE: 12/8/23
CHECKED: DG DRAWN: AS
DRAWING FILE: 23646prhm
PROJECT NO.: 23-646
SHEET NUMBER: 1
OF 1 SHEETS
SCALE: AS SHOWN

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# APPENDIX C

## Hydrology ToC "Plate D.4" Determination

Existing Condition
Proposed Condition




# SAN BERNARDINO COUNTY
## HYDROLOGY MANUAL

## TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

# APPENDIX D

## 10-year & 100-year Small Area Unit Hydrographs

Existing Condition
Proposed Condition

```
*****************************************************************************
          NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                    AND LOW LOSS FRACTION ESTIMATIONS
=============================================================================
         (C) Copyright 1989-2015 Advanced Engineering Software (aes)
             Ver. 22.0  Release Date: 07/01/2015  License ID 1510

                           Analysis prepared by:

                           DRC Engineering, Inc.
                      160 South Old Springs Road, Suite 210
                             Anaheim Hills, CA 92808
                                  714-685-6860

*****************************************************************************
-----------------------------------------------------------------------------

 Problem Descriptions:
  AREA A
  EXISTING CONDITION
  10 YEAR
=============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC II:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     4.12 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA     NUMBER    Fp(in./hr.)    YIELD
         1          6.64        9.30            75.       0.470       0.895

    TOTAL AREA (Acres) =      6.64

    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.044

    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.105
=============================================================================
```

```
**************************************************************************
                    SMALL AREA UNIT HYDROGRAPH MODEL
==========================================================================
         (C) Copyright 1989-2015 Advanced Engineering Software (aes)
             Ver. 22.0  Release Date: 07/01/2015  License ID 1510

                          Analysis prepared by:

                          DRC Engineering, Inc.
                    160 South Old Springs Road, Suite 210
                           Anaheim Hills, CA 92808
                                714-685-6860

**************************************************************************
--------------------------------------------------------------------------

 Problem Descriptions:
  AREA A
  EXISTING CONDITION
  10 YEAR
--------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =    6.64
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.044
    LOW LOSS FRACTION = 0.105
    TIME OF CONCENTRATION(MIN.) = 12.80
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =  10
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.24
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.62
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.93
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  1.72
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  2.36
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  4.12

--------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     1.85
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.43

**************************************************************************
  TIME     VOLUME       Q    0.        5.0      10.0      15.0      20.0
 (HOURS)    (AF)      (CFS)
--------------------------------------------------------------------------
  0.21      0.0033      0.37  Q         .         .         .         .
  0.43      0.0098      0.37  Q         .         .         .         .
```

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0.64 | 0.0164 | 0.38 | Q | . | . | . | . |
| 0.85 | 0.0230 | 0.38 | Q | . | . | . | . |
| 1.07 | 0.0298 | 0.38 | Q | . | . | . | . |
| 1.28 | 0.0365 | 0.39 | Q | . | . | . | . |
| 1.49 | 0.0433 | 0.39 | Q | . | . | . | . |
| 1.71 | 0.0502 | 0.39 | Q | . | . | . | . |
| 1.92 | 0.0572 | 0.39 | Q | . | . | . | . |
| 2.13 | 0.0642 | 0.40 | Q | . | . | . | . |
| 2.35 | 0.0712 | 0.40 | Q | . | . | . | . |
| 2.56 | 0.0784 | 0.41 | Q | . | . | . | . |
| 2.77 | 0.0856 | 0.41 | Q | . | . | . | . |
| 2.99 | 0.0928 | 0.41 | Q | . | . | . | . |
| 3.20 | 0.1002 | 0.42 | Q | . | . | . | . |
| 3.41 | 0.1076 | 0.42 | Q | . | . | . | . |
| 3.63 | 0.1151 | 0.43 | Q | . | . | . | . |
| 3.84 | 0.1226 | 0.43 | Q | . | . | . | . |
| 4.05 | 0.1303 | 0.43 | Q | . | . | . | . |
| 4.27 | 0.1380 | 0.44 | Q | . | . | . | . |
| 4.48 | 0.1458 | 0.44 | Q | . | . | . | . |
| 4.69 | 0.1537 | 0.45 | Q | . | . | . | . |
| 4.91 | 0.1617 | 0.45 | Q | . | . | . | . |
| 5.12 | 0.1697 | 0.46 | Q | . | . | . | . |
| 5.33 | 0.1779 | 0.46 | Q | . | . | . | . |
| 5.55 | 0.1861 | 0.47 | Q | . | . | . | . |
| 5.76 | 0.1945 | 0.48 | Q | . | . | . | . |
| 5.97 | 0.2030 | 0.48 | Q | . | . | . | . |
| 6.19 | 0.2115 | 0.49 | Q | . | . | . | . |
| 6.40 | 0.2202 | 0.50 | Q | . | . | . | . |
| 6.61 | 0.2290 | 0.50 | .Q | . | . | . | . |
| 6.83 | 0.2379 | 0.51 | .Q | . | . | . | . |
| 7.04 | 0.2470 | 0.51 | .Q | . | . | . | . |
| 7.25 | 0.2561 | 0.52 | .Q | . | . | . | . |
| 7.47 | 0.2654 | 0.53 | .Q | . | . | . | . |
| 7.68 | 0.2748 | 0.54 | .Q | . | . | . | . |
| 7.89 | 0.2844 | 0.55 | .Q | . | . | . | . |
| 8.11 | 0.2941 | 0.56 | .Q | . | . | . | . |
| 8.32 | 0.3040 | 0.56 | .Q | . | . | . | . |
| 8.53 | 0.3140 | 0.58 | .Q | . | . | . | . |
| 8.75 | 0.3242 | 0.58 | .Q | . | . | . | . |
| 8.96 | 0.3346 | 0.60 | .Q | . | . | . | . |
| 9.17 | 0.3452 | 0.60 | .Q | . | . | . | . |
| 9.39 | 0.3560 | 0.62 | .Q | . | . | . | . |
| 9.60 | 0.3669 | 0.63 | .Q | . | . | . | . |
| 9.81 | 0.3781 | 0.64 | .Q | . | . | . | . |
| 10.03 | 0.3895 | 0.65 | .Q | . | . | . | . |
| 10.24 | 0.4012 | 0.67 | .Q | . | . | . | . |
| 10.45 | 0.4131 | 0.68 | .Q | . | . | . | . |
| 10.67 | 0.4252 | 0.70 | .Q | . | . | . | . |
| 10.88 | 0.4377 | 0.71 | .Q | . | . | . | . |
| 11.09 | 0.4505 | 0.74 | .Q | . | . | . | . |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 11.31 | 0.4635 | 0.75 | .Q | . | . | . | . |
| 11.52 | 0.4770 | 0.78 | .Q | . | . | . | . |
| 11.73 | 0.4908 | 0.79 | .Q | . | . | . | . |
| 11.95 | 0.5050 | 0.82 | .Q | . | . | . | . |
| 12.16 | 0.5198 | 0.85 | .Q | . | . | . | . |
| 12.37 | 0.5360 | 0.99 | .Q | . | . | . | . |
| 12.59 | 0.5537 | 1.01 | . Q | . | . | . | . |
| 12.80 | 0.5719 | 1.06 | . Q | . | . | . | . |
| 13.01 | 0.5908 | 1.08 | . Q | . | . | . | . |
| 13.23 | 0.6104 | 1.14 | . Q | . | . | . | . |
| 13.44 | 0.6308 | 1.17 | . Q | . | . | . | . |
| 13.65 | 0.6521 | 1.24 | . Q | . | . | . | . |
| 13.87 | 0.6744 | 1.28 | . Q | . | . | . | . |
| 14.08 | 0.6980 | 1.40 | . Q | . | . | . | . |
| 14.29 | 0.7257 | 1.75 | .  Q | . | . | . | . |
| 14.51 | 0.7577 | 1.88 | .  Q | . | . | . | . |
| 14.72 | 0.7914 | 1.95 | .  Q | . | . | . | . |
| 14.93 | 0.8275 | 2.14 | .   Q | . | . | . | . |
| 15.15 | 0.8664 | 2.27 | .   Q | . | . | . | . |
| 15.36 | 0.9096 | 2.64 | .    Q | . | . | . | . |
| 15.57 | 0.9594 | 3.00 | .     Q | . | . | . | . |
| 15.79 | 1.0197 | 3.83 | .      Q | . | . | . | . |
| 16.00 | 1.0944 | 4.64 | .        Q. | . | . | . | . |
| 16.21 | 1.2305 | 10.80 | .         . | .Q | . | . | . |
| 16.43 | 1.3558 | 3.41 | .     Q | . | . | . | . |
| 16.64 | 1.4074 | 2.43 | .   Q | . | . | . | . |
| 16.85 | 1.4468 | 2.04 | .   Q | . | . | . | . |
| 17.07 | 1.4807 | 1.81 | .  Q | . | . | . | . |
| 17.28 | 1.5084 | 1.33 | . Q | . | . | . | . |
| 17.49 | 1.5307 | 1.21 | . Q | . | . | . | . |
| 17.71 | 1.5511 | 1.11 | . Q | . | . | . | . |
| 17.92 | 1.5700 | 1.03 | . Q | . | . | . | . |
| 18.13 | 1.5877 | 0.97 | .Q | . | . | . | . |
| 18.35 | 1.6034 | 0.81 | .Q | . | . | . | . |
| 18.56 | 1.6172 | 0.76 | .Q | . | . | . | . |
| 18.77 | 1.6303 | 0.72 | .Q | . | . | . | . |
| 18.99 | 1.6428 | 0.69 | .Q | . | . | . | . |
| 19.20 | 1.6547 | 0.66 | .Q | . | . | . | . |
| 19.41 | 1.6661 | 0.63 | .Q | . | . | . | . |
| 19.63 | 1.6771 | 0.61 | .Q | . | . | . | . |
| 19.84 | 1.6876 | 0.59 | .Q | . | . | . | . |
| 20.05 | 1.6978 | 0.57 | .Q | . | . | . | . |
| 20.27 | 1.7077 | 0.55 | .Q | . | . | . | . |
| 20.48 | 1.7173 | 0.53 | .Q | . | . | . | . |
| 20.69 | 1.7266 | 0.52 | .Q | . | . | . | . |
| 20.91 | 1.7356 | 0.51 | .Q | . | . | . | . |
| 21.12 | 1.7444 | 0.49 | Q | . | . | . | . |
| 21.33 | 1.7530 | 0.48 | Q | . | . | . | . |
| 21.55 | 1.7614 | 0.47 | Q | . | . | . | . |
| 21.76 | 1.7695 | 0.46 | Q | . | . | . | . |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 21.97 | 1.7775 | 0.45 | Q | . | . | . | . |
| 22.19 | 1.7853 | 0.44 | Q | . | . | . | . |
| 22.40 | 1.7929 | 0.43 | Q | . | . | . | . |
| 22.61 | 1.8004 | 0.42 | Q | . | . | . | . |
| 22.83 | 1.8078 | 0.41 | Q | . | . | . | . |
| 23.04 | 1.8150 | 0.40 | Q | . | . | . | . |
| 23.25 | 1.8220 | 0.40 | Q | . | . | . | . |
| 23.47 | 1.8290 | 0.39 | Q | . | . | . | . |
| 23.68 | 1.8358 | 0.38 | Q | . | . | . | . |
| 23.89 | 1.8425 | 0.38 | Q | . | . | . | . |
| 24.11 | 1.8491 | 0.37 | Q | . | . | . | . |
| 24.32 | 1.8524 | 0.00 | Q | . | . | . | . |

TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
(Note: 100% of Peak Flow Rate estimate assumed to have
an instantaneous time duration)

| Percentile of Estimated Peak Flow Rate | Duration (minutes) |
|---|---|
| 0% | 1446.4 |
| 10% | 294.4 |
| 20% | 102.4 |
| 30% | 51.2 |
| 40% | 25.6 |
| 50% | 12.8 |
| 60% | 12.8 |
| 70% | 12.8 |
| 80% | 12.8 |
| 90% | 12.8 |

```
*************************************************************************
          NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                    AND LOW LOSS FRACTION ESTIMATIONS
=========================================================================
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                          Analysis prepared by:

                          DRC Engineering, Inc.
                    160 South Old Springs Road, Suite 210
                           Anaheim Hills, CA 92808
                                714-685-6860

*************************************************************************
-------------------------------------------------------------------------

 Problem Descriptions:
  AREA A
  EXISTING CONDITION
  100 YEAR
=========================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC III:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     6.39 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA     NUMBER    Fp(in./hr.)    YIELD
         1          6.64        9.30       75.(AMC II)     0.210       0.951

    TOTAL AREA (Acres) =      6.64

    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.020

    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.049
=========================================================================
```

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**************************************************************************
                    SMALL AREA UNIT HYDROGRAPH MODEL
==========================================================================
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                           Analysis prepared by:

                           DRC Engineering, Inc.
                     160 South Old Springs Road, Suite 210
                            Anaheim Hills, CA 92808
                                 714-685-6860

**************************************************************************
--------------------------------------------------------------------------

 Problem Descriptions:
  AREA A
  EXISTING CONDITION
  100 YEAR
--------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =    6.64
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.020
    LOW LOSS FRACTION = 0.049
    TIME OF CONCENTRATION(MIN.) = 12.80
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) = 100
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.38
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.99
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  1.48
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  2.57
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  3.48
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  6.39

--------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     3.04
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.50

**************************************************************************
  TIME     VOLUME       Q    0.        5.0      10.0      15.0      20.0
 (HOURS)    (AF)      (CFS)
--------------------------------------------------------------------------
  0.21      0.0059      0.66  .Q        .         .         .         .
  0.43      0.0176      0.67  .Q        .         .         .         .
```

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0.64 | 0.0295 | 0.67 | .Q | . | . | . | . |
| 0.85 | 0.0414 | 0.68 | .Q | . | . | . | . |
| 1.07 | 0.0534 | 0.68 | .Q | . | . | . | . |
| 1.28 | 0.0655 | 0.69 | .Q | . | . | . | . |
| 1.49 | 0.0778 | 0.70 | .Q | . | . | . | . |
| 1.71 | 0.0901 | 0.70 | .Q | . | . | . | . |
| 1.92 | 0.1025 | 0.71 | .Q | . | . | . | . |
| 2.13 | 0.1151 | 0.71 | .Q | . | . | . | . |
| 2.35 | 0.1277 | 0.72 | .Q | . | . | . | . |
| 2.56 | 0.1404 | 0.73 | .Q | . | . | . | . |
| 2.77 | 0.1533 | 0.73 | .Q | . | . | . | . |
| 2.99 | 0.1663 | 0.74 | .Q | . | . | . | . |
| 3.20 | 0.1794 | 0.74 | .Q | . | . | . | . |
| 3.41 | 0.1926 | 0.75 | .Q | . | . | . | . |
| 3.63 | 0.2059 | 0.76 | .Q | . | . | . | . |
| 3.84 | 0.2194 | 0.77 | .Q | . | . | . | . |
| 4.05 | 0.2330 | 0.77 | .Q | . | . | . | . |
| 4.27 | 0.2467 | 0.78 | .Q | . | . | . | . |
| 4.48 | 0.2606 | 0.79 | .Q | . | . | . | . |
| 4.69 | 0.2746 | 0.80 | .Q | . | . | . | . |
| 4.91 | 0.2888 | 0.81 | .Q | . | . | . | . |
| 5.12 | 0.3031 | 0.82 | .Q | . | . | . | . |
| 5.33 | 0.3176 | 0.82 | .Q | . | . | . | . |
| 5.55 | 0.3322 | 0.84 | .Q | . | . | . | . |
| 5.76 | 0.3470 | 0.84 | .Q | . | . | . | . |
| 5.97 | 0.3620 | 0.86 | .Q | . | . | . | . |
| 6.19 | 0.3771 | 0.86 | .Q | . | . | . | . |
| 6.40 | 0.3924 | 0.88 | .Q | . | . | . | . |
| 6.61 | 0.4079 | 0.88 | .Q | . | . | . | . |
| 6.83 | 0.4237 | 0.90 | .Q | . | . | . | . |
| 7.04 | 0.4396 | 0.91 | .Q | . | . | . | . |
| 7.25 | 0.4557 | 0.92 | .Q | . | . | . | . |
| 7.47 | 0.4720 | 0.93 | .Q | . | . | . | . |
| 7.68 | 0.4886 | 0.95 | .Q | . | . | . | . |
| 7.89 | 0.5054 | 0.96 | .Q | . | . | . | . |
| 8.11 | 0.5225 | 0.98 | .Q | . | . | . | . |
| 8.32 | 0.5398 | 0.99 | .Q | . | . | . | . |
| 8.53 | 0.5574 | 1.01 | . Q | . | . | . | . |
| 8.75 | 0.5752 | 1.02 | . Q | . | . | . | . |
| 8.96 | 0.5933 | 1.04 | . Q | . | . | . | . |
| 9.17 | 0.6118 | 1.05 | . Q | . | . | . | . |
| 9.39 | 0.6305 | 1.08 | . Q | . | . | . | . |
| 9.60 | 0.6496 | 1.09 | . Q | . | . | . | . |
| 9.81 | 0.6691 | 1.12 | . Q | . | . | . | . |
| 10.03 | 0.6889 | 1.13 | . Q | . | . | . | . |
| 10.24 | 0.7091 | 1.16 | . Q | . | . | . | . |
| 10.45 | 0.7297 | 1.18 | . Q | . | . | . | . |
| 10.67 | 0.7508 | 1.21 | . Q | . | . | . | . |
| 10.88 | 0.7723 | 1.23 | . Q | . | . | . | . |
| 11.09 | 0.7943 | 1.27 | . Q | . | . | . | . |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 11.31 | 0.8169 | 1.29 | . Q | . | . | . | . | |
| 11.52 | 0.8400 | 1.33 | . Q | . | . | . | . | |
| 11.73 | 0.8637 | 1.36 | . Q | . | . | . | . | |
| 11.95 | 0.8880 | 1.41 | . Q | . | . | . | . | |
| 12.16 | 0.9130 | 1.43 | . Q | . | . | . | . | |
| 12.37 | 0.9388 | 1.49 | . Q | . | . | . | . | |
| 12.59 | 0.9654 | 1.52 | . Q | . | . | . | . | |
| 12.80 | 0.9929 | 1.59 | . Q | . | . | . | . | |
| 13.01 | 1.0214 | 1.63 | . Q | . | . | . | . | |
| 13.23 | 1.0510 | 1.72 | . Q | . | . | . | . | |
| 13.44 | 1.0818 | 1.77 | . Q | . | . | . | . | |
| 13.65 | 1.1140 | 1.88 | . Q | . | . | . | . | |
| 13.87 | 1.1477 | 1.95 | . Q | . | . | . | . | |
| 14.08 | 1.1835 | 2.11 | . Q | . | . | . | . | |
| 14.29 | 1.2242 | 2.51 | . Q | . | . | . | . | |
| 14.51 | 1.2703 | 2.72 | . Q | . | . | . | . | |
| 14.72 | 1.3195 | 2.86 | . Q | . | . | . | . | |
| 14.93 | 1.3727 | 3.19 | . Q | . | . | . | . | |
| 15.15 | 1.4308 | 3.40 | . Q | . | . | . | . | |
| 15.36 | 1.4959 | 3.99 | . Q | . | . | . | . | |
| 15.57 | 1.5742 | 4.89 | . Q | . | . | . | . | |
| 15.79 | 1.6737 | 6.40 | . | Q | . | . | . | |
| 16.00 | 1.7987 | 7.77 | . | . | Q | . | . | |
| 16.21 | 2.0212 | 17.47 | . | . | . | . | Q | . |
| 16.43 | 2.2254 | 5.69 | . | Q | . | . | . | |
| 16.64 | 2.3078 | 3.66 | . | Q | . | . | . | |
| 16.85 | 2.3666 | 3.01 | . | Q | . | . | . | |
| 17.07 | 2.4161 | 2.61 | . | Q | . | . | . | |
| 17.28 | 2.4568 | 2.02 | . | Q | . | . | . | |
| 17.49 | 2.4907 | 1.82 | . Q | . | . | . | . | |
| 17.71 | 2.5216 | 1.68 | . Q | . | . | . | . | |
| 17.92 | 2.5501 | 1.56 | . Q | . | . | . | . | |
| 18.13 | 2.5767 | 1.46 | . Q | . | . | . | . | |
| 18.35 | 2.6017 | 1.38 | . Q | . | . | . | . | |
| 18.56 | 2.6255 | 1.31 | . Q | . | . | . | . | |
| 18.77 | 2.6480 | 1.25 | . Q | . | . | . | . | |
| 18.99 | 2.6695 | 1.19 | . Q | . | . | . | . | |
| 19.20 | 2.6902 | 1.15 | . Q | . | . | . | . | |
| 19.41 | 2.7100 | 1.10 | . Q | . | . | . | . | |
| 19.63 | 2.7291 | 1.06 | . Q | . | . | . | . | |
| 19.84 | 2.7475 | 1.03 | . Q | . | . | . | . | |
| 20.05 | 2.7654 | 1.00 | .Q | . | . | . | . | |
| 20.27 | 2.7827 | 0.97 | .Q | . | . | . | . | |
| 20.48 | 2.7995 | 0.94 | .Q | . | . | . | . | |
| 20.69 | 2.8159 | 0.91 | .Q | . | . | . | . | |
| 20.91 | 2.8318 | 0.89 | .Q | . | . | . | . | |
| 21.12 | 2.8473 | 0.87 | .Q | . | . | . | . | |
| 21.33 | 2.8624 | 0.85 | .Q | . | . | . | . | |
| 21.55 | 2.8772 | 0.83 | .Q | . | . | . | . | |
| 21.76 | 2.8917 | 0.81 | .Q | . | . | . | . | |

```
 21.97      2.9059      0.79  .Q        .         .         .         .
 22.19      2.9198      0.78  .Q        .         .         .         .
 22.40      2.9334      0.76  .Q        .         .         .         .
 22.61      2.9467      0.75  .Q        .         .         .         .
 22.83      2.9598      0.74  .Q        .         .         .         .
 23.04      2.9727      0.72  .Q        .         .         .         .
 23.25      2.9853      0.71  .Q        .         .         .         .
 23.47      2.9977      0.70  .Q        .         .         .         .
 23.68      3.0099      0.69  .Q        .         .         .         .
 23.89      3.0220      0.68  .Q        .         .         .         .
 24.11      3.0338      0.67  .Q        .         .         .         .
 24.32      3.0397      0.00  Q         .         .         .         .
-------------------------------------------------------------------------
-------------------------------------------------------------------------------
   TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
   (Note: 100% of Peak Flow Rate estimate assumed to have
   an instantaneous time duration)

   Percentile of Estimated              Duration
       Peak Flow Rate                   (minutes)
   ======================             =========
             0%                         1446.4
            10%                          256.0
            20%                           89.6
            30%                           51.2
            40%                           25.6
            50%                           12.8
            60%                           12.8
            70%                           12.8
            80%                           12.8
            90%                           12.8
```

```
******************************************************************************
          NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                    AND LOW LOSS FRACTION ESTIMATIONS
==============================================================================
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                           Analysis prepared by:

                           DRC Engineering, Inc.
                      160 South Old Springs Road, Suite 210
                             Anaheim Hills, CA 92808
                                  714-685-6860

******************************************************************************
------------------------------------------------------------------------------

 Problem Descriptions:
  AREA A
  PROPOSED CONDITION
  10 YEAR
==============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC II:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     4.12 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA     NUMBER    Fp(in./hr.)    YIELD
         1          2.22       22.80            75.       0.470       0.825

    TOTAL AREA (Acres) =      2.22

    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.107

    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.175
==============================================================================
```

```
**************************************************************************
                    SMALL AREA UNIT HYDROGRAPH MODEL
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                          Analysis prepared by:

                          DRC Engineering, Inc.
                    160 South Old Springs Road, Suite 210
                           Anaheim Hills, CA 92808
                                714-685-6860

**************************************************************************
--------------------------------------------------------------------------

 Problem Descriptions:
  AREA A
  PROPOSED CONDITION
  10 YEAR
--------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =    2.22
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.107
    LOW LOSS FRACTION = 0.175
    TIME OF CONCENTRATION(MIN.) = 10.30
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =  10
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.24
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.62
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.93
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  1.72
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  2.36
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  4.12

--------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     0.57
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.19

**************************************************************************
  TIME     VOLUME       Q    0.        2.5       5.0       7.5      10.0
 (HOURS)    (AF)      (CFS)
--------------------------------------------------------------------------
  0.03      0.0000      0.00  Q         .         .         .         .
  0.21      0.0008      0.11  Q         .         .         .         .
```

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0.38 | 0.0024 | 0.11 | Q | . | . | . | . |
| 0.55 | 0.0041 | 0.12 | Q | . | . | . | . |
| 0.72 | 0.0057 | 0.12 | Q | . | . | . | . |
| 0.89 | 0.0074 | 0.12 | Q | . | . | . | . |
| 1.06 | 0.0090 | 0.12 | Q | . | . | . | . |
| 1.24 | 0.0107 | 0.12 | Q | . | . | . | . |
| 1.41 | 0.0124 | 0.12 | Q | . | . | . | . |
| 1.58 | 0.0141 | 0.12 | Q | . | . | . | . |
| 1.75 | 0.0158 | 0.12 | Q | . | . | . | . |
| 1.92 | 0.0175 | 0.12 | Q | . | . | . | . |
| 2.09 | 0.0193 | 0.12 | Q | . | . | . | . |
| 2.27 | 0.0210 | 0.12 | Q | . | . | . | . |
| 2.44 | 0.0228 | 0.12 | Q | . | . | . | . |
| 2.61 | 0.0246 | 0.13 | Q | . | . | . | . |
| 2.78 | 0.0264 | 0.13 | Q | . | . | . | . |
| 2.95 | 0.0282 | 0.13 | Q | . | . | . | . |
| 3.12 | 0.0300 | 0.13 | Q | . | . | . | . |
| 3.30 | 0.0318 | 0.13 | Q | . | . | . | . |
| 3.47 | 0.0337 | 0.13 | Q | . | . | . | . |
| 3.64 | 0.0355 | 0.13 | Q | . | . | . | . |
| 3.81 | 0.0374 | 0.13 | Q | . | . | . | . |
| 3.98 | 0.0393 | 0.13 | Q | . | . | . | . |
| 4.15 | 0.0412 | 0.14 | Q | . | . | . | . |
| 4.33 | 0.0431 | 0.14 | Q | . | . | . | . |
| 4.50 | 0.0451 | 0.14 | Q | . | . | . | . |
| 4.67 | 0.0470 | 0.14 | Q | . | . | . | . |
| 4.84 | 0.0490 | 0.14 | Q | . | . | . | . |
| 5.01 | 0.0510 | 0.14 | Q | . | . | . | . |
| 5.18 | 0.0530 | 0.14 | Q | . | . | . | . |
| 5.36 | 0.0551 | 0.14 | Q | . | . | . | . |
| 5.53 | 0.0571 | 0.15 | Q | . | . | . | . |
| 5.70 | 0.0592 | 0.15 | Q | . | . | . | . |
| 5.87 | 0.0613 | 0.15 | Q | . | . | . | . |
| 6.04 | 0.0634 | 0.15 | Q | . | . | . | . |
| 6.21 | 0.0655 | 0.15 | Q | . | . | . | . |
| 6.39 | 0.0677 | 0.15 | Q | . | . | . | . |
| 6.56 | 0.0699 | 0.15 | Q | . | . | . | . |
| 6.73 | 0.0721 | 0.16 | Q | . | . | . | . |
| 6.90 | 0.0743 | 0.16 | Q | . | . | . | . |
| 7.07 | 0.0765 | 0.16 | Q | . | . | . | . |
| 7.24 | 0.0788 | 0.16 | Q | . | . | . | . |
| 7.42 | 0.0811 | 0.16 | Q | . | . | . | . |
| 7.59 | 0.0835 | 0.17 | Q | . | . | . | . |
| 7.76 | 0.0858 | 0.17 | Q | . | . | . | . |
| 7.93 | 0.0882 | 0.17 | Q | . | . | . | . |
| 8.10 | 0.0906 | 0.17 | Q | . | . | . | . |
| 8.27 | 0.0931 | 0.17 | Q | . | . | . | . |
| 8.45 | 0.0956 | 0.18 | Q | . | . | . | . |
| 8.62 | 0.0981 | 0.18 | Q | . | . | . | . |
| 8.79 | 0.1006 | 0.18 | Q | . | . | . | . |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 8.96 | 0.1032 | 0.18 | Q | . | . | . | . |
| 9.13 | 0.1058 | 0.19 | Q | . | . | . | . |
| 9.30 | 0.1085 | 0.19 | Q | . | . | . | . |
| 9.48 | 0.1112 | 0.19 | Q | . | . | . | . |
| 9.65 | 0.1140 | 0.20 | Q | . | . | . | . |
| 9.82 | 0.1167 | 0.20 | Q | . | . | . | . |
| 9.99 | 0.1196 | 0.20 | Q | . | . | . | . |
| 10.16 | 0.1225 | 0.20 | Q | . | . | . | . |
| 10.34 | 0.1254 | 0.21 | Q | . | . | . | . |
| 10.51 | 0.1284 | 0.21 | Q | . | . | . | . |
| 10.68 | 0.1314 | 0.22 | Q | . | . | . | . |
| 10.85 | 0.1345 | 0.22 | Q | . | . | . | . |
| 11.02 | 0.1377 | 0.23 | Q | . | . | . | . |
| 11.19 | 0.1409 | 0.23 | Q | . | . | . | . |
| 11.37 | 0.1442 | 0.24 | Q | . | . | . | . |
| 11.54 | 0.1475 | 0.24 | Q | . | . | . | . |
| 11.71 | 0.1510 | 0.25 | Q | . | . | . | . |
| 11.88 | 0.1545 | 0.25 | Q | . | . | . | . |
| 12.05 | 0.1581 | 0.26 | .Q | . | . | . | . |
| 12.22 | 0.1620 | 0.30 | .Q | . | . | . | . |
| 12.40 | 0.1663 | 0.31 | .Q | . | . | . | . |
| 12.57 | 0.1707 | 0.31 | .Q | . | . | . | . |
| 12.74 | 0.1753 | 0.32 | .Q | . | . | . | . |
| 12.91 | 0.1799 | 0.33 | .Q | . | . | . | . |
| 13.08 | 0.1847 | 0.34 | .Q | . | . | . | . |
| 13.25 | 0.1896 | 0.35 | .Q | . | . | . | . |
| 13.43 | 0.1947 | 0.37 | .Q | . | . | . | . |
| 13.60 | 0.2000 | 0.38 | .Q | . | . | . | . |
| 13.77 | 0.2055 | 0.40 | .Q | . | . | . | . |
| 13.94 | 0.2111 | 0.41 | .Q | . | . | . | . |
| 14.11 | 0.2174 | 0.48 | .Q | . | . | . | . |
| 14.28 | 0.2246 | 0.54 | . Q | . | . | . | . |
| 14.45 | 0.2326 | 0.57 | . Q | . | . | . | . |
| 14.63 | 0.2409 | 0.59 | . Q | . | . | . | . |
| 14.80 | 0.2496 | 0.64 | . Q | . | . | . | . |
| 14.97 | 0.2588 | 0.66 | . Q | . | . | . | . |
| 15.14 | 0.2686 | 0.73 | . Q | . | . | . | . |
| 15.31 | 0.2792 | 0.77 | .  Q | . | . | . | . |
| 15.48 | 0.2912 | 0.91 | .  Q | . | . | . | . |
| 15.66 | 0.3047 | 1.00 | .  Q | . | . | . | . |
| 15.83 | 0.3204 | 1.21 | .   Q | . | . | . | . |
| 16.00 | 0.3404 | 1.60 | .     Q | . | . | . | . |
| 16.17 | 0.3793 | 3.88 | .  | . | Q | . | . | . |
| 16.34 | 0.4149 | 1.13 | .   Q | . | . | . | . |
| 16.52 | 0.4287 | 0.82 | .  Q | . | . | . | . |
| 16.69 | 0.4394 | 0.69 | . Q | . | . | . | . |
| 16.86 | 0.4487 | 0.61 | . Q | . | . | . | . |
| 17.03 | 0.4570 | 0.56 | . Q | . | . | . | . |
| 17.20 | 0.4639 | 0.42 | .Q | . | . | . | . |
| 17.37 | 0.4696 | 0.39 | .Q | . | . | . | . |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 17.55 | 0.4749 | 0.36 | .Q | . | . | . | . |
| 17.72 | 0.4798 | 0.34 | .Q | . | . | . | . |
| 17.89 | 0.4845 | 0.32 | .Q | . | . | . | . |
| 18.06 | 0.4889 | 0.30 | .Q | . | . | . | . |
| 18.23 | 0.4929 | 0.25 | .Q | . | . | . | . |
| 18.40 | 0.4964 | 0.24 | Q | . | . | . | . |
| 18.58 | 0.4997 | 0.23 | Q | . | . | . | . |
| 18.75 | 0.5030 | 0.22 | Q | . | . | . | . |
| 18.92 | 0.5061 | 0.21 | Q | . | . | . | . |
| 19.09 | 0.5090 | 0.21 | Q | . | . | . | . |
| 19.26 | 0.5119 | 0.20 | Q | . | . | . | . |
| 19.43 | 0.5147 | 0.19 | Q | . | . | . | . |
| 19.61 | 0.5174 | 0.19 | Q | . | . | . | . |
| 19.78 | 0.5200 | 0.18 | Q | . | . | . | . |
| 19.95 | 0.5226 | 0.18 | Q | . | . | . | . |
| 20.12 | 0.5251 | 0.17 | Q | . | . | . | . |
| 20.29 | 0.5275 | 0.17 | Q | . | . | . | . |
| 20.46 | 0.5299 | 0.16 | Q | . | . | . | . |
| 20.64 | 0.5322 | 0.16 | Q | . | . | . | . |
| 20.81 | 0.5344 | 0.16 | Q | . | . | . | . |
| 20.98 | 0.5366 | 0.15 | Q | . | . | . | . |
| 21.15 | 0.5388 | 0.15 | Q | . | . | . | . |
| 21.32 | 0.5409 | 0.15 | Q | . | . | . | . |
| 21.49 | 0.5430 | 0.14 | Q | . | . | . | . |
| 21.67 | 0.5450 | 0.14 | Q | . | . | . | . |
| 21.84 | 0.5470 | 0.14 | Q | . | . | . | . |
| 22.01 | 0.5490 | 0.14 | Q | . | . | . | . |
| 22.18 | 0.5509 | 0.13 | Q | . | . | . | . |
| 22.35 | 0.5528 | 0.13 | Q | . | . | . | . |
| 22.52 | 0.5546 | 0.13 | Q | . | . | . | . |
| 22.69 | 0.5565 | 0.13 | Q | . | . | . | . |
| 22.87 | 0.5583 | 0.13 | Q | . | . | . | . |
| 23.04 | 0.5601 | 0.12 | Q | . | . | . | . |
| 23.21 | 0.5618 | 0.12 | Q | . | . | . | . |
| 23.38 | 0.5635 | 0.12 | Q | . | . | . | . |
| 23.55 | 0.5652 | 0.12 | Q | . | . | . | . |
| 23.73 | 0.5669 | 0.12 | Q | . | . | . | . |
| 23.90 | 0.5686 | 0.12 | Q | . | . | . | . |
| 24.07 | 0.5702 | 0.11 | Q | . | . | . | . |
| 24.24 | 0.5710 | 0.00 | Q | . | . | . | . |

---

TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
(Note: 100% of Peak Flow Rate estimate assumed to have
an instantaneous time duration)

| Percentile of Estimated Peak Flow Rate | Duration (minutes) |
|---|---|
| 0% | 1442.0 |

| | |
|---|---|
| 10% | 216.3 |
| 20% | 72.1 |
| 30% | 30.9 |
| 40% | 20.6 |
| 50% | 10.3 |
| 60% | 10.3 |
| 70% | 10.3 |
| 80% | 10.3 |
| 90% | 10.3 |

```
******************************************************************************
          NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                    AND LOW LOSS FRACTION ESTIMATIONS
==============================================================================
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                           Analysis prepared by:

                           DRC Engineering, Inc.
                      160 South Old Springs Road, Suite 210
                             Anaheim Hills, CA 92808
                                  714-685-6860

******************************************************************************
------------------------------------------------------------------------------

 Problem Descriptions:
  AREA B
  PROPOSED CONDITION
  10 YEAR
==============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC II:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     4.12 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA     NUMBER    Fp(in./hr.)    YIELD
         1          4.42        5.30            75.       0.470       0.916

    TOTAL AREA (Acres) =      4.42

    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.025

    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.084
==============================================================================
```

```
**************************************************************************
                    SMALL AREA UNIT HYDROGRAPH MODEL
==========================================================================
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             Ver. 22.0  Release Date: 07/01/2015  License ID 1510

                          Analysis prepared by:

                          DRC Engineering, Inc.
                    160 South Old Springs Road, Suite 210
                           Anaheim Hills, CA 92808
                                714-685-6860

**************************************************************************
--------------------------------------------------------------------------

 Problem Descriptions:
  AREA B
  PROPOSED CONDITION
  10 YEAR
--------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =    4.42
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.025
    LOW LOSS FRACTION = 0.084
    TIME OF CONCENTRATION(MIN.) = 10.00
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =  10
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.24
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.62
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.93
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  1.72
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  2.36
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  4.12

--------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     1.26
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.25

**************************************************************************
  TIME     VOLUME       Q    0.        2.5       5.0       7.5      10.0
 (HOURS)    (AF)      (CFS)
--------------------------------------------------------------------------
  0.17      0.0017      0.25  .Q        .         .         .         .
  0.33      0.0052      0.25  .Q        .         .         .         .
```

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0.50 | 0.0087 | 0.26 | .Q | . | . | . | . |
| 0.67 | 0.0122 | 0.26 | .Q | . | . | . | . |
| 0.83 | 0.0158 | 0.26 | .Q | . | . | . | . |
| 1.00 | 0.0193 | 0.26 | .Q | . | . | . | . |
| 1.17 | 0.0229 | 0.26 | .Q | . | . | . | . |
| 1.33 | 0.0266 | 0.26 | .Q | . | . | . | . |
| 1.50 | 0.0302 | 0.27 | .Q | . | . | . | . |
| 1.67 | 0.0339 | 0.27 | .Q | . | . | . | . |
| 1.83 | 0.0375 | 0.27 | .Q | . | . | . | . |
| 2.00 | 0.0413 | 0.27 | .Q | . | . | . | . |
| 2.17 | 0.0450 | 0.27 | .Q | . | . | . | . |
| 2.33 | 0.0488 | 0.27 | .Q | . | . | . | . |
| 2.50 | 0.0526 | 0.28 | .Q | . | . | . | . |
| 2.67 | 0.0564 | 0.28 | .Q | . | . | . | . |
| 2.83 | 0.0602 | 0.28 | .Q | . | . | . | . |
| 3.00 | 0.0641 | 0.28 | .Q | . | . | . | . |
| 3.17 | 0.0680 | 0.29 | .Q | . | . | . | . |
| 3.33 | 0.0720 | 0.29 | .Q | . | . | . | . |
| 3.50 | 0.0760 | 0.29 | .Q | . | . | . | . |
| 3.67 | 0.0800 | 0.29 | .Q | . | . | . | . |
| 3.83 | 0.0840 | 0.29 | .Q | . | . | . | . |
| 4.00 | 0.0881 | 0.30 | .Q | . | . | . | . |
| 4.17 | 0.0922 | 0.30 | .Q | . | . | . | . |
| 4.33 | 0.0963 | 0.30 | .Q | . | . | . | . |
| 4.50 | 0.1005 | 0.30 | .Q | . | . | . | . |
| 4.67 | 0.1047 | 0.31 | .Q | . | . | . | . |
| 4.83 | 0.1089 | 0.31 | .Q | . | . | . | . |
| 5.00 | 0.1132 | 0.31 | .Q | . | . | . | . |
| 5.17 | 0.1175 | 0.32 | .Q | . | . | . | . |
| 5.33 | 0.1219 | 0.32 | .Q | . | . | . | . |
| 5.50 | 0.1263 | 0.32 | .Q | . | . | . | . |
| 5.67 | 0.1307 | 0.32 | .Q | . | . | . | . |
| 5.83 | 0.1352 | 0.33 | .Q | . | . | . | . |
| 6.00 | 0.1397 | 0.33 | .Q | . | . | . | . |
| 6.17 | 0.1443 | 0.33 | .Q | . | . | . | . |
| 6.33 | 0.1489 | 0.34 | .Q | . | . | . | . |
| 6.50 | 0.1536 | 0.34 | .Q | . | . | . | . |
| 6.67 | 0.1583 | 0.34 | .Q | . | . | . | . |
| 6.83 | 0.1631 | 0.35 | .Q | . | . | . | . |
| 7.00 | 0.1679 | 0.35 | .Q | . | . | . | . |
| 7.17 | 0.1728 | 0.36 | .Q | . | . | . | . |
| 7.33 | 0.1777 | 0.36 | .Q | . | . | . | . |
| 7.50 | 0.1827 | 0.36 | .Q | . | . | . | . |
| 7.67 | 0.1877 | 0.37 | .Q | . | . | . | . |
| 7.83 | 0.1928 | 0.37 | .Q | . | . | . | . |
| 8.00 | 0.1979 | 0.38 | .Q | . | . | . | . |
| 8.17 | 0.2032 | 0.38 | .Q | . | . | . | . |
| 8.33 | 0.2084 | 0.39 | .Q | . | . | . | . |
| 8.50 | 0.2138 | 0.39 | .Q | . | . | . | . |
| 8.67 | 0.2192 | 0.40 | .Q | . | . | . | . |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 8.83 | 0.2247 | 0.40 | .Q | . | . | . | . |
| 9.00 | 0.2303 | 0.41 | .Q | . | . | . | . |
| 9.17 | 0.2359 | 0.41 | .Q | . | . | . | . |
| 9.33 | 0.2417 | 0.42 | .Q | . | . | . | . |
| 9.50 | 0.2475 | 0.43 | .Q | . | . | . | . |
| 9.67 | 0.2534 | 0.43 | .Q | . | . | . | . |
| 9.83 | 0.2594 | 0.44 | .Q | . | . | . | . |
| 10.00 | 0.2655 | 0.44 | .Q | . | . | . | . |
| 10.17 | 0.2717 | 0.45 | .Q | . | . | . | . |
| 10.33 | 0.2780 | 0.46 | .Q | . | . | . | . |
| 10.50 | 0.2844 | 0.47 | .Q | . | . | . | . |
| 10.67 | 0.2909 | 0.48 | .Q | . | . | . | . |
| 10.83 | 0.2976 | 0.49 | .Q | . | . | . | . |
| 11.00 | 0.3043 | 0.49 | .Q | . | . | . | . |
| 11.17 | 0.3112 | 0.51 | . Q | . | . | . | . |
| 11.33 | 0.3183 | 0.51 | . Q | . | . | . | . |
| 11.50 | 0.3254 | 0.53 | . Q | . | . | . | . |
| 11.67 | 0.3328 | 0.54 | . Q | . | . | . | . |
| 11.83 | 0.3403 | 0.55 | . Q | . | . | . | . |
| 12.00 | 0.3480 | 0.56 | . Q | . | . | . | . |
| 12.17 | 0.3564 | 0.66 | . Q | . | . | . | . |
| 12.33 | 0.3655 | 0.67 | . Q | . | . | . | . |
| 12.50 | 0.3749 | 0.69 | . Q | . | . | . | . |
| 12.67 | 0.3845 | 0.70 | . Q | . | . | . | . |
| 12.83 | 0.3944 | 0.73 | . Q | . | . | . | . |
| 13.00 | 0.4045 | 0.74 | . Q | . | . | . | . |
| 13.17 | 0.4150 | 0.77 | .  Q | . | . | . | . |
| 13.33 | 0.4257 | 0.79 | .  Q | . | . | . | . |
| 13.50 | 0.4368 | 0.82 | .  Q | . | . | . | . |
| 13.67 | 0.4483 | 0.84 | .  Q | . | . | . | . |
| 13.83 | 0.4603 | 0.89 | .  Q | . | . | . | . |
| 14.00 | 0.4727 | 0.91 | .  Q | . | . | . | . |
| 14.17 | 0.4872 | 1.19 | .   Q | . | . | . | . |
| 14.33 | 0.5038 | 1.23 | .   Q | . | . | . | . |
| 14.50 | 0.5213 | 1.30 | .    Q | . | . | . | . |
| 14.67 | 0.5395 | 1.35 | .    Q | . | . | . | . |
| 14.83 | 0.5589 | 1.46 | .    Q | . | . | . | . |
| 15.00 | 0.5794 | 1.52 | .     Q | . | . | . | . |
| 15.17 | 0.6014 | 1.68 | .     Q | . | . | . | . |
| 15.33 | 0.6252 | 1.78 | .      Q | . | . | . | . |
| 15.50 | 0.6522 | 2.15 | .       Q | . | . | . | . |
| 15.67 | 0.6831 | 2.34 | .        Q. | . | . | . | . |
| 15.83 | 0.7183 | 2.76 | .         .Q | . | . | . | . |
| 16.00 | 0.7618 | 3.57 | .         .   Q | . | . | . | . |
| 16.17 | 0.8427 | 8.17 | .         . | . | . | . Q | . |
| 16.33 | 0.9170 | 2.61 | .         Q | . | . | . | . |
| 16.50 | 0.9480 | 1.90 | .      Q | . | . | . | . |
| 16.67 | 0.9721 | 1.59 | .     Q | . | . | . | . |
| 16.83 | 0.9927 | 1.40 | .    Q | . | . | . | . |
| 17.00 | 1.0111 | 1.26 | .    Q | . | . | . | . |

```
 17.17      1.0262      0.94  .  Q      .         .         .         .
 17.33      1.0387      0.87  .  Q      .         .         .         .
 17.50      1.0502      0.81  .  Q      .         .         .         .
 17.67      1.0609      0.76  .  Q      .         .         .         .
 17.83      1.0711      0.72  . Q       .         .         .         .
 18.00      1.0807      0.68  . Q       .         .         .         .
 18.17      1.0893      0.57  . Q       .         .         .         .
 18.33      1.0970      0.54  . Q       .         .         .         .
 18.50      1.1044      0.52  . Q       .         .         .         .
 18.67      1.1114      0.50  . Q       .         .         .         .
 18.83      1.1182      0.48  .Q        .         .         .         .
 19.00      1.1247      0.47  .Q        .         .         .         .
 19.17      1.1310      0.45  .Q        .         .         .         .
 19.33      1.1371      0.44  .Q        .         .         .         .
 19.50      1.1430      0.42  .Q        .         .         .         .
 19.67      1.1487      0.41  .Q        .         .         .         .
 19.83      1.1543      0.40  .Q        .         .         .         .
 20.00      1.1597      0.39  .Q        .         .         .         .
 20.17      1.1650      0.38  .Q        .         .         .         .
 20.33      1.1702      0.37  .Q        .         .         .         .
 20.50      1.1752      0.36  .Q        .         .         .         .
 20.67      1.1801      0.35  .Q        .         .         .         .
 20.83      1.1849      0.35  .Q        .         .         .         .
 21.00      1.1897      0.34  .Q        .         .         .         .
 21.17      1.1943      0.33  .Q        .         .         .         .
 21.33      1.1988      0.33  .Q        .         .         .         .
 21.50      1.2032      0.32  .Q        .         .         .         .
 21.67      1.2076      0.31  .Q        .         .         .         .
 21.83      1.2119      0.31  .Q        .         .         .         .
 22.00      1.2161      0.30  .Q        .         .         .         .
 22.17      1.2202      0.30  .Q        .         .         .         .
 22.33      1.2243      0.29  .Q        .         .         .         .
 22.50      1.2283      0.29  .Q        .         .         .         .
 22.67      1.2322      0.28  .Q        .         .         .         .
 22.83      1.2361      0.28  .Q        .         .         .         .
 23.00      1.2400      0.28  .Q        .         .         .         .
 23.17      1.2437      0.27  .Q        .         .         .         .
 23.33      1.2474      0.27  .Q        .         .         .         .
 23.50      1.2511      0.26  .Q        .         .         .         .
 23.67      1.2547      0.26  .Q        .         .         .         .
 23.83      1.2583      0.26  .Q        .         .         .         .
 24.00      1.2618      0.25  .Q        .         .         .         .
 24.17      1.2636      0.00  Q         .         .         .         .
 --------------------------------------------------------------------------
--------------------------------------------------------------------------------
    TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
    (Note: 100% of Peak Flow Rate estimate assumed to have
    an instantaneous time duration)

    Percentile of Estimated                Duration
```

| Peak Flow Rate | (minutes) |
|---|---|
| 0% | 1440.0 |
| 10% | 240.0 |
| 20% | 90.0 |
| 30% | 40.0 |
| 40% | 20.0 |
| 50% | 10.0 |
| 60% | 10.0 |
| 70% | 10.0 |
| 80% | 10.0 |
| 90% | 10.0 |

```
*************************************************************************
          NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                    AND LOW LOSS FRACTION ESTIMATIONS
=========================================================================
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                          Analysis prepared by:

                          DRC Engineering, Inc.
                    160 South Old Springs Road, Suite 210
                           Anaheim Hills, CA 92808
                                714-685-6860

*************************************************************************
-------------------------------------------------------------------------

 Problem Descriptions:
  AREA A
  PROPOSED CONDITION
  100 YEAR
=========================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC III:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     6.39 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA     NUMBER    Fp(in./hr.)    YIELD
         1          2.22       22.80       75.(AMC II)     0.210       0.934

    TOTAL AREA (Acres) =      2.22

    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.048

    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.066
=========================================================================
```

```
**************************************************************************
                    SMALL AREA UNIT HYDROGRAPH MODEL
==========================================================================
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                          Analysis prepared by:

                          DRC Engineering, Inc.
                    160 South Old Springs Road, Suite 210
                           Anaheim Hills, CA 92808
                                714-685-6860

**************************************************************************
--------------------------------------------------------------------------

 Problem Descriptions:
  AREA A
  PROPOSED CONDITION
  100 YEAR
--------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =    2.22
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.107
    LOW LOSS FRACTION = 0.175
    TIME OF CONCENTRATION(MIN.) = 10.30
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) = 100
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.38
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.99
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  1.48
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  2.57
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  3.48
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  6.39

--------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     0.90
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.29

**************************************************************************
  TIME     VOLUME       Q    0.        2.5       5.0       7.5      10.0
 (HOURS)    (AF)      (CFS)
--------------------------------------------------------------------------
  0.03      0.0000      0.00  Q         .         .         .         .
  0.21      0.0014      0.19  Q         .         .         .         .
```

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0.38 | 0.0041 | 0.19 | Q | . | . | . | . |
| 0.55 | 0.0069 | 0.19 | Q | . | . | . | . |
| 0.72 | 0.0097 | 0.20 | Q | . | . | . | . |
| 0.89 | 0.0124 | 0.20 | Q | . | . | . | . |
| 1.06 | 0.0153 | 0.20 | Q | . | . | . | . |
| 1.24 | 0.0181 | 0.20 | Q | . | . | . | . |
| 1.41 | 0.0209 | 0.20 | Q | . | . | . | . |
| 1.58 | 0.0238 | 0.20 | Q | . | . | . | . |
| 1.75 | 0.0267 | 0.20 | Q | . | . | . | . |
| 1.92 | 0.0296 | 0.21 | Q | . | . | . | . |
| 2.09 | 0.0325 | 0.21 | Q | . | . | . | . |
| 2.27 | 0.0355 | 0.21 | Q | . | . | . | . |
| 2.44 | 0.0384 | 0.21 | Q | . | . | . | . |
| 2.61 | 0.0414 | 0.21 | Q | . | . | . | . |
| 2.78 | 0.0444 | 0.21 | Q | . | . | . | . |
| 2.95 | 0.0475 | 0.21 | Q | . | . | . | . |
| 3.12 | 0.0505 | 0.22 | Q | . | . | . | . |
| 3.30 | 0.0536 | 0.22 | Q | . | . | . | . |
| 3.47 | 0.0567 | 0.22 | Q | . | . | . | . |
| 3.64 | 0.0598 | 0.22 | Q | . | . | . | . |
| 3.81 | 0.0630 | 0.22 | Q | . | . | . | . |
| 3.98 | 0.0661 | 0.22 | Q | . | . | . | . |
| 4.15 | 0.0693 | 0.23 | Q | . | . | . | . |
| 4.33 | 0.0726 | 0.23 | Q | . | . | . | . |
| 4.50 | 0.0758 | 0.23 | Q | . | . | . | . |
| 4.67 | 0.0791 | 0.23 | Q | . | . | . | . |
| 4.84 | 0.0824 | 0.23 | Q | . | . | . | . |
| 5.01 | 0.0857 | 0.24 | Q | . | . | . | . |
| 5.18 | 0.0891 | 0.24 | Q | . | . | . | . |
| 5.36 | 0.0925 | 0.24 | Q | . | . | . | . |
| 5.53 | 0.0959 | 0.24 | Q | . | . | . | . |
| 5.70 | 0.0993 | 0.24 | Q | . | . | . | . |
| 5.87 | 0.1028 | 0.25 | Q | . | . | . | . |
| 6.04 | 0.1064 | 0.25 | Q | . | . | . | . |
| 6.21 | 0.1099 | 0.25 | .Q | . | . | . | . |
| 6.39 | 0.1135 | 0.25 | .Q | . | . | . | . |
| 6.56 | 0.1171 | 0.26 | .Q | . | . | . | . |
| 6.73 | 0.1208 | 0.26 | .Q | . | . | . | . |
| 6.90 | 0.1245 | 0.26 | .Q | . | . | . | . |
| 7.07 | 0.1282 | 0.26 | .Q | . | . | . | . |
| 7.24 | 0.1320 | 0.27 | .Q | . | . | . | . |
| 7.42 | 0.1358 | 0.27 | .Q | . | . | . | . |
| 7.59 | 0.1396 | 0.27 | .Q | . | . | . | . |
| 7.76 | 0.1436 | 0.28 | .Q | . | . | . | . |
| 7.93 | 0.1475 | 0.28 | .Q | . | . | . | . |
| 8.10 | 0.1515 | 0.28 | .Q | . | . | . | . |
| 8.27 | 0.1555 | 0.29 | .Q | . | . | . | . |
| 8.45 | 0.1596 | 0.29 | .Q | . | . | . | . |
| 8.62 | 0.1638 | 0.29 | .Q | . | . | . | . |
| 8.79 | 0.1680 | 0.30 | .Q | . | . | . | . |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 8.96 | 0.1722 | 0.30 | .Q | . | . | . | . |
| 9.13 | 0.1765 | 0.31 | .Q | . | . | . | . |
| 9.30 | 0.1809 | 0.31 | .Q | . | . | . | . |
| 9.48 | 0.1853 | 0.31 | .Q | . | . | . | . |
| 9.65 | 0.1898 | 0.32 | .Q | . | . | . | . |
| 9.82 | 0.1944 | 0.32 | .Q | . | . | . | . |
| 9.99 | 0.1990 | 0.33 | .Q | . | . | . | . |
| 10.16 | 0.2037 | 0.33 | .Q | . | . | . | . |
| 10.34 | 0.2085 | 0.34 | .Q | . | . | . | . |
| 10.51 | 0.2134 | 0.34 | .Q | . | . | . | . |
| 10.68 | 0.2183 | 0.35 | .Q | . | . | . | . |
| 10.85 | 0.2234 | 0.36 | .Q | . | . | . | . |
| 11.02 | 0.2285 | 0.37 | .Q | . | . | . | . |
| 11.19 | 0.2337 | 0.37 | .Q | . | . | . | . |
| 11.37 | 0.2390 | 0.38 | .Q | . | . | . | . |
| 11.54 | 0.2445 | 0.39 | .Q | . | . | . | . |
| 11.71 | 0.2500 | 0.40 | .Q | . | . | . | . |
| 11.88 | 0.2557 | 0.40 | .Q | . | . | . | . |
| 12.05 | 0.2615 | 0.42 | .Q | . | . | . | . |
| 12.22 | 0.2674 | 0.42 | .Q | . | . | . | . |
| 12.40 | 0.2735 | 0.44 | .Q | . | . | . | . |
| 12.57 | 0.2798 | 0.44 | .Q | . | . | . | . |
| 12.74 | 0.2862 | 0.46 | .Q | . | . | . | . |
| 12.91 | 0.2928 | 0.47 | .Q | . | . | . | . |
| 13.08 | 0.2995 | 0.49 | .Q | . | . | . | . |
| 13.25 | 0.3066 | 0.50 | .Q | . | . | . | . |
| 13.43 | 0.3138 | 0.52 | . Q | . | . | . | . |
| 13.60 | 0.3213 | 0.54 | . Q | . | . | . | . |
| 13.77 | 0.3291 | 0.56 | . Q | . | . | . | . |
| 13.94 | 0.3372 | 0.58 | . Q | . | . | . | . |
| 14.11 | 0.3460 | 0.66 | . Q | . | . | . | . |
| 14.28 | 0.3559 | 0.73 | . Q | . | . | . | . |
| 14.45 | 0.3666 | 0.78 | .  Q | . | . | . | . |
| 14.63 | 0.3779 | 0.81 | .  Q | . | . | . | . |
| 14.80 | 0.3898 | 0.87 | .  Q | . | . | . | . |
| 14.97 | 0.4025 | 0.91 | .  Q | . | . | . | . |
| 15.14 | 0.4162 | 1.02 | .   Q | . | . | . | . |
| 15.31 | 0.4312 | 1.10 | .   Q | . | . | . | . |
| 15.48 | 0.4496 | 1.50 | .     Q | . | . | . | . |
| 15.66 | 0.4724 | 1.70 | .     Q | . | . | . | . |
| 15.83 | 0.4992 | 2.08 | .       Q | . | . | . | . |
| 16.00 | 0.5331 | 2.70 | .         Q | . | . | . | . |
| 16.17 | 0.5970 | 6.29 | .           . | . | Q | . | . |
| 16.34 | 0.6552 | 1.92 | .      Q | . | . | . | . |
| 16.52 | 0.6773 | 1.19 | .   Q | . | . | . | . |
| 16.69 | 0.6925 | 0.96 | .  Q | . | . | . | . |
| 16.86 | 0.7053 | 0.84 | .  Q | . | . | . | . |
| 17.03 | 0.7166 | 0.75 | .  Q | . | . | . | . |
| 17.20 | 0.7262 | 0.60 | . Q | . | . | . | . |
| 17.37 | 0.7343 | 0.55 | . Q | . | . | . | . |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 17.55 | 0.7418 | 0.51 | . Q | . | . | . | . |
| 17.72 | 0.7489 | 0.48 | .Q | . | . | . | . |
| 17.89 | 0.7554 | 0.45 | .Q | . | . | . | . |
| 18.06 | 0.7617 | 0.43 | .Q | . | . | . | . |
| 18.23 | 0.7676 | 0.41 | .Q | . | . | . | . |
| 18.40 | 0.7733 | 0.39 | .Q | . | . | . | . |
| 18.58 | 0.7787 | 0.38 | .Q | . | . | . | . |
| 18.75 | 0.7840 | 0.36 | .Q | . | . | . | . |
| 18.92 | 0.7890 | 0.35 | .Q | . | . | . | . |
| 19.09 | 0.7939 | 0.34 | .Q | . | . | . | . |
| 19.26 | 0.7986 | 0.33 | .Q | . | . | . | . |
| 19.43 | 0.8031 | 0.32 | .Q | . | . | . | . |
| 19.61 | 0.8076 | 0.31 | .Q | . | . | . | . |
| 19.78 | 0.8119 | 0.30 | .Q | . | . | . | . |
| 19.95 | 0.8161 | 0.29 | .Q | . | . | . | . |
| 20.12 | 0.8202 | 0.28 | .Q | . | . | . | . |
| 20.29 | 0.8242 | 0.28 | .Q | . | . | . | . |
| 20.46 | 0.8281 | 0.27 | .Q | . | . | . | . |
| 20.64 | 0.8319 | 0.27 | .Q | . | . | . | . |
| 20.81 | 0.8356 | 0.26 | .Q | . | . | . | . |
| 20.98 | 0.8393 | 0.26 | .Q | . | . | . | . |
| 21.15 | 0.8429 | 0.25 | .Q | . | . | . | . |
| 21.32 | 0.8464 | 0.25 | Q | . | . | . | . |
| 21.49 | 0.8498 | 0.24 | Q | . | . | . | . |
| 21.67 | 0.8532 | 0.24 | Q | . | . | . | . |
| 21.84 | 0.8566 | 0.23 | Q | . | . | . | . |
| 22.01 | 0.8598 | 0.23 | Q | . | . | . | . |
| 22.18 | 0.8631 | 0.23 | Q | . | . | . | . |
| 22.35 | 0.8662 | 0.22 | Q | . | . | . | . |
| 22.52 | 0.8694 | 0.22 | Q | . | . | . | . |
| 22.69 | 0.8724 | 0.22 | Q | . | . | . | . |
| 22.87 | 0.8755 | 0.21 | Q | . | . | . | . |
| 23.04 | 0.8785 | 0.21 | Q | . | . | . | . |
| 23.21 | 0.8814 | 0.21 | Q | . | . | . | . |
| 23.38 | 0.8843 | 0.20 | Q | . | . | . | . |
| 23.55 | 0.8872 | 0.20 | Q | . | . | . | . |
| 23.73 | 0.8900 | 0.20 | Q | . | . | . | . |
| 23.90 | 0.8928 | 0.20 | Q | . | . | . | . |
| 24.07 | 0.8956 | 0.19 | Q | . | . | . | . |
| 24.24 | 0.8969 | 0.00 | Q | . | . | . | . |

---

TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
(Note: 100% of Peak Flow Rate estimate assumed to have
an instantaneous time duration)

| Percentile of Estimated Peak Flow Rate | Duration (minutes) |
|---|---|
| 0% | 1442.0 |

| | |
|---|---|
| 10% | 185.4 |
| 20% | 61.8 |
| 30% | 41.2 |
| 40% | 20.6 |
| 50% | 10.3 |
| 60% | 10.3 |
| 70% | 10.3 |
| 80% | 10.3 |
| 90% | 10.3 |

```
******************************************************************************
          NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                    AND LOW LOSS FRACTION ESTIMATIONS
==============================================================================
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                           Analysis prepared by:

                           DRC Engineering, Inc.
                      160 South Old Springs Road, Suite 210
                             Anaheim Hills, CA 92808
                                  714-685-6860

******************************************************************************
------------------------------------------------------------------------------

 Problem Descriptions:
  AREA B
  PROPOSED CONDITION
  100 YEAR
==============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC III:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     6.39 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA     NUMBER    Fp(in./hr.)    YIELD
         1          4.42        5.30       75.(AMC II)     0.210       0.956

    TOTAL AREA (Acres) =      4.42

    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.011

    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.044
==============================================================================
```

```
**************************************************************************
                    SMALL AREA UNIT HYDROGRAPH MODEL
==========================================================================
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                          Analysis prepared by:

                          DRC Engineering, Inc.
                    160 South Old Springs Road, Suite 210
                           Anaheim Hills, CA 92808
                                714-685-6860

**************************************************************************
--------------------------------------------------------------------------

 Problem Descriptions:
  AREA B
  PROPOSED CONDITION
  100 YEAR
--------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =    4.42
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.011
    LOW LOSS FRACTION = 0.044
    TIME OF CONCENTRATION(MIN.) = 10.00
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) = 100
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.38
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.99
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  1.48
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  2.57
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  3.48
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  6.39

--------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     2.04
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.32

