Appendix G: Hydrology

CONCEPTUAL
WATER QUALITY MANAGEMENT PLAN
(CWQMP)

"Lighthouse"
Tentative Tract Map No. 17747
Permit No.

Project Address:
Northwest of West 16th Street and Whittier Avenue
Costa Mesa, CA

Prepared For:

MW Bluffs Owner, LLC
A Delaware Limited Liability Co.

4100 MacArthur Blvd., Suite 330
Newport Beach, CA 92660

Contact: Matt Hamilton
(855) 773-3223

Prepared By:

Hunsaker & Associates Irvine, Inc.
3 Hughes
Irvine, CA 92618
(949) 583-1010

Contact: Phil Dowty

WQMP Preparation Date:

June 19, 2014

WO# 3974-1

CONCEPTUAL WATER QUALITY MANAGEMENT PLAN (WQMP)

"Lighthouse"

Tentative Tract Map No. 17747 | Permit No.

Project Address: Northwest of West 16th Street and Whittier Avenue, Costa Mesa, CA

Conceptual Water Quality Management Plan (CWQMP)

"LIGHTHOUSE"
TENTATIVE TRACT MAP NO. 17747
PERMIT NO.

Located Northwest of West 16th Street and Whittier Avenue
Costa Mesa, CA

Prepared for:

MW Bluffs Owner, LLC
A Delaware Limited Liability Co.
4100 Mac Arthur Blvd., Suite 330
Newport Beach, CA 92660
Contact: Matt Hamilton
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(949) 583-1010
Contact: Phil Dowty

Prepared on:
June 19, 2014

Revised: July 18, 2014

Project Owner's Certification			
Permit/Application No.		Grading Permit No.	Project is in Entitlement Phase – Grading Permit No. to be provided with Final WQMP
Tract/Parcel Map No.	TTM 17747	Building Permit No.	Project is in Entitlement Phase – Building Permit No. to be provided with Final WQMP
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract)			APN 424-391-09, 424-391-10 & 424-91-12

This Water Quality Management Plan (WQMP) has been prepared MW Bluffs Owner, LLC, A Delaware Limited Liability Co. by Hunsaker and Associates Irvine, Inc. The WQMP is intended to comply with the requirements of the local NPDES Stormwater Program requiring the preparation of the plan.

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

Owner: MW Bluffs Owner, LLC, A Delaware Limited Liability Co.			
Title	Matt Hamilton		
Company	MW Bluffs Owner, LLC, A Delaware Limited Liability Co.		
Address	4100 MacArthur Blvd., Suite 330, Newport Beach, CA 92660		
Email	matt@preface.com		
Telephone #	(855) 773-3223		
Signature		Date	

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Attachments

Section I Discretionary Permit(s) and Water Quality Conditions

The project's discretionary permit and water quality information are provided in the following:

Project Infomation			
Permit/Application No.		Tract/Parcel Map No.	TTM No. 17747
Water Quality Conditions			
Water Quality Conditions (list verbatim)	Per City of City of Costa Mesa Municipal Code, Chapter 03, Section 8-32, New development and significant redevelopment: (1) All new development and significant redevelopment within the City of Costa Mesa shall be undertaken in accordance with: (i) The DAMP, including but not limited to the Development Project Guidance; and (ii) Any conditions and requirements established by the development services department and the public services department which are reasonably related to the reduction or elimination of pollutants in storm water runoff from the project site. Project specific conditions of approval are not available at this time and will be provided upon discretionary approval.		
Watershed-Based Plan Conditions			
Provide applicable conditions from watershed - based plans including WIHMPs and TMDLS.	The project is located within the Lower Santa Ana River Watershed. Although the project's receiving waters are considered impaired under Section 303(d) of the Clean Water Act, there are currently no TMDL's established for these waterbodies.		

Section II Project Description

II.1 Project Description

Description of Proposed Project		
Development Category (Verbatim from WQMP):	Priority Project, Category 1 – New development projects that create 10,000 square feet or more of impervious surface. This category includes commercial, industrial, residential housing subdivisions, mixed-use, and public projects on private or public property that falls under the planning and building authority or the Permittees.	
Project Area (ac): 5.7 Acres	Number of Dwelling Units: 89 (49 Residential; 40 Live/Work Residential)	SIC Code:
Narrative Project Description:	The proposed project, Tentative Tract Map 17747 (TTM 17747), encompasses approximately 5.7 acres within the City of Costa Mesa. The subject site is bound to the north by Newhall Street, to the east by existing commercial uses, to the south by 16th Street and to the west by vacant land. Proposed entrance into the site will be via West 16th Street to the south and Newhall Street at the northeast corner. The project proposes the construction of eighty-nine (89) graded lots (Lots 1 – 89) and backbone improvements to accommodate the proposed development. The project proponent will be responsible for the overall site grading, pad grading and construction of the project streets (public), sidewalk, curb and gutter, storm drain and utility lines. The proposed Development Areas will include single-family residential and work/living lots and open space elements. Parking will primarily be provided via each residential lot. Street parking has also been proposed as part of the backbone improvements. Total parking shall be consistent with the City of Costa Mesa parking requirements. Open space/landscaping areas will consist of parkway landscaping, the open lawn play areas, community gathering spaces, as well as private landscaping in private yards. Proposed impervious area constructed as part of the backbone improvements will consist of approximately 4.3 acres, which includes project streets and parkway improvements. Proposed pervious area will consists of the open space lots and private landscaping consisting of approximately 1.4 acres. Typical household wastes are anticipated to be generated daily from the project. Designated trash areas will be provided onsite for each residential lot. Trash shall be removed on a weekly basis, or as needed, by the local waste management company. The locations of the proposed trash pick-up area will be identified in future amendments to this WQMP or site-specific WQMPs under separate cover.	

Description of Proposed Project

Site summary is as follows:

Residential Live/Work

Lot No.	S.F	Lot No.	S.F
1	1350	**21**	1172
2	1363	**22**	1162
3	1362	**23**	1117
4	1315	**24**	1172
5	1371	**25**	1172
6	1383	**26**	1172
7	1389	**27**	1172
8	1397	**28**	1166
9	1403	**29**	1242
10	1411	**30**	1172
11	1417	**31**	1172
12	1424	**32**	1166
13	1431	**33**	1128
14	1438	**34**	1175
15	1438	**35**	1179
16	1166	**36**	1180
17	1172	**37**	1172
18	1172	**38**	1126
19	1172	**39**	1172
20	1171	**40**	1242

Residential

Lot No.	S.F	Lot No.	S.F
1	1,978	**26**	1,602
2	1,987	**27**	1,586
3	1,666	**28**	1,896
4	1,985	**29**	1,755
5	1,984	**30**	2,224
6	1,664	**31**	1,713
7	1,983	**32**	1,710
8	1,982	**33**	1,556
9	1,662	**34**	1,859

Description of Proposed Project

10	1,980	**35**	1,558
11	1,980	**36**	1,755
12	1,660	**37**	1,595
13	2,502	**38**	1,937
14	2,587	**39**	1,623
15	1,838	**40**	1,623
16	1,837	**41**	1,623
17	2,240	**42**	1,937
18	2,549	**43**	1,783
19	1,836	**44**	1,636
20	2,185	**45**	2,149
21	1,723	**46**	1,643
22	2,062	**47**	1,964
23	1,853	**48**	1,645
24	1,720	**49**	1,621
25	1,914		

All proposed backbone improvements are shown in the WQMP Site Plan in Section VI of this WQMP.

Project Area	Pervious		Impervious	
	Area (acres or sq ft)	Percentage	Area (acres or sq ft)	Percentage
Pre-Project Conditions	0.5 acres	0.5 %	5.2 acres	99.5 %
Post-Project Conditions	1.4 acres	25%	4.3 acres	75%

Drainage Patterns/Connections

In the proposed condition, runoff from the project site will be conveyed to an existing 30" RCP offsite, then to an existing catch basin located on the south side of West 16th Street, then conveyed to an existing 36" RCP that runs westerly along West 16th Street.

All runoff is then conveyed southerly into vacant land natural area (unincorporated area) of Newport Beach, then further conveyed and discharged into the Pacific Ocean via Newport Slough and the Santa Ana River.

II.2 Potential Stormwater Pollutants

Table 2.1, Anticipated and Potential Pollutants Generated by Land Use Type from the Technical Guidance Document (May 2011) lists the following Pollutants of Concern (POC's) associated with Attached Residential and Commercial Developments: Suspended Solid/Sediments, Nutrients, Pathogens (Bacteria/Virus), Pesticides, Oil & Grease and Trash & Debris.