**************************************************************************
  TIME     VOLUME       Q    0.        5.0      10.0      15.0      20.0
 (HOURS)    (AF)      (CFS)
--------------------------------------------------------------------------
  0.17      0.0031      0.44  Q         .         .         .         .
  0.33      0.0092      0.45  Q         .         .         .         .
```

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0.50 | 0.0154 | 0.45 | Q | . | . | . | . |
| 0.67 | 0.0216 | 0.45 | Q | . | . | . | . |
| 0.83 | 0.0278 | 0.46 | Q | . | . | . | . |
| 1.00 | 0.0341 | 0.46 | Q | . | . | . | . |
| 1.17 | 0.0404 | 0.46 | Q | . | . | . | . |
| 1.33 | 0.0468 | 0.46 | Q | . | . | . | . |
| 1.50 | 0.0532 | 0.47 | Q | . | . | . | . |
| 1.67 | 0.0597 | 0.47 | Q | . | . | . | . |
| 1.83 | 0.0662 | 0.47 | Q | . | . | . | . |
| 2.00 | 0.0727 | 0.48 | Q | . | . | . | . |
| 2.17 | 0.0793 | 0.48 | Q | . | . | . | . |
| 2.33 | 0.0859 | 0.48 | Q | . | . | . | . |
| 2.50 | 0.0926 | 0.49 | Q | . | . | . | . |
| 2.67 | 0.0993 | 0.49 | Q | . | . | . | . |
| 2.83 | 0.1060 | 0.49 | Q | . | . | . | . |
| 3.00 | 0.1128 | 0.50 | Q | . | . | . | . |
| 3.17 | 0.1197 | 0.50 | Q | . | . | . | . |
| 3.33 | 0.1266 | 0.50 | .Q | . | . | . | . |
| 3.50 | 0.1335 | 0.51 | .Q | . | . | . | . |
| 3.67 | 0.1405 | 0.51 | .Q | . | . | . | . |
| 3.83 | 0.1476 | 0.52 | .Q | . | . | . | . |
| 4.00 | 0.1547 | 0.52 | .Q | . | . | . | . |
| 4.17 | 0.1619 | 0.52 | .Q | . | . | . | . |
| 4.33 | 0.1691 | 0.53 | .Q | . | . | . | . |
| 4.50 | 0.1764 | 0.53 | .Q | . | . | . | . |
| 4.67 | 0.1837 | 0.53 | .Q | . | . | . | . |
| 4.83 | 0.1911 | 0.54 | .Q | . | . | . | . |
| 5.00 | 0.1986 | 0.54 | .Q | . | . | . | . |
| 5.17 | 0.2061 | 0.55 | .Q | . | . | . | . |
| 5.33 | 0.2137 | 0.55 | .Q | . | . | . | . |
| 5.50 | 0.2214 | 0.56 | .Q | . | . | . | . |
| 5.67 | 0.2291 | 0.56 | .Q | . | . | . | . |
| 5.83 | 0.2369 | 0.57 | .Q | . | . | . | . |
| 6.00 | 0.2447 | 0.57 | .Q | . | . | . | . |
| 6.17 | 0.2527 | 0.58 | .Q | . | . | . | . |
| 6.33 | 0.2607 | 0.58 | .Q | . | . | . | . |
| 6.50 | 0.2688 | 0.59 | .Q | . | . | . | . |
| 6.67 | 0.2769 | 0.59 | .Q | . | . | . | . |
| 6.83 | 0.2852 | 0.60 | .Q | . | . | . | . |
| 7.00 | 0.2935 | 0.61 | .Q | . | . | . | . |
| 7.17 | 0.3019 | 0.62 | .Q | . | . | . | . |
| 7.33 | 0.3104 | 0.62 | .Q | . | . | . | . |
| 7.50 | 0.3190 | 0.63 | .Q | . | . | . | . |
| 7.67 | 0.3277 | 0.63 | .Q | . | . | . | . |
| 7.83 | 0.3365 | 0.64 | .Q | . | . | . | . |
| 8.00 | 0.3454 | 0.65 | .Q | . | . | . | . |
| 8.17 | 0.3544 | 0.66 | .Q | . | . | . | . |
| 8.33 | 0.3635 | 0.66 | .Q | . | . | . | . |
| 8.50 | 0.3727 | 0.67 | .Q | . | . | . | . |
| 8.67 | 0.3820 | 0.68 | .Q | . | . | . | . |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 8.83 | 0.3914 | 0.69 | .Q | . | . | . | . |
| 9.00 | 0.4010 | 0.70 | .Q | . | . | . | . |
| 9.17 | 0.4107 | 0.71 | .Q | . | . | . | . |
| 9.33 | 0.4205 | 0.72 | .Q | . | . | . | . |
| 9.50 | 0.4305 | 0.73 | .Q | . | . | . | . |
| 9.67 | 0.4405 | 0.74 | .Q | . | . | . | . |
| 9.83 | 0.4508 | 0.75 | .Q | . | . | . | . |
| 10.00 | 0.4612 | 0.76 | .Q | . | . | . | . |
| 10.17 | 0.4717 | 0.77 | .Q | . | . | . | . |
| 10.33 | 0.4824 | 0.78 | .Q | . | . | . | . |
| 10.50 | 0.4933 | 0.80 | .Q | . | . | . | . |
| 10.67 | 0.5044 | 0.81 | .Q | . | . | . | . |
| 10.83 | 0.5157 | 0.83 | .Q | . | . | . | . |
| 11.00 | 0.5271 | 0.84 | .Q | . | . | . | . |
| 11.17 | 0.5388 | 0.86 | .Q | . | . | . | . |
| 11.33 | 0.5507 | 0.87 | .Q | . | . | . | . |
| 11.50 | 0.5629 | 0.89 | .Q | . | . | . | . |
| 11.67 | 0.5752 | 0.91 | .Q | . | . | . | . |
| 11.83 | 0.5879 | 0.93 | .Q | . | . | . | . |
| 12.00 | 0.6008 | 0.95 | .Q | . | . | . | . |
| 12.17 | 0.6140 | 0.97 | .Q | . | . | . | . |
| 12.33 | 0.6275 | 0.99 | .Q | . | . | . | . |
| 12.50 | 0.6414 | 1.03 | . Q | . | . | . | . |
| 12.67 | 0.6557 | 1.04 | . Q | . | . | . | . |
| 12.83 | 0.6703 | 1.08 | . Q | . | . | . | . |
| 13.00 | 0.6854 | 1.11 | . Q | . | . | . | . |
| 13.17 | 0.7010 | 1.16 | . Q | . | . | . | . |
| 13.33 | 0.7171 | 1.18 | . Q | . | . | . | . |
| 13.50 | 0.7338 | 1.24 | . Q | . | . | . | . |
| 13.67 | 0.7511 | 1.27 | . Q | . | . | . | . |
| 13.83 | 0.7690 | 1.34 | . Q | . | . | . | . |
| 14.00 | 0.7878 | 1.38 | . Q | . | . | . | . |
| 14.17 | 0.8090 | 1.69 | .  Q | . | . | . | . |
| 14.33 | 0.8326 | 1.74 | .  Q | . | . | . | . |
| 14.50 | 0.8575 | 1.86 | .  Q | . | . | . | . |
| 14.67 | 0.8836 | 1.93 | .  Q | . | . | . | . |
| 14.83 | 0.9113 | 2.10 | .   Q | . | . | . | . |
| 15.00 | 0.9409 | 2.20 | .   Q | . | . | . | . |
| 15.17 | 0.9729 | 2.44 | .   Q | . | . | . | . |
| 15.33 | 1.0076 | 2.60 | .    Q | . | . | . | . |
| 15.50 | 1.0497 | 3.50 | .      Q | . | . | . | . |
| 15.67 | 1.1001 | 3.81 | .      Q | . | . | . | . |
| 15.83 | 1.1577 | 4.56 | .        Q. | . | . | . | . |
| 16.00 | 1.2294 | 5.85 | .         .Q | . | . | . | . |
| 16.17 | 1.3598 | 13.09 | .         . | . | Q | . | . |
| 16.33 | 1.4793 | 4.25 | .       Q . | . | . | . | . |
| 16.50 | 1.5278 | 2.80 | .    Q | . | . | . | . |
| 16.67 | 1.5630 | 2.31 | .   Q | . | . | . | . |
| 16.83 | 1.5927 | 2.01 | .   Q | . | . | . | . |
| 17.00 | 1.6190 | 1.80 | .  Q | . | . | . | . |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 17.17 | 1.6412 | 1.42 | . Q | . | . | . | . |
| 17.33 | 1.6600 | 1.30 | . Q | . | . | . | . |
| 17.50 | 1.6773 | 1.21 | . Q | . | . | . | . |
| 17.67 | 1.6934 | 1.13 | . Q | . | . | . | . |
| 17.83 | 1.7085 | 1.06 | . Q | . | . | . | . |
| 18.00 | 1.7228 | 1.01 | . Q | . | . | . | . |
| 18.17 | 1.7363 | 0.96 | .Q | . | . | . | . |
| 18.33 | 1.7493 | 0.92 | .Q | . | . | . | . |
| 18.50 | 1.7616 | 0.88 | .Q | . | . | . | . |
| 18.67 | 1.7735 | 0.85 | .Q | . | . | . | . |
| 18.83 | 1.7850 | 0.82 | .Q | . | . | . | . |
| 19.00 | 1.7961 | 0.79 | .Q | . | . | . | . |
| 19.17 | 1.8068 | 0.77 | .Q | . | . | . | . |
| 19.33 | 1.8172 | 0.74 | .Q | . | . | . | . |
| 19.50 | 1.8273 | 0.72 | .Q | . | . | . | . |
| 19.67 | 1.8371 | 0.70 | .Q | . | . | . | . |
| 19.83 | 1.8467 | 0.68 | .Q | . | . | . | . |
| 20.00 | 1.8560 | 0.67 | .Q | . | . | . | . |
| 20.17 | 1.8651 | 0.65 | .Q | . | . | . | . |
| 20.33 | 1.8740 | 0.64 | .Q | . | . | . | . |
| 20.50 | 1.8827 | 0.62 | .Q | . | . | . | . |
| 20.67 | 1.8912 | 0.61 | .Q | . | . | . | . |
| 20.83 | 1.8995 | 0.60 | .Q | . | . | . | . |
| 21.00 | 1.9077 | 0.59 | .Q | . | . | . | . |
| 21.17 | 1.9157 | 0.58 | .Q | . | . | . | . |
| 21.33 | 1.9236 | 0.57 | .Q | . | . | . | . |
| 21.50 | 1.9313 | 0.56 | .Q | . | . | . | . |
| 21.67 | 1.9389 | 0.55 | .Q | . | . | . | . |
| 21.83 | 1.9463 | 0.54 | .Q | . | . | . | . |
| 22.00 | 1.9537 | 0.53 | .Q | . | . | . | . |
| 22.17 | 1.9609 | 0.52 | .Q | . | . | . | . |
| 22.33 | 1.9680 | 0.51 | .Q | . | . | . | . |
| 22.50 | 1.9750 | 0.50 | .Q | . | . | . | . |
| 22.67 | 1.9819 | 0.50 | Q | . | . | . | . |
| 22.83 | 1.9887 | 0.49 | Q | . | . | . | . |
| 23.00 | 1.9954 | 0.48 | Q | . | . | . | . |
| 23.17 | 2.0021 | 0.48 | Q | . | . | . | . |
| 23.33 | 2.0086 | 0.47 | Q | . | . | . | . |
| 23.50 | 2.0150 | 0.47 | Q | . | . | . | . |
| 23.67 | 2.0214 | 0.46 | Q | . | . | . | . |
| 23.83 | 2.0277 | 0.45 | Q | . | . | . | . |
| 24.00 | 2.0339 | 0.45 | Q | . | . | . | . |
| 24.17 | 2.0370 | 0.00 | Q | . | . | . | . |

---

TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
(Note: 100% of Peak Flow Rate estimate assumed to have
an instantaneous time duration)

Percentile of Estimated Duration

| Peak Flow Rate | (minutes) |
|---|---|
| 0% | 1440.0 |
| 10% | 210.0 |
| 20% | 70.0 |
| 30% | 40.0 |
| 40% | 20.0 |
| 50% | 10.0 |
| 60% | 10.0 |
| 70% | 10.0 |
| 80% | 10.0 |
| 90% | 10.0 |

# APPENDIX E

## 10-year & 100-year Discharge Calculations

Hydraflow Hydrographs
Hydraflow Basin Analysis

# Hydraflow Table of Contents

23646 Hydraflow.gpw

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020.4 Wednesday, 12 / 6 / 2023

## 10 - Year


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## 100 - Year


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# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020.4

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Manual | 3.880 | 5 | 970 | 24,894 | ------ | ------ | ------ | Area A |
| 2 | Reservoir | 3.861 | 5 | 970 | 23,291 | 1 | 675.98 | 2,075 | Detention 1 Outflow |
| 3 | Manual | 8.170 | 5 | 970 | 55,083 | ------ | ------ | ------ | Area B |
| 4 | Reservoir | 3.239 | 5 | 980 | 55,077 | 3 | 674.98 | 6,523 | Basin B Outflow |
| 5 | Reservoir | 3.240 | 5 | 980 | 46,011 | 4 | 675.14 | 9,659 | Detention 2 Outflow |

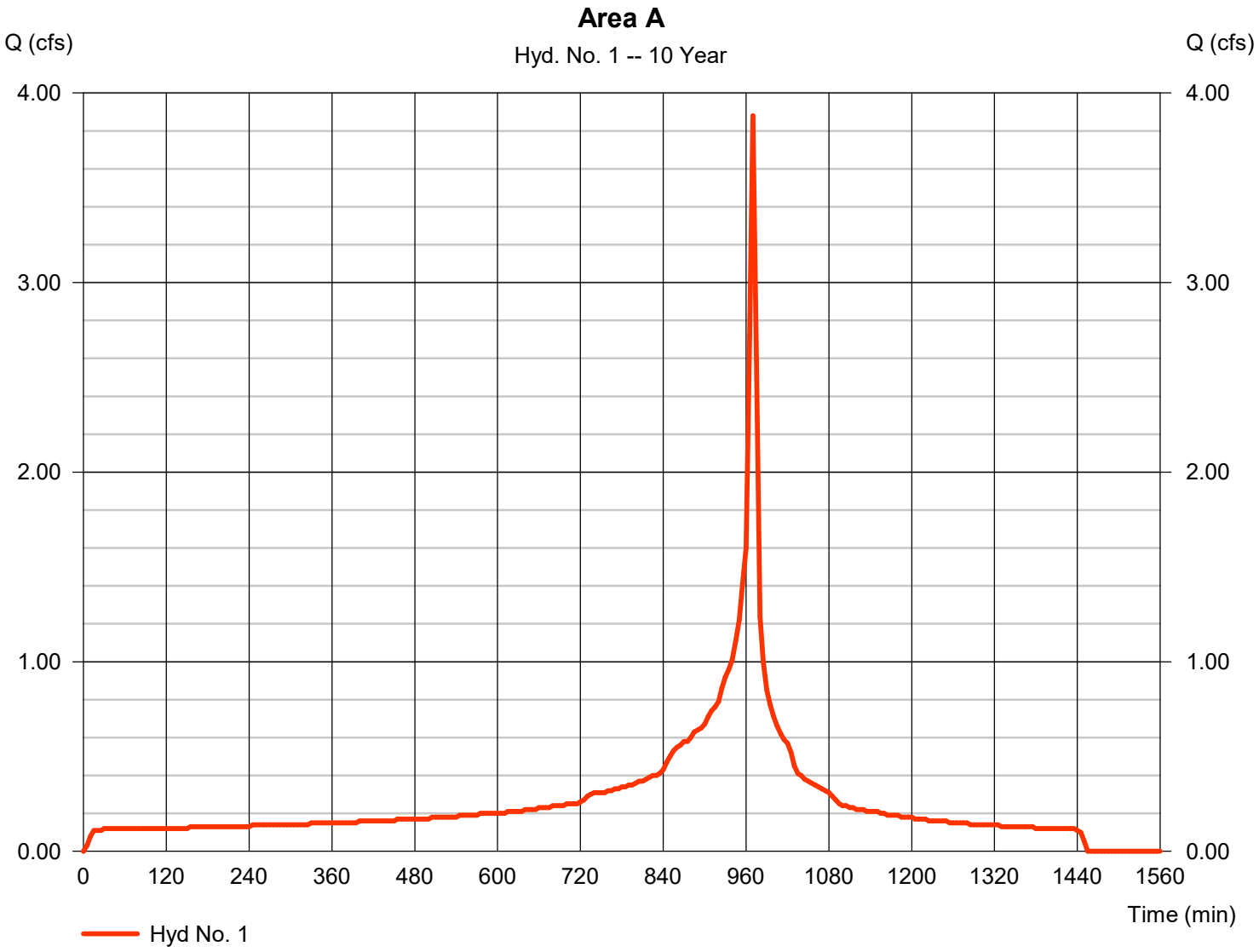
# Hydrograph Report



## Hyd. No. 1

Area A

| | | | |
|---|---|---|---|
| Hydrograph type | = Manual | Peak discharge | = 3.880 cfs |
| Storm frequency | = 10 yrs | Time to peak | = 970 min |
| Time interval | = 5 min | Hyd. volume | = 24,894 cuft |



# Hydrograph Report

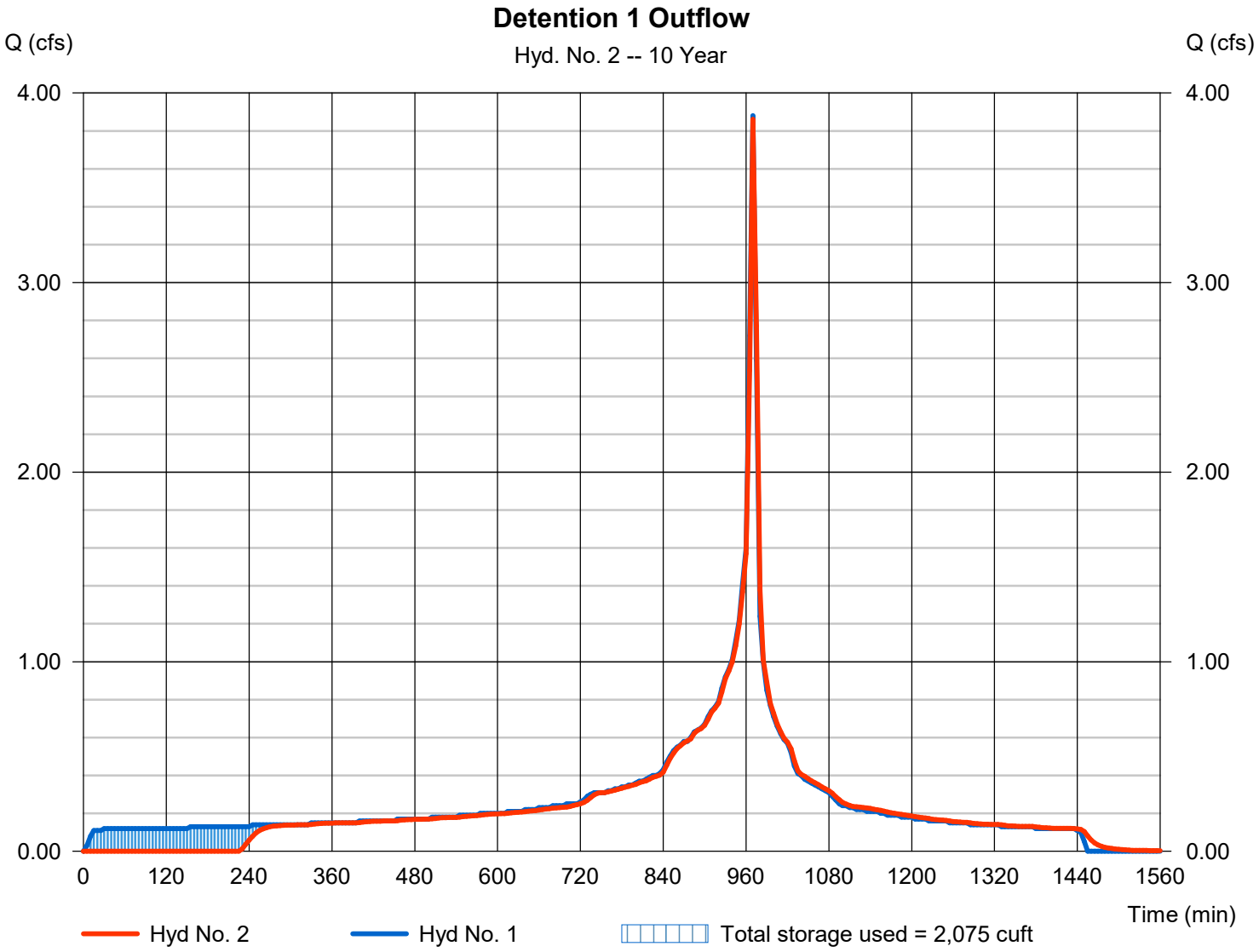


## Hyd. No. 2

Detention 1 Outflow

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Reservoir | Peak discharge | = | 3.861 cfs |
| Storm frequency | = | 10 yrs | Time to peak | = | 970 min |
| Time interval | = | 5 min | Hyd. volume | = | 23,291 cuft |
| Inflow hyd. No. | = | 1 - Area A | Max. Elevation | = | 675.98 ft |
| Reservoir name | = | Detention 1 | Max. Storage | = | 2,075 cuft |

Storage Indication method used.



# Pond Report



## Pond No. 3 - Detention 1

### Pond Data

**UG Chambers -**Invert elev. = 672.20 ft, Rise x Span = 4.00 x 4.00 ft, Barrel Len = 85.00 ft, No. Barrels = 2, Slope = 0.00%, Headers = No

### Stage / Storage Table

| Stage (ft) | Elevation (ft) | Contour area (sqft) | Incr. Storage (cuft) | Total storage (cuft) |
|---|---|---|---|---|
| 0.00 | 672.20 | n/a | 0 | 0 |
| 0.40 | 672.60 | n/a | 111 | 111 |
| 0.80 | 673.00 | n/a | 193 | 304 |
| 1.20 | 673.40 | n/a | 235 | 539 |
| 1.60 | 673.80 | n/a | 259 | 798 |
| 2.00 | 674.20 | n/a | 270 | 1,069 |
| 2.40 | 674.60 | n/a | 270 | 1,339 |
| 2.80 | 675.00 | n/a | 259 | 1,598 |
| 3.20 | 675.40 | n/a | 235 | 1,833 |
| 3.60 | 675.80 | n/a | 193 | 2,026 |
| 4.00 | 676.20 | n/a | 111 | 2,137 |

### Culvert / Orifice Structures

| | [A] | [B] | [C] | [PrfRsr] |
|---|---|---|---|---|
| **Rise (in)** | = 6.00 | Inactive | 0.00 | 0.00 |
| **Span (in)** | = 6.00 | 0.00 | 0.00 | 0.00 |
| **No. Barrels** | = 1 | 0 | 0 | 0 |
| **Invert El. (ft)** | = 675.00 | 0.00 | 0.00 | 0.00 |
| **Length (ft)** | = 10.00 | 0.00 | 0.00 | 0.00 |
| **Slope (%)** | = 0.50 | 0.00 | 0.00 | n/a |
| **N-Value** | = .013 | .013 | .013 | n/a |
| **Orifice Coeff.** | = 0.60 | 0.60 | 0.60 | 0.60 |
| **Multi-Stage** | = n/a | No | No | No |

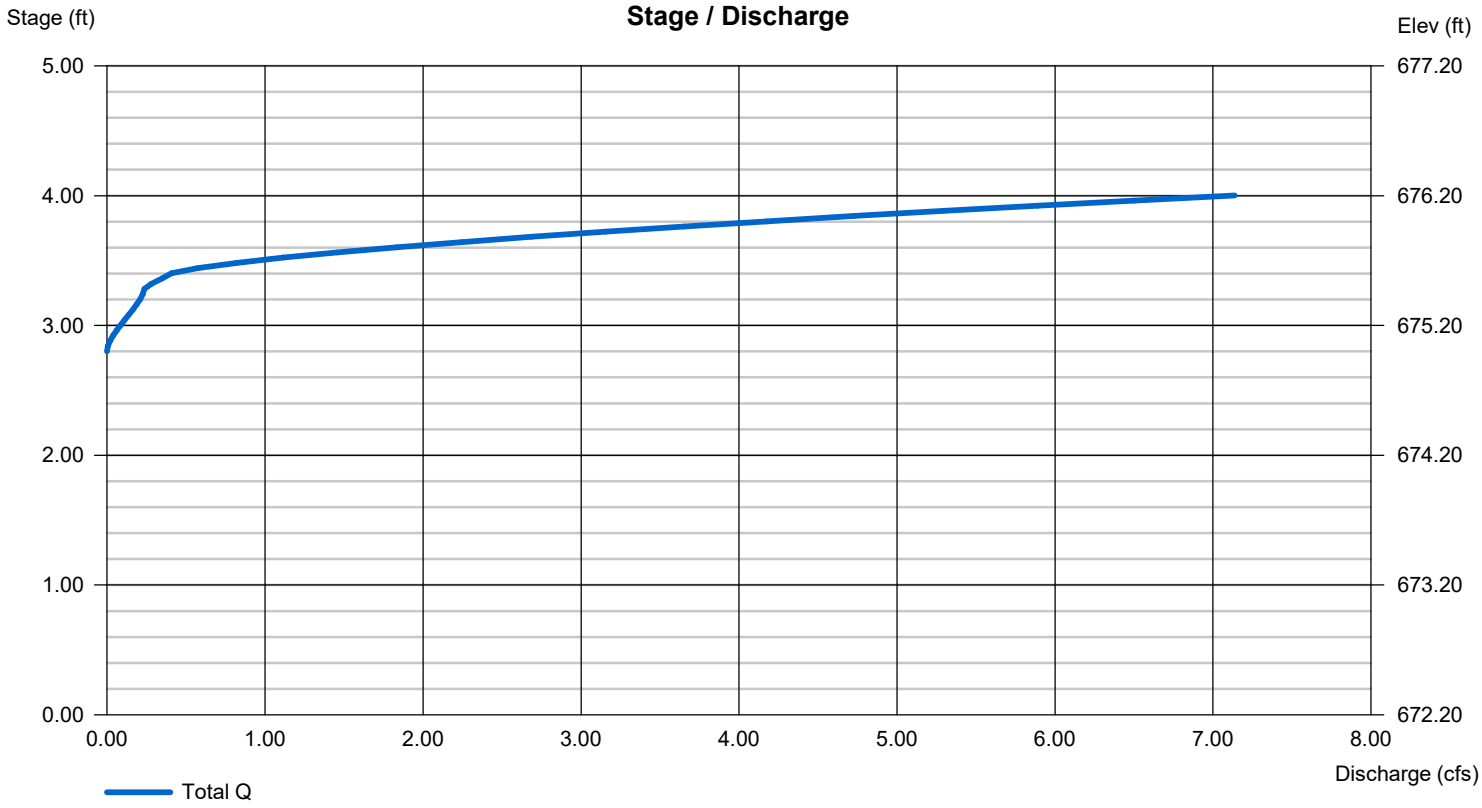
### Weir Structures

| | [A] | [B] | [C] | [D] |
|---|---|---|---|---|
| **Crest Len (ft)** | = 4.00 | 0.00 | 0.00 | 0.00 |
| **Crest El. (ft)** | = 675.60 | 0.00 | 0.00 | 0.00 |
| **Weir Coeff.** | = 3.33 | 3.33 | 3.33 | 3.33 |
| **Weir Type** | = Rect | --- | --- | --- |
| **Multi-Stage** | = No | No | No | No |

**Exfil.(in/hr)** = 0.000 (by Wet area)

**TW Elev. (ft)** = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



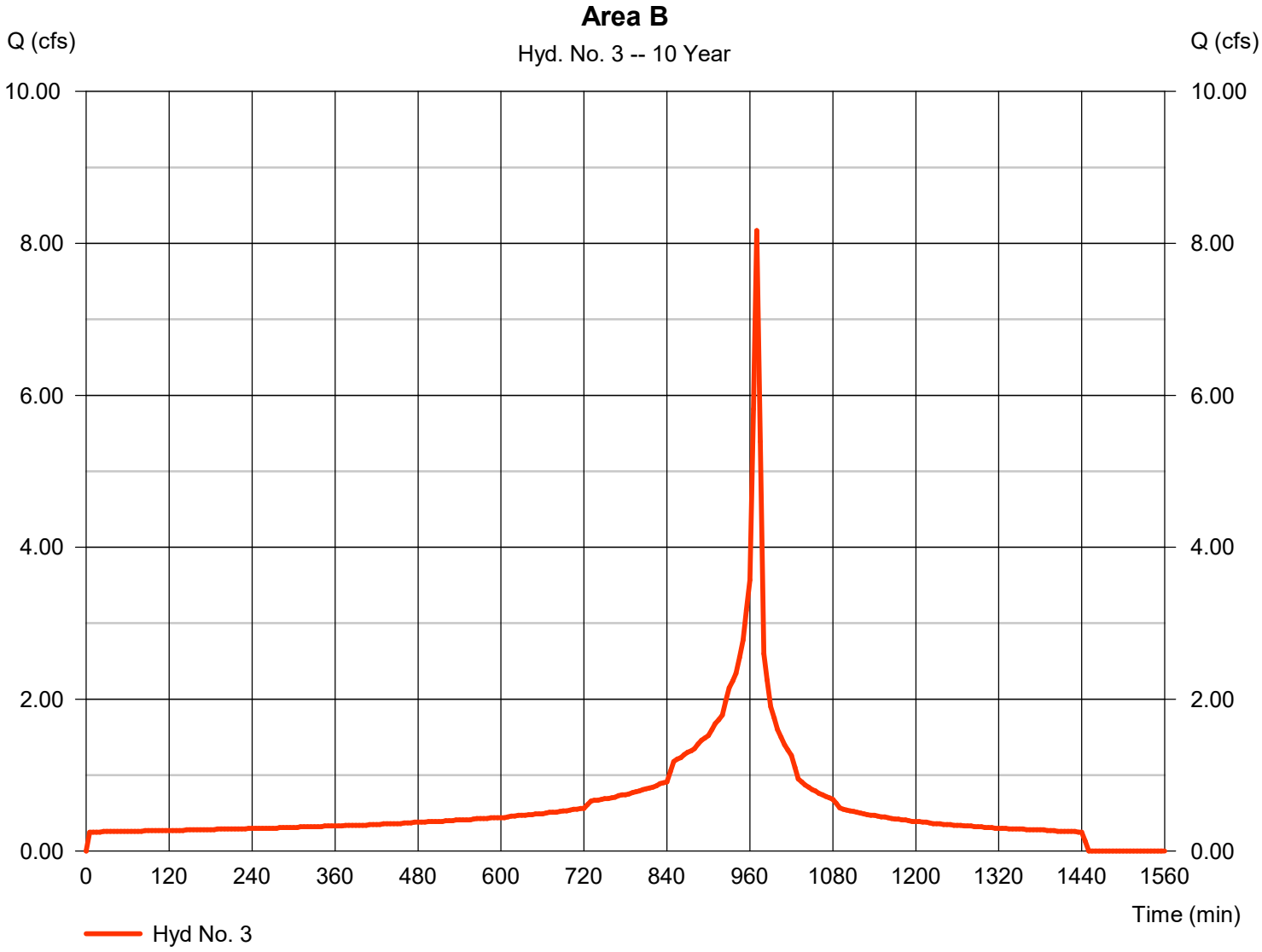
# Hydrograph Report



## Hyd. No. 3

Area B

| | | | |
|---|---|---|---|
| Hydrograph type | = Manual | Peak discharge | = 8.170 cfs |
| Storm frequency | = 10 yrs | Time to peak | = 970 min |
| Time interval | = 5 min | Hyd. volume | = 55,083 cuft |



# Hydrograph Report

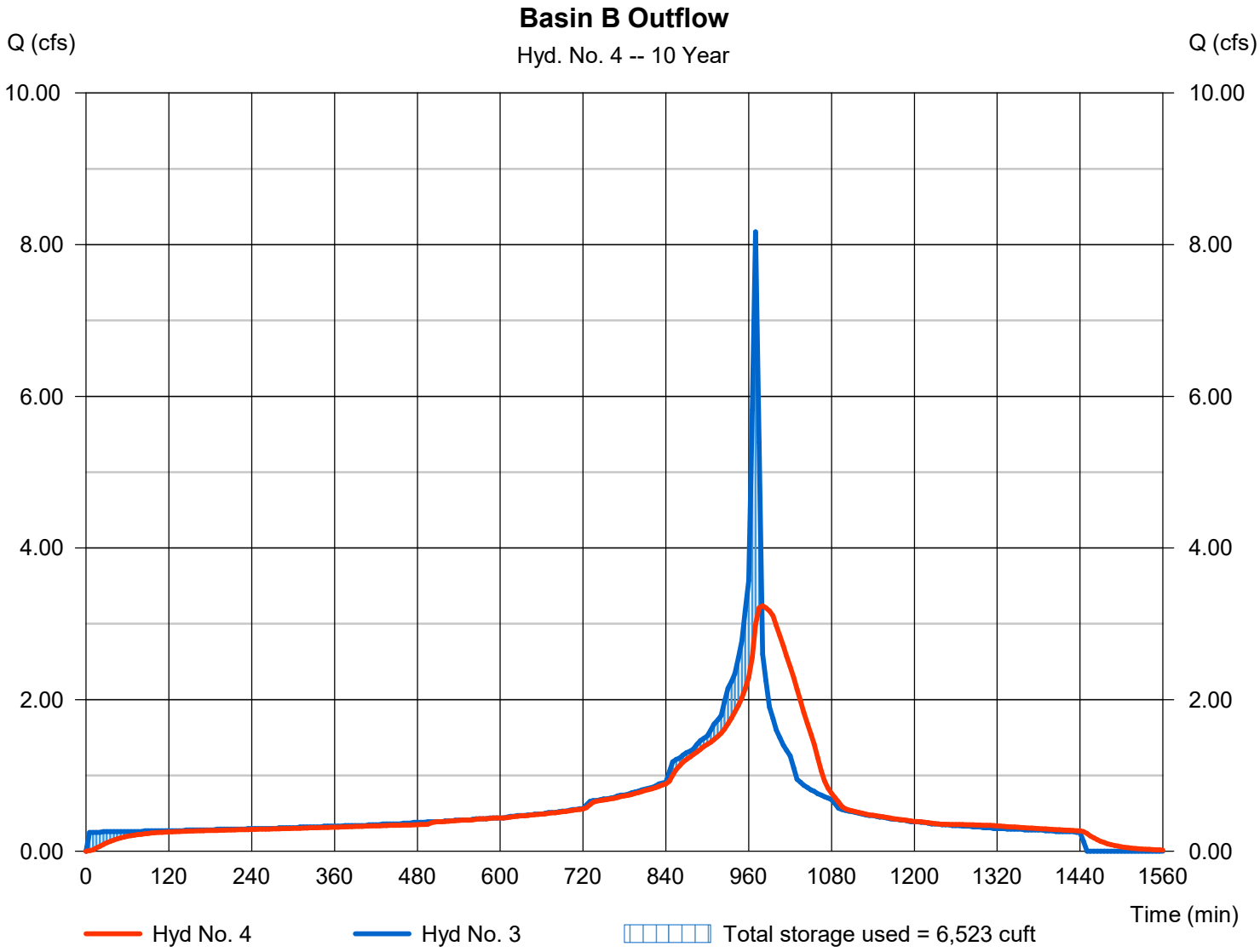


## Hyd. No. 4

Basin B Outflow

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Reservoir | Peak discharge | = | 3.239 cfs |
| Storm frequency | = | 10 yrs | Time to peak | = | 980 min |
| Time interval | = | 5 min | Hyd. volume | = | 55,077 cuft |
| Inflow hyd. No. | = | 3 - Area B | Max. Elevation | = | 674.98 ft |
| Reservoir name | = | Basin B | Max. Storage | = | 6,523 cuft |

Storage Indication method used.



# Pond Report



## Pond No. 2 - Basin B

### Pond Data

**Pond storage is based on user-defined values.**

### Stage / Storage Table

| Stage (ft) | Elevation (ft) | Contour area (sqft) | Incr. Storage (cuft) | Total storage (cuft) |
|---|---|---|---|---|
| 0.00 | 671.80 | n/a | 0 | 0 |
| 0.50 | 672.30 | n/a | 942 | 942 |
| 1.00 | 672.80 | n/a | 942 | 1,884 |
| 1.50 | 673.30 | n/a | 943 | 2,827 |
| 2.00 | 673.80 | n/a | 942 | 3,769 |
| 2.50 | 674.30 | n/a | 942 | 4,711 |
| 3.00 | 674.80 | n/a | 942 | 5,653 |
| 3.50 | 675.30 | n/a | 2,356 | 8,009 |
| 4.00 | 675.80 | n/a | 2,355 | 10,364 |
| 4.50 | 676.30 | n/a | 2,356 | 12,720 |
| 5.00 | 676.80 | n/a | 2,355 | 15,075 |
| 5.50 | 677.30 | n/a | 2,355 | 17,430 |

### Culvert / Orifice Structures

| | [A] | [B] | [C] | [PrfRsr] |
|---|---|---|---|---|
| **Rise (in)** | = 6.00 | 2.00 | 2.00 | 0.00 |
| **Span (in)** | = 6.00 | 2.00 | 2.00 | 0.00 |
| **No. Barrels** | = 2 | 9 | 9 | 0 |
| **Invert El. (ft)** | = 671.80 | 676.30 | 676.30 | 0.00 |
| **Length (ft)** | = 1.00 | 1.00 | 1.00 | 0.00 |
| **Slope (%)** | = 2.00 | 2.00 | 2.00 | n/a |
| **N-Value** | = .013 | .013 | .013 | n/a |
| **Orifice Coeff.** | = 0.60 | 0.60 | 0.60 | 0.60 |
| **Multi-Stage** | = n/a | No | No | No |

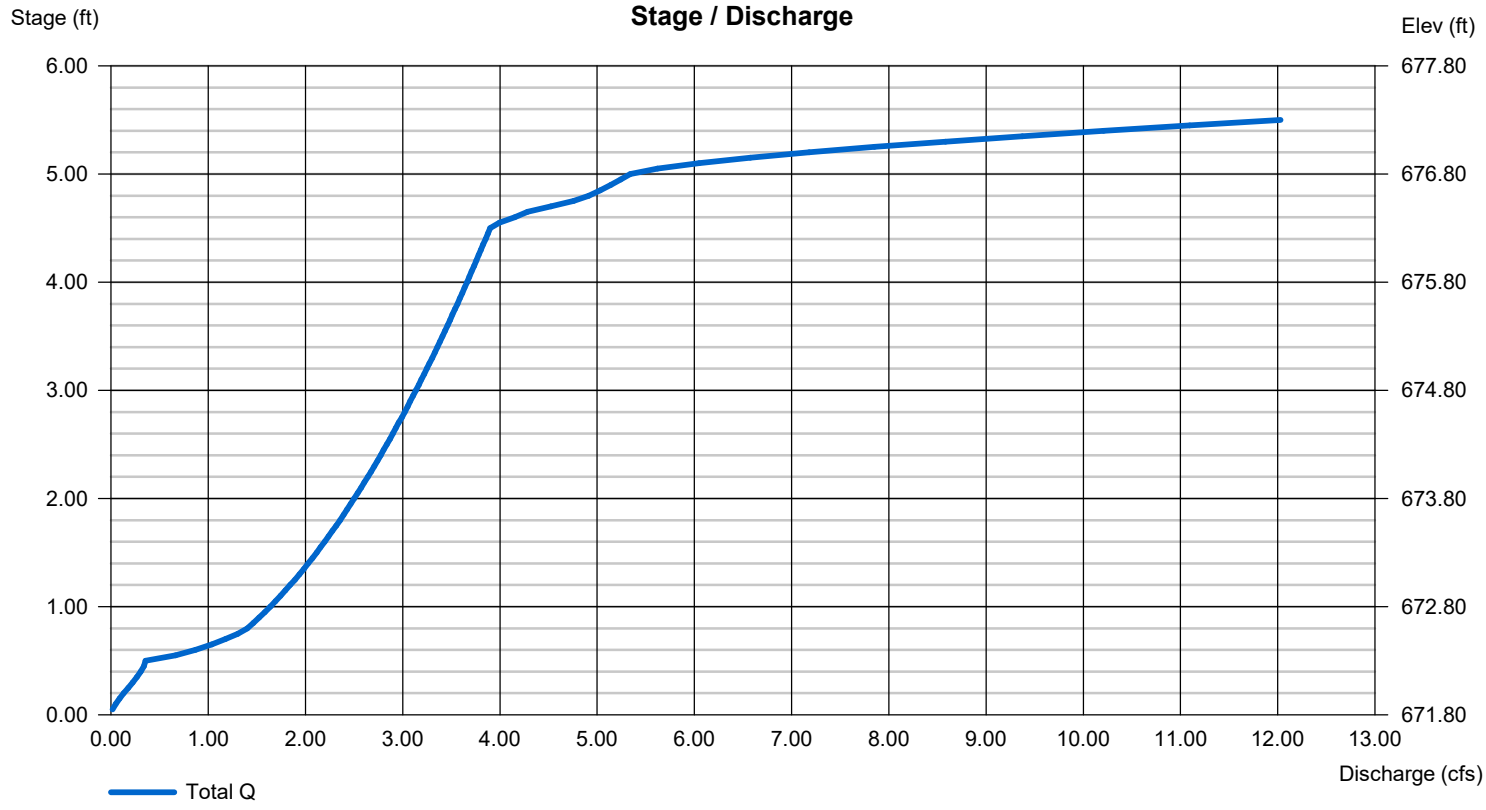
### Weir Structures

| | [A] | [B] | [C] | [D] |
|---|---|---|---|---|
| **Crest Len (ft)** | = 2.50 | 2.50 | 0.00 | 0.00 |
| **Crest El. (ft)** | = 676.80 | 676.80 | 0.00 | 0.00 |
| **Weir Coeff.** | = 3.33 | 3.33 | 3.33 | 3.33 |
| **Weir Type** | = Rect | Rect | --- | --- |
| **Multi-Stage** | = No | No | No | No |

**Exfil.(in/hr)** = 0.000 (by Wet area)

**TW Elev. (ft)** = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



## Basin B Stage-Storage Volume

| | |
|---|---|
| Gravel/Media H | 3.5 |
| Pond H | 2 |
| Width | 10.83 |
| Length | 435 |

| Stage | Height | Porosity | Inc. Volume | Total Volume |
|---|---|---|---|---|
| 671.80 | 0.00 | 40% | 0 | 0 |
| 672.30 | 0.50 | 40% | 942 | 942 |
| 672.80 | 1.00 | 40% | 942 | 1884 |
| 673.30 | 1.50 | 40% | 942 | 2827 |
| 673.80 | 2.00 | 40% | 942 | 3769 |
| 674.30 | 2.50 | 40% | 942 | 4711 |
| 674.80 | 3.00 | 40% | 942 | 5653 |
| 675.30 | 3.50 | 100% | 2356 | 8009 |
| 675.80 | 4.00 | 100% | 2356 | 10364 |
| 676.30 | 4.50 | 100% | 2356 | 12720 |
| 676.80 | 5.00 | 100% | 2356 | 15075 |
| 677.30 | 5.50 | 100% | 2356 | 17431 |

# Hydrograph Report

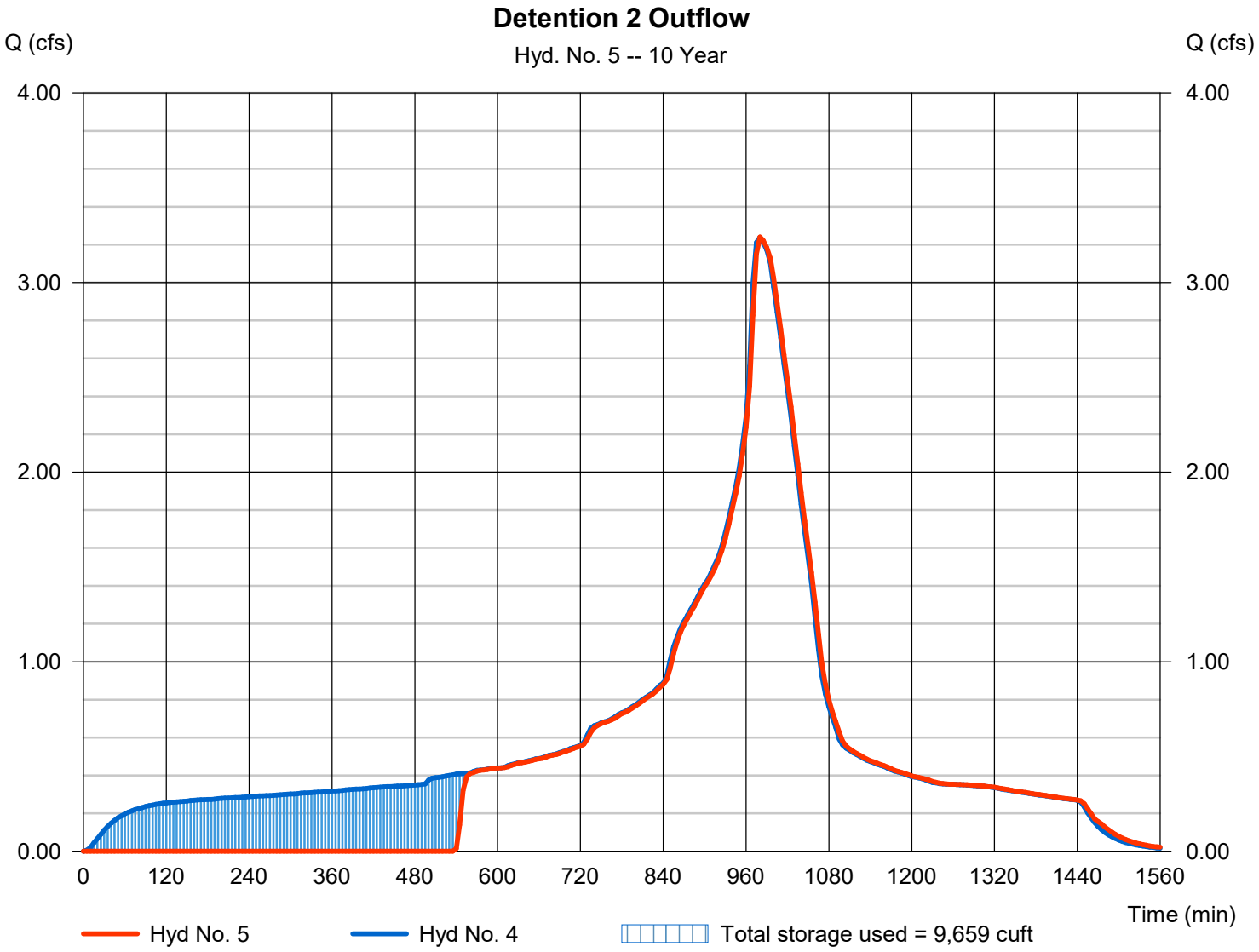


## Hyd. No. 5

Detention 2 Outflow

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Reservoir | Peak discharge | = | 3.240 cfs |
| Storm frequency | = | 10 yrs | Time to peak | = | 980 min |
| Time interval | = | 5 min | Hyd. volume | = | 46,011 cuft |
| Inflow hyd. No. | = | 4 - Basin B Outflow | Max. Elevation | = | 675.14 ft |
| Reservoir name | = | Detention 2 | Max. Storage | = | 9,659 cuft |

Storage Indication method used.



# Pond Report



## Pond No. 4 - Detention 2

### Pond Data

**UG Chambers -**Invert elev. = 671.20 ft, Rise x Span = 4.00 x 4.00 ft, Barrel Len = 155.00 ft, No. Barrels = 5, Slope = 0.00%, Headers = No

### Stage / Storage Table

| Stage (ft) | Elevation (ft) | Contour area (sqft) | Incr. Storage (cuft) | Total storage (cuft) |
|---|---|---|---|---|
| 0.00 | 671.20 | n/a | 0 | 0 |
| 0.40 | 671.60 | n/a | 504 | 504 |
| 0.80 | 672.00 | n/a | 880 | 1,384 |
| 1.20 | 672.40 | n/a | 1,073 | 2,457 |
| 1.60 | 672.80 | n/a | 1,182 | 3,639 |
| 2.00 | 673.20 | n/a | 1,233 | 4,872 |
| 2.40 | 673.60 | n/a | 1,233 | 6,105 |
| 2.80 | 674.00 | n/a | 1,182 | 7,287 |
| 3.20 | 674.40 | n/a | 1,072 | 8,358 |
| 3.60 | 674.80 | n/a | 879 | 9,238 |
| 4.00 | 675.20 | n/a | 503 | 9,741 |

### Culvert / Orifice Structures

| | [A] | [B] | [C] | [PrfRsr] |
|---|---|---|---|---|
| **Rise (in)** | = 0.00 | Inactive | 0.00 | 0.00 |
| **Span (in)** | = 0.00 | 0.00 | 0.00 | 0.00 |
| **No. Barrels** | = 0 | 0 | 0 | 0 |
| **Invert El. (ft)** | = 0.00 | 0.00 | 0.00 | 0.00 |
| **Length (ft)** | = 0.00 | 0.00 | 0.00 | 0.00 |
| **Slope (%)** | = 0.00 | 0.00 | 0.00 | n/a |
| **N-Value** | = .013 | .013 | .013 | n/a |
| **Orifice Coeff.** | = 0.60 | 0.60 | 0.60 | 0.60 |
| **Multi-Stage** | = n/a | No | No | No |

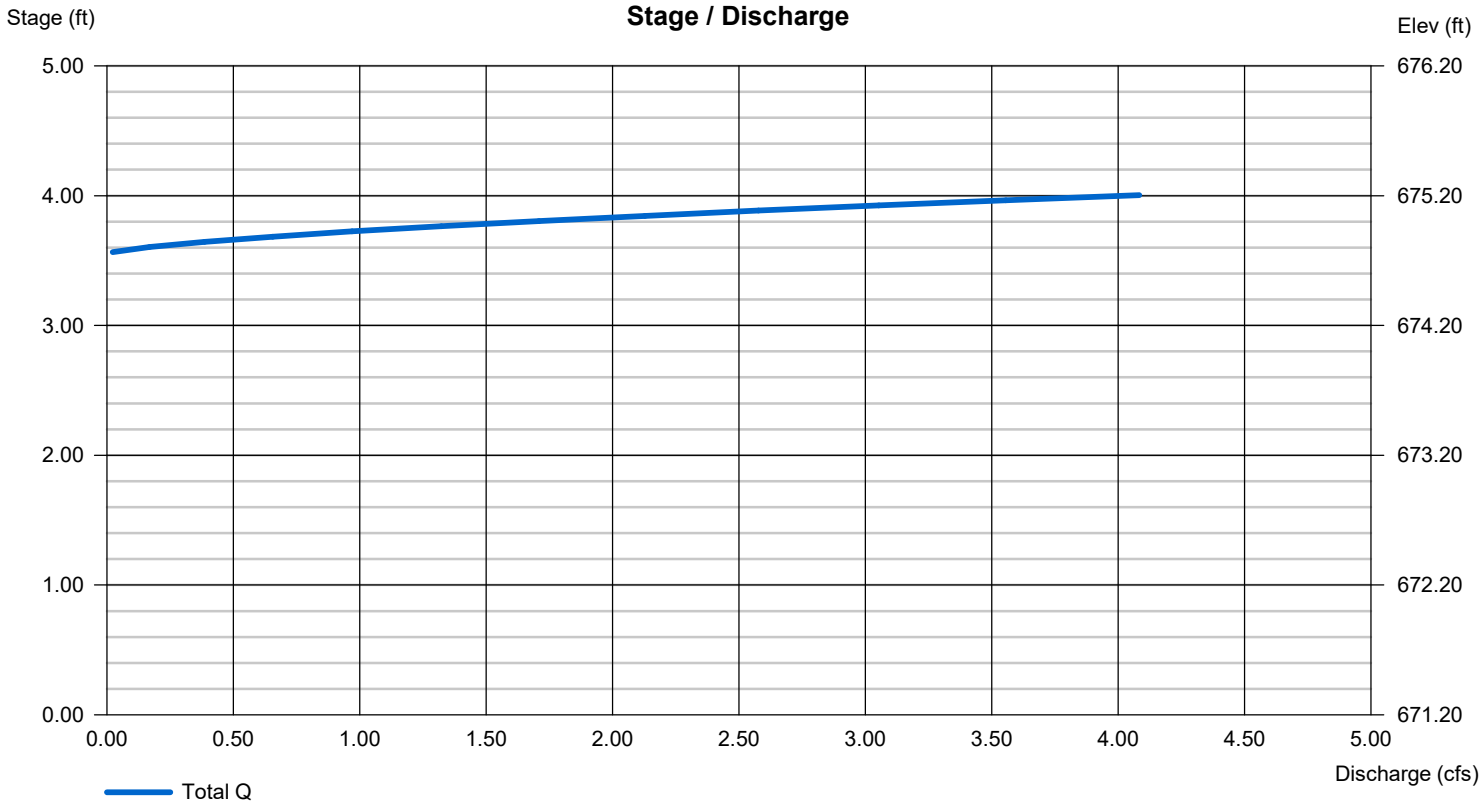
### Weir Structures

| | [A] | [B] | [C] | [D] |
|---|---|---|---|---|
| **Crest Len (ft)** | = 4.00 | 0.00 | 0.00 | 0.00 |
| **Crest El. (ft)** | = 674.75 | 0.00 | 0.00 | 0.00 |
| **Weir Coeff.** | = 3.33 | 3.33 | 3.33 | 3.33 |
| **Weir Type** | = Rect | --- | --- | --- |
| **Multi-Stage** | = No | No | No | No |

**Exfil.(in/hr)** = 0.000 (by Wet area)

**TW Elev. (ft)** = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020.4

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Manual | 6.410 | 5 | 970 | 39,123 | ------ | ------ | ------ | Area A |
| 2 | Reservoir | 6.358 | 5 | 970 | 37,520 | 1 | 676.15 | 2,123 | Detention 1 Outflow |
| 3 | Manual | 13.09 | 5 | 970 | 88,800 | ------ | ------ | ------ | Area B |
| 4 | Reservoir | 3.916 | 5 | 980 | 88,794 | 3 | 676.31 | 12,763 | Basin B Outflow |
| 5 | Reservoir | 3.917 | 5 | 985 | 79,728 | 4 | 675.19 | 9,725 | Detention 2 Outflow |

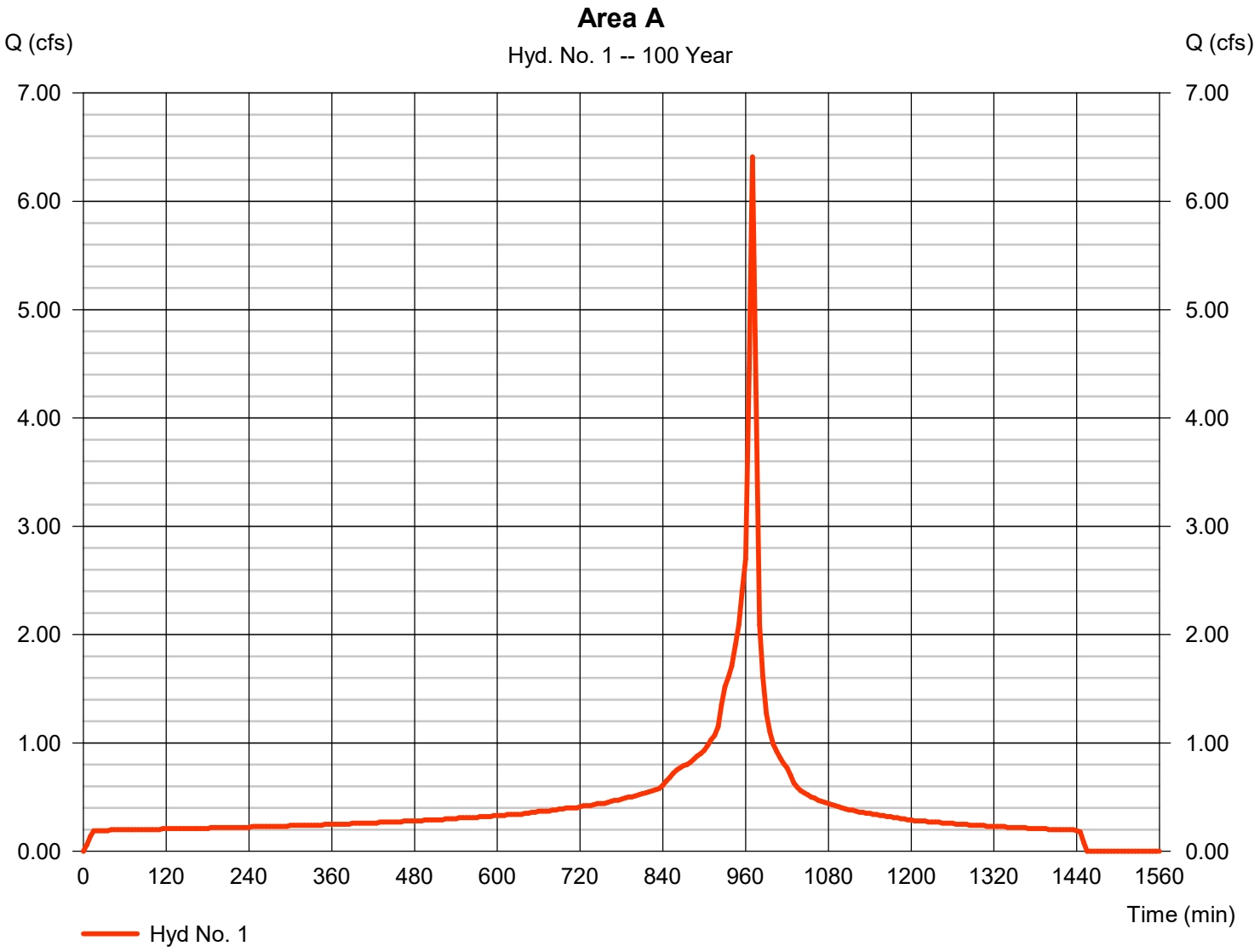
# Hydrograph Report



## Hyd. No. 1

Area A

| | | | |
|---|---|---|---|
| Hydrograph type | = Manual | Peak discharge | = 6.410 cfs |
| Storm frequency | = 100 yrs | Time to peak | = 970 min |
| Time interval | = 5 min | Hyd. volume | = 39,123 cuft |



# Hydrograph Report

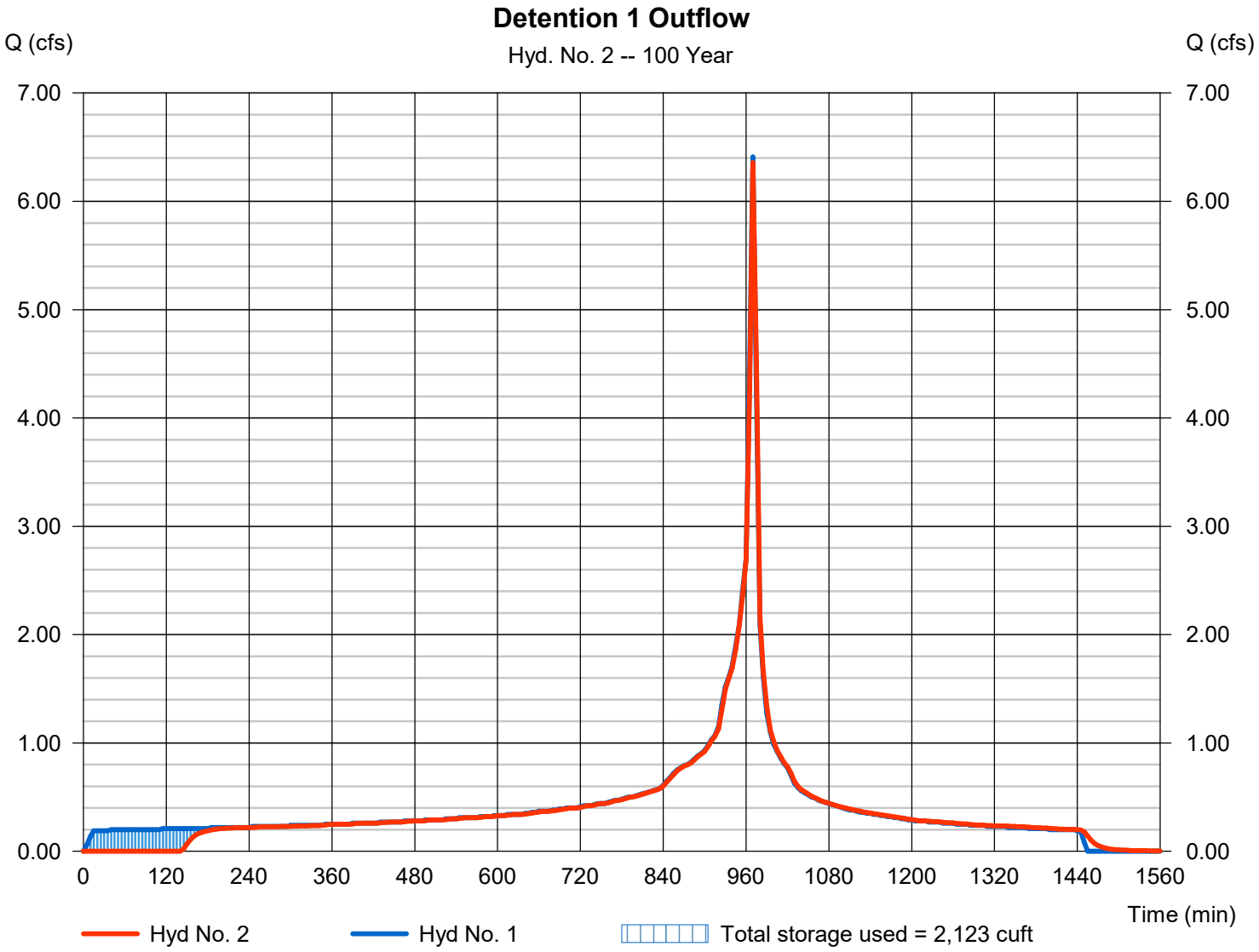


## Hyd. No. 2

Detention 1 Outflow

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Reservoir | Peak discharge | = | 6.358 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 970 min |
| Time interval | = | 5 min | Hyd. volume | = | 37,520 cuft |
| Inflow hyd. No. | = | 1 - Area A | Max. Elevation | = | 676.15 ft |
| Reservoir name | = | Detention 1 | Max. Storage | = | 2,123 cuft |

Storage Indication method used.



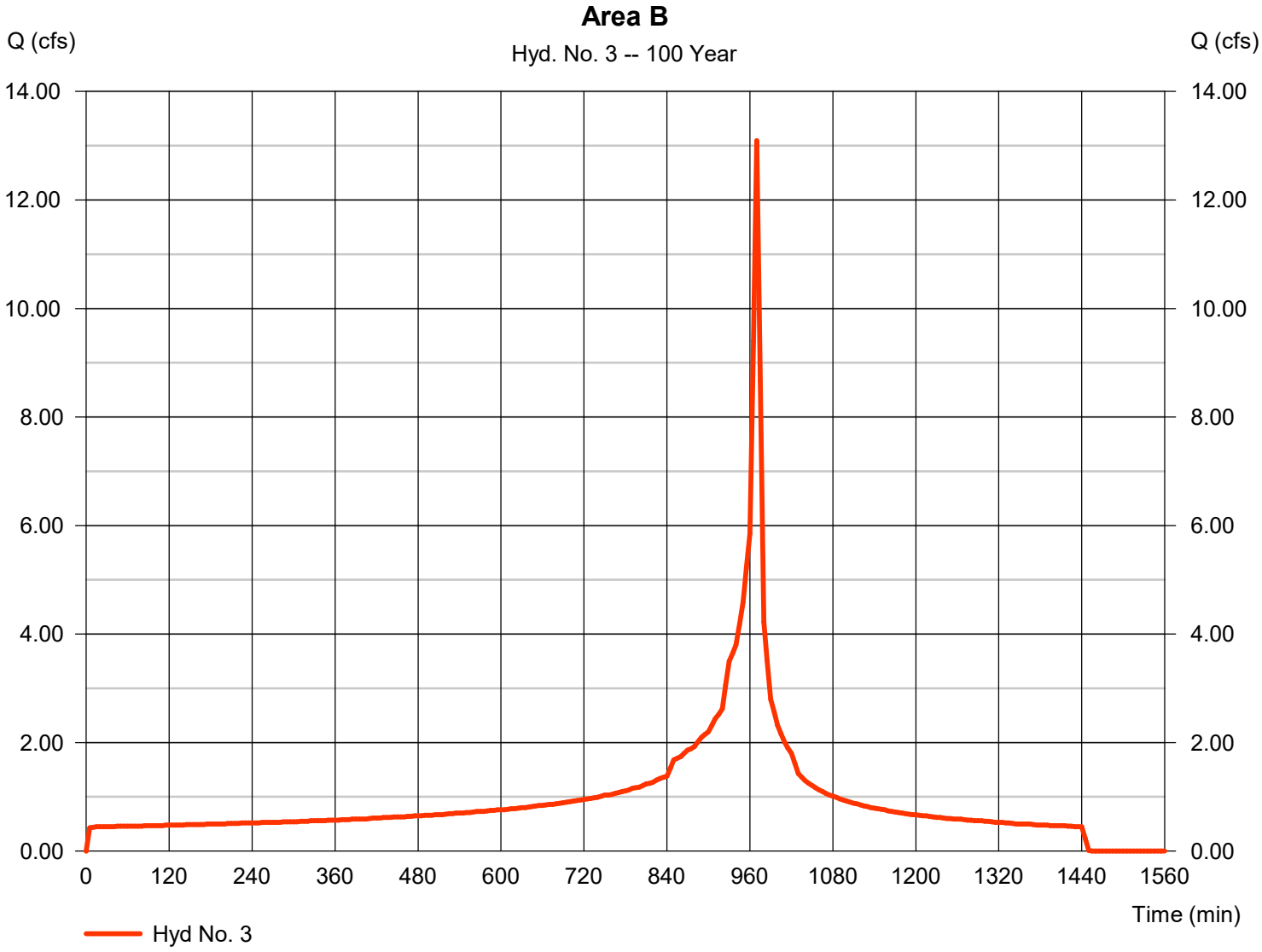
# Hydrograph Report



## Hyd. No. 3

Area B

| | | | |
|---|---|---|---|
| Hydrograph type | = Manual | Peak discharge | = 13.09 cfs |
| Storm frequency | = 100 yrs | Time to peak | = 970 min |
| Time interval | = 5 min | Hyd. volume | = 88,800 cuft |



# Hydrograph Report

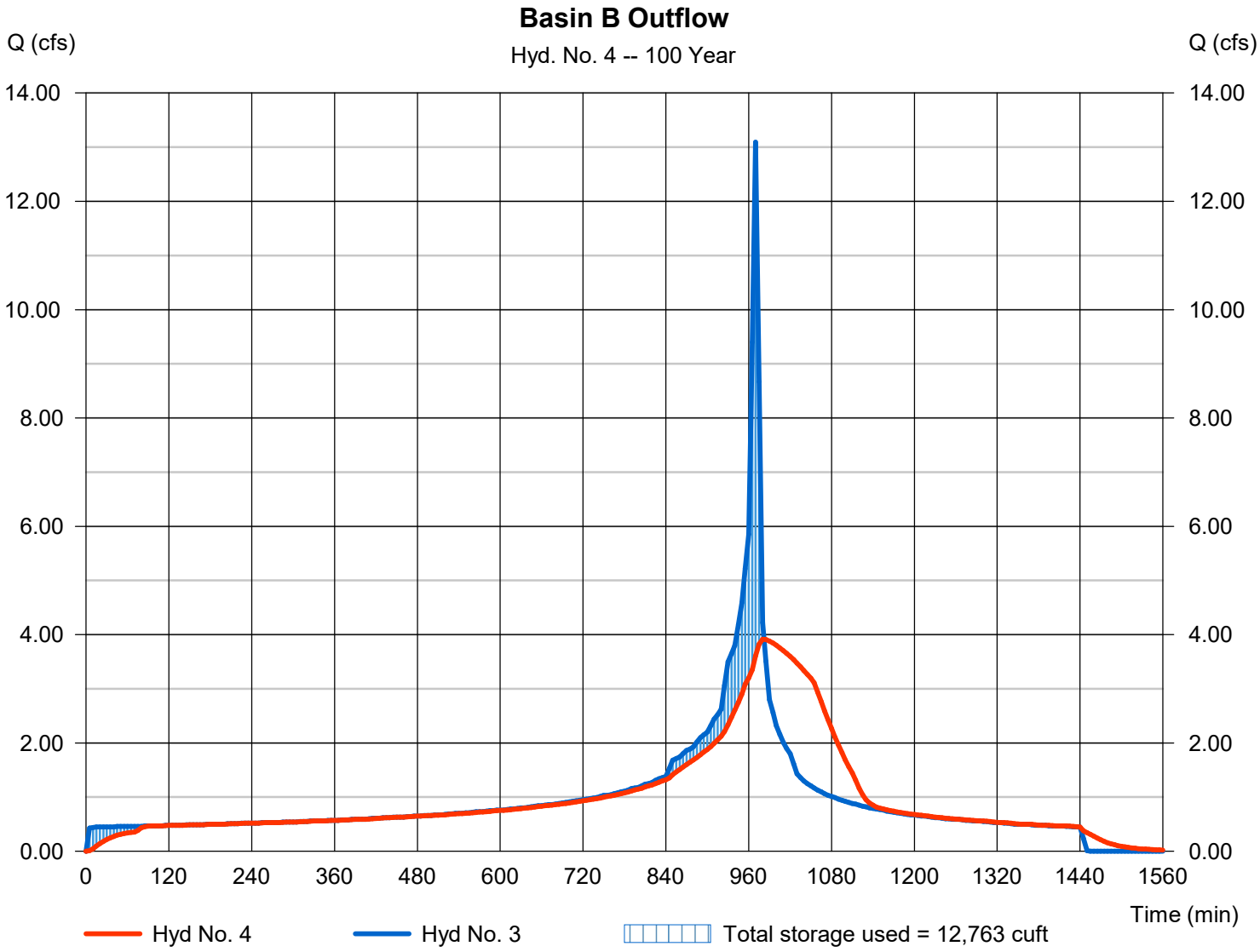


## Hyd. No. 4

Basin B Outflow

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Reservoir | Peak discharge | = | 3.916 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 980 min |
| Time interval | = | 5 min | Hyd. volume | = | 88,794 cuft |
| Inflow hyd. No. | = | 3 - Area B | Max. Elevation | = | 676.31 ft |
| Reservoir name | = | Basin B | Max. Storage | = | 12,763 cuft |

Storage Indication method used.



# Hydrograph Report

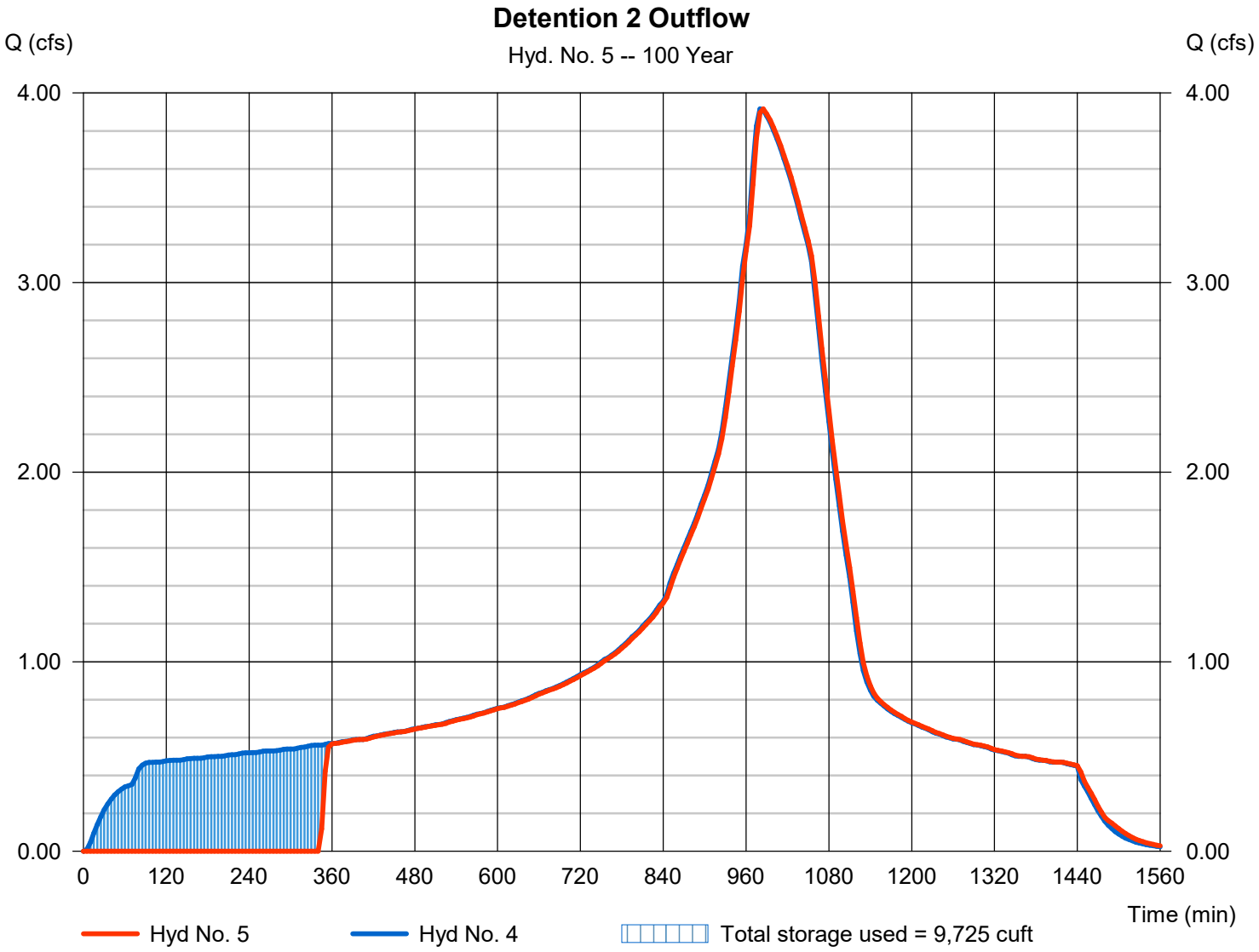


## Hyd. No. 5

Detention 2 Outflow

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Reservoir | Peak discharge | = | 3.917 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 985 min |
| Time interval | = | 5 min | Hyd. volume | = | 79,728 cuft |
| Inflow hyd. No. | = | 4 - Basin B Outflow | Max. Elevation | = | 675.19 ft |
| Reservoir name | = | Detention 2 | Max. Storage | = | 9,725 cuft |

Storage Indication method used.



# APPENDIX F

## 10-year & 100-year Rational Method Calculations

Proposed Condition

```
**************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
         (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
        (c) Copyright 1983-2015 Advanced Engineering Software (aes)
            Ver. 22.0  Release Date: 07/01/2015  License ID 1510

                          Analysis prepared by:

                          DRC Engineering, Inc.
                    160 South Old Springs Road, Suite 210
                          Anaheim Hills, CA 92808
                               714-685-6860

 ************************* DESCRIPTION OF STUDY *************************
* REXFORD INDUSTRIAL                                                    *
* RATIONAL METHOD ANALYSIS                                              *
* 10 YEAR STORM EVENT                                                   *
 ************************************************************************

  FILE NAME: 3646P10.DAT
  TIME/DATE OF STUDY: 15:08 12/04/2023
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED TABLED RAINFALL USED*
  NUMBER OF [TIME,INTENSITY] DATA PAIRS =  5
   1)    5.00;  2.840
   2)   30.00;  1.240
   3)   60.00;  0.927
   4)  180.00;  0.573
   5)  360.00;  0.393
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *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   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

+------------------------------------------------------------------------+
| SUBAREA 100                                                            |
| PROPOSED CONDITION                                                     |
|                                                                        |
+------------------------------------------------------------------------+

**************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
--------------------------------------------------------------------------
```

```
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
================================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   600.00
  ELEVATION DATA: UPSTREAM(FEET) =    684.80  DOWNSTREAM(FEET) =    679.30

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   10.039
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.518
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        1.24      0.47     0.100    75   10.04
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.47
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      2.76
  TOTAL AREA(ACRES) =      1.24   PEAK FLOW RATE(CFS) =      2.76

+------------------------------------------------------------------------------+
| NOTE: SUBAREA FLOW INTO ONE (1) CURB CUT OPENING                             |
| SEE RIP RAP CALCULATIONS                                                     |
|                                                                              |
+------------------------------------------------------------------------------+

********************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    201.00 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.) =   10.04
  RAINFALL INTENSITY(INCH/HR) =   2.52
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.47
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       1.24
  TOTAL STREAM AREA(ACRES) =       1.24
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.76

+------------------------------------------------------------------------------+
| SUBAREA 200                                                                  |
| PROPOSED CONDITION                                                           |
|                                                                              |
+------------------------------------------------------------------------------+

********************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
--------------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
================================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    55.00
  ELEVATION DATA: UPSTREAM(FEET) =    679.90  DOWNSTREAM(FEET) =    679.20

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   11.118
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.448
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL GOOD COVER
  "GRASS"                    D        0.09      0.38     1.000    80   11.12
```

```
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.38
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      0.17
  TOTAL AREA(ACRES) =      0.09   PEAK FLOW RATE(CFS) =      0.17

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    201.00 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.) =   11.12
  RAINFALL INTENSITY(INCH/HR) =   2.45
  AREA-AVERAGED Fm(INCH/HR) =  0.38
  AREA-AVERAGED Fp(INCH/HR) =  0.38
  AREA-AVERAGED Ap =  1.00
  EFFECTIVE STREAM AREA(ACRES) =       0.09
  TOTAL STREAM AREA(ACRES) =       0.09
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.17

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1        2.76   10.04    2.518  0.47( 0.05) 0.10       1.2     100.00
      2        0.17   11.12    2.448  0.38( 0.38) 1.00       0.1     200.00

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

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1        2.91   10.04    2.518  0.43( 0.07) 0.16       1.3     100.00
      2        2.85   11.12    2.448  0.43( 0.07) 0.16       1.3     200.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       2.91    Tc(MIN.) =    10.04
  EFFECTIVE AREA(ACRES) =       1.32   AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.43  AREA-AVERAGED Ap =  0.16
  TOTAL AREA(ACRES) =        1.3
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    201.00 =     600.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    402.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   673.70  DOWNSTREAM(FEET) =   673.10
  FLOW LENGTH(FEET) =   203.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS  10.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.06
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.91
  PIPE TRAVEL TIME(MIN.) =   1.10    Tc(MIN.) =   11.14
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    402.00 =     803.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    402.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
```

```
================================================================================

+------------------------------------------------------------------------------+
| SUBAREA 300                                                                  |
| PROPOSED CONDITION                                                           |
|                                                                              |
+------------------------------------------------------------------------------+

******************************************************************************
  FLOW PROCESS FROM NODE    300.00 TO NODE    301.00 IS CODE =  21
------------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   140.00
  ELEVATION DATA: UPSTREAM(FEET) =    682.70  DOWNSTREAM(FEET) =    680.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.840
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.33      0.47     0.100    75    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.47
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      0.83
  TOTAL AREA(ACRES) =      0.33   PEAK FLOW RATE(CFS) =      0.83

+------------------------------------------------------------------------------+
| NOTE: SUBAREA FLOW INTO THREE (3) CURB CUT OPENINGS                          |
| SEE RIP RAP CALCULATIONS                                                     |
|                                                                              |
+------------------------------------------------------------------------------+

******************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    401.00 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.) =    5.00
  RAINFALL INTENSITY(INCH/HR) =   2.84
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.47
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       0.33
  TOTAL STREAM AREA(ACRES) =       0.33
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.83

+------------------------------------------------------------------------------+
| SUBAREA 400                                                                  |
| PROPOSED CONDITION                                                           |
|                                                                              |
+------------------------------------------------------------------------------+

******************************************************************************
  FLOW PROCESS FROM NODE    400.00 TO NODE    401.00 IS CODE =  21
------------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==============================================================================
```

```
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   115.00
  ELEVATION DATA: UPSTREAM(FEET) =    680.00  DOWNSTREAM(FEET) =    679.20

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   16.851
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.082
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL GOOD COVER
  "GRASS"                     D        0.05      0.38     1.000    80   16.85
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.38
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      0.08
  TOTAL AREA(ACRES) =      0.05   PEAK FLOW RATE(CFS) =      0.08

****************************************************************************
  FLOW PROCESS FROM NODE    401.00 TO NODE    401.00 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.) =   16.85
  RAINFALL INTENSITY(INCH/HR) =   2.08
  AREA-AVERAGED Fm(INCH/HR) =  0.38
  AREA-AVERAGED Fp(INCH/HR) =  0.38
  AREA-AVERAGED Ap =  1.00
  EFFECTIVE STREAM AREA(ACRES) =       0.05
  TOTAL STREAM AREA(ACRES) =       0.05
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.08

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        0.83    5.00    2.840  0.47( 0.05) 0.10       0.3     300.00
      2        0.08   16.85    2.082  0.38( 0.38) 1.00       0.1     400.00

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

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        0.86    5.00    2.840  0.44( 0.06) 0.14       0.3     300.00
      2        0.68   16.85    2.082  0.42( 0.09) 0.22       0.4     400.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       0.86    Tc(MIN.) =     5.00
  EFFECTIVE AREA(ACRES) =       0.34   AREA-AVERAGED Fm(INCH/HR) =  0.06
  AREA-AVERAGED Fp(INCH/HR) =  0.44  AREA-AVERAGED Ap =  0.14
  TOTAL AREA(ACRES) =        0.4
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    401.00 =     140.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    401.00 TO NODE    402.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   674.40  DOWNSTREAM(FEET) =   673.10
  FLOW LENGTH(FEET) =    24.00   MANNING'S N =  0.013
```

```
  DEPTH OF FLOW IN   6.0 INCH PIPE IS   3.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.80
  ESTIMATED PIPE DIAMETER(INCH) =   6.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.86
  PIPE TRAVEL TIME(MIN.) =   0.06    Tc(MIN.) =    5.06
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    402.00 =     164.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    402.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        0.86    5.06    2.836  0.44( 0.06) 0.14       0.3     300.00
      2        0.68   16.91    2.078  0.42( 0.09) 0.22       0.4     400.00
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    402.00 =     164.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.91   11.14    2.447  0.43( 0.07) 0.16       1.3     100.00
      2        2.85   12.23    2.377  0.43( 0.07) 0.16       1.3     200.00
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    402.00 =     803.00 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.40    5.06    2.836  0.44( 0.07) 0.15       0.9     300.00
      2        3.68   11.14    2.447  0.43( 0.07) 0.16       1.7     100.00
      3        3.60   12.23    2.377  0.43( 0.07) 0.17       1.7     200.00
      4        3.16   16.91    2.078  0.43( 0.07) 0.17       1.7     400.00
    TOTAL AREA(ACRES) =         1.7

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =        3.68  Tc(MIN.) =   11.143
  EFFECTIVE AREA(ACRES) =      1.68  AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.43  AREA-AVERAGED Ap =  0.17
  TOTAL AREA(ACRES) =        1.7
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    402.00 =     803.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    402.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    502.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   672.90  DOWNSTREAM(FEET) =   672.50
  FLOW LENGTH(FEET) =    79.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS  10.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.98
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.68
  PIPE TRAVEL TIME(MIN.) =   0.33    Tc(MIN.) =   11.47
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    502.00 =     882.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    502.00 TO NODE    502.00 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.) =   11.47
  RAINFALL INTENSITY(INCH/HR) =   2.43
  AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.43
  AREA-AVERAGED Ap =  0.16
  EFFECTIVE STREAM AREA(ACRES) =       1.68
  TOTAL STREAM AREA(ACRES) =       1.71
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.68

+--------------------------------------------------------------------------+
| SUBAREA 500                                                              |
| PROPOSED CONDITION                                                       |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    500.00 TO NODE    501.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  ELEVATION DATA: UPSTREAM(FEET) =    682.10  DOWNSTREAM(FEET) =    679.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.840
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.15      0.47     0.100    75    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.47
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      0.38
  TOTAL AREA(ACRES) =      0.15   PEAK FLOW RATE(CFS) =      0.38

****************************************************************************
  FLOW PROCESS FROM NODE    501.00 TO NODE    502.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   676.50  DOWNSTREAM(FEET) =   672.50
  FLOW LENGTH(FEET) =    22.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   6.0 INCH PIPE IS   1.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.56
  ESTIMATED PIPE DIAMETER(INCH) =   6.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.38
  PIPE TRAVEL TIME(MIN.) =   0.04    Tc(MIN.) =    5.04
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    502.00 =     122.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    502.00 TO NODE    502.00 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.) =    5.04
  RAINFALL INTENSITY(INCH/HR) =   2.84
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.47
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       0.15
  TOTAL STREAM AREA(ACRES) =       0.15
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.38

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1        2.40    5.44    2.812  0.44( 0.07) 0.15       0.9     300.00
      1        3.68   11.47    2.426  0.43( 0.07) 0.16       1.7     100.00
      1        3.60   12.56    2.356  0.43( 0.07) 0.17       1.7     200.00
      1        3.16   17.25    2.056  0.43( 0.07) 0.17       1.7     400.00
      2        0.38    5.04    2.837  0.47( 0.05) 0.10       0.2     500.00

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

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1        2.63    5.04    2.837  0.44( 0.06) 0.14       1.0     500.00
      2        2.78    5.44    2.812  0.44( 0.06) 0.14       1.1     300.00
      3        4.00   11.47    2.426  0.43( 0.07) 0.16       1.8     100.00
      4        3.91   12.56    2.356  0.43( 0.07) 0.16       1.8     200.00
      5        3.43   17.25    2.056  0.43( 0.07) 0.17       1.9     400.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       4.00    Tc(MIN.) =    11.47
  EFFECTIVE AREA(ACRES) =       1.83   AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.43  AREA-AVERAGED Ap =  0.16
  TOTAL AREA(ACRES) =        1.9
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    502.00 =     882.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    502.00 TO NODE    602.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   672.50  DOWNSTREAM(FEET) =   671.90
  FLOW LENGTH(FEET) =   112.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS  11.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.13
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       4.00
  PIPE TRAVEL TIME(MIN.) =   0.45    Tc(MIN.) =   11.93
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    602.00 =     994.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    602.00 TO NODE    602.00 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.) =   11.93
  RAINFALL INTENSITY(INCH/HR) =   2.40
  AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.43
  AREA-AVERAGED Ap =  0.16
  EFFECTIVE STREAM AREA(ACRES) =       1.83
  TOTAL STREAM AREA(ACRES) =       1.86
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       4.00

+---------------------------------------------------------------------------+
| SUBAREA 600                                                               |
| PROPOSED CONDITION                                                        |
|                                                                           |
+---------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    601.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   180.00
  ELEVATION DATA: UPSTREAM(FEET) =    681.90  DOWNSTREAM(FEET) =    677.60

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.121
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.832
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.35      0.47      0.100    75    5.12
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.47
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      0.88
  TOTAL AREA(ACRES) =      0.35   PEAK FLOW RATE(CFS) =      0.88

****************************************************************************
  FLOW PROCESS FROM NODE    601.00 TO NODE    602.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   673.10  DOWNSTREAM(FEET) =   671.90
  FLOW LENGTH(FEET) =     9.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   6.0 INCH PIPE IS   2.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.65
  ESTIMATED PIPE DIAMETER(INCH) =   6.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.88
  PIPE TRAVEL TIME(MIN.) =   0.02    Tc(MIN.) =    5.14
  LONGEST FLOWPATH FROM NODE    600.00 TO NODE    602.00 =     189.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    602.00 TO NODE    602.00 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.) =    5.14
  RAINFALL INTENSITY(INCH/HR) =   2.83
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.47
```

```
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       0.35
  TOTAL STREAM AREA(ACRES) =       0.35
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.88

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1        2.63    5.54    2.806  0.44( 0.06) 0.14       1.0     500.00
      1        2.78    5.92    2.781  0.44( 0.06) 0.14       1.1     300.00
      1        4.00   11.93    2.397  0.43( 0.07) 0.16       1.8     100.00
      1        3.91   13.01    2.327  0.43( 0.07) 0.16       1.8     200.00
      1        3.43   17.72    2.026  0.43( 0.07) 0.17       1.9     400.00
      2        0.88    5.14    2.831  0.47( 0.05) 0.10       0.3     600.00

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

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1        3.34    5.14    2.831  0.45( 0.06) 0.13       1.3     600.00
      2        3.49    5.54    2.806  0.45( 0.06) 0.13       1.4     500.00
      3        3.64    5.92    2.781  0.45( 0.06) 0.13       1.4     300.00
      4        4.74   11.93    2.397  0.44( 0.06) 0.15       2.2     100.00
      5        4.63   13.01    2.327  0.44( 0.07) 0.15       2.2     200.00
      6        4.05   17.72    2.026  0.43( 0.07) 0.16       2.2     400.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       4.74    Tc(MIN.) =    11.93
  EFFECTIVE AREA(ACRES) =       2.18   AREA-AVERAGED Fm(INCH/HR) =  0.06
  AREA-AVERAGED Fp(INCH/HR) =  0.44  AREA-AVERAGED Ap =  0.15
  TOTAL AREA(ACRES) =        2.2
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    602.00 =     994.00 FEET.

+----------------------------------------------------------------------------+
| NOTE: OUTLET CONTROL STRUCTURE 1                                           |
| PEAK FLOW MITIGATED BY DETENTION 1                                         |
| FOLLOWING IS MANUAL ENTRY FOR MITIGATED PEAK FLOW:                         |
+----------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    602.00 TO NODE    602.00 IS CODE =   7
----------------------------------------------------------------------------
  >>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<
============================================================================
  USER-SPECIFIED VALUES ARE AS FOLLOWS:
  TC(MIN.) =   11.93   RAINFALL INTENSITY(INCH/HR) =  2.40
  EFFECTIVE AREA(ACRES) =     2.18
  TOTAL AREA(ACRES) =     2.20        PEAK FLOW RATE(CFS) =      3.86
  AREA-AVERAGED Fm(INCH/HR) =   0.04  AREA-AVERAGED Fp(INCH/HR) =   0.44
  AREA-AVERAGED Ap =  0.10
  NOTE: EFFECTIVE AREA IS USED AS THE TOTAL CONTRIBUTING AREA FOR ALL
        CONFLUENCE ANALYSES.

****************************************************************************
  FLOW PROCESS FROM NODE    602.00 TO NODE   1003.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   671.90  DOWNSTREAM(FEET) =   669.30
  FLOW LENGTH(FEET) =     7.00   MANNING'S N =  0.013
```

```
  DEPTH OF FLOW IN   9.0 INCH PIPE IS   4.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  20.48
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.86
  PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =   11.94
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE   1003.00 =    1001.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   1003.00 TO NODE   1003.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

+--------------------------------------------------------------------------+
| SUBAREA 700                                                              |
| PROPOSED CONDITION                                                       |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    700.00 TO NODE    701.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   425.00
  ELEVATION DATA: UPSTREAM(FEET) =   6825.30  DOWNSTREAM(FEET) =    677.30

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.840
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.37      0.47     0.100    75    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.47
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      0.93
  TOTAL AREA(ACRES) =      0.37   PEAK FLOW RATE(CFS) =      0.93

+--------------------------------------------------------------------------+
| NOTE: SUBAREA FLOW INTO ONE (1) CURB CUT OPENING                         |
| SEE RIP RAP CALCULATIONS                                                 |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    701.00 TO NODE   1001.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  4
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    5.00
  RAINFALL INTENSITY(INCH/HR) =   2.84
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.47
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       0.37
  TOTAL STREAM AREA(ACRES) =       0.37
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.93

+--------------------------------------------------------------------------+
```

```
| SUBAREA 800                                                                  |
| PROPOSED CONDITION                                                           |
|                                                                              |
+------------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    800.00 TO NODE    801.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   345.00
  ELEVATION DATA: UPSTREAM(FEET) =    682.20  DOWNSTREAM(FEET) =    677.30

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.371
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.688
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp          Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        3.02      0.47      0.100    75    7.37
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.47
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      7.18
  TOTAL AREA(ACRES) =      3.02   PEAK FLOW RATE(CFS) =      7.18

+------------------------------------------------------------------------------+
| NOTE: SUBAREA FLOW INTO SEVEN (7) CURB CUT OPENINGS                          |
| SEE RIP RAP CALCULATIONS                                                     |
|                                                                              |
+------------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    801.00 TO NODE   1001.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  4
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    7.37
  RAINFALL INTENSITY(INCH/HR) =   2.69
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.47
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       3.02
  TOTAL STREAM AREA(ACRES) =       3.02
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       7.18

+------------------------------------------------------------------------------+
| SUBAREA 900                                                                  |
| PROPOSED CONDITION                                                           |
|                                                                              |
+------------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    900.00 TO NODE    901.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   375.00
  ELEVATION DATA: UPSTREAM(FEET) =    686.80  DOWNSTREAM(FEET) =    677.30
```

```
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.788
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.726
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.89      0.47     0.100    75    6.79
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.47
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      2.15
  TOTAL AREA(ACRES) =      0.89   PEAK FLOW RATE(CFS) =      2.15

+-------------------------------------------------------------------------+
| NOTE: SUBAREA FLOW INTO ONE (1) CURB CUT OPENING                        |
| SEE RIP RAP CALCULATIONS                                                |
|                                                                         |
+-------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    901.00 TO NODE   1001.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  4
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
  TIME OF CONCENTRATION(MIN.) =    6.79
  RAINFALL INTENSITY(INCH/HR) =   2.73
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.47
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       0.89
  TOTAL STREAM AREA(ACRES) =       0.89
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.15

+-------------------------------------------------------------------------+
| SUBAREA 1000                                                            |
| PROPOSED CONDITION                                                      |
|                                                                         |
+-------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE   1000.00 TO NODE   1001.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   155.00
  ELEVATION DATA: UPSTREAM(FEET) =    677.30  DOWNSTREAM(FEET) =    676.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   22.142
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  1.743
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL GOOD COVER
  "GRASS"                    D        0.13      0.38     1.000    80   22.14
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.38
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      0.16
  TOTAL AREA(ACRES) =      0.13   PEAK FLOW RATE(CFS) =      0.16

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

```
 FLOW PROCESS FROM NODE   1001.00 TO NODE   1001.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  4
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  4 ARE:
 TIME OF CONCENTRATION(MIN.) =   22.14
 RAINFALL INTENSITY(INCH/HR) =   1.74
 AREA-AVERAGED Fm(INCH/HR) =  0.38
 AREA-AVERAGED Fp(INCH/HR) =  0.38
 AREA-AVERAGED Ap =  1.00
 EFFECTIVE STREAM AREA(ACRES) =       0.13
 TOTAL STREAM AREA(ACRES) =       0.13
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.16

 ** CONFLUENCE DATA **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
     1        0.93    5.00    2.840  0.47( 0.05) 0.10       0.4     700.00
     2        7.18    7.37    2.688  0.47( 0.05) 0.10       3.0     800.00
     3        2.15    6.79    2.726  0.47( 0.05) 0.10       0.9     900.00
     4        0.16   22.14    1.743  0.38( 0.38) 1.00       0.1    1000.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  4 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
     1        7.79    5.00    2.840  0.46( 0.05) 0.11       3.1     700.00
     2        9.83    6.79    2.726  0.46( 0.05) 0.11       4.1     900.00
     3       10.26    7.37    2.688  0.46( 0.05) 0.11       4.3     800.00
     4        6.69   22.14    1.743  0.45( 0.06) 0.13       4.4    1000.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      10.26    Tc(MIN.) =     7.37
 EFFECTIVE AREA(ACRES) =       4.32   AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.46  AREA-AVERAGED Ap =  0.11
 TOTAL AREA(ACRES) =        4.4
 LONGEST FLOWPATH FROM NODE    700.00 TO NODE   1001.00 =     425.00 FEET.

+----------------------------------------------------------------------------+
| NOTE: FLOW IS DISTRIBUTED INTO TWO (2) 18" PIPES                           |
| FOLLOWING IS MANUAL PIPE ENTRY                                             |
|                                                                            |
+----------------------------------------------------------------------------+

****************************************************************************
 FLOW PROCESS FROM NODE   1001.00 TO NODE   1002.00 IS CODE =  41
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   672.30  DOWNSTREAM(FEET) =   671.10
 FLOW LENGTH(FEET) =   273.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  18.0 INCH PIPE IS  11.9 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   4.13
 GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   2
 PIPE-FLOW(CFS) =      10.26
 PIPE TRAVEL TIME(MIN.) =   1.10    Tc(MIN.) =    8.47
 LONGEST FLOWPATH FROM NODE    700.00 TO NODE   1002.00 =     698.00 FEET.
```

```
+----------------------------------------------------------------------+
| NOTE: OUTLET CONTROL STRUCTURE 2                                     |
| PEAK FLOW MITIGATED BY DETENTION 2                                   |
| FOLLOWING IS MANUAL ENTRY FOR MITIGATED PEAK FLOW:                   |
+----------------------------------------------------------------------+

**********************************************************************
  FLOW PROCESS FROM NODE   1002.00 TO NODE   1002.00 IS CODE =   7
----------------------------------------------------------------------
  >>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<
======================================================================
  USER-SPECIFIED VALUES ARE AS FOLLOWS:
  TC(MIN.) =    8.47   RAINFALL INTENSITY(INCH/HR) =  2.62
  EFFECTIVE AREA(ACRES) =     4.32
  TOTAL AREA(ACRES) =     4.40        PEAK FLOW RATE(CFS) =      3.24
  AREA-AVERAGED Fm(INCH/HR) =   0.05  AREA-AVERAGED Fp(INCH/HR) =   0.46
  AREA-AVERAGED Ap =  0.11
  NOTE: EFFECTIVE AREA IS USED AS THE TOTAL CONTRIBUTING AREA FOR ALL
        CONFLUENCE ANALYSES.

**********************************************************************
  FLOW PROCESS FROM NODE   1002.00 TO NODE   1003.00 IS CODE =  31
----------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
======================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   671.10  DOWNSTREAM(FEET) =   669.30
  FLOW LENGTH(FEET) =   178.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   9.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.92
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.24
  PIPE TRAVEL TIME(MIN.) =   0.60    Tc(MIN.) =    9.07
  LONGEST FLOWPATH FROM NODE    700.00 TO NODE   1003.00 =     876.00 FEET.

**********************************************************************
  FLOW PROCESS FROM NODE   1003.00 TO NODE   1003.00 IS CODE =  11
----------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
======================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        3.24    9.07    2.579  0.46( 0.05) 0.11       4.3     700.00
  LONGEST FLOWPATH FROM NODE    700.00 TO NODE   1003.00 =     876.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        3.86   11.94    2.396  0.44( 0.04) 0.10       2.2     100.00
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE   1003.00 =    1001.00 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        6.40    9.07    2.579  0.45( 0.05) 0.11       6.0     700.00
      2        6.87   11.94    2.396  0.45( 0.05) 0.11       6.5     100.00
    TOTAL AREA(ACRES) =         6.6

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =        6.87  Tc(MIN.) =   11.936
  EFFECTIVE AREA(ACRES) =      6.50  AREA-AVERAGED Fm(INCH/HR) =  0.05
```

```
  AREA-AVERAGED Fp(INCH/HR) =  0.45  AREA-AVERAGED Ap =  0.11
  TOTAL AREA(ACRES) =        6.6
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE   1003.00 =    1001.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   1003.00 TO NODE   1004.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   669.30  DOWNSTREAM(FEET) =   669.00
  FLOW LENGTH(FEET) =    40.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.42
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.87
  PIPE TRAVEL TIME(MIN.) =   0.12    Tc(MIN.) =   12.06
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE   1004.00 =    1041.00 FEET.

+--------------------------------------------------------------------------+
| DISCHARGE 1                                                              |
| LOW FLOWS: PUMP TO U-CHANNEL                                             |
| HIGH FLOWS: BUBBLE UP IN MANHOLE WITH OPENING TO U-CHANNEL               |
+--------------------------------------------------------------------------+
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        6.6  TC(MIN.) =     12.06
  EFFECTIVE AREA(ACRES) =      6.50  AREA-AVERAGED Fm(INCH/HR)=  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.45  AREA-AVERAGED Ap = 0.107
  PEAK FLOW RATE(CFS)   =       6.87

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        6.40    9.20    2.571  0.45( 0.05) 0.11       6.0     700.00
      2        6.87   12.06    2.388  0.45( 0.05) 0.11       6.5     100.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
         (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
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                          Analysis prepared by:

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                          Anaheim Hills, CA 92808
                               714-685-6860

 ************************* DESCRIPTION OF STUDY *************************
* REXFORD INDUSTRIAL                                                    *
* RATIONAL METHOD ANALYSIS                                              *
* 100 YEAR STORM EVENT                                                  *
 ************************************************************************

  FILE NAME: 3646P.DAT
  TIME/DATE OF STUDY: 14:50 12/04/2023
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED TABLED RAINFALL USED*
  NUMBER OF [TIME,INTENSITY] DATA PAIRS =  5
   1)    5.00;  4.560
   2)   30.00;  1.980
   3)   60.00;  1.480
   4)  180.00;  0.856
   5)  360.00;  0.580
  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *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   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

+------------------------------------------------------------------------+
| SUBAREA 100                                                            |
| PROPOSED CONDITION                                                     |
|                                                                        |
+------------------------------------------------------------------------+

**************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
--------------------------------------------------------------------------
```

```
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
================================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   600.00
  ELEVATION DATA: UPSTREAM(FEET) =    684.80  DOWNSTREAM(FEET) =    679.30

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   10.039
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.040
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        1.24      0.21      0.100    91   10.04
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.21
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      4.49
  TOTAL AREA(ACRES) =      1.24   PEAK FLOW RATE(CFS) =      4.49

+------------------------------------------------------------------------------+
| NOTE: SUBAREA FLOW INTO ONE (1) CURB CUT OPENING                             |
| SEE RIP RAP CALCULATIONS                                                     |
|                                                                              |
+------------------------------------------------------------------------------+

********************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    201.00 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.) =   10.04
  RAINFALL INTENSITY(INCH/HR) =   4.04
  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.21
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       1.24
  TOTAL STREAM AREA(ACRES) =       1.24
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       4.49

+------------------------------------------------------------------------------+
| SUBAREA 200                                                                  |
| PROPOSED CONDITION                                                           |
|                                                                              |
+------------------------------------------------------------------------------+

********************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
--------------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
================================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    55.00
  ELEVATION DATA: UPSTREAM(FEET) =    679.90  DOWNSTREAM(FEET) =    679.20

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   11.118
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.929
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL GOOD COVER
  "GRASS"                    D        0.09      0.16      1.000    94   11.12
```

```
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.16
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      0.31
  TOTAL AREA(ACRES) =      0.09   PEAK FLOW RATE(CFS) =      0.31

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    201.00 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.) =   11.12
  RAINFALL INTENSITY(INCH/HR) =   3.93
  AREA-AVERAGED Fm(INCH/HR) =  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.16
  AREA-AVERAGED Ap =  1.00
  EFFECTIVE STREAM AREA(ACRES) =       0.09
  TOTAL STREAM AREA(ACRES) =       0.09
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.31

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1        4.49   10.04    4.040  0.21( 0.02) 0.10       1.2     100.00
      2        0.31   11.12    3.929  0.16( 0.16) 1.00       0.1     200.00

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

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1        4.77   10.04    4.040  0.19( 0.03) 0.16       1.3     100.00
      2        4.67   11.12    3.929  0.19( 0.03) 0.16       1.3     200.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       4.77    Tc(MIN.) =    10.04
  EFFECTIVE AREA(ACRES) =       1.32   AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.19  AREA-AVERAGED Ap =  0.16
  TOTAL AREA(ACRES) =        1.3
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    201.00 =     600.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    402.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   673.70  DOWNSTREAM(FEET) =   673.10
  FLOW LENGTH(FEET) =   203.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  13.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.46
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       4.77
  PIPE TRAVEL TIME(MIN.) =   0.98    Tc(MIN.) =   11.02
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    402.00 =     803.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    402.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
```

```
==============================================================================

+----------------------------------------------------------------------------+
| SUBAREA 300                                                                |
| PROPOSED CONDITION                                                         |
|                                                                            |
+----------------------------------------------------------------------------+

******************************************************************************
  FLOW PROCESS FROM NODE    300.00 TO NODE    301.00 IS CODE =  21
------------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   140.00
  ELEVATION DATA: UPSTREAM(FEET) =    682.70  DOWNSTREAM(FEET) =    680.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.560
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.33      0.21     0.100    91    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.21
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      1.35
  TOTAL AREA(ACRES) =      0.33   PEAK FLOW RATE(CFS) =      1.35

+----------------------------------------------------------------------------+
| NOTE: SUBAREA FLOW INTO THREE (3) CURB CUT OPENINGS                        |
| SEE RIP RAP CALCULATIONS                                                   |
|                                                                            |
+----------------------------------------------------------------------------+

******************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    401.00 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.) =    5.00
  RAINFALL INTENSITY(INCH/HR) =   4.56
  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.21
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       0.33
  TOTAL STREAM AREA(ACRES) =       0.33
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.35

+----------------------------------------------------------------------------+
| SUBAREA 400                                                                |
| PROPOSED CONDITION                                                         |
|                                                                            |
+----------------------------------------------------------------------------+

******************************************************************************
  FLOW PROCESS FROM NODE    400.00 TO NODE    401.00 IS CODE =  21
------------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==============================================================================
```

```
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   115.00
  ELEVATION DATA: UPSTREAM(FEET) =    680.00  DOWNSTREAM(FEET) =    679.20

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   16.851
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.337
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL GOOD COVER
  "GRASS"                     D        0.05      0.16     1.000    94   16.85
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.16
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      0.14
  TOTAL AREA(ACRES) =      0.05   PEAK FLOW RATE(CFS) =      0.14

****************************************************************************
  FLOW PROCESS FROM NODE    401.00 TO NODE    401.00 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.) =   16.85
  RAINFALL INTENSITY(INCH/HR) =   3.34
  AREA-AVERAGED Fm(INCH/HR) =  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.16
  AREA-AVERAGED Ap =  1.00
  EFFECTIVE STREAM AREA(ACRES) =       0.05
  TOTAL STREAM AREA(ACRES) =       0.05
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.14

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1        1.35    5.00    4.560  0.21( 0.02) 0.10       0.3     300.00
      2        0.14   16.85    3.337  0.16( 0.16) 1.00       0.1     400.00

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

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1        1.41    5.00    4.560  0.19( 0.03) 0.14       0.3     300.00
      2        1.13   16.85    3.337  0.18( 0.04) 0.22       0.4     400.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       1.41    Tc(MIN.) =     5.00
  EFFECTIVE AREA(ACRES) =       0.34   AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.19  AREA-AVERAGED Ap =  0.14
  TOTAL AREA(ACRES) =        0.4
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    401.00 =     140.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    401.00 TO NODE    402.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   674.40  DOWNSTREAM(FEET) =   673.10
  FLOW LENGTH(FEET) =    24.00   MANNING'S N =  0.013
```

```
  DEPTH OF FLOW IN   9.0 INCH PIPE IS   3.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.71
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.41
  PIPE TRAVEL TIME(MIN.) =   0.05    Tc(MIN.) =    5.05
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    402.00 =     164.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    402.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        1.41    5.05    4.555  0.19( 0.03) 0.14       0.3     300.00
      2        1.13   16.91    3.331  0.18( 0.04) 0.22       0.4     400.00
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    402.00 =     164.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        4.77   11.02    3.939  0.19( 0.03) 0.16       1.3     100.00
      2        4.67   12.10    3.827  0.19( 0.03) 0.16       1.3     200.00
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    402.00 =     803.00 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        3.94    5.05    4.555  0.19( 0.03) 0.15       1.0     300.00
      2        6.04   11.02    3.939  0.19( 0.03) 0.16       1.7     100.00
      3        5.91   12.10    3.827  0.19( 0.03) 0.17       1.7     200.00
      4        5.18   16.91    3.331  0.19( 0.03) 0.17       1.7     400.00
    TOTAL AREA(ACRES) =         1.7

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =        6.04  Tc(MIN.) =   11.018
  EFFECTIVE AREA(ACRES) =      1.68  AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.19  AREA-AVERAGED Ap =  0.17
  TOTAL AREA(ACRES) =        1.7
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    402.00 =     803.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    402.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    502.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   672.90  DOWNSTREAM(FEET) =   672.50
  FLOW LENGTH(FEET) =    79.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.51
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.04
  PIPE TRAVEL TIME(MIN.) =   0.29    Tc(MIN.) =   11.31
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    502.00 =     882.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    502.00 TO NODE    502.00 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.) =   11.31
  RAINFALL INTENSITY(INCH/HR) =   3.91
  AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.19
  AREA-AVERAGED Ap =  0.16
  EFFECTIVE STREAM AREA(ACRES) =       1.68
  TOTAL STREAM AREA(ACRES) =       1.71
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       6.04

+--------------------------------------------------------------------------+
| SUBAREA 500                                                              |
| PROPOSED CONDITION                                                       |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    500.00 TO NODE    501.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  ELEVATION DATA: UPSTREAM(FEET) =    682.10  DOWNSTREAM(FEET) =    679.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.560
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.15      0.21      0.100    91    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.21
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      0.61
  TOTAL AREA(ACRES) =      0.15   PEAK FLOW RATE(CFS) =      0.61

****************************************************************************
  FLOW PROCESS FROM NODE    501.00 TO NODE    502.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   676.50  DOWNSTREAM(FEET) =   672.50
  FLOW LENGTH(FEET) =    22.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   6.0 INCH PIPE IS   2.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.87
  ESTIMATED PIPE DIAMETER(INCH) =   6.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.61
  PIPE TRAVEL TIME(MIN.) =   0.04    Tc(MIN.) =    5.04
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    502.00 =     122.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    502.00 TO NODE    502.00 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.) =    5.04
  RAINFALL INTENSITY(INCH/HR) =   4.56
  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.21
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       0.15
  TOTAL STREAM AREA(ACRES) =       0.15
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.61

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1        3.94    5.38    4.521  0.19( 0.03) 0.15       1.0     300.00
      1        6.04   11.31    3.909  0.19( 0.03) 0.16       1.7     100.00
      1        5.91   12.39    3.797  0.19( 0.03) 0.17       1.7     200.00
      1        5.18   17.21    3.300  0.19( 0.03) 0.17       1.7     400.00
      2        0.61    5.04    4.556  0.21( 0.02) 0.10       0.2     500.00

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

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1        4.33    5.04    4.556  0.19( 0.03) 0.14       1.0     500.00
      2        4.55    5.38    4.521  0.19( 0.03) 0.14       1.1     300.00
      3        6.56   11.31    3.909  0.19( 0.03) 0.16       1.8     100.00
      4        6.42   12.39    3.797  0.19( 0.03) 0.16       1.8     200.00
      5        5.63   17.21    3.300  0.19( 0.03) 0.17       1.9     400.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       6.56    Tc(MIN.) =    11.31
  EFFECTIVE AREA(ACRES) =       1.83   AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.19  AREA-AVERAGED Ap =  0.16
  TOTAL AREA(ACRES) =        1.9
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    502.00 =     882.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    502.00 TO NODE    602.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   672.50  DOWNSTREAM(FEET) =   671.90
  FLOW LENGTH(FEET) =   112.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  13.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.67
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.56
  PIPE TRAVEL TIME(MIN.) =   0.40    Tc(MIN.) =   11.71
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    602.00 =     994.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    602.00 TO NODE    602.00 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.) =   11.71
  RAINFALL INTENSITY(INCH/HR) =   3.87
  AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.19
  AREA-AVERAGED Ap =  0.16
  EFFECTIVE STREAM AREA(ACRES) =       1.83
  TOTAL STREAM AREA(ACRES) =       1.86
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       6.56

+---------------------------------------------------------------------------+
| SUBAREA 600                                                               |
| PROPOSED CONDITION                                                        |
|                                                                           |
+---------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    601.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   180.00
  ELEVATION DATA: UPSTREAM(FEET) =    681.90  DOWNSTREAM(FEET) =    677.60

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.121
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.548
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.35      0.21      0.100    91    5.12
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.21
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      1.43
  TOTAL AREA(ACRES) =      0.35   PEAK FLOW RATE(CFS) =      1.43

****************************************************************************
  FLOW PROCESS FROM NODE    601.00 TO NODE    602.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   673.10  DOWNSTREAM(FEET) =   671.90
  FLOW LENGTH(FEET) =     9.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   6.0 INCH PIPE IS   3.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.80
  ESTIMATED PIPE DIAMETER(INCH) =   6.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.43
  PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =    5.13
  LONGEST FLOWPATH FROM NODE    600.00 TO NODE    602.00 =     189.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    602.00 TO NODE    602.00 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.) =    5.13
  RAINFALL INTENSITY(INCH/HR) =   4.55
  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.21
```

```
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       0.35
  TOTAL STREAM AREA(ACRES) =       0.35
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.43

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1        4.33    5.49    4.510  0.19( 0.03) 0.14       1.0     500.00
      1        4.55    5.81    4.477  0.19( 0.03) 0.14       1.1     300.00
      1        6.56   11.71    3.868  0.19( 0.03) 0.16       1.8     100.00
      1        6.42   12.79    3.756  0.19( 0.03) 0.16       1.8     200.00
      1        5.63   17.62    3.258  0.19( 0.03) 0.17       1.9     400.00
      2        1.43    5.13    4.546  0.21( 0.02) 0.10       0.3     600.00

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

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1        5.51    5.13    4.546  0.20( 0.03) 0.13       1.3     600.00
      2        5.74    5.49    4.510  0.20( 0.03) 0.13       1.4     500.00
      3        5.95    5.81    4.477  0.20( 0.03) 0.13       1.5     300.00
      4        7.77   11.71    3.868  0.19( 0.03) 0.15       2.2     100.00
      5        7.59   12.79    3.756  0.19( 0.03) 0.15       2.2     200.00
      6        6.65   17.62    3.258  0.19( 0.03) 0.16       2.2     400.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       7.77    Tc(MIN.) =    11.71
  EFFECTIVE AREA(ACRES) =       2.18   AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.19  AREA-AVERAGED Ap =  0.15
  TOTAL AREA(ACRES) =        2.2
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    602.00 =     994.00 FEET.

+----------------------------------------------------------------------------+
| NOTE: OUTLET CONTROL STRUCTURE 1                                           |
| PEAK FLOW MITIGATED BY DETENTION 1                                         |
| FOLLOWING IS MANUAL ENTRY FOR MITIGATED PEAK FLOW:                         |
+----------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    602.00 TO NODE    602.00 IS CODE =   7
----------------------------------------------------------------------------
  >>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<
============================================================================
  USER-SPECIFIED VALUES ARE AS FOLLOWS:
  TC(MIN.) =   11.93   RAINFALL INTENSITY(INCH/HR) =  3.84
  EFFECTIVE AREA(ACRES) =     2.18
  TOTAL AREA(ACRES) =     2.20        PEAK FLOW RATE(CFS) =      3.86
  AREA-AVERAGED Fm(INCH/HR) =   0.04  AREA-AVERAGED Fp(INCH/HR) =   0.44
  AREA-AVERAGED Ap =  0.10
  NOTE: EFFECTIVE AREA IS USED AS THE TOTAL CONTRIBUTING AREA FOR ALL
        CONFLUENCE ANALYSES.

****************************************************************************
  FLOW PROCESS FROM NODE    602.00 TO NODE   1003.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   671.90  DOWNSTREAM(FEET) =   669.30
  FLOW LENGTH(FEET) =     7.00   MANNING'S N =  0.013
```

```
  DEPTH OF FLOW IN   9.0 INCH PIPE IS   4.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  20.48
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.86
  PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =   11.94
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE   1003.00 =    1001.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   1003.00 TO NODE   1003.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

+--------------------------------------------------------------------------+
| SUBAREA 700                                                              |
| PROPOSED CONDITION                                                       |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    700.00 TO NODE    701.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   425.00
  ELEVATION DATA: UPSTREAM(FEET) =   6825.30  DOWNSTREAM(FEET) =    677.30

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.560
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.37      0.21      0.100    91    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.21
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      1.51
  TOTAL AREA(ACRES) =      0.37   PEAK FLOW RATE(CFS) =      1.51

+--------------------------------------------------------------------------+
| NOTE: SUBAREA FLOW INTO ONE (1) CURB CUT OPENING                         |
| SEE RIP RAP CALCULATIONS                                                 |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    701.00 TO NODE   1001.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  4
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    5.00
  RAINFALL INTENSITY(INCH/HR) =   4.56
  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.21
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       0.37
  TOTAL STREAM AREA(ACRES) =       0.37
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.51

+--------------------------------------------------------------------------+
```

```
| SUBAREA 800                                                                |
| PROPOSED CONDITION                                                         |
|                                                                            |
+----------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    800.00 TO NODE    801.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   345.00
  ELEVATION DATA: UPSTREAM(FEET) =    682.20  DOWNSTREAM(FEET) =    677.30

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.371
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.315
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp          Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        3.02      0.21      0.100    91    7.37
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.21
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =     11.67
  TOTAL AREA(ACRES) =      3.02   PEAK FLOW RATE(CFS) =     11.67

+----------------------------------------------------------------------------+
| NOTE: SUBAREA FLOW INTO SEVEN (7) CURB CUT OPENINGS                        |
| SEE RIP RAP CALCULATIONS                                                   |
|                                                                            |
+----------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    801.00 TO NODE   1001.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  4
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    7.37
  RAINFALL INTENSITY(INCH/HR) =   4.32
  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.21
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       3.02
  TOTAL STREAM AREA(ACRES) =       3.02
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      11.67

+----------------------------------------------------------------------------+
| SUBAREA 900                                                                |
| PROPOSED CONDITION                                                         |
|                                                                            |
+----------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    900.00 TO NODE    901.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   375.00
  ELEVATION DATA: UPSTREAM(FEET) =    686.80  DOWNSTREAM(FEET) =    677.30
```

```
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.788
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.375
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.89      0.21      0.100    91    6.79
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.21
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      3.49
  TOTAL AREA(ACRES) =      0.89   PEAK FLOW RATE(CFS) =      3.49

+-------------------------------------------------------------------------+
| NOTE: SUBAREA FLOW INTO ONE (1) CURB CUT OPENING                        |
| SEE RIP RAP CALCULATIONS                                                |
|                                                                         |
+-------------------------------------------------------------------------+

**************************************************************************
  FLOW PROCESS FROM NODE    901.00 TO NODE   1001.00 IS CODE =   1
--------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
==========================================================================
  TOTAL NUMBER OF STREAMS =  4
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
  TIME OF CONCENTRATION(MIN.) =    6.79
  RAINFALL INTENSITY(INCH/HR) =   4.38
  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.21
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       0.89
  TOTAL STREAM AREA(ACRES) =       0.89
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.49

+-------------------------------------------------------------------------+
| SUBAREA 1000                                                            |
| PROPOSED CONDITION                                                      |
|                                                                         |
+-------------------------------------------------------------------------+

**************************************************************************
  FLOW PROCESS FROM NODE   1000.00 TO NODE   1001.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   155.00
  ELEVATION DATA: UPSTREAM(FEET) =    677.30  DOWNSTREAM(FEET) =    676.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   22.142
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.791
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL GOOD COVER
  "GRASS"                    D        0.13      0.16      1.000    94   22.14
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.16
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      0.31
  TOTAL AREA(ACRES) =      0.13   PEAK FLOW RATE(CFS) =      0.31

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

```
 FLOW PROCESS FROM NODE   1001.00 TO NODE   1001.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  4
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  4 ARE:
 TIME OF CONCENTRATION(MIN.) =   22.14
 RAINFALL INTENSITY(INCH/HR) =   2.79
 AREA-AVERAGED Fm(INCH/HR) =  0.16
 AREA-AVERAGED Fp(INCH/HR) =  0.16
 AREA-AVERAGED Ap =  1.00
 EFFECTIVE STREAM AREA(ACRES) =       0.13
 TOTAL STREAM AREA(ACRES) =       0.13
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.31

 ** CONFLUENCE DATA **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
     1        1.51    5.00    4.560  0.21( 0.02) 0.10       0.4     700.00
     2       11.67    7.37    4.315  0.21( 0.02) 0.10       3.0     800.00
     3        3.49    6.79    4.375  0.21( 0.02) 0.10       0.9     900.00
     4        0.31   22.14    2.791  0.16( 0.16) 1.00       0.1    1000.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  4 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
     1       12.67    5.00    4.560  0.21( 0.02) 0.11       3.1     700.00
     2       15.99    6.79    4.375  0.21( 0.02) 0.11       4.1     900.00
     3       16.70    7.37    4.315  0.21( 0.02) 0.11       4.3     800.00
     4       10.98   22.14    2.791  0.20( 0.03) 0.13       4.4    1000.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      16.70    Tc(MIN.) =     7.37
 EFFECTIVE AREA(ACRES) =       4.32   AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.21  AREA-AVERAGED Ap =  0.11
 TOTAL AREA(ACRES) =        4.4
 LONGEST FLOWPATH FROM NODE    700.00 TO NODE   1001.00 =     425.00 FEET.

+----------------------------------------------------------------------------+
| NOTE: FLOW IS DISTRIBUTED INTO TWO (2) 18" PIPES                           |
| FOLLOWING IS MANUAL PIPE ENTRY                                             |
|                                                                            |
+----------------------------------------------------------------------------+

****************************************************************************
 FLOW PROCESS FROM NODE   1001.00 TO NODE   1002.00 IS CODE =  41
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   672.30  DOWNSTREAM(FEET) =   671.10
 FLOW LENGTH(FEET) =   273.00   MANNING'S N =  0.013
 ASSUME FULL-FLOWING PIPELINE
 PIPE-FLOW VELOCITY(FEET/SEC.) =   4.12
 (PIPE FLOW VELOCITY CORRESPONDING TO NORMAL-DEPTH FLOW
  AT DEPTH = 0.94 * DIAMETER)
 GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   2
 PIPE-FLOW(CFS) =      16.70
 PIPE TRAVEL TIME(MIN.) =   1.10    Tc(MIN.) =    8.47
```

```
 LONGEST FLOWPATH FROM NODE    700.00 TO NODE   1002.00 =     698.00 FEET.

+----------------------------------------------------------------------------+
| NOTE: OUTLET CONTROL STRUCTURE 2                                           |
| PEAK FLOW MITIGATED BY DETENTION 2                                         |
| FOLLOWING IS MANUAL ENTRY FOR MITIGATED PEAK FLOW:                         |
+----------------------------------------------------------------------------+

****************************************************************************
 FLOW PROCESS FROM NODE   1002.00 TO NODE   1002.00 IS CODE =   7
----------------------------------------------------------------------------
 >>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<
============================================================================
 USER-SPECIFIED VALUES ARE AS FOLLOWS:
 TC(MIN.) =    8.29   RAINFALL INTENSITY(INCH/HR) =  4.22
 EFFECTIVE AREA(ACRES) =     4.32
 TOTAL AREA(ACRES) =     4.40        PEAK FLOW RATE(CFS) =      3.24
 AREA-AVERAGED Fm(INCH/HR) =   0.05  AREA-AVERAGED Fp(INCH/HR) =   0.46
 AREA-AVERAGED Ap =  0.11
 NOTE: EFFECTIVE AREA IS USED AS THE TOTAL CONTRIBUTING AREA FOR ALL
       CONFLUENCE ANALYSES.

****************************************************************************
 FLOW PROCESS FROM NODE   1002.00 TO NODE   1003.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   671.10  DOWNSTREAM(FEET) =   669.30
 FLOW LENGTH(FEET) =   178.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  12.0 INCH PIPE IS   9.4 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   4.92
 ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       3.24
 PIPE TRAVEL TIME(MIN.) =   0.60    Tc(MIN.) =    8.89
 LONGEST FLOWPATH FROM NODE    700.00 TO NODE   1003.00 =     876.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   1003.00 TO NODE   1003.00 IS CODE =  11
----------------------------------------------------------------------------
 >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

 ** MAIN STREAM CONFLUENCE DATA **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1        3.24    8.89    4.158  0.46( 0.05) 0.11       4.3     700.00
 LONGEST FLOWPATH FROM NODE    700.00 TO NODE   1003.00 =     876.00 FEET.

 ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1        3.86   11.94    3.844  0.44( 0.04) 0.10       2.2     100.00
 LONGEST FLOWPATH FROM NODE    100.00 TO NODE   1003.00 =    1001.00 FEET.

 ** PEAK FLOW RATE TABLE **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1        6.35    8.89    4.158  0.45( 0.05) 0.11       5.9     700.00
     2        6.85   11.94    3.844  0.45( 0.05) 0.11       6.5     100.00
   TOTAL AREA(ACRES) =         6.6

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
```

```
  PEAK FLOW RATE(CFS) =        6.85  Tc(MIN.) =   11.936
  EFFECTIVE AREA(ACRES) =      6.50  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.45  AREA-AVERAGED Ap =  0.11
  TOTAL AREA(ACRES) =        6.6
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE   1003.00 =    1001.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   1003.00 TO NODE   1004.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   669.30  DOWNSTREAM(FEET) =   669.00
  FLOW LENGTH(FEET) =    40.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.42
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.85
  PIPE TRAVEL TIME(MIN.) =   0.12    Tc(MIN.) =   12.06
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE   1004.00 =    1041.00 FEET.