Pollutants of Concern			
Pollutant	E=Expected to be of concern N=Not Expected to be of concern		Additional Information and Comments
Suspended-Solid/ Sediment	E		Potential sources of sediment include existing landscaping areas and disturbed earth surfaces.
Nutrients	E		Pollutant is Primary POC as downstream water is impaired for Ammonia. Potential sources of nutrients include fertilizers, sediment and trash/debris.
Heavy Metals		N	Per Table 2.1, pollutant is only expected if project includes metal roofs or outdoor storage areas.
Pathogens (Bacteria/Virus)	E		Pollutant is Primary POC. Potential sources of pathogens include pets, food wastes and landscaping/sediment areas.
Pesticides	E		Pollutant is Primary POC. Potential sources of pesticides include landscaping and open space areas.
Oil and Grease	E		Potential source of oil and grease is parked vehicles.
Toxic Organic Compounds	E		Potential sources include automobile fluids and landscaping materials.
Trash and Debris	E		Potential sources include common litter and trash cans from residential homes.

II.3 Hydrologic Conditions of Concern

The purpose of this section is to identify any hydrologic conditions of concern (HCOC) with respect to downstream flooding, erosion potential of natural channels downstream, impacts of increased flows on natural habitat, etc. As specified in Section 2.3.3 of the 2011 Model WQMP, projects must identify and mitigate any HCOCs. A HCOC is a combination of upland hydrologic conditions and stream biological and physical conditions that presents a condition of concern for physical and/or biological degradation of streams.

In the North Orange County permit area, HCOCs are considered to exist if any streams located downstream from the project are determined to be potentially susceptible to hydromodification impacts and either of the following conditions exists:

- Post-development runoff volume for the 2-yr, 24-hr storm exceeds the pre-development runoff volume for the 2-yr, 24-hr storm by more than 5 percent.

or

- Time of concentration (Tc) of post-development runoff for the 2-yr, 24-hr storm event is less than the time of concentration of the pre-development condition for the 2-yr, 24-hr storm event by more than 5 percent.

If these conditions do not exist or streams are not potentially susceptible to hydromodification impacts, an HCOC does not exist and hydromodification does not need to be considered further. In the North Orange County permit area, downstream channels are considered not susceptible to hydromodification, and therefore do not have the potential for a HCOC, if all downstream conveyance channels that will receive runoff from the project are engineered, hardened, and regularly maintained to ensure design flow capacity, and no sensitive habitat areas will be affected.

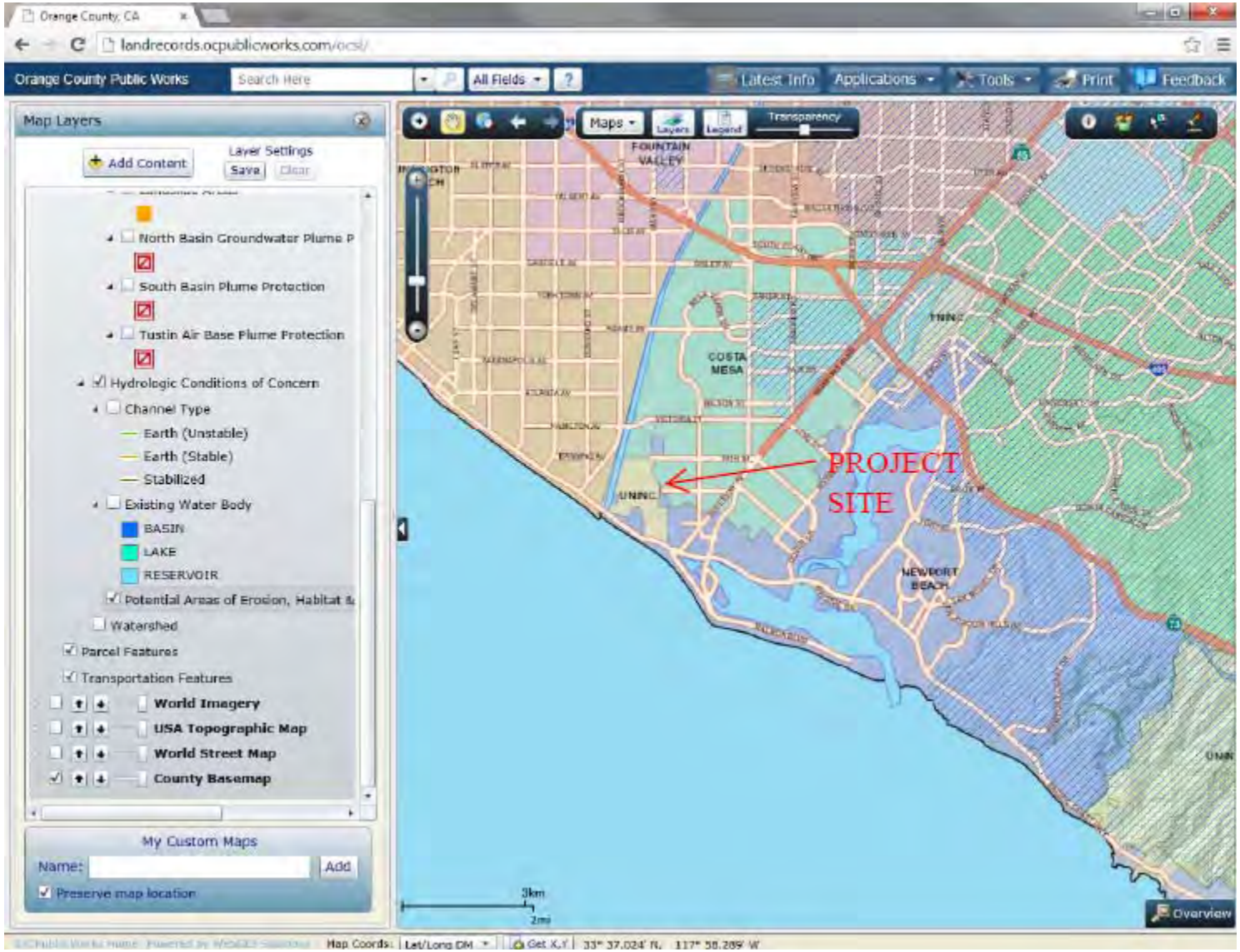
Is the proposed project potentially susceptible to hydromodification impacts?

☐ Yes ☒ No – Show map

The proposed project is not subject to the specific 2-year criteria or susceptibility maps noted above. Runoff from the site is discharged to the existing City storm drain system prior to discharging to the Pacific Ocean.

Per Orange County Public Works Land Records Website, the project site is not located within a potential area of erosion, habitat and physical structure susceptibility. See map below for site location and shaded areas of HCOC's, closest area of HCOC's is approximately 2.3 miles northeast of the project site.

Potential Areas of Erosion, Habitat & Physical Structure Susceptibility



II.4 Post Development Drainage Characteristics

Describe post development drainage characteristics.

In general, drainage for the developed site will be consistent with existing conditions, where storm water flows from north to south. In the proposed condition, flows will be conveyed through the sites storm drain system and connect to the existing catch basin off-site, located on the northerly side of West 16th Street.

Runoff is then conveyed southerly to an existing local 36" RCP and continues southerly towards the Santa Ana River, as in pre-project conditions.

To satisfy the project requirements for Low Impact Development (LID) and storm water treatment, water quality flows (non-storm water flows and the Design Capture Volume) from the project's onsite drainage areas will receive treatment (Per TGD guidelines) via proprietary bioretention units.

Development Areas: Treatment of runoff from the Residential Lots, Work/Living Lots, Neighborhood Streets and Open Space Lots will be conveyed to the projects proprietary bioretention units for water quality treatment. Once treated, flows will be conveyed via the project's storm drain system off-site to the existing catch basin located on the northerly side of West 16th Street, then to the existing 36" RCP and ultimately discharging into the Pacific Ocean via the Santa Ana River.

II.5 Property Ownership/Management

The property owner, MW Bluffs, Owner, LLC, A Delaware Limited Liability Co., shall assume all BMP maintenance and inspection responsibilities until the establishment of a Homeowners Association.

Inspection and maintenance activities are provided in Section V of this CWQMP.