+--------------------------------------------------------------------------+
| DISCHARGE 1                                                              |
| LOW FLOWS: PUMP TO U-CHANNEL                                             |
| HIGH FLOWS: BUBBLE UP IN MANHOLE WITH OPENING TO U-CHANNEL               |
+--------------------------------------------------------------------------+
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        6.6  TC(MIN.) =     12.06
  EFFECTIVE AREA(ACRES) =      6.50  AREA-AVERAGED Fm(INCH/HR)=  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.45  AREA-AVERAGED Ap = 0.107
  PEAK FLOW RATE(CFS)   =       6.85

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        6.35    9.02    4.145  0.45( 0.05) 0.11       5.9     700.00
      2        6.85   12.06    3.832  0.45( 0.05) 0.11       6.5     100.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

# APPENDIX G

## 100-year Hydraulic Capacity Calculations

Curb Inlet Analysis
Grate Inlet Analysis
Riser Inlet Analysis
Curb Cut Opening FlowMaster Analysis
Rip Rap Calculations (and SD County Dwg. D-40)

# French Valley Crossings
# Curb Opening Catch Basin
**100 Year Storm Event**

| Catch Basin Node Number | Opening Length ft | Opening Height ft | Ponding Depth ft | $Q_{100}$ cfs | Area acres | Q/L cfs/ft | Minimum Length ft |
|---|---|---|---|---|---|---|---|
| 601 | 4.00 | 0.50 | 0.50 | 1.43 | 0.35 | 1.10 | 1.30 |

Reference: Bureau of Public Roads "Nomograph for Capacity of Curb - Sump Condition - Table L"

# Rexford Industrial
# Grate Inlet Analysis
### 100 Year Storm Event

| Catch Basin Node Number | Clogging % | Catch Basin Length ft | Catch Basin Width ft | Actual Perimeter ft | Effective Perimeter ft | $Q_{100}$ cfs | Q/P cfs/ft | Head ft |
|---|---|---|---|---|---|---|---|---|
| 501[1] | 33% | 1.00 | 1.00 | 4.00 | 2.68 | 0.31 | 0.11 | 0.11 |

Reference: Bureau of Public Roads "Capacity of Grate Inlet in Sump"

[1]Surface runoff divided between two inlets

# Rexford Industrial
# Riser Inlet Analysis
### 100 Year Storm Event

| BioPond | Node # | Circular Riser Clogging % | Circular Riser Diameter in | Actual Perimeter ft | Effective Perimeter ft | $Q_{100}$ cfs | Q/P cfs/ft | Head[2] ft | Bottom of Pond elev | Top of Riser elev | W.S.E. of Pond elev | Top of Pond elev |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 201 | 25% | 30 | 7.85 | 5.89 | 4.77 | 0.81 | 0.42 | 677.7 | 679.2 | 679.6 | 679.7 |
| B | 1001[1] | 25% | 30 | 7.85 | 5.89 | 5.57 | 0.95 | 0.46 | 675.3 | 676.8 | 677.3 | 677.3 |
| C | 401 | 25% | 30 | 7.85 | 5.89 | 1.41 | 0.24 | 0.19 | 678.7 | 679.2 | 679.4 | 679.7 |

[1]Surface runoff divided between three inlets

[2]Head derived from weir equation using effective perimeter of the riser opening diameter

# Worksheet for NODE 101 - Curb Cut

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---|---|
| Roughness Coefficient | 0.013 |
| Channel Slope | 0.020 ft/ft |
| Bottom Width | 2.00 ft |
| Discharge | 4.49 cfs |

| Results | |
|---|---|
| Normal Depth | 4.1 in |
| Flow Area | 0.7 ft² |
| Wetted Perimeter | 2.7 ft |
| Hydraulic Radius | 3.1 in |
| Top Width | 2.00 ft |
| Critical Depth | 6.5 in |
| Critical Slope | 0.005 ft/ft |
| Velocity | 6.52 ft/s |
| Velocity Head | 0.66 ft |
| Specific Energy | 1.01 ft |
| Froude Number | 1.960 |
| Flow Type | Supercritical |

| GVF Input Data | |
|---|---|
| Downstream Depth | 0.0 in |
| Length | 0.0 ft |
| Number Of Steps | 0 |

| GVF Output Data | |
|---|---|
| Upstream Depth | 0.0 in |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 4.1 in |
| Critical Depth | 6.5 in |
| Channel Slope | 0.020 ft/ft |
| Critical Slope | 0.005 ft/ft |

# Worksheet for NODE 301 - Curb Cut x3

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---|---|
| Roughness Coefficient | 0.013 |
| Channel Slope | 0.020 ft/ft |
| Bottom Width | 6.00 ft |
| Discharge | 1.35 cfs |

| Results | |
|---|---|
| Normal Depth | 0.9 in |
| Flow Area | 0.5 ft² |
| Wetted Perimeter | 6.2 ft |
| Hydraulic Radius | 0.9 in |
| Top Width | 6.00 ft |
| Critical Depth | 1.4 in |
| Critical Slope | 0.005 ft/ft |
| Velocity | 2.90 ft/s |
| Velocity Head | 0.13 ft |
| Specific Energy | 0.21 ft |
| Froude Number | 1.838 |
| Flow Type | Supercritical |

| GVF Input Data | |
|---|---|
| Downstream Depth | 0.0 in |
| Length | 0.0 ft |
| Number Of Steps | 0 |

| GVF Output Data | |
|---|---|
| Upstream Depth | 0.0 in |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 0.9 in |
| Critical Depth | 1.4 in |
| Channel Slope | 0.020 ft/ft |
| Critical Slope | 0.005 ft/ft |

# Worksheet for NODE 701 - Curb Cut

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---|---|
| Roughness Coefficient | 0.013 |
| Channel Slope | 0.020 ft/ft |
| Bottom Width | 2.00 ft |
| Discharge | 1.51 cfs |

| Results | |
|---|---|
| Normal Depth | 2.0 in |
| Flow Area | 0.3 ft² |
| Wetted Perimeter | 2.3 ft |
| Hydraulic Radius | 1.7 in |
| Top Width | 2.00 ft |
| Critical Depth | 3.1 in |
| Critical Slope | 0.005 ft/ft |
| Velocity | 4.46 ft/s |
| Velocity Head | 0.31 ft |
| Specific Energy | 0.48 ft |
| Froude Number | 1.910 |
| Flow Type | Supercritical |

| GVF Input Data | |
|---|---|
| Downstream Depth | 0.0 in |
| Length | 0.0 ft |
| Number Of Steps | 0 |

| GVF Output Data | |
|---|---|
| Upstream Depth | 0.0 in |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 2.0 in |
| Critical Depth | 3.1 in |
| Channel Slope | 0.020 ft/ft |
| Critical Slope | 0.005 ft/ft |

# Worksheet for NODE 801 - Curb Cut x7

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---|---|
| Roughness Coefficient | 0.013 |
| Channel Slope | 0.020 ft/ft |
| Bottom Width | 14.00 ft |
| Discharge | 11.67 cfs |

| Results | |
|---|---|
| Normal Depth | 2.0 in |
| Flow Area | 2.4 ft² |
| Wetted Perimeter | 14.3 ft |
| Hydraulic Radius | 2.0 in |
| Top Width | 14.00 ft |
| Critical Depth | 3.3 in |
| Critical Slope | 0.004 ft/ft |
| Velocity | 4.89 ft/s |
| Velocity Head | 0.37 ft |
| Specific Energy | 0.54 ft |
| Froude Number | 2.088 |
| Flow Type | Supercritical |

| GVF Input Data | |
|---|---|
| Downstream Depth | 0.0 in |
| Length | 0.0 ft |
| Number Of Steps | 0 |

| GVF Output Data | |
|---|---|
| Upstream Depth | 0.0 in |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 2.0 in |
| Critical Depth | 3.3 in |
| Channel Slope | 0.020 ft/ft |
| Critical Slope | 0.004 ft/ft |

# Worksheet for NODE 901 - Curb Cut

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---|---|
| Roughness Coefficient | 0.013 |
| Channel Slope | 0.020 ft/ft |
| Bottom Width | 2.00 ft |
| Discharge | 3.49 cfs |

| Results | |
|---|---|
| Normal Depth | 3.5 in |
| Flow Area | 0.6 ft² |
| Wetted Perimeter | 2.6 ft |
| Hydraulic Radius | 2.7 in |
| Top Width | 2.00 ft |
| Critical Depth | 5.5 in |
| Critical Slope | 0.005 ft/ft |
| Velocity | 5.99 ft/s |
| Velocity Head | 0.56 ft |
| Specific Energy | 0.85 ft |
| Froude Number | 1.955 |
| Flow Type | Supercritical |

| GVF Input Data | |
|---|---|
| Downstream Depth | 0.0 in |
| Length | 0.0 ft |
| Number Of Steps | 0 |

| GVF Output Data | |
|---|---|
| Upstream Depth | 0.0 in |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 3.5 in |
| Critical Depth | 5.5 in |
| Channel Slope | 0.020 ft/ft |
| Critical Slope | 0.005 ft/ft |

# French Valley Crossings
# Rip Rap Calculations
**100 Year Storm Event**

| Curb Cut Rip Rap Node No. | Opening No. # | Opening Width ft | Opening Height ft | $Q_{100}$ cfs | Ponding Depth[1] ft | Velocity[1] ft/s | Rip-Rap Rock Class | Rip-Rap Thickness ft | Rip-Rap Length ft | Rip-Rap Width ft |
|---|---|---|---|---|---|---|---|---|---|---|
| 101 | 1 | 2.00 | 0.50 | 4.49 | 0.34 | 6.52 | No. 2 Backing | 1.1 | 8 | 6 |
| 301[2] | 3 | 2.00 | 0.50 | 0.45 | 0.08 | 2.90 | No. 2 Backing | 1.1 | 3 | 4 |
| 701[2] | 1 | 2.00 | 0.67 | 1.51 | 0.17 | 4.46 | No. 2 Backing | 1.1 | 6 | 4 |
| 801[2] | 7 | 2.00 | 0.67 | 1.67 | 0.17 | 4.89 | No. 2 Backing | 1.1 | 6 | 4 |
| 901 | 1 | 2.00 | 0.67 | 3.49 | 0.29 | 5.99 | No. 2 Backing | 1.1 | 8 | 6 |

Reference: San Diego County Drainage Design Manual July 2005, See Dwg. D-40

[1]Ponding depth and Velocity calculated using Bentley FlowMaster channel worksheets

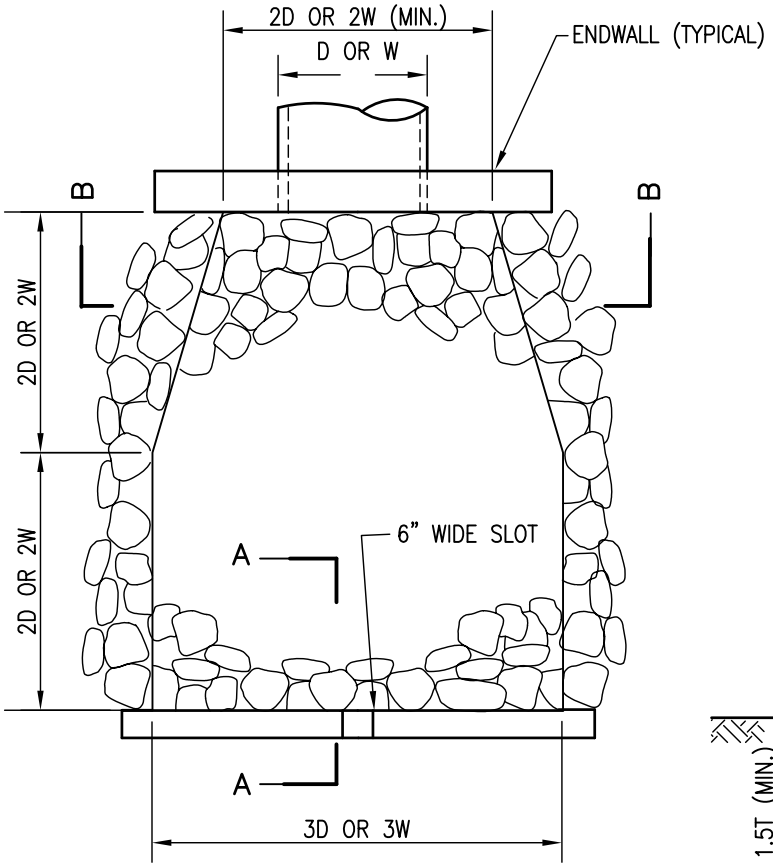
[2]For non-erosive flow (less than 6 ft/s) rip-rap is not required. To be conservative, reduced length rip-rap based on geometric conditions still provided

TABLE 7-1 (BELOW) PER JULY 2005
SAN DIEGO COUNTY DRAINAGE DESIGN MANUAL

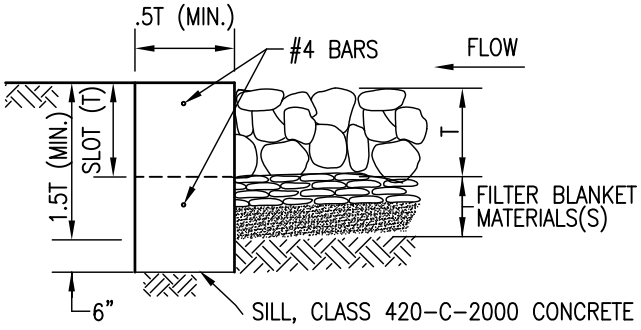
| DESIGN VELOCITY (FT/SEC) * | ROCK CLASS | RIP-RAP THICKNESS "T" (MIN) |
|---|---|---|
| 6-10 | NO. 2 BACKING | 1.1 FT |
| 10-12 | 1/4 TON | 2.7 FT |
| 12-14 | 1/2 TON | 3.5 FT |
| 14-16 | 1 TON | 4.4 FT |
| 16-18 | 2 TON | 5.4 FT |

* OVER 20 FT/SEC REQUIRES SPECIAL DESIGN

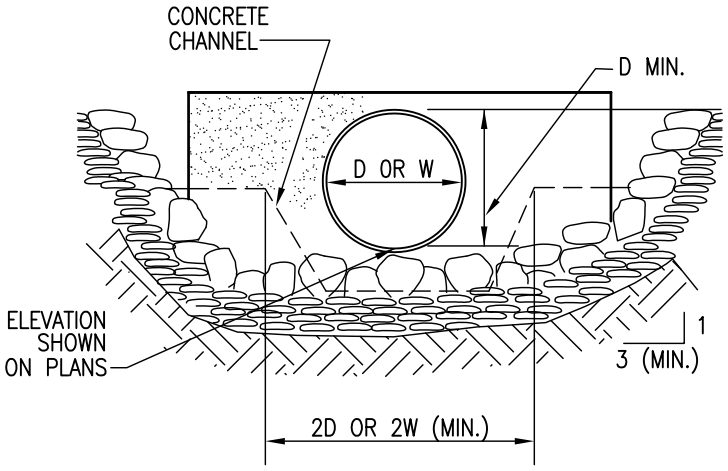
D = PIPE DIAMETER ø
W = BOTTOM WIDTH OF CHANNEL




PLAN




SECTION A-A




SECTION B-B

NOTES

1. PLANS SHALL SPECIFY:
   (A) ROCK CLASS AND RIP-RAP THICKNESS (T). T SHALL BE AT LEAST 1.5 TIMES THE NOMINAL EQUIVALENT DIAMETER OF STONE ($d_{50}$) OF THE SPECIFIED RIP-RAP.
   (B) FILTER BLANKET MATERIAL, NUMBER OF LAYERS AND THICKNESS.
2. RIP-RAP SHALL BE EITHER QUARRY STONE OR BROKEN CONCRETE (IF SHOWN ON PLANS). COBBLES ARE NOT ACCEPTABLE.
3. RIP-RAP SHALL BE PLACED OVER FILTER BLANKET MATERIAL, WHICH MAY BE EITHER GRANULAR MATERIAL OR NON-WOVEN GEOTEXTILE FILTER FABRIC; MATERIAL AT WEIGHT SPECIFIED IN PLANS OR SPECIFICATIONS.
4. SEE TABLE 200-1.7 IN THE SAN DIEGO REGIONAL SUPPLEMENT TO GREENBOOK FOR SELECTION OF FILTER BLANKET.
5. RIP-RAP ENERGY DISSIPATERS SHALL BE DESIGNATED AS EITHER TYPE 1 OR TYPE 2. TYPE 1 SHALL BE WITH CONCRETE SILL; TYPE 2 SHALL BE WITHOUT SILL.

| Revision | By | Approved | Date |
|---|---|---|---|
| ORIGINAL | | Kercheval | 12/75 |
| Edited | T.R. | T. Regello | 10/15 |
| Edited | M.W. | M. Widelski | 10/18 |
| Reviewed | RP | S. Engeda | 03/22 |
| | | | |

SAN DIEGO REGIONAL STANDARD DRAWING

# RIP RAP
# ENERGY DISSIPATER

RECOMMENDED BY THE SAN DIEGO REGIONAL STANDARDS COMMITTEE

Samson Engeda 03/24/2022
Chairperson R.C.E. 52241 Date

DRAWING NUMBER **D-40**

# APPENDIX H
## Geotech Report & Infiltration Testing

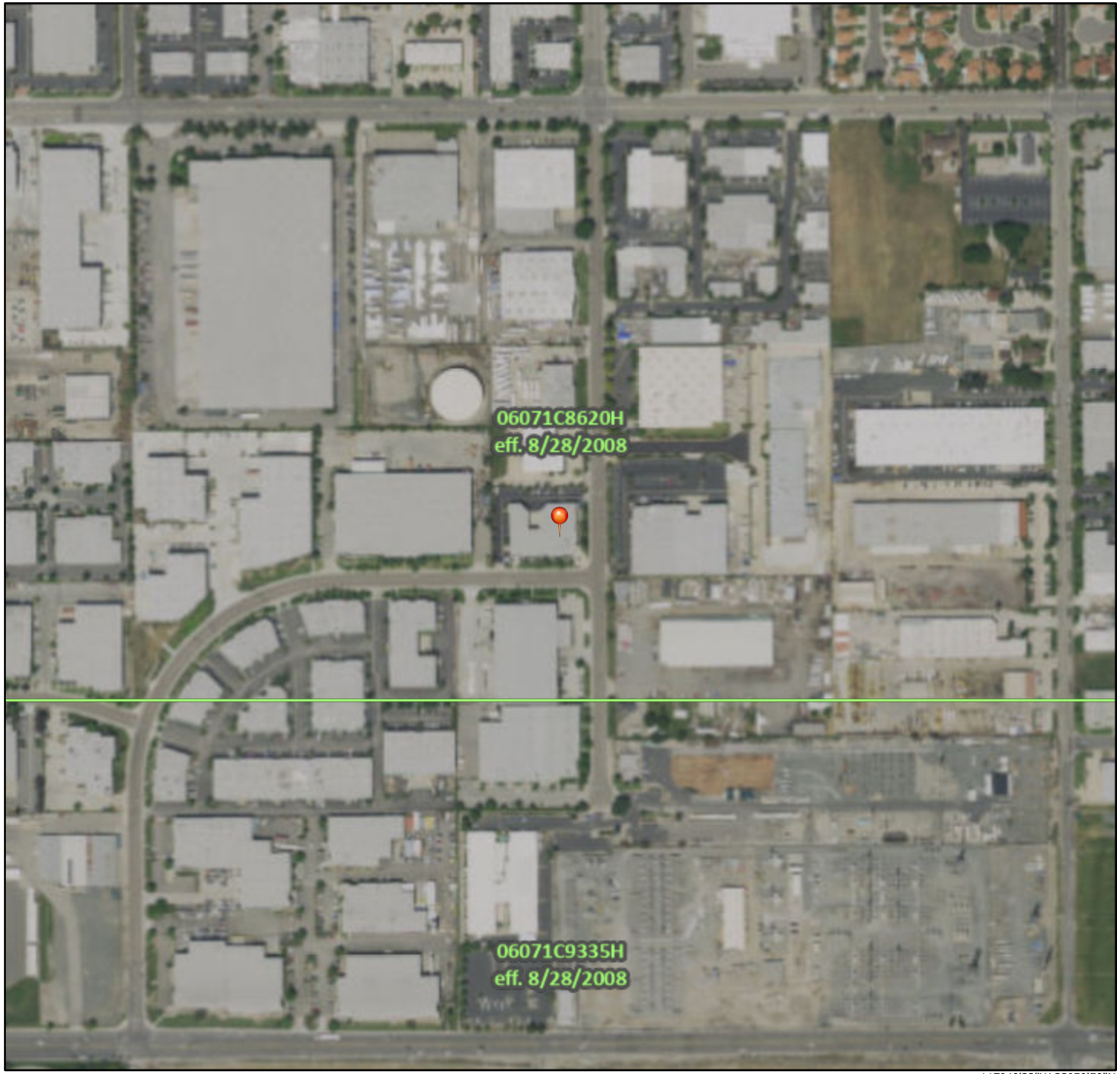
ALREADY REFERENCED IN APPENDIX A
OF THE pWQMP REPORT

# APPENDIX I
# FEMA Firmette Flood Zone Map

# National Flood Hazard Layer FIRMette

FEMA

117°41'10"W 34°0'19"N




117°40'32"W 33°59'50"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

*Basemap Imagery Source: USGS National Map 2023*

## Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

**SPECIAL FLOOD HAZARD AREAS**
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

**OTHER AREAS OF FLOOD HAZARD**
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

**OTHER AREAS**
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

**GENERAL STRUCTURES**
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

**OTHER FEATURES**
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

**MAP PANELS**
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/11/2023 at 6:13 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

# APPENDIX J
# Preliminary Pump Specifications

# WEIL 3-Inch Submersible Wastewater Pump 2441DS

Heavy duty pump for commercial and industrial applications.
Pump clear water, gray water, effluent and wastewater with solids up to 2-inch diameter.

| | |
|---|---|
| Disch. Size | 3 Inch |
| Disch. Type | ANSI |
| Solids Max. | 2 Inch |
| Mounting Style | 2613 Removal |

**Pump**
- Case - Cast Iron
- Impeller - Cast Iron
- Stainless Steel Hardware

**Options**
- Bronze Impeller
- 316 Stainless Steel Impeller 316 Stainless Steel Case
- Additional Power Cable Lengths
- High-temperature motor
- Stainless Steel Lifting Cable

**Motor**

**Double Opposed Seal Mechanical Seal**
- Upper seal faces Carbon against Ceramic
- Lower seal faces Silicon Carbide against Silicon Carbide

**Air-Filled Hermetically Sealed**
**Shaft - Stainless Steel Series 300**
Motor Shell - Cast Iron
Insulation - Class F
Ball Bearings - 2 - Double Sealed
Power Cable Length - 20 ft
Three-phase motor
- 1750 RPM
- 60 Hz, 208-230 or 460 volts

Single-phase capacitor start motor
- 1750 RPM
- 60 Hz, 115 or 208-230 volts
  Automatic reset thermal and overload protection
- 1 1/2 HP Max single phase

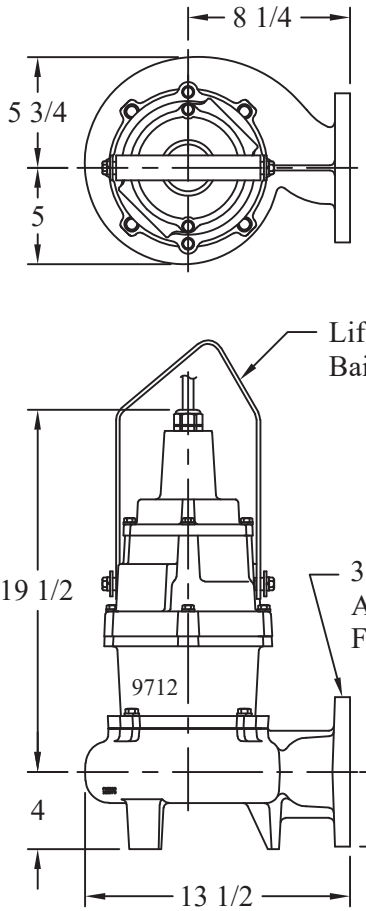
**Capacities** - Wet Wells

| Dia or Side Inches | Gallons per Foot of Depth | |
|---|---|---|
| | Round | Square |
| 18 | 13 | 17 |
| 24 | 24 | 30 |
| 30 | 37 | 47 |
| 36 | 53 | 67 |
| 48 | 94 | 120 |
| 60 | 147 | 187 |
| 72 | 212 | 269 |

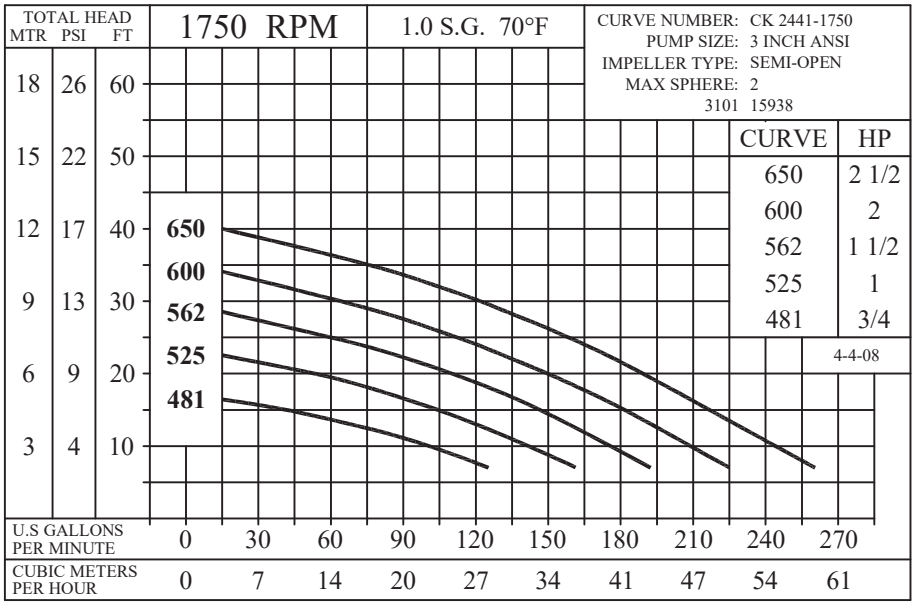
**Flow** - To prevent solids from settling out

| Discharge Pipe Size Dia Inches | Minimum Flow GPM |
|---|---|
| 2 | 25 |
| 3 | 50 |
| 4 | 90 |

**Good wet well design**
Maximum 10 starts per hour.
Minimum run time - 1 1/2 minutes.




Impeller curves are Non-Overloading at any point on curve.
These are standard impeller trims. Other trims are available as options.



**Customer** :
**Reference** :

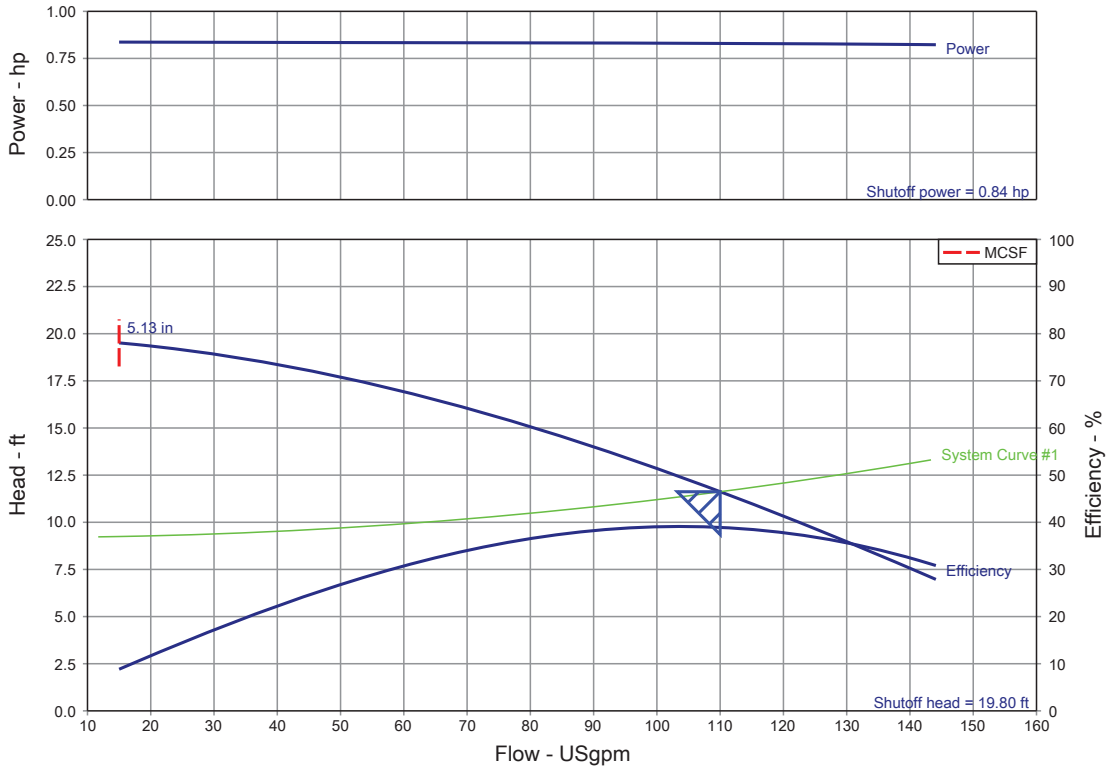
# Pump Performance Datasheet

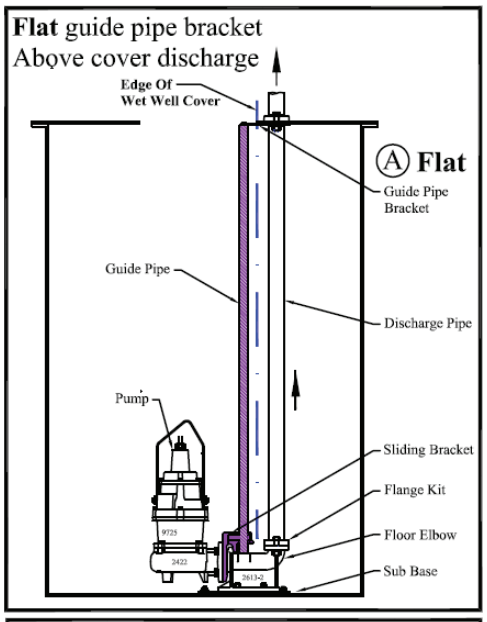
Wilo Quotation System 23.3.1

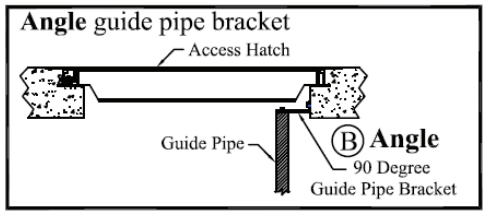
| | | | |
|---|---|---|---|
| Item number | : 001 | Size | : Weil 3-2441-1750 |
| Service | : | Stages | : 1 |
| Quantity | : 1 | Based on curve number | : CK-2441-1750 Rev 0.0 |
| Quote number | : 852370 | Article Number | : |
| | | Date last saved | : 30 Nov 2023 11:39 AM |

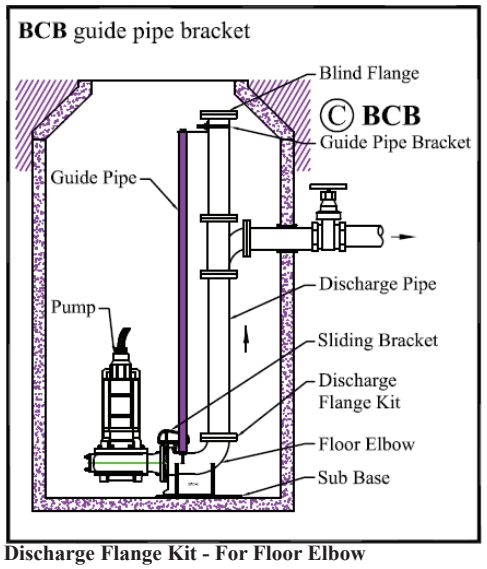
| **Operating Conditions** | |
|---|---|
| Flow, rated | : 110.0 USgpm |
| Differential head / pressure, rated (requested) | : 11.62 ft |
| Differential head / pressure, rated (actual) | : 11.63 ft |
| Suction pressure, rated / max | : 0.00 / 0.00 psi.g |
| NPSH available, rated | : Ample |
| Site Supply Frequency | : 60 Hz |
| **Performance** | |
| Speed criteria | : Synchronous |
| Speed, rated | : 1750 rpm |
| Impeller diameter, rated | : 5.13 in |
| Impeller diameter, maximum | : 6.50 in |
| Impeller diameter, minimum | : 4.80 in |
| Efficiency | : 38.90 % |
| NPSH required / margin required | : - / 0.00 ft |
| Ns (imp. eye flow) / Nss (imp. eye flow) | : 2,059 / - US Units |
| MCSF | : 15.00 USgpm |
| Head, maximum, rated diameter | : 19.51 ft |
| Head rise to shutoff | : 70.36 % |
| Flow, best eff. point | : 103.6 USgpm |
| Flow ratio, rated / BEP | : 106.21 % |
| Diameter ratio (rated / max) | : 78.85 % |
| Head ratio (rated dia / max dia) | : 37.17 % |
| Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010] | : 1.00 / 1.00 / 1.00 / 1.00 |
| Selection status | : Acceptable |

| **Liquid** | |
|---|---|
| Liquid type | : Water |
| Additional liquid description | : |
| Solids Diameter, required / pump max | : 0.00 in / 2.00 in |
| Solids concentration, by volume | : 0.00 % |
| Temperature, max | : 68.00 deg F |
| Fluid density, rated / max | : 1.000 / 1.000 SG |
| Viscosity, rated | : 1.00 cP |
| Vapor pressure, rated | : 0.34 psi.a |
| **Material** | |
| Material selected | : Standard |
| **Pressure Data** | |
| Maximum working pressure | : 8.44 psi.g |
| Maximum allowable working pressure | : N/A |
| Maximum allowable suction pressure | : N/A |
| Hydrostatic test pressure | : N/A |
| **Driver & Power Data (@Max density)** | |
| Driver sizing specification | : Rated power |
| Margin over specification | : 0.00 % |
| Service factor | : 1.00 |
| Power, hydraulic | : 0.32 hp |
| Power, rated | : 0.83 hp |
| Power, maximum, rated diameter | : 0.84 hp |
| Minimum recommended motor rating | : 1.00 hp / 0.75 kW |






**Discharge Flange Kit - For Floor Elbow**

Includes - Flange, Gasket and Hardware
Weil = 2 bolt oval configuration

| Order Number | Material | Pipe Type | Flange Type |
|---|---|---|---|
| 2613K203 | Cast Iron | Plain End | Weil |
| 2613K943 | 316 SS | Plain End | Weil |
| 2613K103 | Cast Iron | Threaded | Weil |
| 2613K105 | Cast Iron | Threaded | ANSI |
| 2613K953 | 316 SS | Threaded | ANSI |

**Intermediate Guide Pipe Bracket:**

| | |
|---|---|
| 205.666.001 | Intermediate Guide Pipe Bracket |

**System Includes:**

- Discharge Floor Elbow - one
- Sliding Bracket - one
  - Iron or
  - Bronze for use with Explosion Proof Motors
    - 316 Stainless Steel
- Guide Pipe Bracket - one
  A - Flat (cover mount) - bolts to wet well cover or
  B - Angle 90º (side mount) bolts to vertical side wall or
  C - BCB Bracket - Duplex or Simplex mounts to discharge pipe(s) - see pg 2 diagrams

**Not Included:**

- Discharge Pipe - (3 inch schedule 40)
- Guide Pipe - (2 inch schedule 40)

**Options:**

- Discharge Flange Kit for Floor Elbow
- Intermediate Guide Pipe Bracket
- Sub Base for Floor Elbow
- Level Control Lifting Assembly for BCB Duplex Bracket

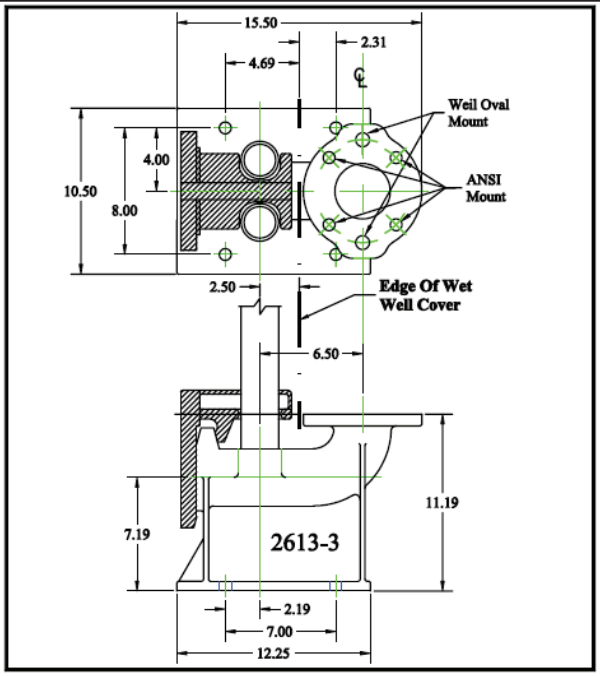
**Removal System:**

**Simplex**

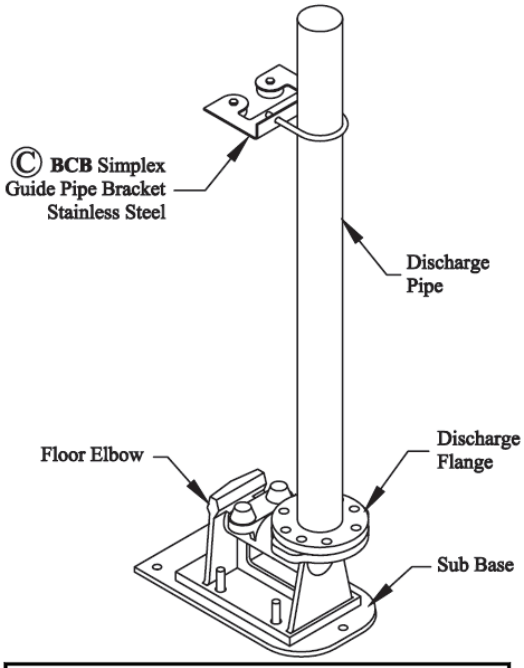
| Order Number | Floor Elbow | Sliding Bracket | Guide Pipe Bracket | Mount Type | Weight Lbs. |
|---|---|---|---|---|---|
| 2613K1022 | Iron | Iron | Flat | Cover | 92 |
| 2613K2022 | Iron | Bronze | Flat | Cover | 92 |
| 2613K9103 | 316 SS | 316 SS | Flat | Cover | 92 |
| 2613K5012 | Iron | Iron | Angle | Side | 92 |
| 2613K6033 | Iron | Bronze | Angle | Side | 92 |
| 2613K9123 | 316 SS | 316 SS | Angle | Side | 92 |
| 2613K3022 | Iron | Iron | BCB | Pipe | 92 |
| 2613K4022 | Iron | Bronze | BCB | Pipe | 92 |
| 2613K9133 | 316 SS | 316 SS | BCB | Pipe | 92 |

**Duplex - BCB System**

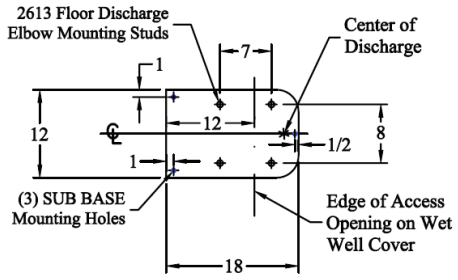
| Order Number | Floor Elbow | Sliding Bracket | Guide Pipe Bracket | Mount Type | Weight Lbs. |
|---|---|---|---|---|---|
| 2613K7022 | Iron | Iron | Pipe | BCB | 184 |
| 2613K7032 | Iron | Bronze | Pipe | BCB | 184 |
| 2613K9723 | 316 SS | 316 SS | Pipe | BCB | 184 |



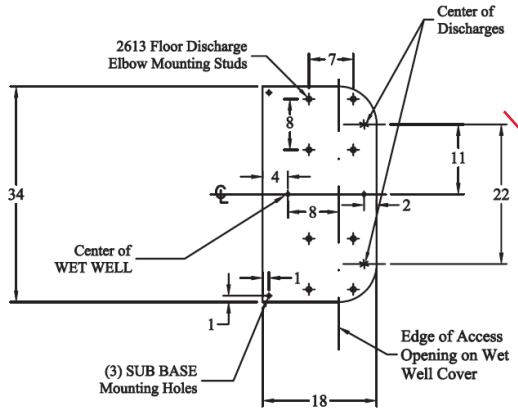
## BCB - Simplex



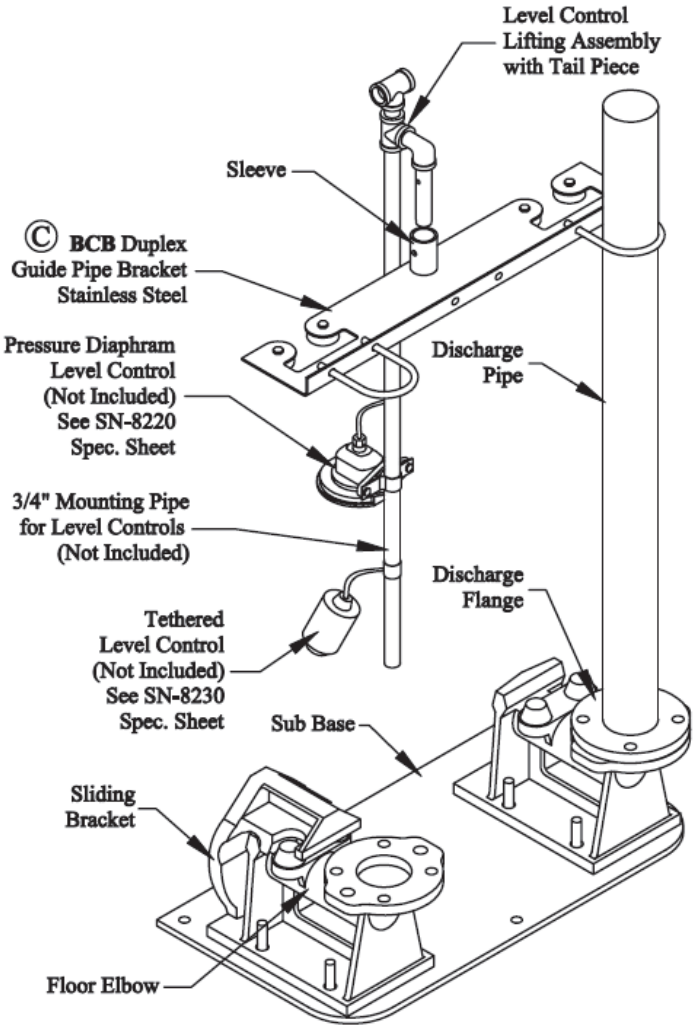

**Sub-Base - SIMPLEX**




**Sub-Base - DUPLEX**




## BCB - Duplex




**Sub Base for Simplex/Duplex Installations**

Epoxy Coated or Stainless Steel sub base with stainless steel studs is used to locate and install the 2613 discharge floor elbows in a wet well. Mounting locations match standard Weil 8804/8815 wet well covers and 2616 valves. Three 9/16 holes for bolting to the wet well floor. Waterproof adhesive 3M Marine 5200 could be used instead of bolting.

| Order Number | Style | Material | Stud Size | Pump Size | Min. Wet Well Diameter |
|---|---|---|---|---|---|
| 2613K603 | Simplex | Epoxy Coated | 1/2" | 7" case | 30" |
| 2613K923 | Simplex | 304 SS | 1/2" | 9" case | 36" |
| 2613K502 | Duplex | Epoxy Coated | 1/2" | 7" case | 42" |
| 2613K903 | Duplex | 304 SS | 1/2" | 9" case | 48" |

**Level Control Lifting Assembly**
**(Duplex BCB systems only)**

Does not include level control switches or mounting pipe.
See SN-8220 and SN-8230

| Order Number | |
|---|---|
| 2613K801 | Level Control Lifting Assembly with Tailpiece |

# WEIL Tethered Level Control 8233

## Float Switch

The 8233 level controls utilize pole mounted tethered switches. The pole may be suspended from either a wet well cover or a bracket fastened to the wall of the wet well.

Each tethered switch includes a cord grip and strap mount for mounting to a 3/4 inch or 1 inch pole.

The 8233 tethered switch is normally open, closing on liquid rise. Use with Weil 8100 Control Panels. The switch is not rated for motor loads.

- Single-pole switch has 16/2 cord with 2 wires, black/white
- 115 volt, 3 amp pilot duty

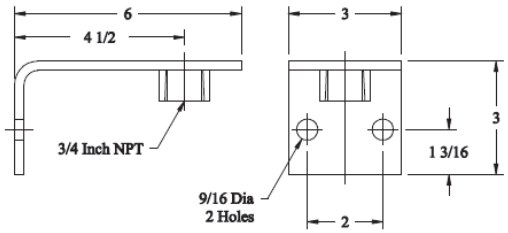
**Duplex System**

Lead pump starts when the liquid level activates Switch FS2. The lead pump will run until the liquid level deactivates Switch FS1.

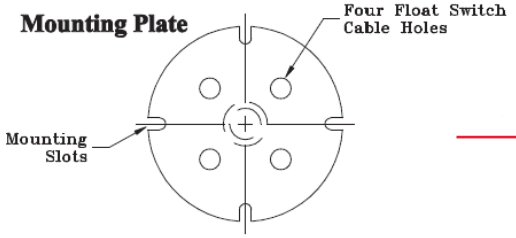
The Lag pump will start if the liquid level activates Switch FS3. Both pumps continue to run until the liquid level deactivates Switch FS1.

If the liquid level activates Switch FSA the high water alarm circuit will turn on.

**Mounting Bracket**




**Mounting Plate**




| Configuration | Switches Required |
|---|---|
| Simplex | 2 |
| Simplex with Alarm | 3 |
| Duplex | 3 |
| Duplex with Alarm | 4 |

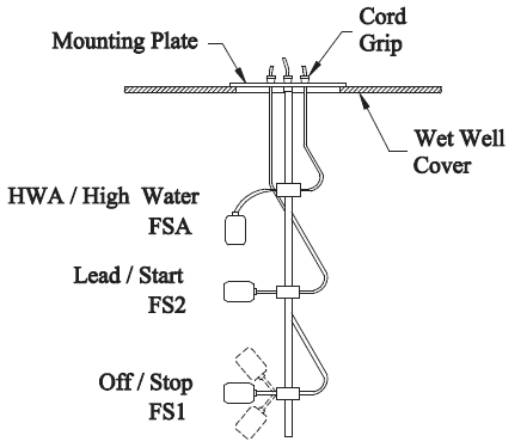
**8233 Tethered Float Switch**

| Order Number | Type of Assembly | Cord Length (Ft.) | Approx. Wt. (Lbs.) |
|---|---|---|---|
| **8233K1006** | Switch only with cord grip | 20 | 4 |
| **8233K1014** | Switch only with cord grip | 40 | 6 |
| **8233K1016** | Switch only with cord grip | 60 | 8 |
| **8233K1018** | Switch only with cord grip | 80 | 10 |
| **8233K1020** | Switch only with cord grip | 100 | 12 |

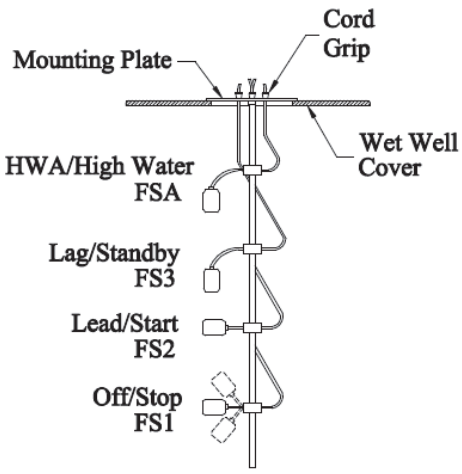
**8233 Options**

| Option | Description |
|---|---|
| **314.399.000** | Mounting Bracket - For sidewall suspends 3/4 inch pipe from wet well wall. Pipe Not included. |
| **315.445.001** | Mounting Plate - Round 8-inch diameter with four holes for level control cable cord grips. Suspends 3/4 or 1 inch pipe from mounting plate. Pipe Not included. Fastens to wet well cover with fasteners. |
| **304.331.096** | Mounting Pipe - 3/4 inch schedule 40, 10 feet long. Threaded on one end. |
| **303.935.103** | Mounting Pipe - 1 inch schedule 40, 10 feet long. Threaded on one end. |

**Simplex Configuration**




**Duplex Configuration**

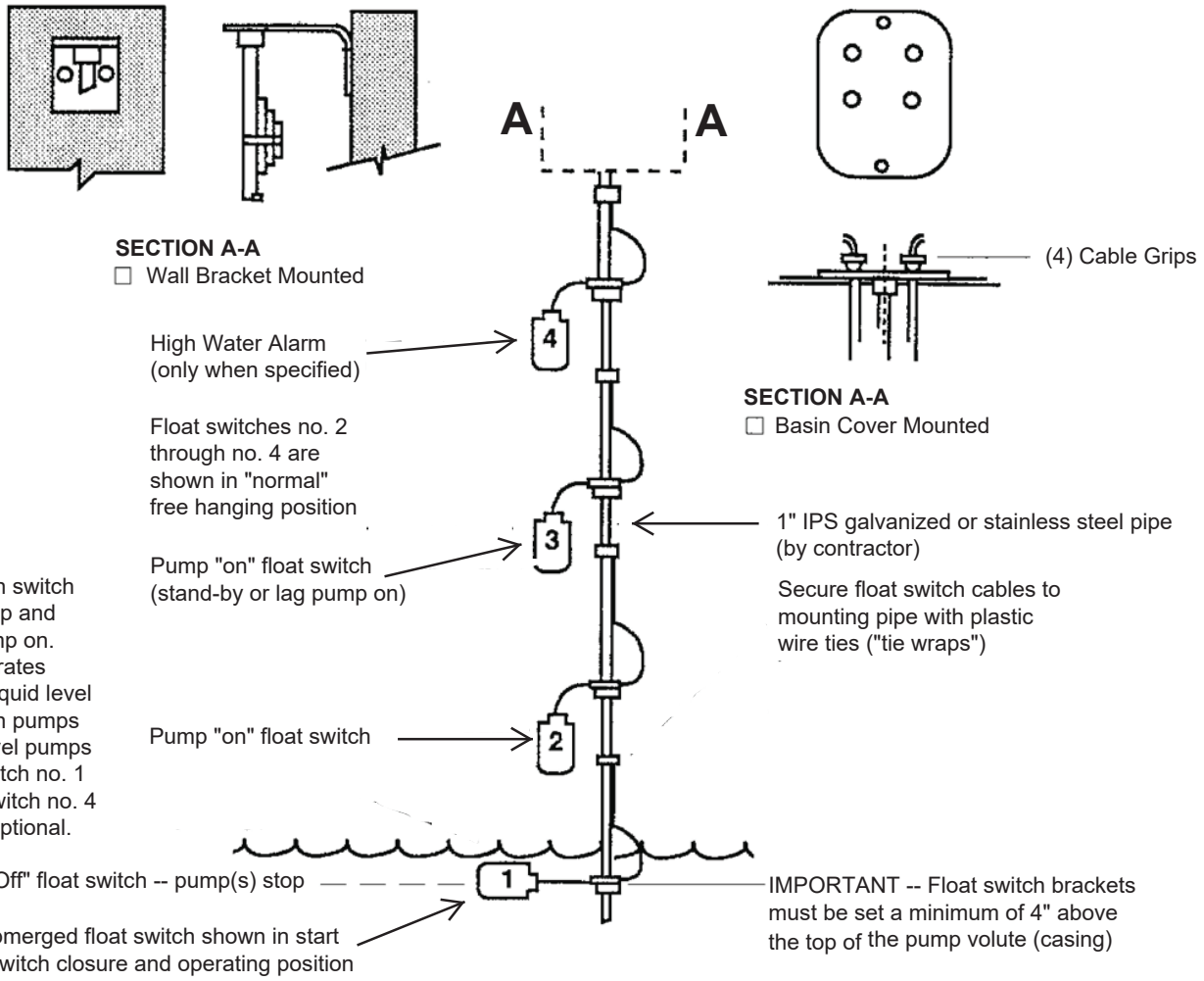



**How to order:** Specify Model Number and Wet Well Depth. F.O.B. Cedarburg (Milwaukee), Wisconsin

weil aquatronics
Treating Water as a Resource ™

*13630 San Antonio Dr.*
*Norwalk, CA 90650*
*(562) 364-7430*
*Fax: 818-247-0083*
*www.weilaquatronics.com*

# MECHANICAL FLOAT SWITCH INSTALLATION INSTRUCTIONS
# DUPLEX - 4 FLOAT SWITCHES




**SEQUENCE**

Float switch no. 2 (with switch no. 1 already floated up and closed) turns lead pump on. Float switch no. 3 operates second (lag) pump if liquid level continues to rise. Both pumps turn off when liquid level pumps down and the float switch no. 1 circuit opens. Float switch no. 4 (high water alarm) is optional.

**In determining the correct spacing of the float switches, please follow these steps:**

1) Set float switch no. 4 "high water alarm level" at least 2" below the lowest inlet.
2) Float switch no. 3 "standby" should be set directly below float switch no. 4, with the float switches at least 90 degrees apart to prevent the lower no. 3 switch from hitting or entangling with the upper no. 4 switch as it rises with the liquid.
3) Float switch no. 2 "pump on" should be set 3"- 4" below switch no. 3.
4) Float switch no. 1 "pumps stop" ("off") must be set a minimum of 4" above the top of the pump volute (casing).
5) Check complete installation to see that none of the float switches hit the basin wall, the pumps, piping, or valves. This check should be made with the float switches in both "on" and "off" positions.

**NOTE:** *Float switches are not to be installed evenly spaced as shown. Spacing between float switch no. 1 and no. 2 determines the pump run time. This should be at least 2 minutes.*

1) If floats are close enough to touch, then the floats should be offset from each other to prevent any possible obstruction/entanglement.
2) ALL CABLES SHOULD BE SECURED NEATLY TO THE FLOAT POLE TO PREVENT ANY OBSTRUCTION.
3) Do not run float cables through the upper float bracket hole.

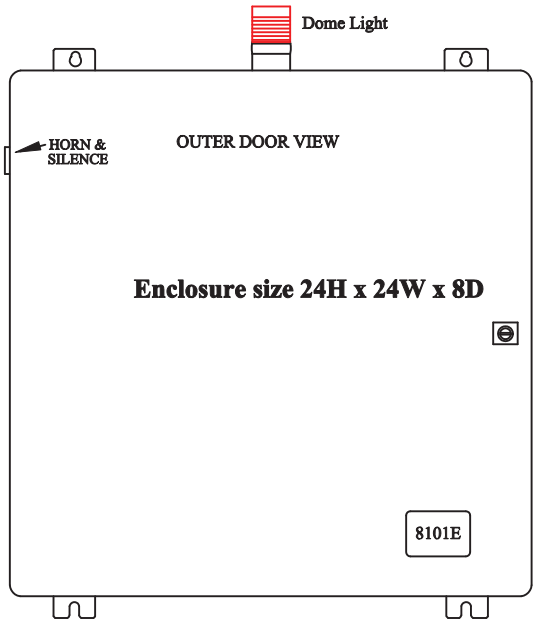
**QUESTIONS? Call 1-800-74-PUMPS**

# WEIL Duplex Alternating Pump Control Panel 8101E

Duplex

## Two Independent Control Circuits
## Type 4 Double Door Dead Front Enclosure

- The 8101E Duplex panel has complete electrical separation of the control circuits for both pumps. It is a specification grade panel that utilizes single-pole level controls.
- Each pump has an independent control circuit power supply. Each pump control circuit also serves as backup for the other pump control circuit.
- Panel can be operated at 50 or 60 Hertz power.
- Type 4 enclosure for indoor or outdoor use. Provides protection against falling rain, splashing water or hose directed water; undamaged by the formation of ice on the enclosure.
- Exceeds Type 1, 3R and 12 requirements.
- Select level controls
  - 8213 Lever
  - 8220 Pressure Diaphragm
  - 8230 Tethered Float
- Requires one 8213 lever or four 8220 or 8230 level switches - three switches for level control and one switch for the high water.