Section III Site Description

III.1 Physical Setting

General descriptions of the project area are provided below:

Planning Area/ Community Name	Planning Area: N/A Community Name: Lighthouse
Location/Address	Northwest of West 16th Street and Whittier Avenue.
Project Area Description	The subject site is bound to the north by Newhall Street, to the east by existing commercial uses, to the south by 16th Street and to the west by vacant land. Proposed entrance into the site will be via West 16th Street to the south and Newhall Street at the northeast corner. The project site currently consists of existing industrial buildings and one existing residence. The site is fully developed. All buildings will be demolished as part of the proposed project.
Land Use	Existing: Industrial Proposed: Residential and Live/Work Residential
Zoning	Existing: General Industrial Proposed: Residential
Acreage	5.7 acres
Predominant Soil Type	Hydrologic Soil Type D

III.2 Site Characteristics

The following table summarizes general characteristics of the project site:

Precipitation Zone	0.70 in.
Topography	In general, the project site is relatively flat, with a gentle gradient to the north and to the south.
Drainage Patterns/Connections	In the pre-project condition, runoff typically drains from north to south. Runoff from the site flows towards West 16th Street into an existing local storm drain system. Runoff for the existing local storm drain system in West 16th Street are conveyed southerly across a vacant natural area and towards the Santa Ana River (Channel E01), then ultimately discharging into the Pacific Ocean.
Soil Type, Geology, and Infiltration Properties	The project site resides on the lowers reach of the Santa Ana River Basin within the Peninsular Ranges geomorphic province of California in the central block of the Peninsular Ranges physiographic. The Peninsular Ranges province has an elongated series of mountainous ridges and peaks rising in places to altitudes of more than 10,000 feet above sea level. The province extends southwestward about 900 miles from near Los Angeles, to the tip of Baja California. Basement rocks of the province are overlain by marine and non-marine clastic strata of Late Cretaceous or Cenozoic age. Based on information from the Natural Resource Conservation Service Web Soil Survey, onsite soils consists primarily of Myford sandy loam, which is rated as a Hydrologic Group D Soil, characterized as having a very low to moderately low infiltrate rate (0.00 to 0.06 in/hr).
Hydrogeologic (Groundwater) Conditions	Based on The County of Orange Watershed Infiltration and Hydromodification Plan (WIHMP), groundwater is anticipated to be greater than 10 feet below ground surface.
Geotechnical Conditions (relevant to infiltration)	Based on the TGD and NRCS data, underlying soils consists primarily of Group "D" soils, which are not favorable for infiltration.
Off-Site Drainage	Under proposed conditions, the project receives offsite flows from the northeast side of the project site and will be collected by proposed inlets at nodes 4.2 and 4.3 and conveyed through the sites storm drain system and discharge offsite in West 16th street.
Utility and Infrastructure Information	Wet and dry utilities are proposed for this tract and will connect to existing facilities located in West 16th Street.

III.3 Watershed Description

The following table includes descriptions of the project's receiving waters:

Receiving Waters	Newport Slough and Santa Ana River (Channel E01)
303(d) Listed Impairments	Enterococus (pathogen), Fecal Coliform (pathogen) and Total Coliform (pathogen)
Applicable TMDLs	Currently, no TMDLs have been established for the 303(d) listed pollutants.
Pollutants of Concern for the Project	Pollutants of Concern: Suspended Solids/Sediment, Nutrients, Pathogens, Pesticides, Oil & Grease, Toxic Organic Compounds, Trash & Debris. Primary Pollutants of concern: Nutrients, Pathogens and Pesticides.
Environmentally Sensitive and Special Biological Significant Areas	There are no Areas of Special Biological Significance (ASBS) or ESA's within the project site.

Section IV Best Management Practices (BMPs)

IV. 1 Project Performance Criteria

Project Performance Criteria			
(NOC Permit Area only) Is there an approved WIHMP or equivalent for the project area that includes more stringent LID feasibility criteria or if there are opportunities identified for implementing LID on regional or sub-regional basis?		YES ☐	NO ☒
If yes, describe WIHMP feasibility criteria or regional/sub-regional LID opportunities.	A WIHMP has not been approved for the watershed.		
If HCOC exists, list applicable hydromodification control performance criteria	As discussed in Section II.3, there are no Hydrologic Conditions of Concern for the project.		
List applicable LID performance criteria	LID BMPs for the project proposes to meet the following LID performance criteria: • Retain, onsite, (infiltrate, harvest and use, or evapotranspire) stormwater runoff as feasible up to the Design Capture Volume		
List applicable treatment control BMP performance criteria	Project proposes the use of LID BMPs to address the project's design capture volume.		
Calculate LID design storm capture volume for Project.	DCV = C x D x A x 43560 sf/ac x 1/12 in/ft Where: DCV = design storm capture volume, cu-ft C = runoff coefficient = (0.75 x imp + 0.15) Imp = impervious fraction of drainage area (ranges from 0 to 1) D = storm depth (inches) A = tributary area (acres) Imp = 0.75 (ultimate site build out) D = 0.70 inches A = 5.7 DCV[1] = 0.7125 x 0.70 x 5.7ac x 43560 sf/ac x 1/12 in/ft = 10,319ft^3		

[1] *Estimate based on TTM boundary. For DCV based on DMAs, refer to Section IV.3.2*

IV.2 Site Design and Drainage Plan

The primary goal of site design principles and techniques is to reduce land development impacts on water quality and downstream hydrologic conditions. Benefits of site design include reductions in the size of downstream BMPs, conveyance systems, pollutant loading and hydromodification impacts.

IV.2.1 Site Design BMPs

The following section describes the site design BMPs that have been incorporated into this project.

Minimize Impervious Area

The project will reduce impervious surfaces as compared to the site's previous land use which consisted of industrial buildings and parking lots. The existing impervious area is approximately 99.5% and the developed area is approximately 75% impervious. Landscaping will be provided within the open space lots, open lawn play areas, as well as within each private residential lot.

Maximize Natural Infiltration Capacity

Project site is not feasible for infiltration. The project site consists of Type "D" soils.

Preserve Existing Drainage Patterns and Time of Concentration

The proposed drainage pattern is consistent with existing drainage patterns. In regards to the time of concentration for the project's runoff, the proposed land use is anticipated to increase the time of concentration from the site's existing condition (industrial with minimal landscaping).

Disconnect Impervious Areas

Landscaping will be provided adjacent to sidewalks, within common areas, as well as open areas between residential lots to break up the project's impervious areas.

Protect Existing Vegetation and Sensitive Areas, and Revegetate Disturbed Areas

The site has minimal vegetation in the pre-project condition. There are no natural areas or critical landscaping areas to preserve. All disturbed areas will either be paved or landscaped.

Xeriscape Landscaping

Native and/or tolerant landscaping will be incorporated into the site design consistent with City guidelines.

IV.3 LID BMP Selection and Project Conformance Analysis

Per the 4th Term MS4 Storm Water Permit (Order No. R8-2009-0030, as amended by Order No. R8-2010-0062), Low Impact Development (LID) BMPs must be incorporated into design features and source controls to reduce project related storm water pollutants. The incorporation of LID BMPs into project design requires evaluation of LID measures in the following treatment hierarchy: infiltration, evapotranspiration, harvest/reuse and biotreatment.

IV.3.1 Hydrologic Source Controls (HSCs)

Hydrologic source controls (HSCs) can be considered to be an integration of site design practices and LID BMPs. The goal of HSCs is to reduce runoff volume for a given drainage area without reducing the site's true impervious area.

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

Hydrologic Source Controls (HSCs) have not been selected for use on this proposed project. However, they may be utilized during the final WQMP stage of the project.

IV.3.2 Infiltration BMPs

Infiltration BMPs are LID BMPs that capture, store and infiltrate storm water runoff. These BMPs are engineered to store a specified volume of water and have no design surface discharge (underdrain or outlet structure) until this volume is exceeded. Examples of infiltration BMPs include infiltration trenches, bioretention without underdrains, infiltration wells, permeable pavement, and underground infiltration galleries.

Name	Included?
Bioretention without underdrains	☐
Rain gardens	☐
Porous landscaping	☐
Infiltration planters	☐
Retention swales	☐
Infiltration trenches	☐
Infiltration basins	☐
Infiltration wells	☐
Subsurface infiltration galleries	☐
French drains	☐
Permeable asphalt	☐
Permeable concrete	☐
Permeable concrete pavers	☐

No infiltration LID BMPs are proposed for the project. Based on the TGD and NRCS data, underlying soils consists primarily of Group "D" soils, which are not favorable for infiltration. Additionally, percolation rates are not available at this stage of the project, once infiltration tests results are available the project will be re-evaluated for the use of infiltration LID BMPs.

IV.3.3 Evapotranspiration, Rainwater Harvesting BMPs

Name	Included?
EVAPOTRANSPIRATION	
All HSCs; *See Section IV.3.1*	☐
Surface-based infiltration BMPs	☐
Biotreatment BMPs	☐
HARVEST & REUSE/ RAINWATER HARVESTING	

Above-ground cisterns and basins	☐
Underground detention	☐
Other:	☐
Other:	☐
Other:	☐

Evapotranspiration

Evapotranspiration BMPs are a class of retention BMPs that discharges stored volume predominately to ET, through some infiltration may occur. ET includes both evaporation and transpiration, and ET BMPs may incorporate one or more of these processes. BMPs must be designed to achieve the maximum feasible ET, where required to demonstrate that the maximum amount of water has been retained on-site. Since ET is not the sole process in the proposed BMPs, specific design and sizing criteria have not been developed for ET-based BMPs.

Harvest and Reuse

Harvest and Reuse (aka. Rainwater Harvesting) BMPs are LID BMPs that capture and store storm water runoff for later use. These BMPs are engineered to store a specified volume of water and have no design surface discharge until this volume is exceeded. Harvest and use BMPs include both above-ground and below-ground cisterns. Examples of uses for harvested water include irrigation, toilet and urinal flushing, vehicle washing, evaporative cooling, industrial processes and other non-potable uses.

The project does not propose the use of harvesting BMPs, as the project has selected the use of Biotreatment BMP to address project runoff.

IV.3.4 Biotreatment BMPs

Biotreatment BMPs are a class of structural LID BMPs that treat suspended solids and dissolved pollutants in storm water using mechanisms characteristic of biologically active systems. These BMPs are considered treat and release facilities and include treatment mechanisms that employ soil microbes and plants. Additional benefits of these BMPs may include aesthetic enjoyment, recreational use, wildlife habitat and reduction in storm water volume.

BIOTREATMENT		
ID	Name	Included?
BIO-1	Bioretention with underdrains	☐
	Stormwater planter boxes with underdrains	☐
	Rain gardens with underdrains	☐
BIO-5	Constructed wetlands	☐
BIO-2	Vegetated swales	☐
BIO-3	Vegetated filter strips	☐

BIO-7	Proprietary vegetated biotreatment systems	☒
BIO-4	Wet extended detention basin	☐
BIO-6	Dry extended detention basins	☐

Proprietary bioretention BMPs have been selected to treat runoff for the project site.

BMP Sizing

Each proposed biotreatment BMP shall be sized according to its respective Drainage Management Area (DMA). Details of each DMA are provided in the following table. Tentative locations of the BMPs are provided in the WQMP Site Plan provided in Section VI.

TREATMENT BMP SUMMARY					
DMA	**% Imp.**	**Initial Rainfall Intensity (in/hr)**	**Area (Ac)**	**Runoff Coef. (C)**	**Treatment Q (cfs)**
1	0.75	0.270	0.10	0.71	0.02
2	0.75	0.235	1.10	0.71	0.18
3	0.75	0.230	0.74	0.71	0.12
4	0.75	0.27	0.38	0.71	0.07
5	0.75	0.27	0.39	0.71	0.07
6	0.75	0.27	0.23	0.71	0.04
7	0.75	0.24	0.57	0.71	0.10
8	1.0	0.27	0.05	0.90	0.01
9	0.75	0.235	1.0	0.71	0.17
10	0.75	0.230	1.16	0.71	0.19

IV.3.5 Hydromodification Control BMPs

Not applicable. Per discussion in Section II.3 of this WQMP, the project does not have hydrologic conditions of concern.

IV.3.6 Regional/Sub-Regional LID BMPs

Not applicable. Proprietary bioretention BMPs will be employed onsite for water quality treatment.

IV.3.7 Treatment Control BMPs

Not applicable. Project proposes the use of LID BMPs to address potential pollutants present in the project's runoff.

IV.3.8 Non-structural Source Control BMPs

The Table below indicates all Non-Structural Source Control BMPs to be utilized in the project. Discussions of the selected BMPs are provided in the BMP Inspection and Maintenance Responsibility Matrix provided in Section V of this WQMP.

Non-Structural Source Control BMPs				
Identifier	Name	Check One		If not applicable, state brief reason
		Included	Not Applicable	
N1	Education for Property Owners, Tenants and Occupants	☒	☐	
N2	Activity Restrictions	☒	☐	
N3	Common Area Landscape Management	☒	☐	
N4	BMP Maintenance	☒	☐	
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	Proposed facility will not generate waste subject to Title 22 CCR compliance.
N6	Local Industrial Permit Compliance	☐	☒	Not applicable to residential developments or parks.
N7	Spill Contingency Plan	☐	☒	Proposed facilities will not generate waste or store materials subject to the requirements of Chapter 6.95 of the CA Health and Safety Code.
N8	Underground Storage Tank Compliance	☐	☒	None proposed.
N9	Hazardous Materials Disclosure Compliance	☐	☒	Proposed project will not store or generate hazardous materials subject to agency requirements.
N10	Uniform Fire Code Implementation	☐	☒	Proposed facility does not propose to store toxic or highly toxic compressed gases.
N11	Common Area Litter Control	☒	☐	
N12	Employee Training	☒	☐	
N13	Housekeeping of Loading Docks	☒	☐	
N14	Common Area Catch Basin Inspection	☒	☐	
N15	Street Sweeping Private Streets and Parking Lots	☐	☒	All streets are public.
N16	Retail Gasoline Outlets	☐	☒	Not in project scope.

IV.3.9 Structural Source Control BMPs

The Table below indicates all Structural Source Control BMPs to be utilized in the project. Discussions of the selected BMPs are provided in the BMP Inspection and Maintenance Responsibility Matrix provided in Section V of this WQMP.

Structural Source Control BMPs				
Identifier	Name	Check One		If not applicable, state brief reason
		Included	Not Applicable	
S1	Provide storm drain system stenciling and signage	☒	☐	
S2	Design and construct outdoor material storage areas to reduce pollution introduction	☐	☒	No outdoor material storage areas proposed for project use.
S3	Design and construct trash and waste storage areas to reduce pollution introduction	☒	☐	
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	☒	☐	
S5	Protect slopes and channels and provide energy dissipation	☐	☒	Not applicable. No large slopes (hillside landscaping) proposed.
	Incorporate requirements applicable to individual priority project categories (from SDRWQCB NPDES Permit)	☐	☒	Not applicable. Project resides in SARWQCB.
S6	Dock areas	☒	☐	
S7	Maintenance bays	☐	☒	None proposed.
S8	Vehicle wash areas	☐	☒	None proposed.
S9	Outdoor processing areas	☐	☒	None proposed.
S10	Equipment wash areas	☐	☒	None proposed.
S11	Fueling areas	☐	☒	None proposed.
S12	Hillside landscaping	☐	☒	None proposed.
S13	Wash water control for food preparation areas	☒	☐	
S14	Community car wash racks	☐	☒	None proposed.

A discussion of each selected source control BMP is provided in Section V of this WQMP.

IV.4 Alternative Compliance Plan (If Applicable)

IV.4.1 Water Quality Credits

The project does not propose to use of water quality credits to reduce the DCV.

<table>
<tr><th colspan="6">Description of Proposed Project</th></tr>
<tr><td colspan="6">Project Types that Qualify for Water Quality Credits (Select all that apply):</td></tr>
<tr><td colspan="2">☐ Redevelopment projects that reduce the overall impervious footprint of the project site.</td><td colspan="2">☐ Brownfield redevelopment, meaning redevelopment, expansion, or reuse of real property which may be complicated by the presence or potential presence of hazardous substances, pollutants or contaminants, and which have the potential to contribute to adverse ground or surface WQ if not redeveloped.</td><td colspan="2">☐ Higher density development projects which include two distinct categories (credits can only be taken for one category): those with more than seven units per acre of development (lower credit allowance); vertical density developments, for example, those with a Floor to Area Ratio (FAR) of 2 or those having more than 18 units per acre (greater credit allowance).</td></tr>
<tr><td colspan="2">☐ Mixed use development, such as a combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that can demonstrate environmental benefits that would not be realized through single use projects (e.g. reduced vehicle trip traffic with the potential to reduce sources of water or air pollution).</td><td colspan="2">☐ Transit-oriented developments, such as a mixed use residential or commercial area designed to maximize access to public transportation; similar to above criterion, but where the development center is within one half mile of a mass transit center (e.g. bus, rail, light rail or commuter train station). Such projects would not be able to take credit for both categories, but may have greater credit assigned</td><td>☐ Redevelopment projects in an established historic district, historic preservation area, or similar significant city area including core City Center areas (to be defined through mapping).</td></tr>
<tr><td>☐ Developments with dedication of undeveloped portions to parks, preservation areas and other pervious uses.</td><td>☐ Developments in a city center area.</td><td>☐ Developments in historic districts or historic preservation areas.</td><td>☐ Live-work developments, a variety of developments designed to support residential and vocational needs together – similar to criteria to mixed use development; would not be able to take credit for both categories.</td><td>☐ In-fill projects, the conversion of empty lots and other underused spaces into more beneficially used spaces, such as residential or commercial areas.</td></tr>
<tr><td>Calculation of Water Quality Credits
(if applicable)</td><td colspan="5">Not applicable.</td></tr>
</table>

IV.4.2 Alternative Compliance Plan Information

Not applicable. The project is able to meet LID BMP requirements onsite to address pollutants in project related storm water runoff.