**Panel Includes**

- U/L Listed Label
- LED Lights, hour meter, switches, and test buttons are on inner door.
- One lockable panel disconnect; through-the-door with door interlock on inner door. The mechanical interlock prevents the door from being opened when the disconnect is in the ON position. Lock is not provided.
- Padlocking hasp - on outer door, padlock not included.
- Two Industrial duty contactors.
- Two lockable pump disconnects, on motor overload protectors. Lock is not provided.
- Electric Alternator has a 3 position selector switch; that locks the pumps in Auto, Pump 1-2 or Pump 2-1 sequencing.
- Two Overloads - one per pump. Ambient compensated bimetallic (Class 10) motor overload circuit protector. Instantaneous magnetic trip for short circuit protection. Single-phase short circuit protection for three-phase motors. Field adjustable within the amp range.
- Two Control transformers with fused primary and fused secondary on all three-phase and single-phase 208 and 230-volt. Single-phase 115-volt has two fused control circuits.
- Pump run switches - one per pump. Three position TOA (test-off-automatic) with spring return to off from test.
- Green light indicates power to pump motor. One light per pump.
- White light indicates control power on. One light per control circuit.
- Red overload light indicates motor overload condition and pump is off. Light remains on and pump remains off until rest. One light per pump.
- Hour meters; non resetting meters indicates total pump run time.
- General Alarm Fault and Pump Run Status isolated contacts.
- High Water Alarm System Type 4X. Hold finger over hole of horn for 1-2 seconds and remove to silence horn (95 dB).
  - Red HWA light and alarm test button on inner door.
  - Two isolated contacts for remote monitoring and/or to use as a connection to a phone dialer.
- Alarm LED Dome Light - Lexan, red flashing on top of enclosure. Light indicates a general fault condition; overload, high water, moisture sensor or over temp condition. Light remains on until condition is corrected.
- Control Terminal board, numbered and wired.
- Layout and schematic CAD diagrams are provided. Installer connections at terminal board are clearly marked.

| Motor Protrector Amp Range | Order Number | | | Approx. Weight Lbs. |
|---|---|---|---|---|
| | Single-Phase 115 Volts | Single-phase 208 or 230 Volts | Three-Phase 208, 230,460 Volts | |
| 1.0 - 1.6 | 8101E-L-016 | 8101E-D-016 | 8101E-T-016 | 86 |
| 1.6 - 2.5 | 8101E-L-025 | 8101E-D-025 | 8101E-T-025 | 86 |
| 2.5 - 4.0 | 8101E-L-040 | 8101E-D-040 | 8101E-T-040 | 86 |
| 4.0 - 6.3 | 8101E-L-063 | 8101E-D-063 | 8101E-T-063 | 86 |
| 6.3 - 10.0 | 8101E-L-100 | 8101E-D-100 | 8101E-T-100 | 86 |
| 10.0 - 16.0 | 8101E-L-160 | 8101E-D-160 | 8101E-T-160 | 86 |
| 16.0 - 20.0 | 8101E-L-200 | 8101E-D-200 | 8101E-T-200 | 88 |
| 20.0 - 25.0 | 8101E-L-250 | 8101E-D-250 | 8101E-T-250 | 88 |
| *25.0 - 32.0 | 8101E-L-320 | 8101E-D-320 | 8101E-T-320 | 101 |
| *32.0 - 40.0 | 8101E-L-400 | 8101E-D-400 | 8101E-T-400 | 101 |
| *40.0 - 50.0 | 8101E-L-500 | 8101E-D-500 | 8101E-T-500 | 116 |

*Includes 2nd disconnect and larger enclosure

**Options:**

**8100K7079** Type 4X 304 Stainless Steel outer enclosure

**8100K7222D** Option is for a duplex set of pumps with standard Non-Explosion-Proof Motors (9712 & 9725).
- Moisture sensor relay and test buttons only. Two yellow lights indicate moisture in the pump motor.

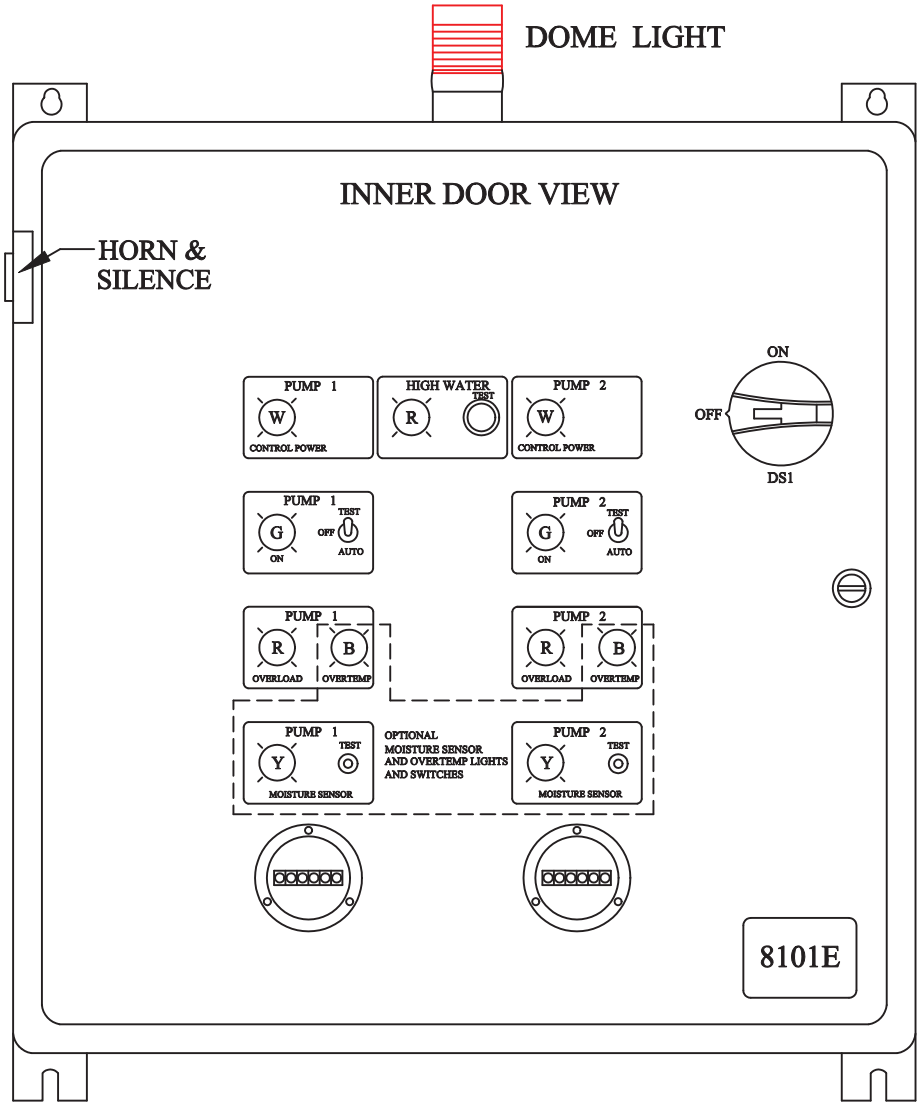
**8100K7224D** Option is for a duplex set of pumps with standard Non-Explosion-Proof Motors (9706, 9709, & 9727).
- Moisture sensor relay and test button. Two yellow lights indicate moisture in the pump motor.
- Temperature limiter circuit shuts down pump motor when motor temperature is sensed. The temperature limiter circuit automatically resets when the motor temperature falls to a normal temperature operating range. Two Blue lights indicates motor over temperature.

**How to Order:** Specify the Order Number, System Phase and Voltage, Pump Motor HP and any options.
F.O.B. Cedarburg (Milwaukee), Wisconsin

# WEIL Duplex Alternating Pump Control Panel 8101E

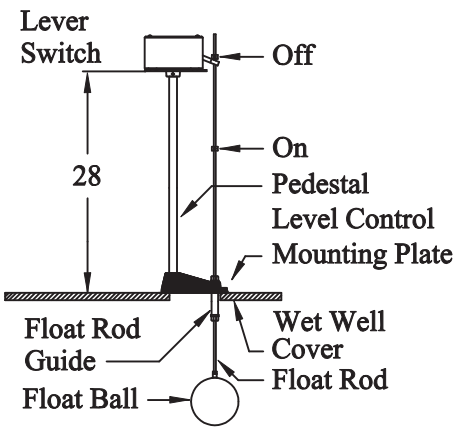
Two Independant Control Circuits
Type 4 Double Door Dead Front Enclosure

Duplex

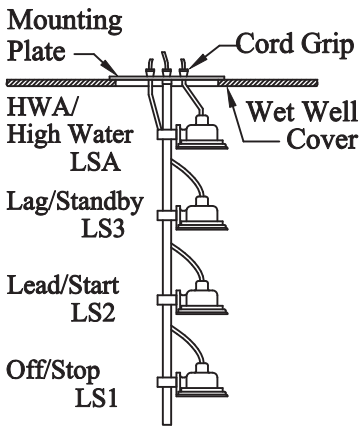



**Use any of the three level controls with duplex control panel.**

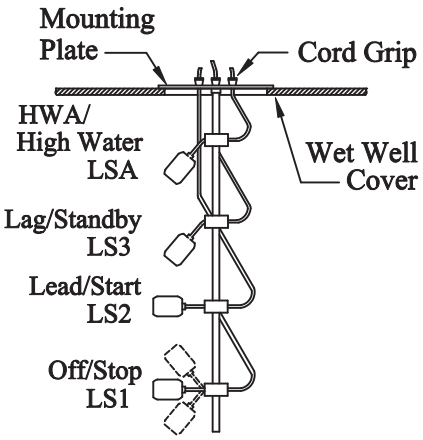
**8213 Lever**

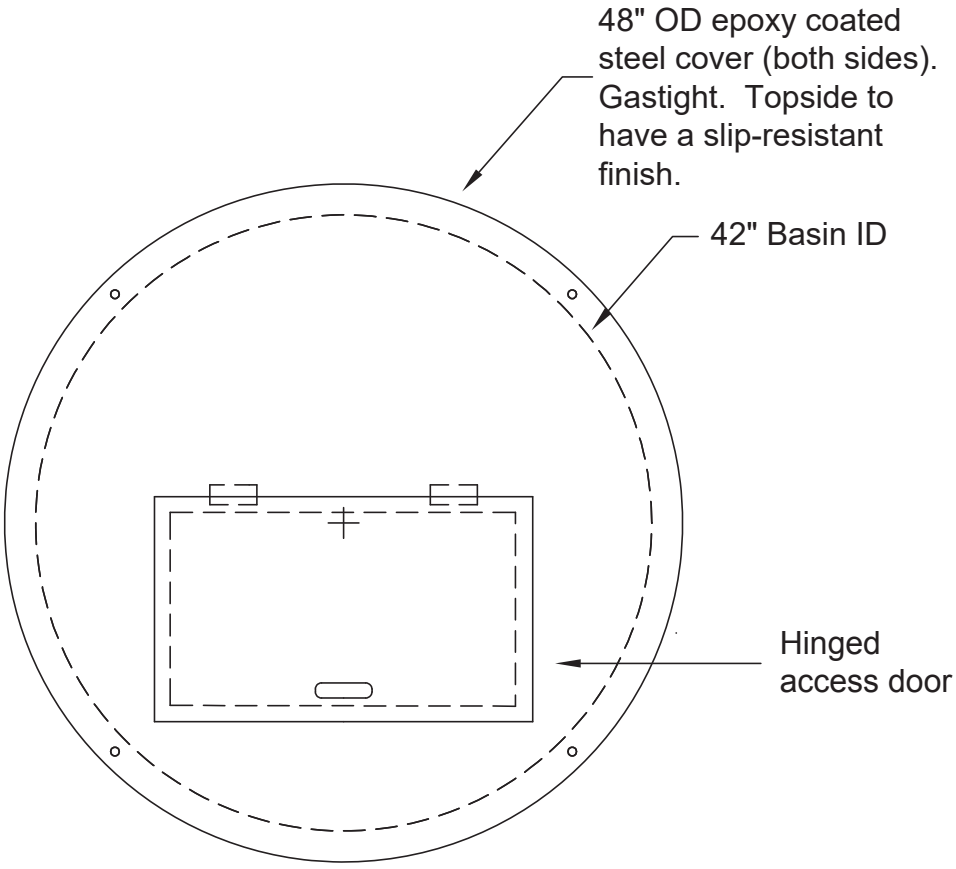



**8220 Pressure Diaphragm**



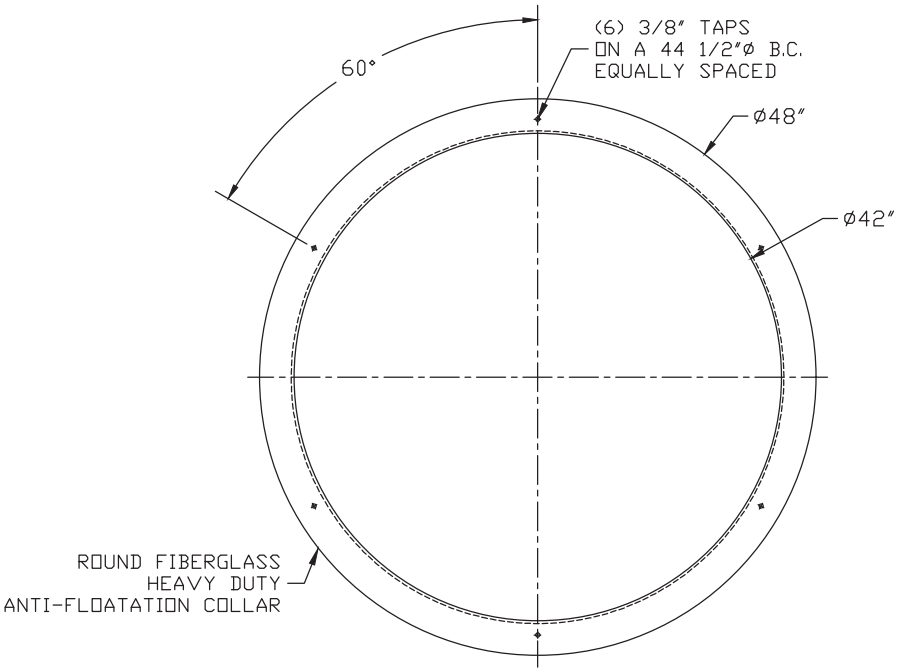

**8230 Tethered**

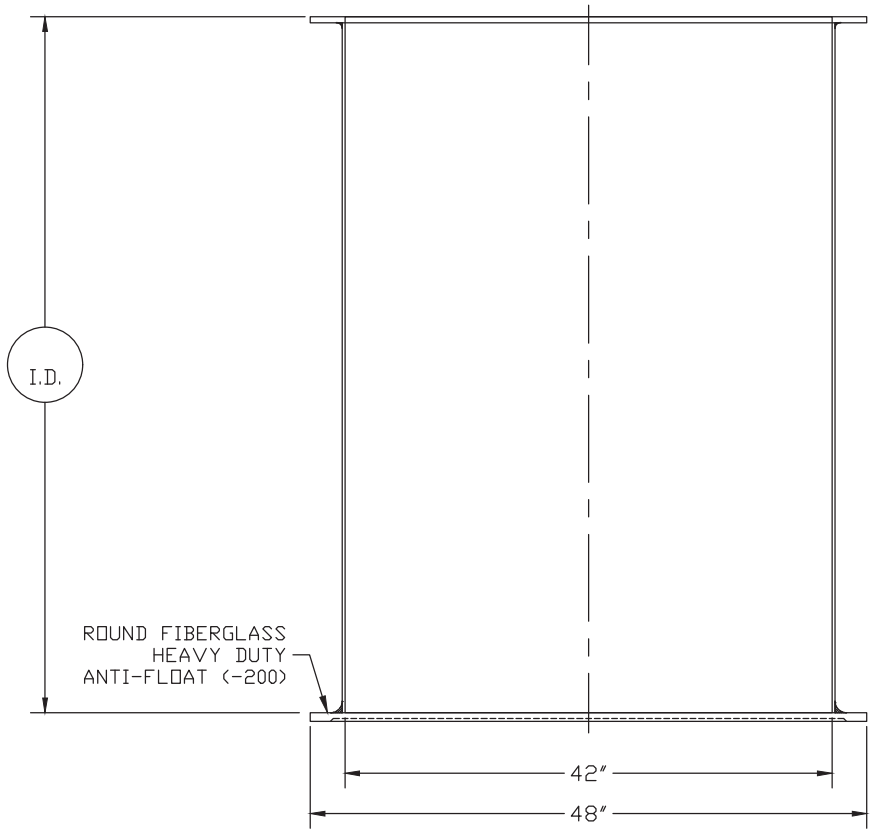





| | | | | |
|---|---|---|---|---|
| PROJECT: Rexford Insustrial | weil aquatronics<br>Engineered Pumps and Hydronic Equipment<br>Phone: 800-747-8677 Fax: 818-247-0083 | | | |
| LOCATION: Chino | | | | |
| ITEM: SP Cover | | | | |
| CONTRACTOR: | DWG: 78.HAD.PTW | BY: RFB | Date: 11/30/23 | Scale: NTS |

| PART/PRINT #: | PART DESCRIPTION: | DATE: |
|---|---|---|
| GB-42-200 | 42"ø FIBERGLASS BASIN W/ ROUND HEAVY DUTY ANTI-FLOATATION COLLAR | 08/14/19 |




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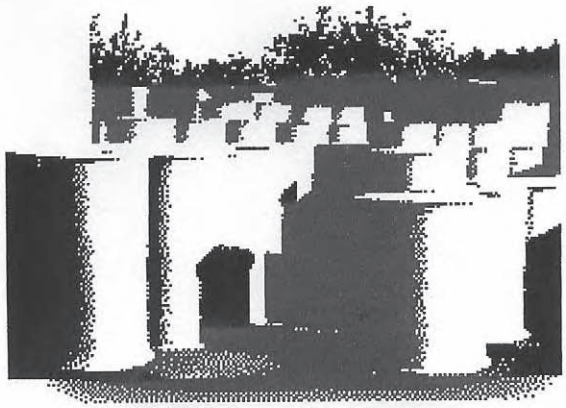
| DRAWN BY: | SCALE: | REVISION#: | SIGNATURE: |
|---|---|---|---|
| A.HARTUNG<br>J.CONLEY | NOT TO SCALE | | |

weil aquatronics

*Treating Water as a Resource™*

# Fiberglass Basins

Protect groundwater and the environment with Weil Aquatronics light weight, maintenance-free fiberglass basins.



## Featuring

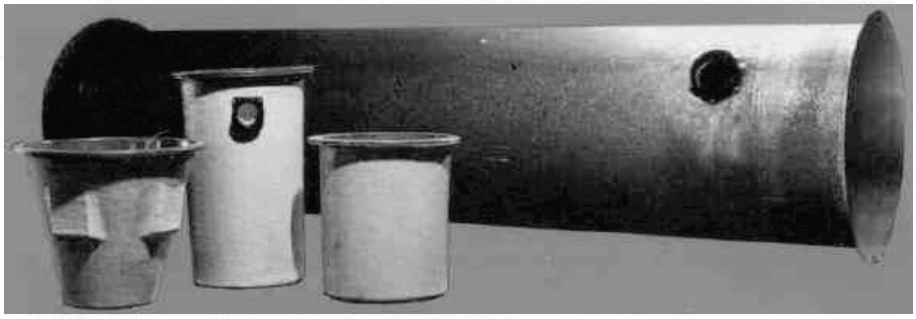
- Tremendous strength-to-weight ratio
- Non-corrosive and non-contaminating
- Quality and durability
- Wide range of sizes and configurations
- Maintenance-free for long term performance
- Size range18"-72" diameter, up to 21' deep
- Can be built in sections for on-site assembly

Weil Aquatronics fiberglass basins are well proven in hundreds of installations, handling everything from storm water to raw sewage to contaminated waste. These basins are manufactured to National Bureau of Standards PS-15-69 and ASTM-D-4097 requirements. Standard resins are resistant to attack from normal domestic sewage. Special premium resins are available for chemical waste and corrosive applications.

Basin walls have a minimum flexural strength of 12,000 PSI per ASTM D790, a tensile strength of 10,500 PSI per ASTMD638, and an ASTM D695 compression strength of 15,000 PSI.

## Applications

- Sump and sewage wet wells
- Condensate receivers
- Catch basins
- Blow-off basins
- Holding tanks
- Valve boxes
- Secondary containment vessels
- Above ground and buried
- Potable and fire water storage




weil aquatronics

*Treating Water as a Resource™*

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environ™

# Installation Instructions
# Flexible Entry Boots

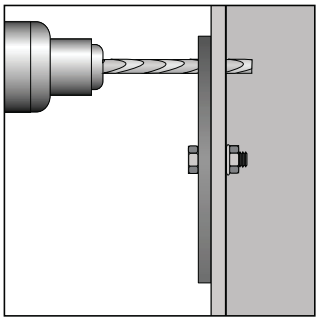
REINFORCED PIPE FITTINGS
(SEE BASIN DWG FOR SIZES)

## Flexible Entry Boots

These one-piece rubber boots are designed to seal pipe and conduit entries for both flat and curved surfaces. For proper installation, the appropriate size fabrication template should be used for accurate hole drilling. The recommended sizes of hole saws must be used for the given *Flexible Entry Boot* size.

### Step #1

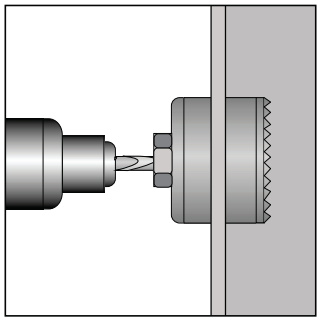
Locate the center entry point in the flat wall section of the sump base and drill a 5/16" hole. Install the *Entry Boot Template* to the sump base wall using a 1/4" bolt and nut. Drill out one hole of the appropriate bolt hole circle for the size boot to be installed using the same 5/16" drill bit. Insert a second 1/4" bolt and nut through this hole to secure the template. Continue to drill the remaining holes of the bolt hole pattern. After drilling, remove the template from the sump base wall.



### Step #2

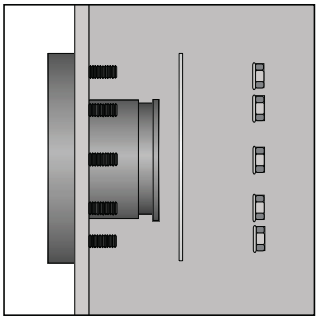
Drill out the entry boot opening by using the appropriate size hole saw. After drilling out opening, clean rough edges with a razor knife or deburing tool.

| Hole Saw | Flexible Entry Boots |
|---|---|
| 1-3/4" | Small profile FEB-3075 |
| 2-3/8" | Large profile FEB-3075 |
| 2-3/8" | FEB-3050, 3100, 3150, 3157 |
| 3" | FEB-5150 |
| 4-1/4" | FEB-6150, 6200, 6300 |
| 5-1/2" | FEB-7360, 7390, 7400 |
| 5-1/2" | SAB-7400 |
| 5-1/2" | GDB-4515, 4520, 4530, 7450 |
| Sabre Saw | FEB-8600 |



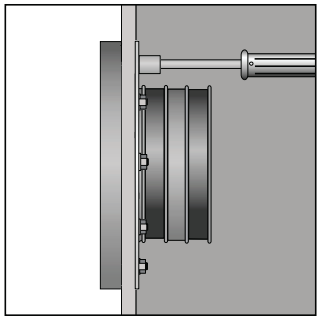
### Step #3

Install the entry boot from outside the sump by inserting the studs through the bolt holes. From the inside of the sump, install the compression ring over the studs and install nuts by hand.



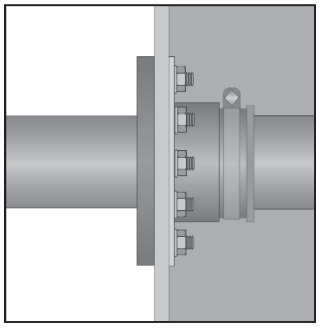
### Step #4

In a clockwise or counter clockwise pattern, gradually tighten all of the nuts evenly to 60 inch lbs. Several passes may be necessary as the rubber will compress. To prevent deforming the boots, do not exceed 60 inch lbs.



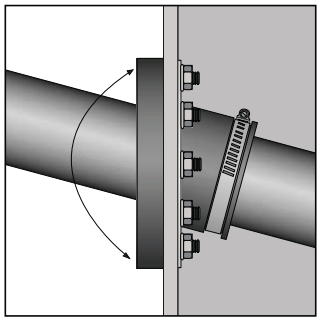
### Step #5

Insert the appropriate sized pipe or conduit into the flexible boot from the outside of the sump. After the pipe or conduit has been positioned, install the band clamp around the boot and tighten to 30 in. lbs.



### Angled Entries

The flexible entry boot is designed to permit angled pipe or conduit entries up to 15° off the centerline. Angles greater than 15° could prevent the boot from sealing around the pipe or conduit, and will void the product warranty.



**WARNING**

**Keep all fiberglass cleaning solvents away from boots. These types of solvents could cause severe damage.**

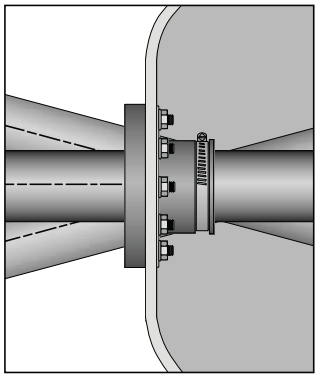
**IMPORTANT**

**The recommended hole saw size must always be used for proper installation of the *Flexible Entry Boot* and maintain the product warranty.**

**A hydrostatic test must be performed to ensure a positive seal.**

### Fiberglass Surfaces

*Flexible Entry Boots* may be installed on round surfaces which have a diameter greater than 30". The installation procedures are the same as described above except, extra care shall be taken to properly hand sand the surface to be bonded. Make sure all raised sections of FRP are minimized and remove all sharp edges. The 5/16" bolt holes should be made slightly larger after initial drilling. This can be accomplished by moving the 5/16" bit from side to side in each bolt hole after the *Entry Boot Template* has been removed. Tighten down each nut in stages so the boot flange and compression ring can evenly conform to the rounded surface and achieve a positive seal.



**Environ Products, Inc. • 3250 US 70 Business West • Smithfield, NC 27577 • Tel: (919) 359-3400**
**Fax: (919) 359-3687 • Customer Service: (800) 833-1883 • www.envproduct.com •** **© Copyright 2004**

Flexible fittings: Inlet, vent, & electrical
(see basin dwg for sizes)

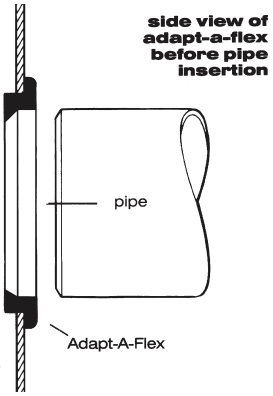
AK INDUSTRIES, INC.

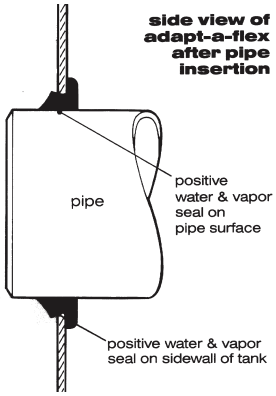
# Adaptaflex Fittings



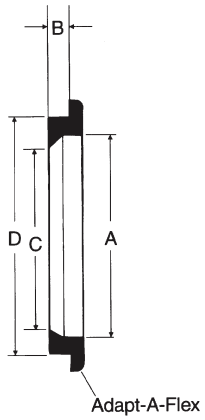
Instantly provides a water and vapor seal on either curved or flat surfaces!

- Ease of Installation
- Weather and Corrosion Resistant
- No Bolts or Gaskets Required
- Requires No Sealants
- Durable PVC Composition
- Available in 3/8" through 6" sizes
- Works with Steel Pipe, Schedule 35 and 40 Plastic Pipe




| Number | | A | B | C | Hole D | Saw Size |
|---|---|---|---|---|---|---|
| GA-375AAF | 3/8" | .068 | .200 | .045 | 1.050 | 1" |
| GA-050AAF | 1/2" | .086 | .240 | .630 | 1.310 | 1-1/4" |
| GA-075AAF | 3/4" | 1.040 | .240 | .820 | 1.310 | 1-1/4" |
| GA-100AAF | 1" | 1.300 | .220 | 1.050 | 1.780 | 1-3/4" |
| GA-125AAF | 1-1/4" | 1.630 | .230 | 1.350 | 3.050 | 3" |
| GA-150AAF | 1-1/2" | 1.870 | .230 | 1.560 | 3.050 | 3" |
| GA-200AAF | 2" | 2.300 | .250 | 2.000 | 3.050 | 3" |
| GA-300AAF | 3" | 3.450 | .250 | 3.100 | 4.010 | 4" |
| GA-400AAF35 | 4" SDR 35 | 4.270 | .250 | 3.800 | 5.025 | 5" |
| GA-400AAF40 | 4" | 4.450 | .250 | 4.120 | 5.060 | 5" |
| GA-600AAF35 | 6" SDR 35 | 6.200 | .250 | 5.850 | 7.205 | 7" |
| GA-600AAF40 | 6" | 6.450 | .250 | 6.125 | 7.060 | 7" |



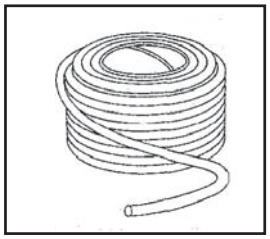
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Treating Water as a Resource ™

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Norwalk, CA 90650
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Fax: 818-247-0083
www.weilaquatronics.com

# Gastight Sealing of Weil Aquatronics Basin Covers

Basin covers supplied by Weil Aquatronics are provided with rope-type caulking material. This material, properly installed, will provide a gastight seal between covers and frames, between access doors and covers, and any other flat mating surfaces on the cover.

We supply M-D Building Materials rope-type caulking material, part number 71522 (gray – 30' linear feet); however, any waterproof rope-type caulking material would be sufficient.



**REPLACEABLE CORD WEATHERSTRIP**

This weatherstrip cord is easily installed by pressing into the gap to be filled. This product can be used both inside and outside. Can be cut to length to fit your application. Available in 30' and 90' rolls.

| Item No. | Width | Height | Length | Finish |
|---|---|---|---|---|
| **71522** | n/ a | n/ a | 360" | Gray |

## Installation & Maintenance:

1. Clean surfaces to be sealed.

2. Apply caulking material as required. Normally one bead of material is sufficient to provide a gastight seal, however large or irregular surfaces may require more than one bead of material to provide a proper seal.

3. Mating surfaces that are unsealed (access doors, inspection plates, etc.) should have the existing material removed. Then clean the sealing surfaces and apply new sealing material.

weil aquatronics
Engineered Pumps
and Hydronic Equipment

***1-800-74-PUMPS*** *(747-8677)*
*562-364-7430  Fax: 818-247-0083*
*E-Mail: info@weilaquatronics.com*

# FIBERGLASS SUMP BASINS
## *INSTALLATION INSTRUCTIONS*

1. **Excavation Dimensions**: Excavation shall be 6" deeper than the depth of the basin, below finish grade and done in such a manner as to preserve the undisturbed state of bearing soils at the bottom. Diameter of excavation shall be sufficient to allow for necessary external pipe connections with a minimum **12"** greater than the basin diameter.

2. Backfill Materials:
   a. The backfill materials shall be inert, free flowing granular soil such as clean sand or gravel (1/4" mesh or finer).
   b. Acceptable backfill includes "stone dust" from rock crushing operation provided it possesses all the characteristics of free flowing sand and contains less than 20% by weight passing the No. 200 mesh sieve. Soil fines must be non-plastic.
   c. Silts, clays, organic soil, granulated cinder, slag and similar corrosive material shall not be used. Backfill shall be free of organic material, loam, trash, snow, ice, stones, rubble, etc.
   d. A free flowing material is essential for preparation of the support bed and for backfilling in order to provide complete and proper support for the bottom and sides of the basin.

3. **Pipe Connections**: Make necessary pipe connection in approved manner. Connection may be threaded, caulked joints, no-hub or other specified approved method.

4. Backfill as follows:
   a. If the hole is flooded, the water level shall be pumped down to maximum depth of 3 inches before preparing the bed and placing the basin. Water level shall be maintained below bottom of the basin until the excavation is backfilled and until there is adequate safety against uplift.
   b. The first layer of backfill is the base for the basin and shall be at least 6" thick.
   c. Place the basin on the bed and after aligning and leveling, push additional fill under and around the basin and compact by tarnping to a uniform depth of 12" around the basin. This insures that the established grade and level of the basin will be maintained during remainder of the backfilling operation.
   d. Backfill shall be continued in one foot layers with specified backfill uniformly distributed and compacted around the basin.
   e. Concrete encasement in lieu of backfill is **NOT** recommended.

5. **Cover**: The cover shall be bolted in place with an approved gasket material to effect a gas tight seal. Basins installed in traffic areas must have separate curb frames imbedded in finish floor and not in contact with any portion of the basin.

**NOTE**: In accordance with City of Los Angeles General Approval:
"Sump pumps shall not rest on the bottom of the sump unless the bottom is supported on a suitable level concrete base."

© 1980 Weil Aquatronics, Inc.

## BACKFILLING

**BACKFILL MATERIAL.** Backfill material should be clean, well-granulated, free-flowing, noncorrosive, and inert. It should be free of ice, snow, debris, rock, or organic material, all of which could damage the tank and interfere with the compaction of the backfill material. The largest particles should not be larger than 3/4 inch. Not more than 3 percent (by weight) should pass through a #8 sieve, and the backfill material should conform to ASTM C-33, Paragraph 9.1 requirements. Approved backfill materials include:

- Pea Gravel, naturally-rounded particles with a minimum diameter of 1/8 inch and a maximum diameter of 3/4 inch.
- Crushed Rock, washed and free-flowing angular particles between 1/8 inch and 1/2 inch in size.

**PLACEMENT AND COMPACTION OF BACKFILL.** compaction of backfill materials should be adequate to ensure the support of the tank, and to prevent movement or settlement. Backfill materials should be place in 12 inch lifts and compacted to a minimum soil modulus of 700 pounds per square inch (psi).

**SUPPORTING PIPING, EQUIPMENT AND ACCESSORIES.** Support for piping, equipment and other accessories must be provided during backfilling. Using the basin to support piping, equipment, cribbing, bracing or blocking is never permitted. During backfilling, temporary supporting materials must be carefully installed and removed to prevent damage to the basin, piping or equipment.

**WARNING! Using the basin to support any loading carried or created by piping, equipment, cribbing, bracing or blocking is never permitted.**

## ANCHORAGE

**GENERAL.** When basin installations are located in areas subject to high water tables or flooding, provisions should be made to prevent the basins, either empty or filled, from floating. The buoyancy force to be offset is determined primarily by the volume of the basin. The principle offsetting factors include:

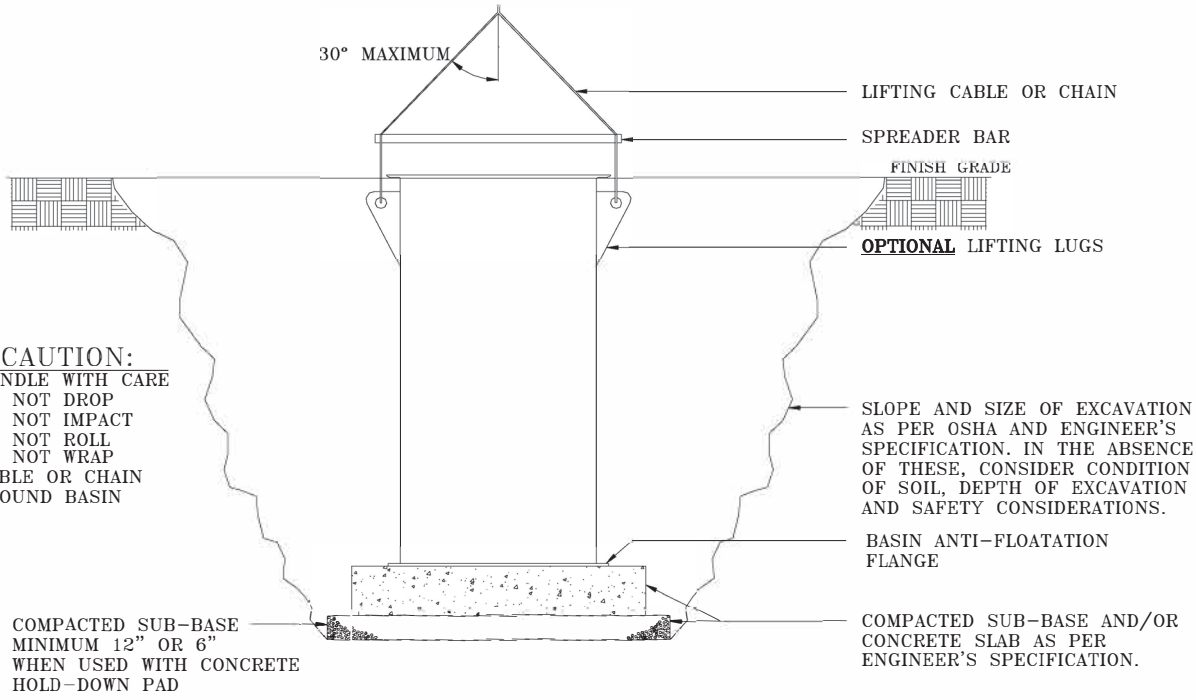
- Backfill materials.
- Concrete hold-down pad.
- Friction between the tank, backfill materials and the surrounding soil.

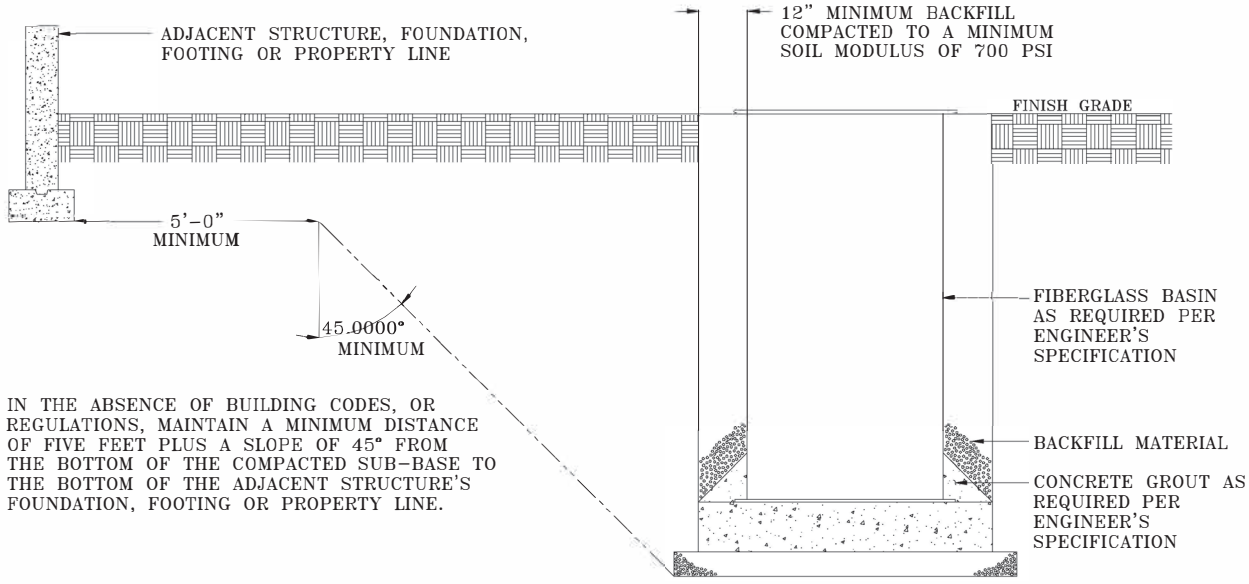
**METHODS OF ANCHORAGE.** All methods of anchoring basins use the weight of the backfill materials to offset the buoyancy forces. The use of supplemental mechanical anchoring methods (a concrete hold-down pad) increases the amount of backfill ballast which is mechanically attached to the basin. The recommended method of attachment is to pour concrete grout over the basin's anti-floatation flange and concrete hold-down pad (see attached illustration).

**ANCHORAGE REQUIREMENTS.** Requirements for anchorage, thickness of concrete hold-down pads, as well as the size of anchors and reinforcement must be calculated for each installation based on the environmental conditions of that specific installation.

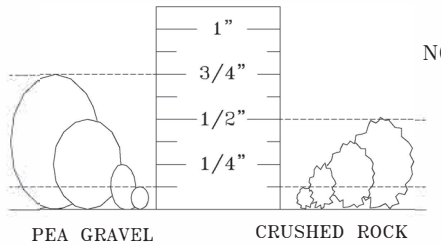
**WARNING! Use "submerged" material weights when calculating anchorage requirements. Example: weight of concrete (150 pounds per cubic foot) minus the weight of the water 62.4 pounds per cubic foot) equals a "submerged" weight of 87.6 pounds per cubic foot.**

# FIBERGLASS BASIN
# INSTALLATION REFERENCE GUIDE




IN THE ABSENCE OF BUILDING CODES, OR REGULATIONS, MAINTAIN A MINIMUM DISTANCE OF FIVE FEET PLUS A SLOPE OF 45° FROM THE BOTTOM OF THE COMPACTED SUB-BASE TO THE BOTTOM OF THE ADJACENT STRUCTURE'S FOUNDATION, FOOTING OR PROPERTY LINE.




BACKFILL MATERIAL REQUIREMENTS

NOTE:

The intent of these installation instructions and illustrations is to ensure that damage or premature failure to the basin will not occur. These installation instructions and illustrations are NOT intended to preclude normal safety procedures which should be followed to prevent injury to personnel. SAFE INSTALLATION PROCEDURES SHALL BE ENTIRELY THE RESPONSIBILITY OF THE INSTALLER.

# APPENDIX E

Educational Materials

To be provided in Final WQMP Report

# Stormwater Pollution Prevention

## *Best Management Practices for Homeowner's Associations, Property Managers and Property Owners*

*Your Guide To Maintaining Water Friendly Standards In Your Community*

**sbcountystormwater.org**

Big Bear · Chino · Chino Hills · Colton · Fontana · Grand Terrace · Highland · Loma Linda · Montclair · Ontario · Rancho Cucamonga
Redlands · Rialto · San Bernardino · San Bernardino County · San Bernardino County Flood Control District · Upland · Yucaipa

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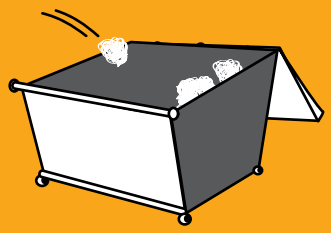
# COMMERCIAL TRASH ENCLOSURES

## FOLLOW THESE **REQUIREMENTS** TO **KEEP OUR WATERWAYS CLEAN**

Trash enclosures, such as those found in commercial and apartment complexes, typically contain materials that are intended to find their way to a landfill or a recycling facility. **These materials are NOT meant to go into our local lakes and rivers.**

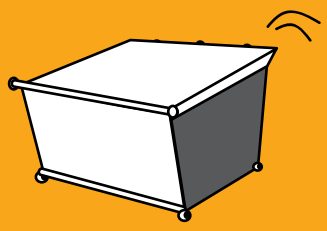
### PROTECT WATER QUALITY BY FOLLOWING THESE SIMPLE STEPS

#### PUT TRASH INSIDE



Place trash inside the bin (preferably in sealed bags)

#### CLOSE THE LID



Prevent rain from entering the bin in order to avoid leakage of polluted water runoff

#### KEEP TOXICS OUT



- Paint
- Grease, fats and used oils
- Batteries, electronics and fluorescent lights

### SOME ADDITIONAL GUIDELINES, INCLUDE

**✓ SWEEP FREQUENTLY**
Sweep trash enclosure areas frequently, instead of hosing them down, to prevent polluted water from flowing into the streets and storm drains.

**✓ FIX LEAKS**
Address trash bin leaks immediately by using dry clean up methods and report to your waste hauler to receive a replacement.

**✓ CONSTRUCT ROOF**
Construct a solid cover roof over the existing trash enclosure structure to prevent rainwater from coming into contact with trash and garbage. Check with your local City/County for Building Codes.

In San Bernardino County, stormwater pollution is caused by food waste, landscape waste, chemicals and other debris that are washed into storm drains and end up in our waterways - untreated! You can be part of the solution by maintaining a water-friendly trash enclosure.

**THANK YOU FOR HELPING TO KEEP SAN BERNARDINO COUNTY CLEAN AND HEALTHY!**

San Bernardino County STORMWATER PROGRAM

In the event of a spill or discharge to a storm drain or waterway, contact San Bernardino County Stormwater immediately: (877) WASTE18 | sbcountystormwater.org/report

**sbcountystormwater.org**

Big Bear • Chino • Chino Hills • Colton • Fontana • Grand Terrace • Highland • Loma Linda • Montclair • Ontario • Rancho Cucamonga
Redlands • Rialto • San Bernardino • San Bernardino County • San Bernardino County Flood Control District • Upland • Yucaipa

# CESQG PROGRAM

**Conditionally Exempt Small Quantity Generator**

## WHAT IS A CESQG?

Businesses that generate 27 gallons or 220 lbs. of hazardous waste, or 2.2 lbs. of extremely hazardous waste per month are called "Conditionally Exempt Small Quantity Generators," or CESQGs. San Bernardino County Household Hazardous Program provides waste management services to CESQG businesses. The most common CESQGs in San Bernardino County are painters, print shops, auto shops, builders, agricultural operators and property managers, but there are many others. When you call, be ready to describe the types and amounts of waste your business generates in a typical month. If you generate hazardous waste on a regular basis, you must:

- Register with San Bernardino County Fire Department (909) 386-8400 as a hazardous waste generator.
- To obtain an EPA ID# and application form from the State visit www.dtsc.ca.gov.
- Manage hazardous waste in accordance with all applicable local, state and federal laws and regulations.

## HOW DO I GET SERVICE?

To arrange an appointment for the CESQG Program, call 1-800-OILY CAT or 909-382-5401. Be ready to describe the type and amount of hazardous waste your business is ready to dispose of, and the types and size(s) of containers that the waste is in.

## Waste Type and Cost

There is a small handling fee involved in the collection of hazardous waste from your business. Disposal costs depend on the type of waste.

| | |
|---|---|
| Aerosols | $1.29/lb. |
| Automobile motor oil | $.73/gal. |
| Anti-freeze | $1.57/gal. |
| Contaminated oil | $4.48/gal. |
| Car batteries | $.62/ea. |
| Corrosive liquids, solids | $2.80/lb. |
| Flammable solids, liquids | $1.57/lb. |
| Latex Paint | $.73/lb. |
| Mercury | $10.08/lb. |
| NiCad/Alkaline Batteries | $2.13/lb. |
| Oil Base Paints | $1.00/lb. |
| Oil Filters | $.56/ea. |
| Oxidizers | $9.63/lb. |
| PCB Ballasts | $5.94/lb. |
| Pesticides (most) | $2.91/lb. |
| Photofixer, developer | $4.31/gal. |
| Television & Monitors | $11.20/ea. |
| Additional Handling | $138.00/hr. |

*Rates subject to change without notice*

## WE CANNOT ACCEPT

- Radioactives
- Water reactives
- Explosives
- Compressed gas cylinders
- Medical or biohazardous waste
- Asbestos
- Remediation wastes

# HAZARDOUS WASTE

## WHY IS THE FIRE DEPARTMENT COLLECTING HAZARDOUS WASTE?

Small Quantity Generators often have difficulty disposing of small quantities of hazardous waste. Hazardous waste companies usually have a minimum amount of waste that they will pick up, or charge a minimum fee for service. Typically, the minimum fee exceeds the cost of disposal for the hazardous waste. This leaves the small quantity generator in a difficult situation. Some respond by storing hazardous waste until it becomes economical for the hazardous waste transporter to pick it up, putting the business out of compliance by exceeding regulatory accumulation time limits. Other businesses simply store their hazardous wastes indefinitely, creating an unsafe work environment and exceeding accumulation time limits. Yet other businesses attempt to illegally dispose of their waste at household hazardous waste collection facilities. These facilities are not legally permitted to accept commercial wastes, nor are prepared to provide legal documentation for commercial hazardous waste disposal. In answer to the problems identified above, the San Bernardino County Fire Department Household Hazardous Program instituted the Conditionally Exempt Small Quantity Generator Program.