Section V Inspection/Maintenance Responsibility for BMPs

Refer to the BMP inspection and maintenance responsibility matrix below. Inspection and maintenance records must be kept for a minimum of five years for inspection by the regulatory agencies.

BMP INSPECTION & MAINTENANCE RESPONSIBILITIES MATRIX				
BMP		**Inspection/ Maintenance Activities Required**	**Minimum Frequency**	**Reponsible Party(s)**
INFILTRATION BMPs				
	N/A			
BIO-TREATMENT BMPs				
BIO-7	Proprietary Biotreatment	Inspect for trash, debris and sediment accumulation. Inspect plant for overall health. Clean out unit of trash, sediment and debris and/or replace mulch/media per manufacturer's recommendations.	Annually and after significant storm events	Homeowners Association
NON-STRUCTURAL SOURCE CONTROL BMPs				
N1	Education for Property Owners, Tenants and Occupants	Educational materials will be provided to tenants and employees by the HOA. Materials shall include those provided in Attachment A of this WQMP and any updated materials.	Annually	Owner/HOA
N2	Activity Restrictions	The Owner/HOA will prescribe activity restrictions to protect surface water quality, through CC&Rs, a lease agreement, or other equally effective measure.	Ongoing	Owner/HOA

BMP INSPECTION & MAINTENANCE RESPONSIBILITIES MATRIX				
BMP		**Inspection/ Maintenance Activities Required**	**Minimum Frequency**	**Reponsible Party(s)**
N3	Common Area Landscape Management	Maintenance shall be consistent with City requirements, plus fertilizer and/or pesticide usages shall be consistent with County guidelines for use of fertilizers and pesticides (OC DAMP Section 5.5). Maintenance includes mowing, weeding, and debris removal on a weekly basis. Trimming, replanting and replacement of mulch shall be performed on an as-needed basis. Trimmings, clippings, and other waste shall be properly disposed of off-site in accordance with local regulations. Materials temporarily stockpiled during maintenance activities shall be placed away from water courses and drain inlets.	Monthly	Owner/HOA
N4	BMP Maintenance	Maintenance of BMPs implemented at the project site shall be performed at the frequency prescribed in this WQMP. Records of inspections and BMP maintenance shall be maintained by the responsible party and documented with the WQMP, and shall be available for review upon request.	Ongoing	Owner/HOA
N11	Common Area Litter control	Litter patrol, violations investigation, reporting and other litter control activities shall be performed in conjunction with maintenance activities. Littler collection and removal shall be performed on a weekly basis.	Weekly	Owner/HOA
N14	Common Area Catch Basin Inspection	Private catch basin inlets, area drains, and other private drainage systems shall be inspected prior to October 1st of each year and after large storm events. If necessary, drains shall be cleaned prior to any succeeding rain events.	Annually	Owner/HOA

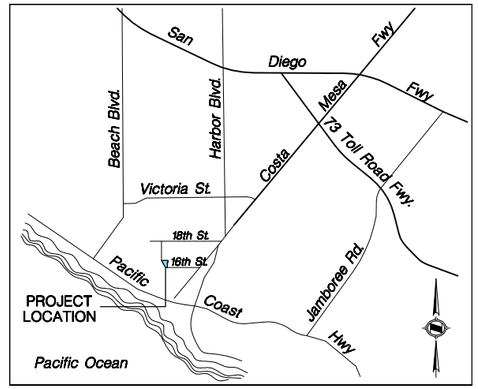
BMP INSPECTION & MAINTENANCE RESPONSIBILITIES MATRIX				
BMP		**Inspection/ Maintenance Activities Required**	**Minimum Frequency**	**Reponsible Party(s)**
STRUCTURAL SOURCE CONTROL BMPs				
S1 SD-13	Provide storm drain system stencilling and signage	Storm drain stencils shall be inspected for legibility, at minimum, once prior to the storm season, no later than October 1st each year. Those determined to be illegible will be re-stenciled as soon as possible.	Annually	Owner/HOA
S4 SD-12	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	In conjunction with routine maintenance activities, verify that landscape design continues to function properly by adjusting properly to eliminate overspray to hardscape areas, and to verify that irrigation timing and cycle lengths are adjusted in accordance with water demands, given time of year, weather, day or night time temperatures based on system specifications and local climate patterns. In the event of any leaks, system shall be repaired as soon as possible.	Monthly	Owner/HOA

Section VI Site Plan and Drainage Plan

The exhibits provided in this section are to illustrate the post construction BMPs prescribed within this WQMP. Drainage flow information of the proposed project, such as general surface flow lines, concrete or other surface drainage conveyances, and storm drain facilities are also depicted. All structural source control and treatment control BMPs are shown as well.

Exhibits

- Vicinity Map
- Conceptual WQMP Site Plan



LEGEND

- TRACT BOUNDARY
- DRAINAGE MANAGEMENT AREA (DMA) BOUNDARY
- 1 / 0.10 — DMA DESIGNATION AND ACREAGE
- NAP — NOT A PART
- DIRECTION OF SURFACE FLOW (ONSITE)
- DIRECTION OF SURFACE FLOW (OFFSITE)
- PROPOSED STORM DRAIN (ONSITE)
- PROPOSED STORM DRAIN (OFFSITE)
- EXISTING STORM DRAIN (OFFSITE)
- DIRECTION OF GUTTER FLOW (ONSITE)
- COMMON (HOA) LANDSCAPE AREAS WITH BMP's:
  S4 (SD-10) SITE DESIGN/LANDSCAPE PLANNING
  (SD-12) EFFICIENT IRRIGATION
- PROPOSED ONSITE CATCH BASIN (PRIVATE) WITH BMPS:
  S1 (SD-13) STORM DRAIN STENCILING
  BIO-7 PROPRIETARY BIOTREATMENT
- EXISTING CATCH BASIN (OFFSITE)
- DISCHARGE POINT

PREPARED BY:

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DATE PREPARED: 07/17/14

W.O. 3974-1X

"LIGHTHOUSE"
VESTING TENTATIVE TRACT MAP NO. 17747
CITY OF COSTA MESA, CA

CONCEPTUAL WATER QUALITY MANAGEMENT PLAN SITE PLAN

PLOTTED BY: Julian Castaneda DATE: Jul. 18, 2014 12:47:14 PM FILE: F:\0847\Planning\SY_WQ\Exhibit\WQMP.dwg

Vicinity Map, Conceptual BMP WQMP Site Plan

Section VII Educational Materials

Education Materials			
Residential Material (http://www.ocwatersheds.com)	Check If Applicable	Business Material (http://www.ocwatersheds.com)	Check If Applicable
The Ocean Begins at Your Front Door	☒	Tips for the Automotive Industry	☐
Tips for Car Wash Fund-raisers	☐	Tips for Using Concrete and Mortar	☐
Tips for the Home Mechanic	☐	Tips for the Food Service Industry	☒
Homeowners Guide for Sustainable Water Use	☐	Proper Maintenance Practices for Your Business	☒
Household Tips	☒	Other Material	Check If Attached
Proper Disposal of Household Hazardous Waste	☒		
Recycle at Your Local Used Oil Collection Center (North County)	☒		☐
Recycle at Your Local Used Oil Collection Center (Central County)	☐		☐
Recycle at Your Local Used Oil Collection Center (South County)	☐		☐
Tips for Maintaining a Septic Tank System	☐		☐
Responsible Pest Control	☒		☐
Sewer Spill	☐		☐
Tips for the Home Improvement Projects	☐		☐
Tips for Horse Care	☐		☐
Tips for Landscaping and Gardening	☒		☐
Tips for Pet Care	☒		☐
Tips for Pool Maintenance	☒		☐
Tips for Residential Pool, Landscape and Hardscape Drains	☒		☐
Tips for Projects Using Paint	☒		☐

Attachment A

Educational Materials

Educational Materials to be provided in Final WQMP for dispersal to owners and tenants, as appropriate.

Attachment B

O & M Plan

See Section V. Signed/Notarized O&M Plan to be provided at Final WQMP.

Attachment C

Preliminary Geotechnical Recommendation

(To be provided prior to Final WQMP approval)

Attachment D

BMP Details

- BIO-7 Proprietary Vegetative Biotreatment Systems

BMP Details – Proprietary Biotreatment (BIO-7)

Actual sizing of units and model numbers will be provided in Final WQMP.

Worksheet D: Capture Efficiency Method for Flow-Based BMPs (DMA #1)

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	5.0	min
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.27	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design} = I_1 - I_2$	I_{design}=	0.27	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.10	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.75	
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=	0.71	
4	Calculate design flow rate, $Q_{design} = (C \times i_{design} \times A)$	Q_{design}=	0.02	cfs
Supporting Calculations				
Describe system: Proprietary Biotreatment Units to be used to treat storm water prior to discharging to the existing off-site storm drain system in West 16th Street.				

Worksheet D: Capture Efficiency Method for Flow-Based BMPs (DMA #2)

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	7.6	min
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.235	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design} = I_1 - I_2$	I_{design}=	0.235	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	1.10	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.75	
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=	0.71	
4	Calculate design flow rate, $Q_{design} = (C \times i_{design} \times A)$	Q_{design}=	0.18	cfs
Supporting Calculations				
Describe system: Proprietary Biotreatment Units to be used to treat storm water prior to discharging to the existing off-site storm drain system in West 16th Street.				

Worksheet D: Capture Efficiency Method for Flow-Based BMPs (DMA #3)

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	7.0	min
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.23	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design} = I_1 - I_2$	I_{design}=	0.23	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.74	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.75	
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=	0.71	
4	Calculate design flow rate, $Q_{design} = (C \times i_{design} \times A)$	Q_{design}=	0.12	cfs
Supporting Calculations				
Describe system: Proprietary Biotreatment Units to be used to treat storm water prior to discharging to the existing off-site storm drain system in West 16th Street.				

Worksheet D: Capture Efficiency Method for Flow-Based BMPs (DMA #4)

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	5.0	min
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.27	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design}= I_1-I_2$	I_{design}=	0.27	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.38	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.75	
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=	0.71	
4	Calculate design flow rate, $Q_{design}= (C \times i_{design} \times A)$	Q_{design}=	0.07	cfs
Supporting Calculations				
Describe system: Proprietary Biotreatment Units to be used to treat storm water prior to discharging to the existing off-site storm drain system in West 16th Street.				

Worksheet D: Capture Efficiency Method for Flow-Based BMPs (DMA #5)

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	10.6	min
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.27	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design}= I_1-I_2$	I_{design}=	0.27	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.62	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.75	
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=	0.71	
4	Calculate design flow rate, $Q_{design}= (C \times i_{design} \times A)$	Q_{design}=	0.07	cfs
Supporting Calculations				
Describe system: Proprietary Biotreatment Units to be used to treat storm water prior to discharging to the existing off-site storm drain system in West 16th Street.				

Worksheet D: Capture Efficiency Method for Flow-Based BMPs (DMA #6)

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	7.5	min
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.24	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design} = I_1 - I_2$	I_{design}=	0.24	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.57	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.75	
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=	0.71	
4	Calculate design flow rate, $Q_{design} = (C \times i_{design} \times A)$	Q_{design}=	0.10	cfs
Supporting Calculations				
Describe system: Proprietary Biotreatment Units to be used to treat storm water prior to discharging to the existing off-site storm drain system in West 16th Street.				

Worksheet D: Capture Efficiency Method for Flow-Based BMPs (DMA #7)

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	5.0	min
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.27	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design} = I_1 - I_2$	I_{design}=	0.27	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.05	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	1	
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=	0.9	
4	Calculate design flow rate, $Q_{design} = (C \times i_{design} \times A)$	Q_{design}=	0.01	cfs
Supporting Calculations				
Describe system: Proprietary Biotreatment Units to be used to treat storm water prior to discharging to the existing off-site storm drain system in West 16th Street.				

Worksheet D: Capture Efficiency Method for Flow-Based BMPs (DMA #8)

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	7.9	min
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.235	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design} = I_1 - I_2$	I_{design}=	0.235	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	1.0	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.75	
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=	0.71	
4	Calculate design flow rate, $Q_{design} = (C \times i_{design} \times A)$	Q_{design}=	0.17	cfs
Supporting Calculations				
Describe system: Proprietary Biotreatment Units to be used to treat storm water prior to discharging to the existing off-site storm drain system in West 16th Street.				

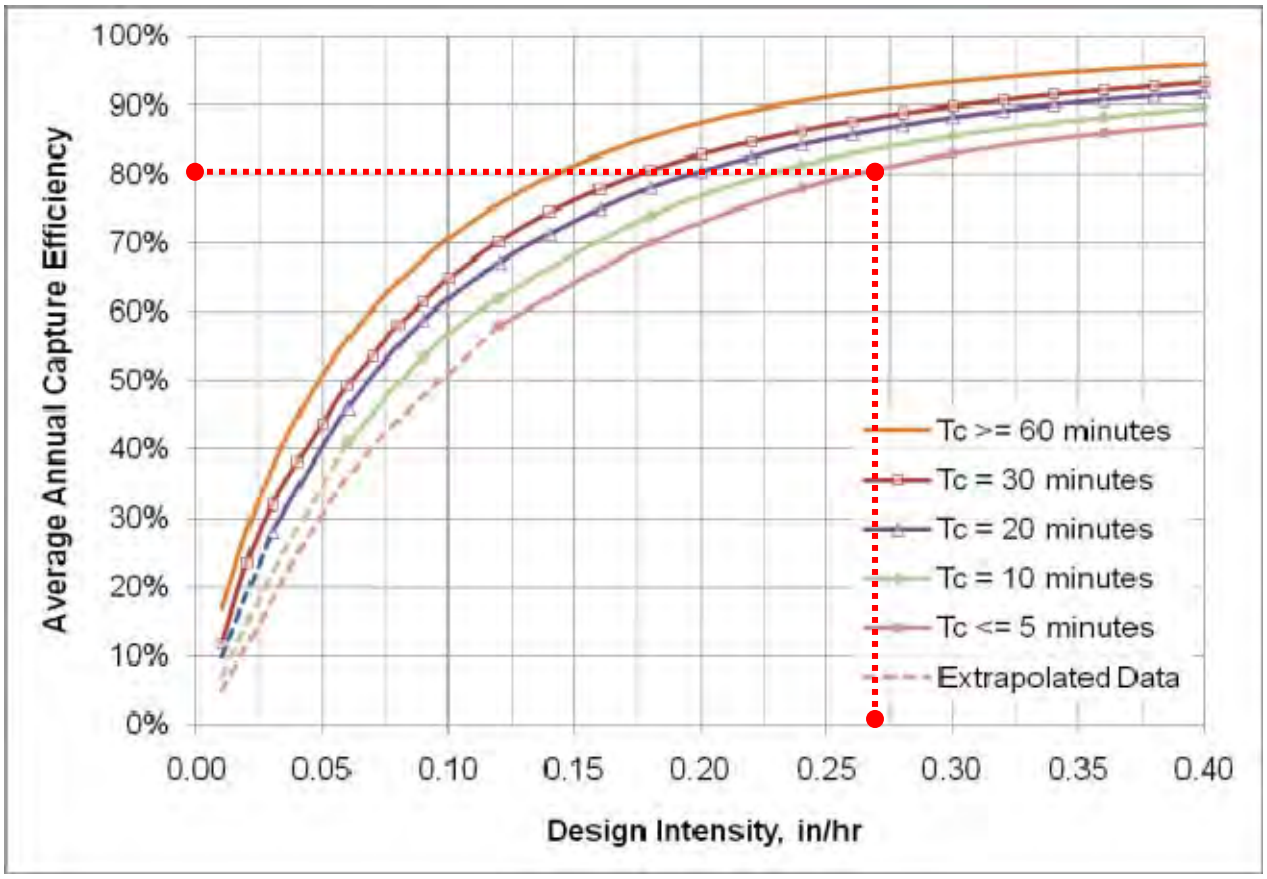
Worksheet D: Capture Efficiency Method for Flow-Based BMPs (DMA #9)

Worksheet D: Capture Efficiency Method for Flow-Based BMPs (DMA #9)

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	8.1	min
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.23	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design} = I_1 - I_2$	I_{design}=	0.23	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	1.16	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.75	
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=	0.71	
4	Calculate design flow rate, $Q_{design} = (C \times i_{design} \times A)$	Q_{design}=	0.19	cfs
Supporting Calculations				
Describe system: Proprietary Biotreatment Units to be used to treat storm water prior to discharging to the existing off-site storm drain system in West 16th Street.				

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

Graphical Operations



Provide supporting graphical operations. See Example III.7.

BIO-7: Proprietary Biotreatment

Proprietary biotreatment devices are devices that are manufactured to mimic natural systems such as bioretention areas by incorporating plants, soil, and microbes engineered to provide treatment at higher flow rates or volumes and with smaller footprints than their natural counterparts. Incoming flows are typically filtered through a planting media (mulch, compost, soil, plants, microbes, etc.) and either infiltrated or collected by an underdrain and delivered to the storm water conveyance system. Tree box filters are an increasingly common type of proprietary biotreatment device that are installed at curb level and filled with a bioretention type soil. For low to moderate flows they operate similarly to bioretention systems and are bypassed during high flows. Tree box filters are highly adaptable solutions that can be used in all types of development and in all types of soils but are especially applicable to dense urban parking lots, street, and roadways.