## PAYMENT FOR SERVICES

The CESQG Program will prepare an invoice for your business at the time of service. You can pay at the time of service with cash or a check, or you can mail your payment to the Fire Department within 30 days. Please note that we do not accept credit card payments. The preferred method of payment is to handle payment at time of service. Additional charges may apply for accounts not paid within 30 days.

## ARE THERE ANY OTHER WAYS THAT I CAN SAVE MONEY ON HAZARDOUS WASTE DISPOSAL?

Yes! First, start by reducing the amount of waste that you produce by changing processes or process chemicals, at your business. Next, examine if there is a way that you can recycle your waste back into your processes. Network with similar businesses or trade associations for waste minimization and pollution prevention solutions.

## WHAT IF YOUR BUSINESS DOES NOT QUALIFY?

Call the San Bernardino County Fire Department Field Services Division for assistance with hazardous waste management at 909-386-8400.

If you reduce the amount of waste you generate each month to 27 gallons or less, you may qualify in the future.

## WHAT HAPPENS TO YOUR HAZARDOUS WASTE?

Hazardous waste collected by the CESQG Program is transported to a state permitted processing facility in San Bernardino. The waste is further processed at this point and packaged for off-site recycling (oil filters, oil, latex paint, antifreeze, and batteries) or destructive incineration (pesticides, corrosives, flammables, oil based paint).

San Bernardino County Fire Department
CESQG Program
2824 East "W" Street
San Bernardino, CA 92415-0799
Phone: 909-382-5401
Fax: 909-382-5413
www.sbcfire.org/ofm/hhw/HouseholdHazardousWaste.aspx
Email: mvangese@sbcfire.org

# WHEN WORKING OUTDOORS USE THE 3Cs

## CUANDO TRABAJE AL AIRE LIBRE UTILICE LAS 3Cs

### CONTROL | CONTROL



Locate the nearest storm drain and ensure nothing can enter or be discharged into it.

*Ubique el desagüe de aguas pluviales más cercano y asegúrese de que nada pueda ingresar a éste ni descargarse en él.*

### CONTAIN | CONTENER



Isolate your area to prevent material from potentially flowing or being blown away.

*Aísle su área para evitar que el material pueda discurrirse o ser llevado por el viento.*

### CAPTURE | CAPTURAR



Sweep up debris and place it in the trash. Clean up spills with an absorbent material (e.g. kitty litter) or vacuum with a Wet-Vac and dispose of properly.

*Recoja los restos y colóquelos en la basura. Limpie los derrames con un material absorbente (como la arena para gatos) o aspírelos con una Wet-Vac (aspiradora de humedad) y deséchelos correctamente.*

# COMMERCIAL LANDSCAPE

DISCHARGE TO THE STORM DRAIN, **ACCIDENTAL OR NOT**, COULD LEAD TO ENFORCEMENT ACTIONS, WHICH COULD INCLUDE FINES.

Follow the best practices below to **prevent water pollution from landscaping activities.**

## RECYCLE YARD WASTE



- Recycle leaves, grass clippings and other yard waste.
- Do not blow, sweep, rake or hose yard waste into the street or catch basin.
- **Try grasscycling:** the natural recycling of grass by leaving clippings on the lawn when mowing.

  For more information, please visit: **www.calrecycle.ca.gov/organics/grasscycling**

## USE FERTILIZERS, HERBICIDES AND PESTICIDES SAFELY



- Fertilizers, herbicides and pesticides are often carried into the storm drain system by sprinkler runoff. Use natural and non-toxic alternatives as often as possible.
- If you must use chemical fertilizers, herbicides or pesticides:
  - Spot apply, rather than blanketing entire areas.
  - Avoid applying near curbs and driveways, and **never** before a rain.
  - Apply fertilizers as needed: when plants could best use it and when the potential runoff would be low.
  - Follow the manufacturer's instructions carefully—this will not only give the best results, but will save money.

## USE WATER WISELY



- Control the amount of water and direction of sprinklers. Sprinklers should only be on long enough to allow water to soak into the ground, but not so long as to cause runoff.
- Periodically inspect, fix leaks and realign sprinkler heads.
- Plant native vegetation to reduce the need of water, fertilizers, herbicides and pesticides.

## HOMEOWNERS

KEEP THESE TIPS IN MIND WHEN HIRING PROFESSIONAL LANDSCAPERS AND REMIND AS NECESSARY.



Leftover pesticides, fertilizers, and herbicides contaminate landfills and should be disposed of through a Hazardous Waste Facility.

For more information on proper disposal call,

**(909) 382-5401 or 1-800-OILY CAT.**

In the event of a spill or discharge to a storm drain or waterway, contact San Bernardino County Stormwater immediately: (877) WASTE18 | sbcountystormwater.org/report

**sbcountystormwater.org**

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Redlands • Rialto • San Bernardino • San Bernardino County • San Bernardino County Flood Control District • Upland • Yucaipa

# SIDEWALK, PLAZA, ENTRY MONUMENT & FOUNTAIN MAINTENANCE

**Pollutants on sidewalks and other pedestrian traffic areas and plazas are typically due to littering and vehicle use. Fountain water containing chlorine and copperbased algaecides is toxic to aquatic life. Proper inspection, cleaning, and repair of pedestrian areas and HOA owned surfaces and structures can reduce pollutant runoff from these areas. Maintaining these areas may involve one or more of the following activities:**

1. **Surface Cleaning**
2. **Graffiti Cleaning**
3. **Sidewalk Repair**
4. **Controlling Litter**
5. **Fountain Maintenance**

## POLLUTION PREVENTION:

Pollution prevention measures have been considered and incorporated in the model procedures. Implementation of these measures may be more effective and reduce or eliminate the need to implement other more complicated or costly procedures. Possible pollution prevention measures for sidewalk, plaza, and fountain maintenance and cleaning include:

- Use dry cleaning methods whenever practical for surface cleaning activities.
- Use the least toxic materials available (e.g. water based paints, gels or sprays for graffiti removal).
- Once per year, educate HOA staff and tenants on pollution prevention measures.

## MODEL PROCEDURES:

### 1. Surface Cleaning

**Discharges of wash water to the storm water drainage system from cleaning or hosing of impervious surfaces is prohibited.**

**Sidewalks, Plazas**

✓ Use dry methods (e.g. sweeping, backpack blowers, vacuuming) whenever practical to clean sidewalks and plazas rather than hosing, pressure washing, or steam cleaning. DO NOT sweep or blow material into curb; use devices that contain the materials.

✓ If water must be used, block storm drain inlets and contain runoff. Discharge wash water to landscaping or contain and dispose of properly.

# SIDEWALK, PLAZA, ENTRY MONUMENT & FOUNTAIN MAINTENANCE

**Parking Areas, Driveways, Drive-thru**

✓ Parking facilities should be swept/vacuumed on a regular basis. Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.

✓ If water must be used, block storm drain inlets and contain runoff. Discharge wash water to landscaping or contain and dispose of properly.

✓ Sweep all parking lots at least once before the onset of the wet season.

✓ Use absorbents to pick up oil; then dry sweep.

✓ Appropriately dispose of spilled materials and absorbents.

OPTIONAL:

- Consider increasing sweeping frequency based on factors such as traffic volume, land use, field observations of sediment and trash accumulation, proximity to water courses, etc.

**Building Surfaces, Decks, etc., without loose paint**

✓ Use high-pressure water, no soap.

✓ If water must be used, block storm drain inlets and contain runoff. Discharge wash water to landscaping or contain and dispose of properly.

**Unpainted Building Surfaces, Wood Decks, etc.**

✓ If water must be used, block storm drain inlets and contain runoff. Discharge wash water to landscaping or contain and dispose of properly.

✓ If using a biodegradable or other cleaning agent to remove deposits contain and dispose of properly.

## 2. Graffiti Cleaning

**Graffiti Removal**

✓ Avoid graffiti abatement activities during rain events.

✓ When graffiti is removed by painting over, implement the procedures under Painting and Paint Removal in the Roads, Streets, and Highway Operation and Maintenance procedure sheet.

✓ Protect nearby storm drain inlets prior to removing graffiti from walls, signs, sidewalks, or other structures needing graffiti abatement. Clean up afterwards by sweeping or vacuuming thoroughly, and/or by using absorbent and properly disposing of the absorbent.

# SIDEWALK, PLAZA, ENTRY MONUMENT & FOUNTAIN MAINTENANCE

✓ Note that care should be taken when disposing of waste since it may need to be disposed of as hazardous waste.

OPTIONAL:

• Consider using a waterless and non-toxic chemical cleaning method for graffiti removal (e.g. gels or spray compounds).

## 3. Sidewalk Repair

**Surface Removal and Repair**

✓ Schedule surface removal activities for dry weather if possible.

✓ Avoid creating excess dust when breaking asphalt or concrete.

✓ Take measures to protect nearby storm drain inlets prior to breaking up asphalt or concrete (e.g. place hay bales or sand bags around inlets). Clean afterwards by sweeping up material.

✓ Designate an area for clean up and proper disposal of excess materials.

✓ Remove and recycle as much of the broken pavement as possible.

✓ When making saw cuts in pavement, use as little water as possible. Cover each storm drain inlet with filter fabric during the sawing operation and contain the slurry by placing straw bales, sandbags, or gravel dams around the inlets. After the liquid drains shovel or vacuum the slurry, remove from site and dispose of properly.

✓ Always dry sweep first to clean up tracked dirt. Use a street sweeper or vacuum truck. Do not dump vacuumed liquid in storm drains. Once dry sweeping is complete, the area may be hosed down if needed. Discharge wash water to landscaping, pump to the sanitary sewer if permitted to do so or contain and dispose of properly.

**Concrete Installation and Repair**

✓ Avoid mixing excess amounts of fresh concrete or cement mortar on-site. Only mix what is needed for the job.

✓ Wash concrete trucks off-site or in designated areas on-site, such that there is no discharge of concrete wash water into storm drain inlets, open ditches, streets, or other storm water conveyance structures. (See Concrete Waste Management BMP WM – 8)

# SIDEWALK, PLAZA, ENTRY MONUMENT & FOUNTAIN MAINTENANCE

✓ Store dry and wet concrete materials under cover, protected from rainfall and runoff and away from drainage areas. After job is complete remove temporary stockpiles (asphalt materials, sand, etc.) and other materials as soon as possible.

✓ Return leftover materials to the transit mixer. Dispose of small amounts of excess concrete, grout, and mortar in the trash.

✓ When washing concrete to remove fine particles and expose the aggregate, contain the wash water for proper disposal.

✓ Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stock pile, or dispose in the trash.

✓ Protect applications of fresh concrete from rainfall and runoff until the material has hardened.

## 4. Litter Control

✓ Enforce anti-litter laws.

✓ Provide litter receptacles in busy, high pedestrian traffic areas of the community, at recreational facilities, and at community events.

✓ Cover litter receptacles and clean out frequently to prevent leaking/spillage or overflow.

OPTIONAL:

• Post "No Littering" signs.

## 5. Fountain Maintenance

✓ Do not use copper-based algaecides. Control algae with chlorine or other alternatives, such as sodium bromide.

✓ Allow chlorine to dissipate for a few days and then recycle/reuse water by draining it gradually onto a landscaped area. Water must be tested prior to discharge to ensure that chlorine is not present (concentration must be less than 0.1 ppm).

✓ Contact local agency for approval to drain into sewer or storm drain.

✓ Avoid mixing excess amounts of fresh concrete or cement mortar on-site. Only mix what is needed for the job.

# EQUIPMENT MAINTENANCE & REPAIR

**Vehicle or equipment maintenance has the potential to be a significant source of stormwater pollution. Engine repair and service (parts cleaning, spilled fuel, oil, etc.), replacement of fluids, and outdoor equipment storage and parking (dripping engines) can all contaminate stormwater. Conducting the following activities in a controlled manner will reduce the potential for stormwater contamination:**

1. **General Maintenance and Repair**
2. **Vehicle and Machine Repair**
3. **Waste Handling/Disposal**

**Related vehicle maintenance activities are covered under the following program headings in this manual: "Vehicle and Equipment Cleaning", "Vehicle and Equipment Storage", and "Vehicle Fueling".**

## POLLUTION PREVENTION:

Pollution prevention measures have been considered and incorporated in the model procedures. Implementation of these measures may be more effective and reduce or eliminate the need to implement other more complicated or costly procedures. Possible pollution prevention measures for equipment maintenance and repair include:

- Review maintenance activities to verify that they minimize the amount of pollutants discharged to receiving waters. Keep accurate maintenance logs to evaluate materials removed and improvements made.
- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Minimize use of solvents. Clean parts without using solvents whenever possible. Recycle used motor oil, diesel oil, and other vehicle fluids and parts whenever possible.
- Once per year, educate HOA staff and tenants on pollution prevention measures.

# EQUIPMENT MAINTENANCE & REPAIR

## MODEL PROCEDURES:

### 1. General Maintenance and Repair

**General Guidelines**

➔ *Note: Permission must be obtained for any discharge of wash water to the sanitary sewer from the local sewering agency.*

- ✓ Review maintenance activities to verify that they minimize the amount of pollutants discharged to receiving waters. Keep accurate maintenance logs to evaluate materials removed and improvements made.
- ✓ Regularly inspect vehicles and equipment for leaks.
- ✓ Move activity indoors or cover repair area with a permanent roof if feasible.
- ✓ Minimize contact of stormwater with outside operations through berming the local sewering and drainage routing.
- ✓ Place curbs around the immediate boundaries of the process equipment.
- ✓ Clean yard storm drain inlets regularly and stencil them.

**Good Housekeeping**

- ✓ Avoid hosing down work areas. If work areas are washed and if discharge to the sanitary sewer is allowed, treat water with an appropriate treatment device (e.g. clarifier) before discharging. If discharge to the sanitary sewer is not permitted, pump water to a tank and dispose of properly.
- ✓ Collect leaking or dripping fluids in drip pans or container. Fluids are easier to recycle or dispose of properly if kept separate.
- ✓ Keep a drip pan under the vehicle while you unclip hoses, unscrew filters, any discharge of or remove other parts. Place a drip pan under any vehicle that might leak while you work on it to keep splatters or drips off the shop floor.
- ✓ Educate employees on proper handling and disposal of engine fluids.
- ✓ Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.
- ✓ Do not pour liquid waste to floor drains, sinks, outdoor storm drain inlets, or other storm drains or sewer connections.
- ✓ Post signs at sinks and stencil outdoor storm drain inlets.

### 2. Vehicle Repair

**General Guidelines**

- ✓ Perform vehicle fluid removal or changing inside of a building or in a contained covered area, where feasible, to prevent the run-on of stormwater and the runoff of spills.
- ✓ Regularly inspect vehicles and equipment for leaks, and repair as needed.

# EQUIPMENT MAINTENANCE & REPAIR

- ✓ Use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- ✓ Immediately drain all fluids from wrecked vehicles. Ensure that the drain pan or drip pan is large enough to contain drained fluids (e.g. larger pans are needed to contain antifreeze, which may gush from some vehicles).
- ✓ Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.
- ✓ Recycle used motor oil, diesel oil, and other vehicle fluids and parts whenever possible.
- ✓ Oil filters disposed of in trash cans or dumpsters can leak oil. Place the oil filter in a funnel over a waste oil recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters.
- ✓ Store cracked batteries in a non-leaking secondary container and dispose of properly at recycling facilities or at County hazardous waste disposal site.

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**Vehicle Leak and Spill Control**

- ✓ Use absorbent materials on small spills. Remove the absorbent materials promptly and dispose of properly.
- ✓ Place a stockpile of spill cleanup materials where it will be readily accessible.
- ✓ Sweep floor using dry absorbent material.

## 3. Machine Repair

- ✓ Keep equipment clean; don't allow excessive build-up of oil or grease.
- ✓ Minimize use of solvents.
- ✓ Use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- ✓ Perform major equipment repairs at the corporation yard, when practical.
- ✓ Following good housekeeping measures in Vehicle Repair section.

## 4. Waste Handling/Disposal

**Waste Reduction**

- ✓ Prevent spills and drips of solvents and cleansers to the shop floor.
- ✓ Do liquid cleaning at a centralized station so the solvents and residues stay in one area. Recycle liquid cleaners when feasible.

✓ Locate drip pans, drain boards, and drying racks to direct drips back into a solvent sink or fluid holding tank for reuse.

OPTIONAL:

- If possible, eliminate or reduce the amount of hazardous materials and waste by substituting non-hazardous or less hazardous material:

  -Use non-caustic detergents instead of caustic cleaning for parts cleaning.

  -Use a water-based cleaning service and have tank cleaned. Use detergent-based or water-based cleaning systems in place of organic solvent degreasers.

  -Replace chlorinated organic solvents with non-chlorinated solvents. Non-chlorinated solvents like kerosene or mineral spirits are less toxic and less expensive to dispose of properly. Check list of active ingredients to see whether it contains chlorinated solvents.

  -Choose cleaning agents that can be recycled.

**Recycling**

OPTIONAL:

- Separate wastes for easier recycling. Keep hazardous and non-hazardous wastes separate, do not mix used oil and solvents, and keep chlorinated solvents separate from non-chlorinated solvents.

- Label and track the recycling of waste material (e.g. used oil, spent solvents, batteries).

- Purchase recycled products to support the market for recycled materials.

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## LIMITATIONS:

Space and time limitations may preclude all work being conducted indoors. It may not be possible to contain and clean up spills from vehicles/equipment brought on-site after working hours. Dry floor cleaning methods may not be sufficient for some spills – see spill prevention and control procedures sheet. Identification of engine leaks may require some use of solvents.

# POOL MAINTENANCE

***Pool chemicals and filter solids, when discharged to the City streets, gutters or storm drans, DO NOT GET TREATED before reaching the Santa Ana River. Chlorine, acid cleaning chemicals and metal-based algaecides used in pools can kill beneficial organisms in the food chain and pollute our drinking water.***

**When emptying your swimming pool, spa or fountain, please use one of the following best management practices to prevent water pollution:**

- Reuse the water as landscape irrigation
- Empty the water into the sewer between midnight and 6:00 am
- Remove solids and floating debris and dispose of in the trash, de-chlorinate the water to a chlorine residual = 0, wait 24 hours, then discharge the water to the street or storm drain
- Try not to use metal-based algaecides (i.e. copper sulfate) in your pool or spa. If you have, empty your pool or spa into the sewer. *Prior to discharging pool water into the sanitary sewer system, contact your local agency.*
- If the pool contains algae and mosquito larvae, discharge the water to the sewer

**When acid cleaning or other chemical cleaning:**

- Neutralize the pool water to pH of 6.5 to 8.5, then discharge to the sewer

**For swimming pool and spa filter backwash:**

- Dispose of solids into trash bag, then wash filter into a landscape area
- Settle, dispose of solids in trash and discharge water to the sewer, never to the storm drain

# » For Residents

*The following is a preview of the information we have available to residents. For more fact sheets, visit* ***sbcountystormwater.org***

## Household Hazardous Waste Center Locations

### DO YOU HAVE THE FOLLOWING ITEMS IN YOUR HOME?



Automotive Fluids
Batteries
Cooking Oil
Fertilizers & Pesticides
Fluorescent Bulbs
Household Cleaners
Medicine
Motor Oil & Filters
Paint Products
Pool Chemicals

**PROTECT YOUR COMMUNITY!**
**Take your toxic products to a local waste collection center:**

Big Bear Lake
Chino
Fontana
Ontario
Rancho Cucamonga
Redlands
Rialto
San Bernardino
Upland

**No business waste accepted. Must be a San Bernardino County resident.*

Find locations and a full list of items, visit
**tootoxictotrash.com**

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WHERE WATER MEETS COMMUNITY



# WE DID IT OURSELVES AND WE DID IT RIGHT

When painting your home, protect your family and community.

- **PAINTS** that are water-based are less toxic and should be used whenever possible.
- **BRUSHES** with water-based paint should be washed in the sink. Those with oil-based paint should be cleaned with paint thinner.
- **SAFELY** dispose of unwanted paint and paint thinner.

The County of San Bernardino offers 9 HHW Centers that accept paint and other household hazardous waste from residents FREE of charge. For a list of acceptable materials, location information, and hours of operation visit TooToxicToTrash.com.

# VEHICLE MAINTENANCE

Oil, grease, anti-freeze and other toxic automotive fluids often make their way into the San Bernardino County storm drain system, and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution and protect public health.

**Cleaning Auto Parts**
Scrape parts with a wire brush or use a bake oven rather than liquid cleaners. Arrange drip pans, drying racks and drain boards so that fluids are directed back into the parts washer or the fluid holding tank. Do not wash parts or equipment in a sink, parking lot, driveway or street.

**Storing Hazardous Waste**
Keep your liquid waste segregated. Many fluids can be recycled via hazardous waste disposal companies if they are not mixed. Store all materials under cover with spill containment or inside to prevent contamination of rainwater runoff.

**Preventing Leaks and Spills**
Conduct all vehicle maintenance inside of a garage. Place drip pans underneath vehicle to capture fluids. Use absorbent materials instead of water to clean work areas.

**Cleaning Spills**
Use dry methods for spill cleanup (sweeping, absorbent materials). To report accidental spills into the street or storm drain call (877) WASTE18 or 911.

**Proper Disposal of Hazardous Waste**
Dispose of household hazardous waste by taking it to your nearest household hazardous waste center. For more information, call 1-800-OILY CAT or check out TooToxicToTrash.com.

# PET WASTE DISPOSAL






# » Get In Touch With Us Online!

**» Website**
*sbcountystormwater.org*

**» eUpdates**
*sbcountystormwater.org/newsletter*

**» Facebook**
*facebook.com/sbcountystormwater*

**» YouTube**
*youtube.com/sbcountystormwater*



**» Report Pollution Violations**
*sbcountystormwater.org/report*

**» Email**
*info@sbcountystormwater.org*

# Spill Prevention, Control & Cleanup SC-11

## Description

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

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

| Objectives |
|---|
| ■ *Cover* |
| ■ *Contain* |
| ■ *Educate* |
| ■ *Reduce/Minimize* |
| ■ *Product Substitution* |

| Targeted Constituents | |
|---|---|
| *Sediment* | |
| *Nutrients* | |
| *Trash* | |
| *Metals* | ✓ |
| *Bacteria* | |
| *Oil and Grease* | ✓ |
| *Organics* | ✓ |

| Minimum BMPs Covered | |
|---|---|
| *Good Housekeeping* | |
| *Preventative Maintenance* | |
| *Spill and Leak Prevention and Response* | ✓ |
| *Material Handling & Waste Management* | |
| *Erosion and Sediment Controls* | |
| *Employee Training Program* | ✓ |
| *Quality Assurance Record Keeping* | ✓ |

## Approach

### *General Pollution Prevention Protocols*

- ☐ Develop procedures to prevent/mitigate spills to storm drain systems.
- ☐ Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.
- ☐ Establish procedures and/or controls to minimize spills and leaks. The procedures should address:
  - ✓ Description of the facility, owner and address, activities, chemicals, and quantities present;

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- ✓ Facility map of the locations of industrial materials;
- ✓ Notification and evacuation procedures;
- ✓ Cleanup instructions;
- ✓ Identification of responsible departments; and
- ✓ Identify key spill response personnel.

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



### *Spill and Leak Prevention and Response*

*Spill Prevention*

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

- ☐ If illegal dumping is observed at the facility:

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

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

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



### *Preventative Maintenance*

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

- ☐ Store and maintain appropriate spill cleanup materials in a location known to all near the tank storage area; and ensure that employees are familiar with the site's spill control plan and/or proper spill cleanup procedures.

- ☐ Sweep and clean the storage area monthly if it is paved, *do not hose down the area to a storm drain.*

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

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

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

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

- ☐ Identify key spill response personnel.

*Spill Response*

- ☐ Clean up leaks and spills immediately.

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

- ☐ On paved surfaces, clean up spills with as little water as possible.

  - ✓ Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills.

  - ✓ If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste.

  - ✓ If possible use physical methods for the cleanup of dry chemicals (e.g., brooms, shovels, sweepers, or vacuums).

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

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

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

*Reporting*

- Report spills that pose an immediate threat to human health or the environment to the Regional Water Quality Control Board or local authority as location regulations dictate.
- Federal regulations require that any oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hour).
- Report spills to 911 for dispatch and clean-up assistance when needed. Do not contact fire agencies directly.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - ✓ Types and quantities (in some cases) of wastes;
  - ✓ Patterns in time of occurrence (time of day/night, month, or year);
  - ✓ Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills);
  - ✓ Clean-up procedures; and
  - ✓ Responsible parties.



***Employee Training Program***

- Educate employees about spill prevention and cleanup.
- Well-trained employees can reduce human errors that lead to accidental releases or spills:
  - ✓ The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur; and
  - ✓ Employees should be familiar with the Spill Prevention Control and Countermeasure Plan.
- Employees should be educated about aboveground storage tank requirements. Employees responsible for aboveground storage tanks and liquid transfers should be thoroughly familiar with the Spill Prevention Control and Countermeasure Plan and the plan should be readily available.
- Train employees to recognize and report illegal dumping incidents.

### *Other Considerations (Limitations and Regulations)*

- State regulations exist for facilities with a storage capacity of 10,000 gallons or more of petroleum to prepare a Spill Prevention Control and Countermeasure (SPCC) Plan (Health & Safety Code Chapter 6.67).
- State regulations also exist for storage of hazardous materials (Health & Safety Code Chapter 6.95), including the preparation of area and business plans for emergency response to the releases or threatened releases.
- Consider requiring smaller secondary containment areas (less than 200 sq. ft.) to be connected to the sanitary sewer, prohibiting any hard connections to the storm drain.

## Requirements

### *Costs (including capital and operation & maintenance)*

- Will vary depending on the size of the facility and the necessary controls.
- Prevention of leaks and spills is inexpensive. Treatment and/or disposal of contaminated soil or water can be quite expensive.

### *Maintenance (including administrative and staffing)*

- Develop spill prevention and control plan, provide and document training, conduct inspections of material storage areas, and supply spill kits.
- Extra time is needed to properly handle and dispose of spills, which results in increased labor costs.

## Supplemental Information

### *Further Detail of the BMP*

*Reporting*

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

- Date and time of the incident;
- Weather conditions;
- Duration of the spill/leak/discharge;

- Cause of the spill/leak/discharge;
- Response procedures implemented;
- Persons notified; and
- Environmental problems associated with the spill/leak/discharge.

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

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

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

*Aboveground Tank Leak and Spill Control*

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

The most common causes of unintentional releases are:

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

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

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

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

- Check for external corrosion and structural failure.
- Check for spills and overfills due to operator error.
- Check for failure of piping system (pipes, pumps, flanges, coupling, hoses, and valves).
- Check for leaks or spills during pumping of liquids or gases from truck or rail car to a storage facility or vice versa.
- Visually inspect new tank or container installation for loose fittings, poor welding, and improper or poorly fitted gaskets.
- Inspect tank foundations, connections, coatings, and tank walls and piping system. Look for corrosion, leaks, cracks, scratches, and other physical damage that may weaken the tank or container system.
- Frequently relocate accumulated stormwater during the wet season.

- Periodically conduct integrity testing by a qualified professional.

*Vehicle Leak and Spill Control*

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

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

*Vehicle and Equipment Maintenance*

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

*Vehicle and Equipment Fueling*

- Design the fueling area to prevent the run-on of stormwater and the runoff of spills:

  Cover fueling area if possible.

  Use a perimeter drain or slope pavement inward with drainage to a sump.

  Pave fueling area with concrete rather than asphalt.

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

### *Industrial Spill Prevention Response*

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

The program should:

- Integrate with existing emergency response/hazardous materials programs (e.g., Fire Department).
- Develop procedures to prevent/mitigate spills to storm drain systems.
- Identify responsible departments.

- Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.
- Address spills at municipal facilities, as well as public areas.
- Provide training concerning spill prevention, response and cleanup to all appropriate personnel.

## References and Resources

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

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

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

Orange County Stormwater Program, Best Management Practices for Industrial/Commercial Business Activities. Available online at: http://ocwatersheds.com/documents/bmp/industrialcommercialbusinessesactivities

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

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

# Vehicle and Equipment Cleaning SC-21

## Description

Wash water from vehicle and equipment cleaning activities performed outdoors or in areas where wash water flows onto the ground can contribute toxic hydrocarbons and other organic compounds, oils and greases, nutrients, phosphates, heavy metals, and suspended solids to stormwater runoff. Use of the procedures outlined below can prevent or reduce the discharge of pollutants to stormwater during vehicle and equipment cleaning.

## Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives

***General Pollution Prevention Protocols***

- If possible, use properly maintained off-site commercial washing and steam cleaning businesses whenever possible. These businesses are better equipped to handle and properly dispose of the wash waters.
- Use dry cleaning methods to remove debris and sweep area; avoid washing with water when possible.
- Good housekeeping practices can minimize the risk of contamination from wash water discharges.
- Use biodegradable, phosphate-free detergents for washing vehicles as appropriate
- Emphasize the connection between the storm drain system and runoff, help reinforce that vehicle and equipment washing activities affect local water quality through storm drain stenciling programs.

| **Objectives** |
|---|
| ■ *Cover* |
| ■ *Contain* |
| ■ *Educate* |
| ■ *Reduce/Minimize* |
| ■ *Product Substitution* |

| **Targeted Constituents** | |
|---|---|
| *Sediment* | ✓ |
| *Nutrients* | ✓ |
| *Trash* | |
| *Metals* | ✓ |
| *Bacteria* | |
| *Oil and Grease* | ✓ |
| *Organics* | ✓ |

| **Minimum BMPs Addressed** | |
|---|---|
| *Good Housekeeping* | ✓ |
| *Preventative Maintenance* | ✓ |
| *Spill and Leak Prevention and Response* | ✓ |
| *Material Handling & Waste Management* | ✓ |
| *Erosion and Sediment Controls* | |
| *Employee Training Program* | ✓ |
| *Quality Assurance Record Keeping* | ✓ |

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- Map on-site storm drain locations to avoid discharges to the storm drain system.
- Designate specific wash area with clarifier or place wash areas away from storm drain connections.



***Good Housekeeping***

- Mark the area clearly as a wash area by:
  - ✓ Posting signs stating that only washing is allowed in wash area; and
  - ✓ Providing information on how washing is to be done.
- Provide trash containers in wash area.
- Have all vehicle and equipment washing done in areas designed to collect and hold the wash and rinse water or effluent generated. Recycle, collect or treat wash water effluent prior to discharge to the sanitary sewer system.
- If washing/cleaning must occur on-site, consider washing vehicles and equipment inside the building or on an impervious surface to control the targeted constituents by directing them to the sanitary sewer.
- If washing must occur on-site and outdoor:
  - ✓ Use designated paved wash areas. This area must be covered or bermed to collect the wash water and graded to direct the wash water to a treatment or disposal facility.
  - ✓ Do not conduct oil changes and other engine maintenance in the designated washing area. Perform these activities in a place designated for oil change and maintenance activities.
  - ✓ Cover the wash area when not in use to prevent contact with rain water.
- Do not permit steam cleaning wash water to enter the storm drain system.
- If possible, conduct pressure and steam cleaning at appropriate off-site areas to avoid generating runoff with high pollutant concentrations.



***Preventative Maintenance***

- Install sumps or drain lines to collect wash water for treatment.
- Use hoses with nozzles that automatically turn off when left unattended.
- Perform routine inspections of drain lines, holding tanks, and hoses and repair leaks immediately.

- Perform routine inspection and maintenance of wash water recycling and treatment systems.



### *Spill Response and Prevention Procedures*

- Keep the spill prevention and control plan up-to-date.
- Have an emergency plan, equipment, and trained personnel ready at all times to deal immediately with major spills.
- Collect all spilled liquids and properly dispose of them.
- Store and maintain appropriate spill cleanup materials in a location known to all near the designated wash area.



### *Material Handling and Waste Management*

- Collect all wash water from vehicle and equipment cleaning operations. Consider treating and reusing or discharging wash waters to a sanitary sewer system.
- Large quantities of wash waters may require treatment at the facility. Treatment using a process treatment system (e.g., holding tank, filtration system, and related appurtenances) will require engineering and capital expenditures.
- Collect and treat small amounts of wash water at the facility and either recycle or discharge to the sanitary sewer system or collect and dispose of as an industrial waste.
- Discharge wash waters into sanitary sewer only after contacting local sewer authority to find out if pretreatment is required.



### *Employee Training Program*

- Train employees on proper cleaning and wash water disposal procedures and conduct “refresher” courses on a regular basis.
- Train staff on proper maintenance measures for the wash area.
- Train employees and contractors on proper spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.
- Use a training log or similar method to document training.




### *Quality Assurance and Record Keeping*

- Keep accurate maintenance/inspection logs that document the minimum BMP activities performed for vehicle and equipment cleaning activities and improvement actions.

- Keep accurate logs of spill response actions that document what was spilled, how it was cleaned up, and how the waste was disposed.

- Establish procedures to complete logs and file them in the central office.

## Other Facility-Specific Considerations

- Some municipalities may require pretreatment and monitoring of wash water discharges to the sanitary sewer.

- Steam cleaning can generate significant pollutant concentrations requiring that careful consideration be given to the environmental impacts and compliance issues related to the condensate wastewater generated.

## Potential Limitations and Work-Arounds

Some facilities may have space constraints, limited staffing and time limitations that may preclude implementation of certain BMPs. Provided below are typical limitations and recommended "work-arounds":

- Most car washing best management practices are inexpensive, and rely more on good housekeeping practices (where vehicles are washed, planning for the collection of wash water) than on expensive technology. However, the construction of a specialized area for vehicle washing can be expensive. Also, for facilities that cannot recycle their wash water, the cost of pre-treating wash water through either structural practices or planning for collection and hauling of contaminated water to sewage treatment plants can be cost-prohibitive.

- A potential work-around is to use properly maintained off-site commercial washing and steam cleaning businesses whenever possible.

## Potential Capital Facility Costs and Operation & Maintenance Requirements

### *Facilities*

- Many facilities will already have indoor covered areas where vehicle and equipment cleaning takes place and will require no additional capital expenditures for providing cover.

- Capital investments will be required at some sites if systems to collect and recycle/treat and properly discharge wash water are not in place. The cost associated with these investments will vary depending on the size of the washing facility and local regulations regarding effluent wash water.

### *Maintenance*

- Perform wash and collection system inspections and repair.

- Sweep washing areas frequently to remove solid debris.

- Repair berms and dikes as necessary.
- Inspect and maintain sumps, oil/water separators, and on-site treatment/recycling units.

## Supplemental Information

***Designated Cleaning Areas***

- Washing operations outside should be conducted in a designated wash area having the following characteristics:
  - ✓ Paved with Portland cement concrete
  - ✓ Covered and bermed to prevent contact with stormwater and contain wash water
  - ✓ Sloped for wash water collections
  - ✓ Drainage system for wash water to the sanitary or recycle treatment process waste sewer, or to a dead-end sump equipped with an oil/water separator if necessary.

## References and Resources

Orange County Stormwater Program, Best Management Practices for Industrial/Commercial Business Activities. Available online at: http://ocwatersheds.com/documents/bmp/industrialcommercialbusinessesactivities.

Oregon Department of Environmental Quality, 2013. *Industrial Stormwater Best Management Practices Manual- BMP 8 Vehicle, Pavement and Building Washing*. Available online at: http://www.deq.state.or.us/wq/wqpermit/docs/IndBMP021413.pdf.

Sacramento Stormwater Management Program. *Best Management Practices for Industrial Storm Water Pollution Control*. Available online at: http://www.msa.saccounty.net/sactostormwater/documents/guides/industrial-BMP-manual.pdf.

Sacramento County Environmental Management Stormwater Program: Best Management Practices –Vehicle Washing. Available online at: http://www.emd.saccounty.net/EnvHealth/Stormwater/Stormwater-BMPs.html.

Santa Clara Valley Urban Runoff Pollution Prevention Program. http://www.scvurppp-w2k.com/.

US EPA. National Pollutant Discharge Elimination System – Stormwater Menu of BMPs - Municipal Vehicle and Equipment Washing. Available online at: http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=browse&Rbutton=detail&bmp=132.

Washington State Department of Ecology, 2012 .*Vehicle and Equipment Washwater Discharges Best Management Practices Manual.* Publication no. WQ-R-95-056. Available online at: https://fortress.wa.gov/ecy/publications/publications/95056.pdf.

# Vehicle and Equipment Repair SC-22

## Description

Vehicle or equipment maintenance and repair are potentially significant sources of stormwater pollution, due to use of harmful materials and wastes during maintenance and repair processes. Engine repair and service (e.g., parts cleaning), replacement of fluids (e.g., oil change), and outdoor equipment storage and parking (leaking vehicles) can impact water quality if stormwater runoff from areas with these activities becomes polluted by a variety of contaminants. Implementation of the following activities must be done where applicable to prevent or reduce the discharge of pollutants to stormwater from vehicle and equipment maintenance and repair activities.

## Approach

The BMP approach is to reduce the potential for pollutant discharges through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives. General pollution prevention protocols are presented followed by applicable minimum BMPs as required by the Industrial General Permit.

### *General Pollution Prevention Protocols*

- ☐ Designate a vehicle maintenance area designed to prevent stormwater pollution.
- ☐ Minimize contact of stormwater with outside operations through berming and appropriate drainage routing.
- ☐ Keep accurate maintenance logs to evaluate materials removed and improvements made.
- ☐ Switch to non-toxic chemicals for maintenance when possible.
- ☐ Choose cleaning agents that can be recycled.
- ☐ Use drop cloths and drip pans.

| Objectives |
|---|
| ■ *Cover* |
| ■ *Contain* |
| ■ *Educate* |
| ■ *Reduce/Minimize* |
| ■ *Product Substitution* |

| Targeted Constituents | |
|---|---|
| *Sediment* | |
| *Nutrients* | |
| *Trash* | |
| *Metals* | ✓ |
| *Bacteria* | |
| *Oil and Grease* | ✓ |
| *Organics* | ✓ |

| Minimum BMPs Covered | |
|---|---|
| *Good Housekeeping* | ✓ |
| *Preventative Maintenance* | ✓ |
| *Spill and Leak Prevention and Response* | ✓ |
| *Material Handling & Waste Management* | ✓ |
| *Erosion and Sediment Controls* | |
| *Employee Training Program* | ✓ |
| *Quality Assurance Record Keeping* | ✓ |

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- Minimize use of solvents. Clean parts without using solvents whenever possible, or use water-based solvents for cleaning.
- Recycle used motor oil, diesel oil, and other vehicle fluids and parts whenever possible.

### *Operational Protocols*

*General*

- Move maintenance and repair activities indoors whenever feasible.
- Place curbs around the immediate boundaries of process equipment.



### *Good Housekeeping*

- Store idle equipment under cover
- Use a vehicle maintenance area designed to prevent stormwater pollution - minimize contact of stormwater with outside operations through berming and appropriate drainage routing.
- Avoid hosing down your work areas. If work areas are washed, collect and direct wash water to sanitary sewer. Use dry sweeping if possible.
- Paint signs on storm drain inlets to indicate that they are not to receive liquid or solid wastes.
- Post signs at sinks to remind employees not to pour wastes down drains.
- Clean yard storm drain inlets(s) regularly and especially after large storms.
- Do not pour materials down storm drains.
- Cover the work area to limit exposure to rain.
- Place curbs around the immediate boundaries of process equipment.
- Build a shed or temporary roof over areas where parked cars await repair or salvage, especially wrecked vehicles. Build a roof over vehicles kept for parts.



### *Preventive Maintenance and Repair Activities*

- Provide a designated area for vehicle maintenance.
- Inspect vehicles and equipment for leaks regularly and repair immediately.
- Make sure incoming vehicles are checked for leaking oil and fluids. Do not allow leaking vehicles or equipment on-site without correcting the source of the leak and cleaning up any spill.
- Keep equipment clean; don't allow excessive build-up of oil and grease.

- Perform all vehicle fluid removal or changing inside or under cover if possible to prevent the run-on of stormwater and the runoff of spills.

- Use a tarp, ground cloth, or drip pans beneath the vehicle or equipment to capture all spills and drips if temporary work is being conducted outside. Collected drips and spills must be disposed, reused, or recycled properly.

- It is important to sweep the maintenance area weekly, if it is paved, to collect loose particles, and wipe up spills with rags and other absorbent material immediately. Do not hose down the area to a storm drain.

- Establish standard procedures to prevent spillage/leakage of fluids including:

  - ✓ Keep a drip pan under the vehicle while you unclip hoses, unscrew filters, or remove other parts. Use a drip pan under any vehicle that might leak while working on it to keep splatters or drips off the shop floor.

  - ✓ Promptly transfer used fluids to the proper waste or recycling drums. Do not leave drip pans or other open containers lying around.

  - ✓ Keep drip pans or containers under vehicles or equipment that may drip during repairs.

  - ✓ Do not change motor oil or perform equipment maintenance in non-appropriate areas.

- Drain oil and other fluids first if the vehicle or equipment is to be stored outdoors. Elevate and tarp stored vehicles and equipment.

- Monitor parked vehicles closely for leaks. Pans should be placed under any leaks to collect the fluids for proper disposal or recycling.

- Mechanics should clean vehicle parts without using liquid cleaners wherever possible to reduce waste.

- Steam cleaning and pressure washing may be used instead of solvent parts cleaning. The wastewater generated from steam cleaning must be discharged to an on-site oil water separator that is connected to a sanitary sewer or blind sump. Non-caustic detergents should be used instead of caustic cleaning agents, detergent-based or water-based cleaning systems in place of organic solvent degreasers, and non-chlorinated solvent in place of chlorinated organic solvents for parts cleaning. Refer to SC21 for more information on steam cleaning.

- Fifth-wheel bearings on trucks require routine lubrication. Typically chassis grease is applied to the fifth-wheel bearing at rates that result in grease dripping off of the bearing into the environment. To address this concern the following options are available:

  - ✓ Use specialized lubricants with good adhesion (e.g., stay in place) properties. Carefully follow manufacturer's label regarding the use of adhesive lubricant for

truck fifth-wheels. Typically this means applying no more than 8 oz. of grease. No visible extrusion of lubricant from the fifth-wheel bearing when truck and trailer are connected should be present.

- ✓ Use on-board truck or on-board trailer automatic lubrication systems. If these systems apply lube thinner than National Grease Lubrication Institute #2, equipment for collection of used lubricant is needed to prevent excess lubricant from dripping off the truck.
- ✓ Use plastic or Teflon plates instead of grease or other lubricants. Carefully follow manufacturer's instructions for installation and operation.

- ☐ Use one of the following for lubricating vehicle-trailer coupling:
  - ✓ Specialized adhesive lubricants;
  - ✓ Grease-free fifth wheel slip plates (e.g., plastic or Teflon coatings); and
  - ✓ On-Board automatic lubricating systems.



### *Spill and Leak Prevention and Response Procedures*

- ☐ Keep your spill prevention and control plan up-to-date.
- ☐ Place an adequate stockpile of spill cleanup materials where it will be readily accessible.
- ☐ Clean leaks, drips, and other spills with as little water as possible. Use rags for small spills, a damp mop for general cleanup, and dry absorbent material for larger spills. Use the following three-step method for cleaning floors:
  - ✓ Clean spills with rags or other absorbent materials;
  - ✓ Sweep floor using dry absorbent material; and
  - ✓ Mop the floor.

  Mop water may be discharged to the sanitary sewer via a toilet or sink.
- ☐ Remove the adsorbent materials promptly and dispose of properly when using adsorbent materials on small spills.



### *Material Handling and Waste Management*

- ☐ Designate a special area to drain and replace motor oil, coolant, and other fluids, where there are no connections to the storm drain or the sanitary sewer, and drips and spills can be easily cleaned up.
- ☐ Drain all fluids immediately from wrecked vehicles. Ensure that the drain pan or drip pan is large enough to contain drained fluids (e.g., larger pans are needed to contain antifreeze, which may gush from some vehicles).

- Do not pour liquid waste to floor drains, sinks, outdoor storm drain inlets, or other storm drains or sewer connections.
- Do not put used or leftover cleaning solutions, solvents, and automotive fluids and in the sanitary sewer.
- Collect leaking or dripping fluids in drip pans or containers. Fluids are easier to recycle if kept separate.
- Promptly transfer used fluids to the proper waste or recycling drums. Do not leave drip pans or other open containers lying around.
- Place oil filter in a funnel over a waste oil recycling drum to drain excess oil before disposal since municipalities prohibit or discourage disposal of these items in solid waste facilities.
- Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters. Oil filters disposed of in trashcans or dumpsters can leak oil and contaminate stormwater.
- Store cracked batteries in a non-leaking secondary container and dispose of properly at recycling or household hazardous waste facilities.



### *Employee Training Program*

- Train employees and contractors in the proper handling and disposal of engine fluids and waste materials.
- Employees should have the tools and knowledge to immediately begin cleaning up a spill should one occur.
- Conduct annual training to ensure that employees are familiar with the facility's spill control plan and/or proper spill cleanup procedures (You can use reusable cloth rags to clean up small drips and spills instead of disposables; these can be washed by a permitted industrial laundry. Do not clean them at home or at a coin-operated laundry business).
- Use a training log or similar method to document training.




### *Quality Assurance and Recordkeeping*

- Keep accurate maintenance logs to evaluate materials removed and improvements made.
- Establish procedures to collect and file maintenance logs in the central office.

### *Other Facility-Specific Considerations*

*Parts Cleaning*

Vehicle and equipment maintenance facilities often must clean parts as a part of day-today operations. The following activities should be considered:

- Clean vehicle parts without using liquid cleaners wherever possible to reduce waste.
- Steam cleaning and pressure washing may be used instead of solvent parts cleaning.
- Wastewater generated from steam cleaning must be discharged to an on-site oil water separator that is connected to a sanitary sewer or blind sump.
- Use non-caustic detergents instead of caustic cleaning agents, detergent-based or water-based cleaning systems in place of organic solvent degreasers, and non-chlorinated solvent in place of chlorinated organic solvents for parts cleaning. Refer to SC21 for more information on steam cleaning.

### *Potential Limitations and Work-Arounds*

- Some facilities may have space constraints and time limitations that may preclude all work from being conducted indoors.
  - ✓ Designate specific areas for outdoor activities.
  - ✓ Require employees to understand and follow preventive maintenance and spill and leak prevention BMPs.
- It may not be possible to contain and clean up spills from vehicles/equipment brought on-site after working hours.
  - ✓ Provide a designated area for afterhours deliveries.
  - ✓ Install spill kits.
- Drain pans (usually 1 ft. x 1 ft.) are generally too small to contain antifreeze
  - ✓ Purchase or fabricate large drip pans (3 ft. x 3 ft.) with sufficient volume to contain expected quantities of liquids based on equipment/vehicle specifications.
- Dry floor cleaning methods may not be sufficient for some spills.
  - ✓ Use three-step method instead.
- Identification of engine leaks may require some use of solvents.
  - ✓ Minimize the use of solvents and use drip pans to collect spills and leaks.
- Prices for recycled materials and fluids may be higher than those of non-recycled materials.

- Some facilities may be limited by a lack of providers of recycled materials, and by the absence of businesses to provide services such as hazardous waste removal, structural treatment practice maintenance, or solvent equipment and solvent recycling.

## Potential Facilities and Maintenance Requirements

### *Facilities Requirements*

- For facilities that already have covered areas where maintenance takes place, have berms or other means to retain spills and leaks, and/ have other appropriate constructed systems for containment, there may not need to be any significant new capital investment. Capital costs will likely be required at some sites if adequate cover and containment facilities do not exist and can vary significantly depending upon site conditions.



### *Maintenance Requirements*

- Most of the operations and maintenance activity associated with implementing this BMP are integrally linked to routine operations as previously described. Therefore, significant additional operations and maintenance efforts are not likely to be required.

- For facilities responsible for pre-treating their wastewater prior to discharging, the proper functioning of structural treatment system is an important maintenance consideration. Routine cleanout of oil and grease is required for the devices to maintain their effectiveness, usually at least once a month. During periods of heavy rainfall, cleanout is required more often to ensure pollutants are not washed through the trap. Sediment removal is also required on a regular basis to keep the device working efficiently.

- It is important to sweep the maintenance area weekly, if it is paved, to collect loose particles, and wipe up spills with rags and other absorbent material immediately. Do not hose down the area to a storm drain.

## Supplemental Information

### *Waste Reduction*

Parts are often cleaned using solvents such as trichloroethylene, 1,1,1-trichloroethane or methylene chloride. Many of these cleaners are harmful and must be disposed of as a hazardous waste. Cleaning without using liquid cleaners (e.g., wire brush) whenever possible reduces waste. Prevent spills and drips of solvents and cleansers to the shop floor. Do all liquid cleaning at a centralized station so the solvents and residues stay in one area. Locate drip pans, drain boards, and drying racks to direct drips back into a solvent sink or fluid holding tank for reuse. Reducing the number of solvents makes recycling easier and reduces hazardous waste management costs. Often, one solvent can perform a job as well as two different solvents.

- Clean parts without using liquid cleaners whenever possible to reduce waste.

- Prevent spills and drips of solvents and cleansers to the shop floor.

- Do all liquid cleaning at a centralized station so the solvents and residues stay in one area.

- Locate drip pans, drain boards, and drying racks to direct drips back into a solvent sink or fluid holding tank for reuse.