Also known as:

- *Catch basin planter box*
- *Bioretention vault*
- *Tree box filter*

Proprietary biotreatment
Source: http://www.americastusa.com /index.php/filterra/

Feasibility Screening Considerations

- Proprietary biotreatment devices that are unlined may cause incidental infiltration. Therefore, an evaluation of site conditions should be conducted to evaluate whether the BMP should include an impermeable liner to avoid infiltration into the subsurface.

Opportunity Criteria

- Drainage areas of 0.25 to 1.0 acres.
- Land use may include commercial, residential, mixed use, institutional, and subdivisions. Proprietary biotreatment facilities may also be applied in parking lot islands, traffic circles, road shoulders, and road medians.
- Must not adversely affect the level of flood protection provided by the drainage system.

OC-Specific Design Criteria and Considerations

☐ Frequent maintenance and the use of screens and grates to keep trash out may decrease the likelihood of clogging and prevent obstruction and bypass of incoming flows.

☐ Consult proprietors for specific criteria concerning the design and performance.

☐ Proprietary biotreatment may include specific media to address pollutants of concern. However, for proprietary device to be considered a biotreatment device the media must be capable of supporting rigorous growth of vegetation.

☐ Proprietary systems must be acceptable to the reviewing agency. Reviewing agencies shall have the discretion to request performance information. Reviewing agencies shall have the discretion to deny the use of a proprietary BMP on the grounds of performance, maintenance considerations, or other relevant factors.

☐ In right of way areas, plant selection should not impair traffic lines of site. Local jurisdictions may also limit plant selection in keeping with landscaping themes.

Computing Sizing Criteria for Proprietary Biotreatment Device

- Proprietary biotreatment devices can be volume based or flow-based BMPs.
- Volume-based proprietary devices should be sized using the Simple Design Capture Volume Sizing Method described in **Appendix III.3.1** or the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs described in **Appendix III.3.2**.
- The required design flowrate for flow-based proprietary devices should be computed using the Capture Efficiency Method for Flow-based BMPs described in **Appendix III.3.3)**.

In South Orange County, the provided ponding plus pore volume must be checked to demonstrate that it is greater than 0.75 of the remaining DCV that this BMP is designed to address. Many propretary biotreatment BMPs will not be able to meet the definition of "biofiltration" that applies in South Orange County. See Section III.7 and Worksheet SOC-1.

Additional References for Design Guidance

- Los Angeles Unified School District (LAUSD) Stormwater Technical Manual, Chapter 4: **http://www.laschools.org/employee/design/fs-studies-and-reports/download/white_paper_report_material/Storm_Water_Technical_Manual_2009-opt-red.pdf?version_id=76975850**
- Los Angeles County Stormwater BMP Design and Maintenance Manual, Chapter 9: **http://dpw.lacounty.gov/DES/design_manuals/StormwaterBMPDesignandMaintenance.pdf**
- Santa Barbara BMP Guidance Manual, Chapter 6: **http://www.santabarbaraca.gov/NR/rdonlyres/91D1FA75-C185-491E-A882-49EE17789DF8/0/Manual_071008_Final.pdf**

HUNSAKER
& ASSOCIATES
IRVINE, INC.

PLANNING
ENGINEERING
SURVEYING
GOVERNMENT RELATIONS

IRVINE
LOS ANGELES
PALM DESERT
RIVERSIDE
SAN DIEGO

July 18, 2014

Mr. Daniel D. Villines, PE
VP, Water Resources
VA CONSULTING, INC.
46 Discovery, No. 250
Irvine, CA 92618

Subject: **Lighthouse Development Project**
City Costa Mesa
Response to July 10, 2014 1st Plan Check Comments

Dear Mr. Villines:

We are in receipt of your comments, dated July 10, 2014, regarding the above referenced project. We have listed the comments in the order received, followed by our responses in bold text.

1. LID BMP Design Calculations – The Tc for DMA #3 and DMA #7 are both 7.5 min. However, the design intensities for DMA #3 and DMA #7 are different (0.23 in/hr and 0.24 in/hr, respectively) even though they have the same Tc. Please clarify the reasons for the difference in design intensities between DMA #3 and DMA #7.

   Calculations have been updated.

2. Receiving Waters – It appears that the project discharges into the Newport Slough as opposed to the Santa Ana River Reach 1. Please confirm. Should the development drain to the Newport Slough, the following 303(d) TMDL's should be identified and discussed in the CWQMP: Enterococcus (pathogen), Fecal Coliform (pathogen), Total Coliform (pathogen).

   Updated receiving waters information.

3. BMP Site Map – The proposed development has 10 Drainage Management Areas (DMAs). However, it appears that only 8 biotreatment BMPs are identified on the SWQMP Site Plan. It is not clear that all 10 DMAs are being treated by the 8 proposed BMPs. Please confirm and clarify that all 10 DMAs are being treated by the proposed BMPs.

   The DMA's have been updated, the proposed development will consist of 9 DMA's. See CWQMP Site Plan for updated DMA locations.

Should you have any questions please do not hesitate to call me at (949) 458-5455.

Sincerely,

HUNSAKER & ASSOCIATES IRVINE, INC.

Martin Parker, CESSWI/QSP #23923
Water Quality Specialist

MP:ca
xc: Phil Dowty, H&A
W.O. 3974-1 (f\c\wo\3974-1 L01-mp.doc)

Three Hughes
Irvine, California
92618-2021
(949) 583-1010 PH
(949) 583-0759 FX
www.hunsaker.com

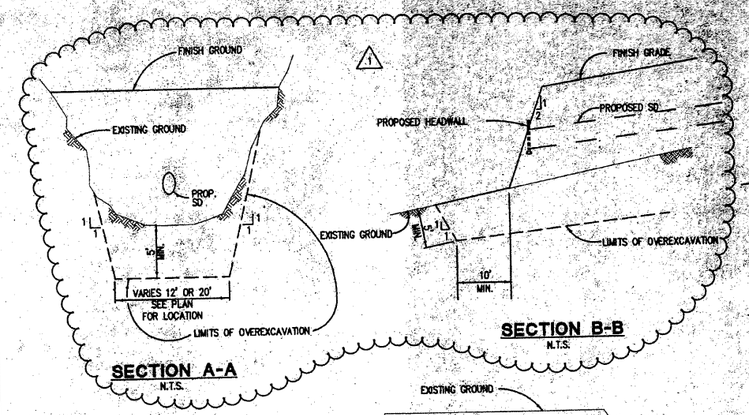
June 2014

PRELIMINARY HYDROLOGY ANALYSIS

Tentative Tract 17747

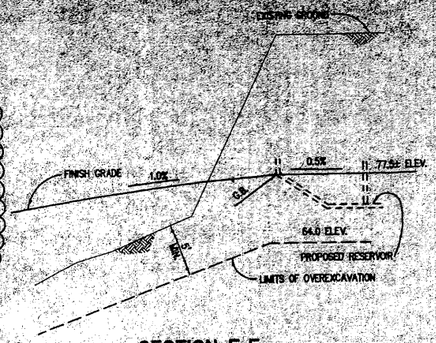
City of Costa Mesa | County of Orange

HUNSAKER & ASSOCIATES IRVINE, INC.

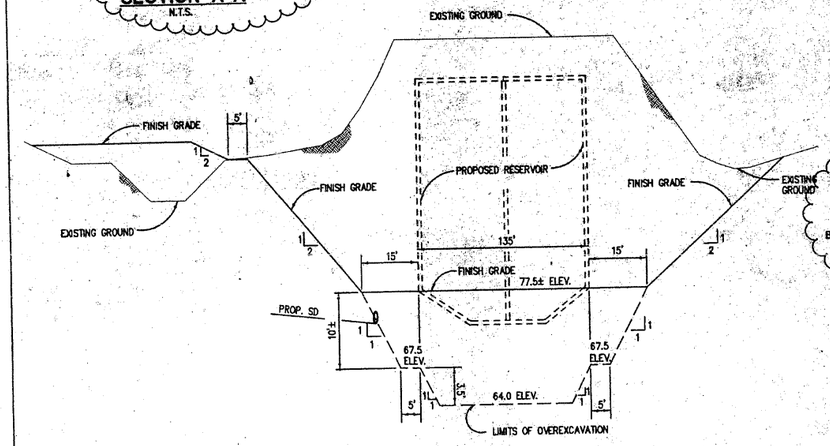


SECTION A-A
N.T.S.