***Recycling***

Separating wastes allows for easier recycling and may reduce treatment costs. Keep hazardous and non-hazardous wastes separate, do not mix used oil and solvents, and keep chlorinated solvents (e.g., 1,1,1-trichloroethane) separate from non-chlorinated solvents (e.g., kerosene and mineral spirits).

Many products made of recycled (i.e., refined or purified) materials are available. Engine oil, transmission fluid, antifreeze, and hydraulic fluid are available in recycled form. Buying recycled products supports the market for recycled materials.

- Recycling is always preferable to disposal of unwanted materials.

- Separate wastes for easier recycling. Keep hazardous and non-hazardous wastes separate, do not mix used oil and solvents, and keep chlorinated solvents separate from non-chlorinated solvents.

- Label and track the recycling of waste material (e.g., used oil, spent solvents, batteries).

- Purchase recycled products to support the market for recycled materials.

***Safer Alternatives***

If possible, eliminate or reduce the amount of hazardous materials and waste by substituting non-hazardous or less hazardous material:

- Use non-caustic detergents instead of caustic cleaning for parts cleaning.

- Use detergent-based or water-based cleaning systems in place of organic solvent degreasers. Wash water may require treatment before it can be discharged to the sewer.

- Replace chlorinated organic solvents with non-chlorinated solvents. Non-chlorinated solvents like kerosene or mineral spirits are less toxic and less expensive to dispose of properly. Check list of active ingredients to see whether it contains chlorinated solvents.

- Choose cleaning agents that can be recycled.

## References and Resources

Orange County Stormwater Program, Best Management Practices for Industrial/Commercial Business Activities. Available online at: http://ocwatersheds.com/documents/bmp/industrialcommercialbusinessesactivities.

Oregon Department of Environmental Quality, 2013. *Industrial Stormwater Best Management Practices Manual- BMP 8 Vehicle, Pavement and Building Washing*. Available online at: http://www.deq.state.or.us/wq/wqpermit/docs/IndBMP021413.pdf.

Sacramento Stormwater Management Program. *Best Management Practices for Industrial Storm Water Pollution Control*. Available online at: http://www.msa.saccounty.net/sactostormwater/documents/guides/industrial-BMP-manual.pdf.

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US EPA, National Pollutant Discharge Elimination System – Stormwater Menu of BMPs - Municipal Vehicle and Equipment Washing. Available online at: http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=browse&Rbutton=detail&bmp=132.

Washington State Department of Ecology, 2012. *Vehicle and Equipment Washwater Discharges Best Management Practices Manual*. Publication no. WQ-R-95-056. Available online at: https://fortress.wa.gov/ecy/publications/publications/95056.pdf.

# Outdoor Loading/Unloading SC-30

## Description

The loading/unloading of materials usually takes place outside on docks or terminals; therefore, materials spilled, leaked, or lost during loading/unloading may collect in the soil or on other surfaces and have the potential to be carried away by wind, stormwater runoff or when the area is cleaned. Additionally, rainfall may wash pollutants from machinery used to unload or move materials. Implementation of the following protocols will prevent or reduce the discharge of pollutants to stormwater from outdoor loading/unloading of materials.

## Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

### *General Pollution Prevention Protocols*

- Park tank trucks or delivery vehicles in designated areas so that spills or leaks can be contained.
- Limit exposure of material to rainfall whenever possible.
- Prevent stormwater run-on.
- Check equipment regularly for leaks.



### *Good Housekeeping*

- Develop an operations plan that describes procedures for loading and/or unloading.
- Conduct loading and unloading in dry weather if possible.

| Objectives |
|---|
| ■ *Cover* |
| ■ *Contain* |
| ■ *Educate* |
| ■ *Reduce/Minimize* |
| ■ *Product Substitution* |

| Targeted Constituents | |
|---|---|
| *Sediment* | ✓ |
| *Nutrients* | ✓ |
| *Trash* | |
| *Metals* | ✓ |
| *Bacteria* | |
| *Oil and Grease* | ✓ |
| *Organics* | ✓ |

| Minimum BMPs Covered | |
|---|---|
| *Good Housekeeping* | ✓ |
| *Preventative Maintenance* | |
| *Spill and Leak Prevention and Response* | ✓ |
| *Material Handling & Waste Management* | ✓ |
| *Erosion and Sediment Controls* | |
| *Employee Training Program* | ✓ |
| *Quality Assurance Record Keeping* | ✓ |

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- Cover designated loading/unloading areas to reduce exposure of materials to rain.
- Consider placing a seal or door skirt between delivery vehicles and building to prevent exposure to rain.
- Design loading/unloading area to prevent stormwater run-on, which would include grading or berming the area, and position roof downspouts so they direct stormwater away from the loading/unloading areas.
- Have employees load and unload all materials and equipment in covered areas such as building overhangs at loading docks if feasible.
- Load/unload only at designated loading areas.
- Use drip pans underneath hose and pipe connections and other leak-prone spots during liquid transfer operations, and when making and breaking connections. Several drip pans should be stored in a covered location near the liquid transfer area so that they are always available, yet protected from precipitation when not in use. Drip pans can be made specifically for railroad tracks. Drip pans must be cleaned periodically, and drip collected materials must be disposed of properly.
- Pave loading areas with concrete instead of asphalt.
- Avoid placing storm drains inlets in the area.
- Grade and/or berm the loading/unloading area with drainage to sump; regularly remove materials accumulated in sump.



### *Spill Response and Prevention Procedures*

- Keep your spill prevention and control plan up-to-date or have an emergency spill cleanup plan readily available, as applicable.
- Contain leaks during transfer.
- Store and maintain appropriate spill cleanup materials in a location that is readily accessible and known to all employees.
- Ensure that employees are familiar with the site's spill control plan and proper spill cleanup procedures.
- Use drip pans or comparable devices when transferring oils, solvents, and paints.



### *Material Handling and Waste Management*

- Spot clean leaks and drips routinely to prevent runoff of spillage.
- Do not pour liquid wastes into floor drains, sinks, outdoor storm drain inlets, or other storm drains or sewer connections.

- Do not put used or leftover cleaning solutions, solvents, and automotive fluids in the storm drain or sanitary sewer.
- Collect leaking or dripping fluids in drip pans or containers. Fluids are easier to recycle if kept separate.
- Promptly transfer used fluids to the proper waste or recycling drums. Do not leave drip pans or other open containers lying around.
- Minimize the possibility of stormwater pollution from outside waste receptacles by doing at least one of the following:
  - ✓ Use only watertight waste receptacle(s) and keep the lid(s) closed.
  - ✓ Grade and pave the waste receptacle area to prevent run-on of stormwater.
  - ✓ Install a roof over the waste receptacle area.
  - ✓ Install a low containment berm around the waste receptacle area.
  - ✓ Use and maintain drip pans under waste receptacles.
- Post "no littering" signs.
- Perform work area clean-up and dry sweep after daily operations.



### *Employee Training Program*

- Train employees (e.g., fork lift operators) and contractors on proper spill containment and cleanup.
- Have employees trained in spill containment and cleanup present during loading/unloading.
- Train employees in proper handling techniques during liquid transfers to avoid spills.
- Make sure forklift operators are properly trained on loading and unloading procedures.




### *Quality Assurance and Record Keeping*

- Keep accurate maintenance logs that document activities performed, quantities of materials removed, and improvement actions.
- Keep accurate logs of spill response actions that document what was spilled, how it was cleaned up, and how the waste was disposed.
- Establish procedures to complete logs and file them in the central office.
- Keep accurate logs of daily clean-up operations.

## Potential Limitations and Work-Arounds

Some facilities may have space constraints, limited staffing and time limitations that may preclude implementation of BMPs. Provided below are typical limitations and recommended "work-arounds."

- Space and time limitations may preclude all transfers from being performed indoors or under cover.
  - ✓ Designate specific areas for outdoor loading and unloading.
  - ✓ Require employees to understand and follow spill and leak prevention BMPs.
- It may not be possible to conduct transfers only during dry weather.
  - ✓ Limit materials and equipment rainfall exposure to all extents practicable.
  - ✓ Require employees to understand and follow spill and leak prevention BMPs.

## Potential Capital Facility Costs and Operation & Maintenance Requirements

### *Facilities*

Many facilities will already have indoor or covered areas where loading/unloading takes place and will require no additional capital expenditures.

If outdoor activities are required, construction of berms or other means to retain spills and leaks may require appropriate constructed systems for containment. These containment areas may require significant new capital investment.

Capital investments will likely be required at some sites if adequate cover and containment facilities do not exist and can vary significantly depending upon site conditions.

### *Maintenance*

Most of the operations and maintenance activities associated with implementing this BMP are integrally linked to routine operations as previously described. Therefore additional O&M is not required.

- Conduct regular inspections and make repairs and improvements as necessary.
- Check loading and unloading equipment regularly for leaks.
- Conduct regular broom dry-sweeping of area. Do not wash with water.

## Supplemental Information

### *Loading and Unloading of Liquids*

- Loading or unloading of liquids should occur in the manufacturing building so that any spills that are not completely retained can be discharged to the sanitary sewer,

treatment plant, or treated in a manner consistent with local sewer authorities and permit requirements.

- For loading and unloading tank trucks to above and below ground storage tanks, the following procedures should be used:
  - ✓ The area where the transfer takes place should be paved. If the liquid is reactive with the asphalt, Portland cement should be used to pave the area.
  - ✓ The transfer area should be designed to prevent run-on of stormwater from adjacent areas. Sloping the pad and using a curb, like a speed bump, around the uphill side of the transfer area should reduce run-on.
  - ✓ The transfer area should be designed to prevent runoff of spilled liquids from the area. Sloping the area to a drain should prevent runoff. The drain should be connected to a dead-end sump or to the sanitary sewer. A positive control valve should be installed on the drain.
- For transfer from rail cars to storage tanks that must occur outside, use the following procedures:
  - ✓ Drip pans should be placed at locations where spillage may occur, such as hose connections, hose reels, and filler nozzles. Use drip pans when making and breaking connections.
  - ✓ Drip pan systems should be installed between the rails to collect spillage from tank cars.

## References and Resources

Minnesota Pollution Control Agency, *Industrial Stormwater Best Management Practices Guidebook BMP 26 Fueling and Liquid Loading/Unloading Operations*. Available online at: http://www.pca.state.mn.us/index.php/view-document.html?gid=10557.

New Jersey Department of Environmental Protection, 2013. *Basic Industrial Stormwater General Permit Guidance Document NJPDES General Permit No NJ0088315*. Available online at: http://www.nj.gov/dep/dwq/pdf/5G2_guidance_color.pdf.

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# Waste Handling & Disposal SC-34

## Description

Improper storage and handling of solid wastes can allow toxic compounds, oils and greases, heavy metals, nutrients, suspended solids, and other pollutants to enter stormwater runoff. The discharge of pollutants to stormwater from waste handling and disposal can be prevented and reduced by tracking waste generation, storage, and disposal; reducing waste generation and disposal through source reduction, reuse, and recycling; and preventing run-on and runoff.

## Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

### *General Pollution Prevention Protocols*

- ☐ Accomplish reduction in the amount of waste generated using the following source controls:
  - ✓ Production planning and sequencing;
  - ✓ Process or equipment modification;
  - ✓ Raw material substitution or elimination;
  - ✓ Loss prevention and housekeeping;
  - ✓ Waste segregation and separation; and
  - ✓ Close loop recycling.
- ☐ Establish a material tracking system to increase awareness about material usage. This may reduce spills and minimize contamination, thus reducing the amount of waste produced.
- ☐ Recycle materials whenever possible.

| Objectives |
|---|
| ■ *Cover* |
| ■ *Contain* |
| ■ *Educate* |
| ■ *Reduce/Minimize* |
| ■ *Product Substitution* |

| Targeted Constituents | |
|---|---|
| *Sediment* | |
| *Nutrients* | |
| *Trash* | |
| *Metals* | ✓ |
| *Bacteria* | ✓ |
| *Oil and Grease* | ✓ |
| *Organics* | ✓ |

| Minimum BMPs Covered | |
|---|---|
| *Good Housekeeping* | ✓ |
| *Preventative Maintenance* | ✓ |
| *Spill and Leak Prevention and Response* | ✓ |
| *Material Handling & Waste Management* | ✓ |
| *Erosion and Sediment Controls* | |
| *Employee Training Program* | ✓ |
| *Quality Assurance Record Keeping* | ✓ |

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- Use the entire product before disposing of the container.
- To the extent possible, store wastes under cover or indoors after ensuring all safety concerns such as fire hazard and ventilation are addressed.
- Provide containers for each waste stream at each work station. Allow time after shift to clean area.



***Good Housekeeping***

- Cover storage containers with leak proof lids or some other means. If waste is not in containers, cover all waste piles (plastic tarps are acceptable coverage) and prevent stormwater run-on and runoff with a berm. The waste containers or piles must be covered except when in use.
- Use drip pans or absorbent materials whenever grease containers are emptied by vacuum trucks or other means. Grease cannot be left on the ground. Collected grease must be properly disposed of as garbage.
- Dispose of rinse and wash water from cleaning waste containers into a sanitary sewer if allowed by the local sewer authority. Do not discharge wash water to the street or storm drain. Clean in a designated wash area that drains to a clarifier.
- Transfer waste from damaged containers into safe containers.
- Take special care when loading or unloading wastes to minimize losses. Loading systems can be used to minimize spills and fugitive emission losses such as dust or mist. Vacuum transfer systems can minimize waste loss.
- Keep the waste management area clean at all times by sweeping and cleaning up spills immediately.
- Use dry methods when possible (e.g., sweeping, use of absorbents) when cleaning around restaurant/food handling dumpster areas. If water must be used after sweeping/using absorbents, collect water and discharge through grease interceptor to the sewer.
- Stencil or demarcate storm drains on the facility's property with prohibitive message regarding waste disposal.
- Cover waste piles with temporary covering material such as reinforced tarpaulin, polyethylene, polyurethane, polypropylene or hypalon.
- If possible, move the activity indoor after ensuring all safety concerns such as fire hazard and ventilation are addressed.



***Preventative Maintenance***

- Prevent stormwater run-on from entering the waste management area by enclosing the area or building a berm around the area.
- Prevent waste materials from directly contacting rain.

- Cover waste piles with temporary covering material such as reinforced tarpaulin, polyethylene, polyurethane, polypropylene or hypalon.
- Cover the area with a permanent roof if feasible.
- Cover dumpsters to prevent rain from washing waste out of holes or cracks in the bottom of the dumpster.
- Check waste containers weekly for leaks and to ensure that lids are on tightly. Replace any that are leaking, corroded, or otherwise deteriorating.
- Sweep and clean the waste management area regularly. Use dry methods when possible (e.g., sweeping, vacuuming, use of absorbents) when cleaning around restaurant/food handling dumpster areas. If water must be used after sweeping/using absorbents, collect water and discharge through grease interceptor to the sewer.
- Inspect and replace faulty pumps or hoses regularly to minimize the potential of releases and spills.
- Repair leaking equipment including valves, lines, seals, or pumps promptly.



***Spill Response and Prevention Procedures***

- Keep your spill prevention and plan up-to-date.
- Have an emergency plan, equipment and trained personnel ready at all times to deal immediately with major spills.
- Collect all spilled liquids and properly dispose of them.
- Store and maintain appropriate spill cleanup materials in a location known to all near the designated wash area.
- Ensure that vehicles transporting waste have spill prevention equipment that can prevent spills during transport. Spill prevention equipment includes:
  - ✓ Vehicles equipped with baffles for liquid waste; and
  - ✓ Trucks with sealed gates and spill guards for solid waste.



***Material Handling and Waste Management***

*Litter Control*

- Post "No Littering" signs and enforce anti-litter laws.
- Provide a sufficient number of litter receptacles for the facility.
- Clean out and cover litter receptacles frequently to prevent spillage.

*Waste Collection*

- Keep waste collection areas clean.

- Inspect solid waste containers for structural damage regularly. Repair or replace damaged containers as necessary.
- Secure solid waste containers; containers must be closed tightly when not in use.
- Do not fill waste containers with washout water or any other liquid.
- Ensure that only appropriate solid wastes are added to the solid waste container. Certain wastes such as hazardous wastes, appliances, fluorescent lamps, pesticides, etc., may not be disposed of in solid waste containers (see chemical/ hazardous waste collection section below).
- Do not mix wastes; this can cause chemical reactions, make recycling impossible, and complicate disposal. Affix labels to all waste containers.

*Chemical/Hazardous Wastes*

- Select designated hazardous waste collection areas on-site.
- Store hazardous materials and wastes in covered containers and protect them from vandalism.
- Place hazardous waste containers in secondary containment.
- Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.
- Hazardous waste cannot be reused or recycled; it must be disposed of by a licensed hazardous waste hauler.



### *Employee Training Program*

- Educate employees about pollution prevention measures and goals.
- Train employees how to properly handle and dispose of waste using the source control BMPs described above.
- Train employees and subcontractors in proper hazardous waste management.
- Use a training log or similar method to document training.
- Ensure that employees are familiar with the site's spill control plan and/or proper spill cleanup procedures.




### *Quality Assurance and Record Keeping*

- Keep accurate maintenance logs that document minimum BMP activities performed for waste handling and disposal, types and quantities of waste disposed of, and any improvement actions.
- Keep accurate logs of spill response actions that document what was spilled, how it was cleaned up, and how the waste was disposed.

- Establish procedures to complete logs and file them in the central office.

## Potential Capital Facility Costs and Operation & Maintenance Requirements

### *Facilities*

- Capital costs will vary substantially depending on the size of the facility and the types of waste handled. Significant capital costs may be associated with reducing wastes by modifying processes or implementing closed-loop recycling.
- Many facilities will already have indoor covered areas where waste materials will be stored and will require no additional capital expenditures for providing cover.
- If outdoor storage of wastes is required, construction of berms or other means to prevent stormwater run-on and runoff may require appropriate constructed systems for containment.
- Capital investments will likely be required at some sites if adequate cover and containment facilities do not exist and can vary significantly depending upon site conditions.

### *Maintenance*

- Check waste containers weekly for leaks and to ensure that lids are on tightly. Replace any that are leaking, corroded, or otherwise deteriorating.
- Sweep and clean the waste management area regularly. Use dry methods when possible (e.g., sweeping, use of absorbents) when cleaning around restaurant/food handling dumpster areas. If water must be used after sweeping/using absorbents, collect water and discharge through grease interceptor to the sewer.
- Inspect and replace faulty pumps or hoses regularly to minimize the potential of releases and spills.
- Repair leaking equipment including valves, lines, seals, or pumps promptly.

## References and Resources

Minnesota Pollution Control Agency, *Industrial Stormwater Best Management Practices Guidebook*. Available online at: http://www.pca.state.mn.us/index.php/view-document.html?gid=10557.

New Jersey Department of Environmental Protection, 2013. *Basic Industrial Stormwater General Permit Guidance Document NJPDES General Permit No NJ0088315,* Revised. Available online at: http://www.nj.gov/dep/dwq/pdf/5G2_guidance_color.pdf.

Orange County Stormwater Program, Best Management Practices for Industrial/Commercial Business Activities. Available online at: http://ocwatersheds.com/documents/bmp/industrialcommercialbusinessesactivities

Oregon Department of Environmental Quality, 2013. *Industrial Stormwater Best Management Practices Manual- BMP 26 Fueling and Liquid Loading/Unloading Operations*. Available online at: http://www.deq.state.or.us/wq/wqpermit/docs/IndBMP021413.pdf.

Sacramento Stormwater Management Program. *Best Management Practices for Industrial Storm Water Pollution Control*. Available online at: http://www.msa.saccounty.net/sactostormwater/documents/guides/industrial-BMP-manual.pdf.

Sacramento County Environmental Management Stormwater Program: Best Management Practices. Available online at: http://www.emd.saccounty.net/EnvHealth/Stormwater/Stormwater-BMPs.html.

Santa Clara Valley Urban Runoff Pollution Prevention Program. http://www.scvurppp-w2k.com/

US EPA. National Pollutant Discharge Elimination System – Industrial Fact Sheet Series for Activities Covered by EPA's Multi Sector General Permit. Available online at: http://cfpub.epa.gov/npdes/stormwater/swsectors.cfm.

# Building & Grounds Maintenance SC-41

## Description

Stormwater runoff from building and grounds maintenance activities can be contaminated with toxic hydrocarbons in solvents, fertilizers and pesticides, suspended solids, heavy metals, abnormal pH, and oils and greases. Utilizing the protocols in this fact sheet will prevent or reduce the discharge of pollutants to stormwater from building and grounds maintenance activities by washing and cleaning up with as little water as possible, following good landscape management practices, preventing and cleaning up spills immediately, keeping debris from entering the storm drains, and maintaining the stormwater collection system.

## Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

### *General Pollution Prevention Protocols*

- Switch to non-toxic chemicals for maintenance to the maximum extent possible.
- Choose cleaning agents that can be recycled.
- Encourage proper lawn management and landscaping, including use of native vegetation.
- Encourage use of Integrated Pest Management techniques for pest control.
- Encourage proper onsite recycling of yard trimmings.
- Recycle residual paints, solvents, lumber, and other material as much as possible.

| **Objectives** |
|---|
| ■ *Cover* |
| ■ *Contain* |
| ■ *Educate* |
| ■ *Reduce/Minimize* |
| ■ *Product Substitution* |

| **Targeted Constituents** | |
|---|---|
| *Sediment* | ✓ |
| *Nutrients* | ✓ |
| *Trash* | |
| *Metals* | ✓ |
| *Bacteria* | ✓ |
| *Oil and Grease* | |
| *Organics* | |

| **Minimum BMPs Covered** | |
|---|---|
| *Good Housekeeping* | ✓ |
| *Preventative Maintenance* | |
| *Spill and Leak Prevention and Response* | ✓ |
| *Material Handling & Waste Management* | ✓ |
| *Erosion and Sediment Controls* | |
| *Employee Training Program* | ✓ |
| *Quality Assurance Record Keeping* | ✓ |

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- Clean work areas at the end of each work shift using dry cleaning methods such as sweeping and vacuuming.



***Good Housekeeping***

*Pressure Washing of Buildings, Rooftops, and Other Large Objects*

- In situations where soaps or detergents are used and the surrounding area is paved, pressure washers must use a water collection device that enables collection of wash water and associated solids. A sump pump, wet vacuum or similarly effective device must be used to collect the runoff and loose materials. The collected runoff and solids must be disposed of properly.

- If soaps or detergents are not used, and the surrounding area is paved, wash runoff does not have to be collected but must be screened. Pressure washers must use filter fabric or some other type of screen on the ground and/or in the catch basin to trap the particles in wash water runoff.

- If you are pressure washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the grass and not drain to pavement.

*Landscaping Activities*

- Dispose of grass clippings, leaves, sticks, or other collected vegetation as garbage, or by composting. Do not dispose of collected vegetation into waterways or storm drainage systems.

- Use mulch or other erosion control measures on exposed soils. See also SC-40, Contaminated and Erodible Areas, for more information.

*Building Repair, Remodeling, and Construction*

- Do not dump any toxic substance or liquid waste on the pavement, the ground, or toward a storm drain.

- Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.

- Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.

- Clean paintbrushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.

- Use a storm drain cover, filter fabric, or similarly effective runoff control mechanism if dust, grit, wash water, or other pollutants may escape the work area and enter a catch basin. This is particularly necessary on rainy days. The containment device(s) must be in place at the beginning of the work day, and accumulated dirty runoff and

solids must be collected and disposed of before removing the containment device(s) at the end of the work day.

- If you need to de-water an excavation site, you may need to filter the water before discharging to a catch basin or off-site. If directed off-site, you should direct the water through hay bales and filter fabric or use other sediment filters or traps.
- Store toxic material under cover during precipitation events and when not in use. A cover would include tarps or other temporary cover material.

*Mowing, Trimming, and Planting*

- Dispose of leaves, sticks, or other collected vegetation as garbage, by composting or at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures when soils are exposed.
- Place temporarily stockpiled material away from watercourses and drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Consider an alternative approach when bailing out muddy water: do not put it in the storm drain; pour over landscaped areas.
- Use hand weeding where practical.

*Fertilizer and Pesticide Management*

- Do not use pesticides if rain is expected.
- Do not mix or prepare pesticides for application near storm drains.
- Use the minimum amount needed for the job.
- Calibrate fertilizer distributors to avoid excessive application.
- Employ techniques to minimize off-target application (e.g., spray drift) of pesticides, including consideration of alternative application techniques.
- Apply pesticides only when wind speeds are low.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Irrigate slowly to prevent runoff and then only as much as is needed.
- Clean pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.

*Inspection*

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

# Building & Grounds Maintenance SC-41



### *Spill Response and Prevention Procedures*

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials, such as brooms, dustpans, and vacuum sweepers (if desired) near the storage area where it will be readily accessible.
- Have employees trained in spill containment and cleanup present during the loading/unloading of dangerous wastes, liquid chemicals, or other materials.
- Familiarize employees with the Spill Prevention Control and Countermeasure Plan.
- Clean up spills immediately.



### *Material Handling and Waste Management*

- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.
- Use less toxic pesticides that will do the job when applicable. Avoid use of copper-based pesticides if possible.
- Dispose of empty pesticide containers according to the instructions on the container label.
- Use up the pesticides. Rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Implement storage requirements for pesticide products with guidance from the local fire department and County Agricultural Commissioner. Provide secondary containment for pesticides.



### *Employee Training Program*

- Educate and train employees on pesticide use and in pesticide application techniques to prevent pollution.
- Train employees and contractors in proper techniques for spill containment and cleanup.
- Be sure the frequency of training takes into account the complexity of the operations and the needs of individual staff.




### *Quality Assurance and Record Keeping*

- Keep accurate logs that document maintenance activities performed and minimum BMP measures implemented.
- Keep accurate logs of spill response actions that document what was spilled, how it was cleaned up, and how the waste was disposed.
- Establish procedures to complete logs and file them in the central office.

## Potential Capital Facility Costs and Operation & Maintenance Requirements

***Facilities***

- Additional capital costs are not anticipated for building and grounds maintenance. Implementation of the minimum BMPs described above should be conducted as part of regular site operations.

***Maintenance***

- Maintenance activities for the BMPs described above will be minimal, and no additional cost is anticipated.

## Supplemental Information

***Fire Sprinkler Line Flushing***

Site fire sprinkler line flushing may be a source of non-stormwater runoff pollution. The water entering the system is usually potable water, though in some areas it may be non-potable reclaimed wastewater. There are subsequent factors that may drastically reduce the quality of the water in such systems. Black iron pipe is usually used since it is cheaper than potable piping, but it is subject to rusting and results in lower quality water. Initially, the black iron pipe has an oil coating to protect it from rusting between manufacture and installation; this will contaminate the water from the first flush but not from subsequent flushes. Nitrates, poly-phosphates and other corrosion inhibitors, as well as fire suppressants and antifreeze may be added to the sprinkler water system. Water generally remains in the sprinkler system a long time (typically a year) and between flushes may accumulate iron, manganese, lead, copper, nickel, and zinc. The water generally becomes anoxic and contains living and dead bacteria and breakdown products from chlorination. This may result in a significant BOD problem and the water often smells. Consequently dispose fire sprinkler line flush water into the sanitary sewer. Do not allow discharge to storm drain or infiltration due to potential high levels of pollutants in fire sprinkler line water.

## References and Resources

City of Seattle, Seattle Public Utilities Department of Planning and Development, 2009. *Stormwater Manual Vol. 1 Source Control Technical Requirements Manual.*

Kennedy/Jenks Consultants, 2007. *The Truckee Meadows Industrial and Commercial Storm Water Best Management Practices Handbook*. Available online at: http://www.cityofsparks.us/sites/default/files/assets/documents/env-control/construction/TM-I-C_BMP_Handbook_2-07-final.pdf.

Orange County Stormwater Program, Best Management Practices for Industrial/Commercial Business Activities. Available online at: http://ocwatersheds.com/documents/bmp/industrialcommercialbusinessesactivities.

Sacramento Stormwater Management Program. *Best Management Practices for Industrial Storm Water Pollution Control*. Available online at:

http://www.msa.saccounty.net/sactostormwater/documents/guides/industrial-BMP-manual.pdf.

US EPA, 1997. *Best Management Practices Handbook for Hazardous Waste Containers*. Available online at: http://www.epa.gov/region6/6en/h/handbk4.pdf.

Ventura Countywide Stormwater Management Program Clean Business Fact Sheets. Available online at: http://www.vcstormwater.org/documents/programs_business/building.pdf.

# Parking Area Maintenance SC-43

## Description

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

BMPs for other outdoor areas on site (loading/unloading, material storage, and equipment operations) are described in SC-30 through SC-33.

## Approach

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

### *General Pollution Prevention Protocols*

- Encourage advanced designs and maintenance strategies for impervious parking lots. Refer to the treatment control BMP fact sheets in this manual for additional information.
- Keep accurate maintenance logs to evaluate BMP implementation.

### *Good Housekeeping*

- Keep all parking areas clean and orderly. Remove debris, litter, and sediments in a timely fashion.
- Post "No Littering" signs and enforce anti-litter laws.

| Objectives |
|---|
| *Cover* |
| *Contain* |
| *Educate* |
| *Reduce/Minimize* |
| *Product Substitution* |

| Targeted Constituents | |
|---|---|
| *Sediment* | ✓ |
| *Nutrients* | |
| *Trash* | ✓ |
| *Metals* | ✓ |
| *Bacteria* | |
| *Oil and Grease* | ✓ |
| *Organics* | ✓ |

| Minimum BMPs Covered | |
|---|---|
| *Good Housekeeping* | ✓ |
| *Preventative Maintenance* | ✓ |
| *Spill and Leak Prevention and Response* | ✓ |
| *Material Handling & Waste Management* | |
| *Erosion and Sediment Controls* | |
| *Employee Training Program* | ✓ |
| *Quality Assurance Record Keeping* | ✓ |

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- ☐ Provide an adequate number of litter receptacles.
- ☐ Clean out and cover litter receptacles frequently to prevent spillage.



***Preventative Maintenance***

*Inspection*

Have designated personnel conduct inspections of parking facilities and stormwater conveyance systems associated with parking facilities on a regular basis.

- ☐ Inspect cleaning equipment/sweepers for leaks on a regular basis.

*Surface Cleaning*

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

*Surface Repair*

- ☐ Check local ordinance for SUSMP/LID ordinance.
- ☐ Preheat, transfer or load hot bituminous material away from storm drain inlets.
- ☐ Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff.
- ☐ Cover and seal nearby storm drain inlets where applicable (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in

place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal.

- Use only as much water as necessary for dust control during sweeping to avoid runoff.
- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.



### *Spill Response and Prevention Procedures*

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



### *Employee Training Program*

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




### *Quality Assurance and Record Keeping*

- Keep accurate maintenance logs that document minimum BMP activities performed for parking area maintenance, types and quantities of waste disposed of, and any improvement actions.
- Keep accurate logs of spill response actions that document what was spilled, how it was cleaned up, and how the waste was disposed.
- Establish procedures to complete logs and file them in the central office.

## Potential Capital Facility Costs and Operation & Maintenance Requirements

### *Facilities*

- Capital investments may be required at some sites to purchase sweeping equipment, train sweeper operators, install oil/water/sand separators, or implement advanced BMPs. These costs can vary significantly depending upon site conditions and the amount of BMPs required.

***Maintenance***

- Sweep and clean parking lots regularly to minimize pollutant transport into storm drains from stormwater runoff.
- Clean out oil/water/sand separators regularly, especially after heavy storms.
- Maintain advanced BMPs such as vegetated swales, infiltration trenches, or detention basins as appropriate. Refer to the treatment control fact sheets for more information.

## Supplemental Information

***Advanced BMPs***

Some parking areas may require advanced BMPs to further reduce pollutants in stormwater runoff, and a few examples are listed below. Refer to the Treatment Control Fact Sheets and the New Development and Redevelopment Manual for more information.

- When possible, direct sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low quantities.
- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.

## References and Resources

City of Seattle, Seattle Public Utilities Department of Planning and Development, 2009. *Stormwater Manual Vol. 1 Source Control Technical Requirements Manual.*

California Stormwater Quality Association, 2003. *New Development and Redevelopment Stormwater Best Management Practice Handbook*. Available online at: https://www.casqa.org/resources/bmp-handbooks/new-development-redevelopment-bmp-handbook.

Kennedy/Jenks Consultants, 2007. *The Truckee Meadows Industrial and Commercial Storm Water Best Management Practices Handbook*. Available online at: http://www.cityofsparks.us/sites/default/files/assets/documents/env-control/construction/TM-I-C_BMP_Handbook_2-07-final.pdf.

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Pollution from Surface Cleaning Folder, 1996, 2003. Bay Area Stormwater Management Agencies Association. Available online at: http://basmaa.org/Portals/0/documents/pdf/Pollution%20from%20Surface%20Cleaning.pdf.

Sacramento Stormwater Management Program. *Best Management Practices for Industrial Storm Water Pollution Control*. Available online at: http://www.msa.saccounty.net/sactostormwater/documents/guides/industrial-BMP-manual.pdf.

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

US EPA. *Post-Construction Stormwater Management in New Development and Redevelopment*. BMP Fact Sheets. Available online at: http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=min_measure&min_measure_id=5.

# Drainage System Maintenance SC-44

## Description

As a consequence of its function, the stormwater drainage facilities on site convey stormwater that may contain certain pollutants either to the offsite conveyance system that collects and transports urban runoff and stormwater, or directly to receiving waters. The protocols in this fact sheet are intended to reduce pollutants leaving the site to the offsite drainage infrastructure or to receiving waters through proper on-site conveyance system operation and maintenance. The targeted constituents will vary depending on site characteristics and operations.

## Approach

Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

### *General Pollution Prevention Protocols*

- ☐ Maintain catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis to remove pollutants, reduce high pollutant concentrations during the first flush of storms, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.
- ☐ Develop and follow a site specific drainage system maintenance plan that describes maintenance locations, methods, required equipment, water sources, sediment collection areas, disposal requirements, and any other pertinent information.

### *Good Housekeeping*

*Illicit Connections and Discharges*

- ☐ Look for evidence of illegal discharges or illicit connections during routine maintenance of conveyance system and drainage structures:

| Objectives |
|---|
| ■ *Cover* |
| ■ *Contain* |
| ■ *Educate* |
| ■ *Reduce/Minimize* |

| Targeted Constituents | |
|---|---|
| *Sediment* | ✓ |
| *Nutrients* | ✓ |
| *Trash* | ✓ |
| *Metals* | ✓ |
| *Bacteria* | ✓ |
| *Oil and Grease* | ✓ |
| *Organics* | ✓ |

| Minimum BMPs Covered | |
|---|---|
| *Good Housekeeping* | ✓ |
| *Preventative Maintenance* | ✓ |
| *Spill and Leak Prevention and Response* | ✓ |
| *Material Handling & Waste Management* | |
| *Erosion and Sediment Controls* | |
| *Employee Training Program* | ✓ |
| *Quality Assurance Record Keeping* | ✓ |

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- ✓ Identify evidence of spills such as paints, discoloring, odors, etc.
- ✓ Record locations of apparent illegal discharges/illicit connections.
- ✓ Track flows back to potential discharges and conduct aboveground inspections. This can be done through visual inspection of upgradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
- ✓ Eliminate the discharge once the origin of flow is established.

- ☐ Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" or similar stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- ☐ Refer to fact sheet SC-10 Non-Stormwater Discharges for additional information.

*Illegal Dumping*

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



***Preventative Maintenance***

*Catch Basins/Inlet Structures*

- ☐ Staff should regularly inspect facilities to ensure compliance with the following:
  - ✓ Immediate repair of any deterioration threatening structural integrity.
  - ✓ Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.

- Clean catch basins, storm drain inlets, and other conveyance structures before the wet season to remove sediments and debris accumulated during the summer.
- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Prioritize storm drain inlets; clean and repair as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
- Dewater the wastes if necessary with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed. Do not dewater near a storm drain or stream.

*Storm Drain Conveyance System*

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.
- Collect and pump flushed effluent to the sanitary sewer for treatment whenever possible.

*Pump Stations*

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge to reach the storm drain system when cleaning a storm drain pump station or other facility.
- Conduct routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.

*Open Channel*

- Modify storm channel characteristics to improve channel hydraulics, increase pollutant removals, and enhance channel/creek aesthetic and habitat value.
- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural state of any river, stream, or lake in California, must enter into a Steam or Lake Alteration Agreement with the Department of Fish and Wildlife. The developer-applicant should also contact local governments (city, county, special districts), other state agencies (SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Army Corps of Engineers and USFWS.



***Spill Response and Prevention Procedures***

- Keep your spill prevention control plan up-to-date.

- Investigate all reports of spills, leaks, and/or illegal dumping promptly.
- Place a stockpile of spill cleanup materials where it will be readily accessible or at a central location.
- Clean up all spills and leaks using "dry" methods (with absorbent materials and/or rags) or dig up, remove, and properly dispose of contaminated soil.



***Employee Training Program***

- Educate employees about pollution prevention measures and goals.
- Train employees how to properly handle and dispose of waste using the source control BMPs described above.
- Train employees and subcontractors in proper hazardous waste management.
- Use a training log or similar method to document training.
- Ensure that employees are familiar with the site's spill control plan and/or proper spill cleanup procedures.
- Have staff involved in detection and removal of illicit connections trained in the following:
  - ✓ OSHA-required Health and Safety Training (29 CFR 1910.120) plus annual refresher training (as needed).
  - ✓ OSHA Confined Space Entry training (Cal-OSHA Confined Space, Title 8 and Federal OSHA 29 CFR 1910.146).
  - ✓ Procedural training (field screening, sampling, smoke/dye testing, TV inspection).




***Quality Assurance and Record Keeping***

- Keep accurate maintenance logs that document minimum BMP activities performed for drainage system maintenance, types and quantities of waste disposed of, and any improvement actions.
- Keep accurate logs of spill response actions that document what was spilled, how it was cleaned up, and how the waste was disposed.
- Keep accurate logs of illicit connections, illicit discharges, and illegal dumping into the storm drain system including how wastes were cleaned up and disposed.
- Establish procedures to complete logs and file them in the central office.

## Potential Limitations and Work-Arounds

Provided below are typical limitations and recommended "work-arounds" for drainage system maintenance:

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

  - ✓ Perform all maintenance onsite and do not flush accumulated material downstream to private property or riparian habitats.

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

  - ✓ Develop and follow a site specific drainage system maintenance plan that describes maintenance locations, methods, required equipment, water sources, sediment collection areas, disposal requirements, and any other pertinent information.

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

  - ✓ Do not dump illegal materials anywhere onsite.

  - ✓ Identify illicit connections, illicit discharge, and illegal dumping.

  - ✓ Cleanup spills immediately and properly dispose of wastes.

- Local municipal codes may include sections prohibiting discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the sanitary sewer system.

  - ✓ Collect all materials and pollutants accumulated in drainage system and dispose of according to local regulations.

  - ✓ Install debris excluders in areas with a trash TMDL.

## Potential Capital Facility Costs and Operation & Maintenance Requirements

### *Facilities*

- Capital costs will vary substantially depending on the size of the facility and characteristics of the drainage system. Significant capital costs may be associated with purchasing water trucks, vacuum trucks, and any other necessary cleaning equipment or improving the drainage infrastructure to reduce the potential .

- Developing and implementing a site specific drainage system maintenance plan will require additional capital if a similar program is not already in place.

***Maintenance***

- Two-person teams may be required to clean catch basins with vactor trucks.
- Teams of at least two people plus administrative personnel are required to identify illicit discharges, depending on the complexity of the storm sewer system.
- Arrangements must be made for proper disposal of collected wastes.
- Technical staff are required to detect and investigate illegal dumping violations.
- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary.

## Supplemental Information

*Storm Drain Flushing*

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

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

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

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

## References and Resources

City of Seattle, Seattle Public Utilities Department of Planning and Development, 2009. *Stormwater Manual Vol. 1 Source Control Technical Requirements Manual*.

Knox County Tennessee *Stormwater Management Manual* Chapter 5 Drainage System Maintenance, 2008. Available online at: http://www.knoxcounty.org/stormwater/manual/Volume%201/knoxco_swmm_v1_chap5_jan2008.pdf.

US EPA. Storm Drain System Cleaning, 2012. Available online at: http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=browse&Rbutton=detail&bmp=102.

# Site Design & Landscape Planning SD-10



**Design Objectives**

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

## Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from stormwater.

## Approach

Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

## Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

## Design Considerations

Design requirements for site design and landscapes planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.

***Designing New Installations***

Begin the development of a plan for the landscape unit with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.
- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open unwooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (e.g., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

*Conserve Natural Areas during Landscape Planning*

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.
- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.
- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.
- Promote natural vegetation by using parking lot islands and other landscaped areas.
- Preserve riparian areas and wetlands.

*Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit*

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.
- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and

regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

- Evaluating infiltration opportunities by referring to the stormwater management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydrogeological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

*Protection of Slopes and Channels during Landscape Design*

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Vegetate slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

### *Redeveloping Existing Installations*

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

Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, disconnect directly connected impervious areas.

### Other Resources

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

Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

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

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

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

# Roof Runoff Controls SD-11



Rain Garden

**Design Objectives**

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

## Description

Various roof runoff controls are available to address stormwater that drains off rooftops. The objective is to reduce the total volume and rate of runoff from individual lots, and retain the pollutants on site that may be picked up from roofing materials and atmospheric deposition. Roof runoff controls consist of directing the roof runoff away from paved areas and mitigating flow to the storm drain system through one of several general approaches: cisterns or rain barrels; dry wells or infiltration trenches; pop-up emitters, and foundation planting. The first three approaches require the roof runoff to be contained in a gutter and downspout system. Foundation planting provides a vegetated strip under the drip line of the roof.

## Approach

Design of individual lots for single-family homes as well as lots for higher density residential and commercial structures should consider site design provisions for containing and infiltrating roof runoff or directing roof runoff to vegetative swales or buffer areas. Retained water can be reused for watering gardens, lawns, and trees. Benefits to the environment include reduced demand for potable water used for irrigation, improved stormwater quality, increased groundwater recharge, decreased runoff volume and peak flows, and decreased flooding potential.

## Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

## Design Considerations

### *Designing New Installations*

*Cisterns or Rain Barrels*

One method of addressing roof runoff is to direct roof downspouts to cisterns or rain barrels. A cistern is an above ground storage vessel with either a manually operated valve or a permanently open outlet. Roof runoff is temporarily stored and then released for irrigation or infiltration between storms. The number of rain

barrels needed is a function of the rooftop area. Some low impact developers recommend that every house have at least 2 rain barrels, with a minimum storage capacity of 1000 liters. Roof barrels serve several purposes including mitigating the first flush from the roof which has a high volume, amount of contaminants, and thermal load. Several types of rain barrels are commercially available. Consideration must be given to selecting rain barrels that are vector proof and childproof. In addition, some barrels are designed with a bypass valve that filters out grit and other contaminants and routes overflow to a soak-away pit or rain garden.

If the cistern has an operable valve, the valve can be closed to store stormwater for irrigation or infiltration between storms. This system requires continual monitoring by the resident or grounds crews, but provides greater flexibility in water storage and metering. If a cistern is provided with an operable valve and water is stored inside for long periods, the cistern must be covered to prevent mosquitoes from breeding.

A cistern system with a permanently open outlet can also provide for metering stormwater runoff. If the cistern outlet is significantly smaller than the size of the downspout inlet (say ¼ to ½ inch diameter), runoff will build up inside the cistern during storms, and will empty out slowly after peak intensities subside. This is a feasible way to mitigate the peak flow increases caused by rooftop impervious land coverage, especially for the frequent, small storms.

*Dry wells and Infiltration Trenches*

Roof downspouts can be directed to dry wells or infiltration trenches. A dry well is constructed by excavating a hole in the ground and filling it with an open graded aggregate, and allowing the water to fill the dry well and infiltrate after the storm event. An underground connection from the downspout conveys water into the dry well, allowing it to be stored in the voids. To minimize sedimentation from lateral soil movement, the sides and top of the stone storage matrix can be wrapped in a permeable filter fabric, though the bottom may remain open. A perforated observation pipe can be inserted vertically into the dry well to allow for inspection and maintenance.

In practice, dry wells receiving runoff from single roof downspouts have been successful over long periods because they contain very little sediment. They must be sized according to the amount of rooftop runoff received, but are typically 4 to 5 feet square, and 2 to 3 feet deep, with a minimum of 1-foot soil cover over the top (maximum depth of 10 feet).

To protect the foundation, dry wells must be set away from the building at least 10 feet. They must be installed in solids that accommodate infiltration. In poorly drained soils, dry wells have very limited feasibility.

Infiltration trenches function in a similar manner and would be particularly effective for larger roof areas. An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. These are described under Treatment Controls.

*Pop-up Drainage Emitter*

Roof downspouts can be directed to an underground pipe that daylights some distance from the building foundation, releasing the roof runoff through a pop-up emitter. Similar to a pop-up irrigation head, the emitter only opens when there is flow from the roof. The emitter remains flush to the ground during dry periods, for ease of lawn or landscape maintenance.

*Foundation Planting*

Landscape planting can be provided around the base to allow increased opportunities for stormwater infiltration and protect the soil from erosion caused by concentrated sheet flow coming off the roof. Foundation plantings can reduce the physical impact of water on the soil and provide a subsurface matrix of roots that encourage infiltration. These plantings must be sturdy enough to tolerate the heavy runoff sheet flows, and periodic soil saturation.

### *Redeveloping Existing Installations*

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

## Supplemental Information

### *Examples*

- City of Ottawa's Water Links Surface –Water Quality Protection Program
- City of Toronto Downspout Disconnection Program
- City of Boston, MA, Rain Barrel Demonstration Program

## Other Resources

Hager, Marty Catherine, Stormwater, "Low-Impact Development", January/February 2003. www.stormh2o.com

Low Impact Urban Design Tools, Low Impact Development Design Center, Beltsville, MD. www.lid-stormwater.net

Start at the Source, Bay Area Stormwater Management Agencies Association, 1999 Edition

# Efficient Irrigation SD-12



**Design Objectives**

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

## Description

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

## Approach

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

## Suitable Applications

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

## Design Considerations

### *Designing New Installations*

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

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

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

***Redeveloping Existing Installations***

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

## Other Resources

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

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

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

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

# Storm Drain Signage SD-13



**Design Objectives**

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

## Description

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

## Approach

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

## Suitable Applications

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

## Design Considerations

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

### *Designing New Installations*

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

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

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

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

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

***Redeveloping Existing Installations***

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

## Additional Information

***Maintenance Considerations***

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

***Placement***

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

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

## Supplemental Information

***Examples***

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

## Other Resources

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

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

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

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

# Maintenance Bays & Docks SD-31



**Design Objectives**

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

## Description

Several measures can be taken to prevent operations at maintenance bays and loading docks from contributing a variety of toxic compounds, oil and grease, heavy metals, nutrients, suspended solids, and other pollutants to the stormwater conveyance system.

## Approach

In designs for maintenance bays and loading docks, containment is encouraged. Preventative measures include overflow containment structures and dead-end sumps. However, in the case of loading docks from grocery stores and warehouse/distribution centers, engineered infiltration systems may be considered.

## Suitable Applications

Appropriate applications include commercial and industrial areas planned for development or redevelopment.

## Design Considerations

Design requirements for vehicle maintenance and repair are governed by Building and Fire Codes, and by current local agency ordinances, and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code requirements.

### *Designing New Installations*

Designs of maintenance bays should consider the following:

- Repair/maintenance bays and vehicle parts with fluids should be indoors; or designed to preclude urban run-on and runoff.
- Repair/maintenance floor areas should be paved with Portland cement concrete (or equivalent smooth impervious surface).

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- Repair/maintenance bays should be designed to capture all wash water leaks and spills. Provide impermeable berms, drop inlets, trench catch basins, or overflow containment structures around repair bays to prevent spilled materials and wash-down waters form entering the storm drain system. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the storm drain system is prohibited. If required by local jurisdiction, obtain an Industrial Waste Discharge Permit.

- Other features may be comparable and equally effective.

The following designs of loading/unloading dock areas should be considered:

- Loading dock areas should be covered, or drainage should be designed to preclude urban run-on and runoff.

- Direct connections into storm drains from depressed loading docks (truck wells) are prohibited.

- Below-grade loading docks from grocery stores and warehouse/distribution centers of fresh food items should drain through water quality inlets, or to an engineered infiltration system, or an equally effective alternative. Pre-treatment may also be required.

- Other features may be comparable and equally effective.

### *Redeveloping Existing Installations*

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

## Additional Information

Stormwater and non-stormwater will accumulate in containment areas and sumps with impervious surfaces. Contaminated accumulated water must be disposed of in accordance with applicable laws and cannot be discharged directly to the storm drain or sanitary sewer system without the appropriate permit.

## Other Resources

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

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

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

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

# Trash Storage Areas SD-32

**Design Objectives**

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

## Description

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

## Approach

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

## Suitable Applications

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

## Design Considerations

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

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

### *Designing New Installations*

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

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

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

### *Redeveloping Existing Installations*

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

## Additional Information

### *Maintenance Considerations*

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

## Other Resources

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

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

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

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

# APPENDIX F

Activity Restriction – C, C&R's & Lease Agreements

To be provided in Final WQMP Report