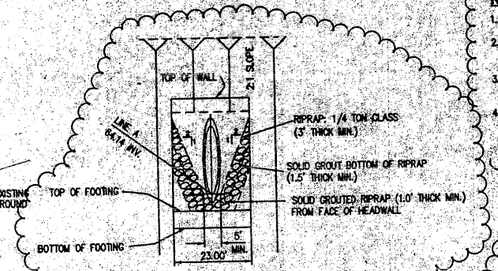
SECTION B-B
N.T.S.



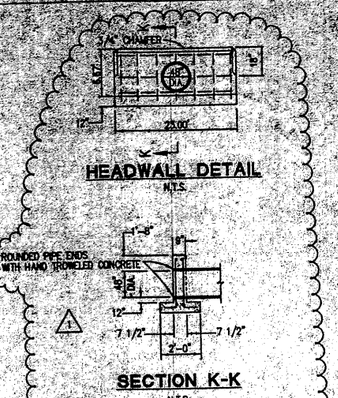
SECTION E-E
N.T.S.



SECTION C-C
N.T.S.



SECTION H-H
N.T.S.

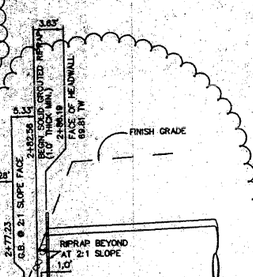


HEADWALL DETAIL
N.T.S.

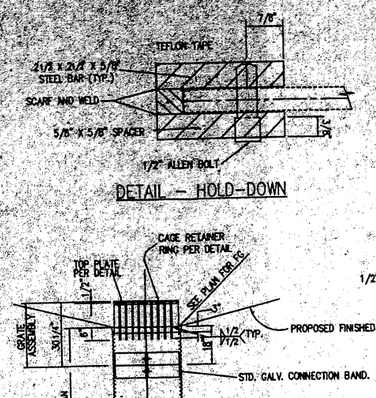
SECTION K-K
N.T.S.

NOTES:

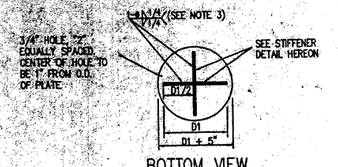
1. CONCRETE SHALL BE 560-C-3250.
2. ALL REINFORCING STEEL #4 BARS. ALL VERTICAL AND HORIZONTAL TIE BARS 18" MAXIMUM SPACING.
3. ALL REINFORCING STEEL 1-1/2" CLEAR FROM FACE OF WALL.
4. SAN DIEGO REGIONAL STANDARD DRAWING STRAIGHT HEADWALL - TYPE A (CIRCULAR PIPE) DRAWING NUMBER D-30



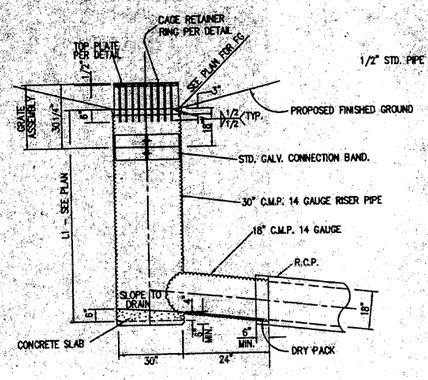
SECTION G-G
NTS



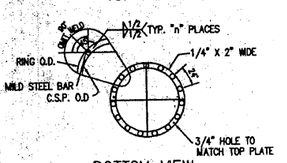
DETAIL - HOLD-DOWN



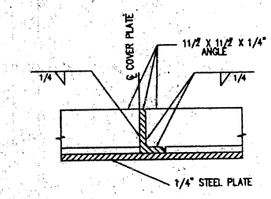
BOTTOM VIEW TOP PLATE



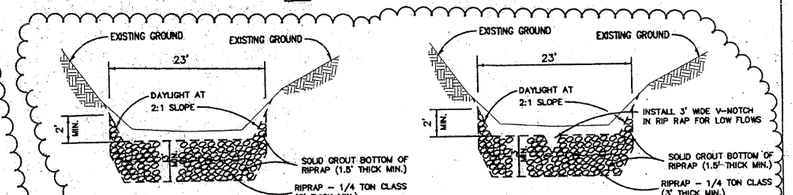
C.M.P. RISER DETAIL
N.T.S.



BOTTOM VIEW CAGE RETAINER RING

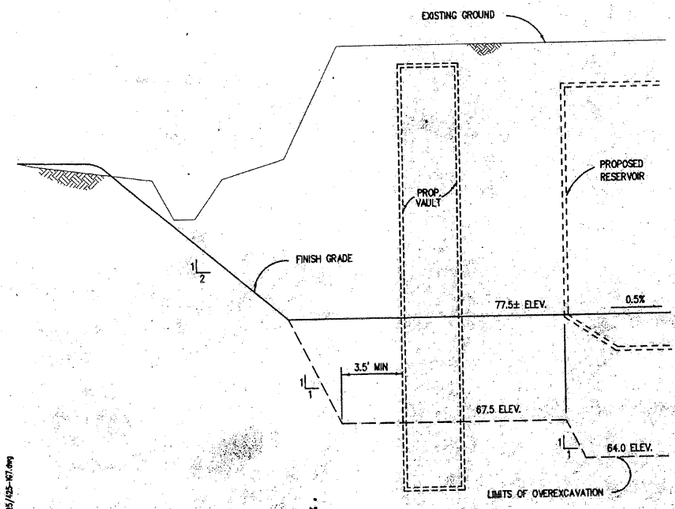


DETAIL - PLATE STIFFENER

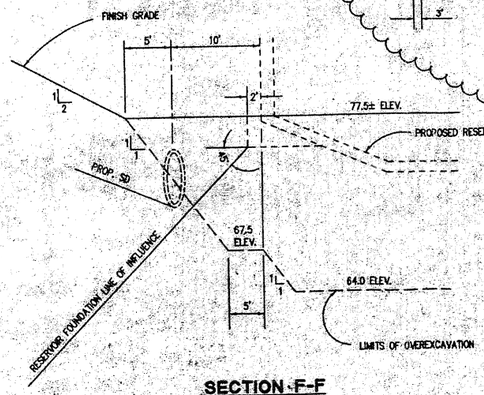


SECTION L-L
NTS

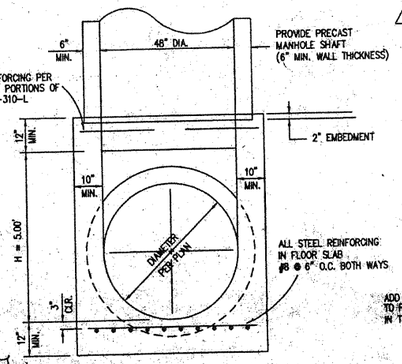
SECTION M-M
NTS



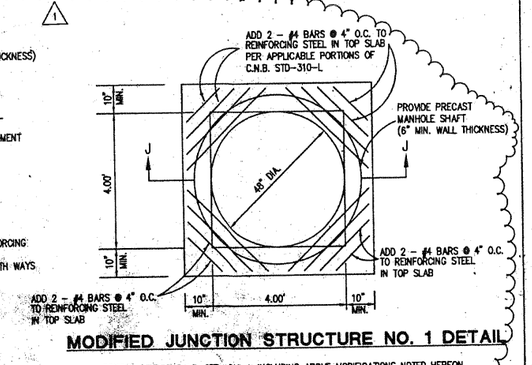
SECTION D-D
N.T.S.



SECTION F-F
N.T.S.



SECTION J-J



MODIFIED JUNCTION STRUCTURE NO. 1 DETAIL

CONSTRUCT PER C.N.B. STD.-310-L INCLUDING ABOVE MODIFICATIONS NOTED HEREON.
NOTE: THIS DETAIL SHOWS ONLY THE MODIFICATIONS TO THE ABOVE MENTIONED STD.

REGISTERED PROFESSIONAL ENGINEER DEREK J. McGREGOR No. 38483 Exp. 3-31-97 Civil STATE OF CALIFORNIA

DMC Engineering
Civil • Surveying • Planning
18 Technology Drive, Suite 100
Irvine, CA 92718
(714) 753-9583 fax (714) 753-9322

PLANS PREPARED UNDER MY SUPERVISION OF: DEREK J. McGREGOR RCE 38483 — 1-24-94 DATE

NO.	DATE	BY	DESCRIPTION	APP'D
1	2-14-94	DSG	ADDENDA NO. 1	

REVISIONS

APPROVED
UTILITIES DIRECTOR R.C.E. NO. 38483
DATE 1-24-94

DESIGNED H.K. DRAWN E.A.T.
CHECKED D.J.M. DATE 1-21-94

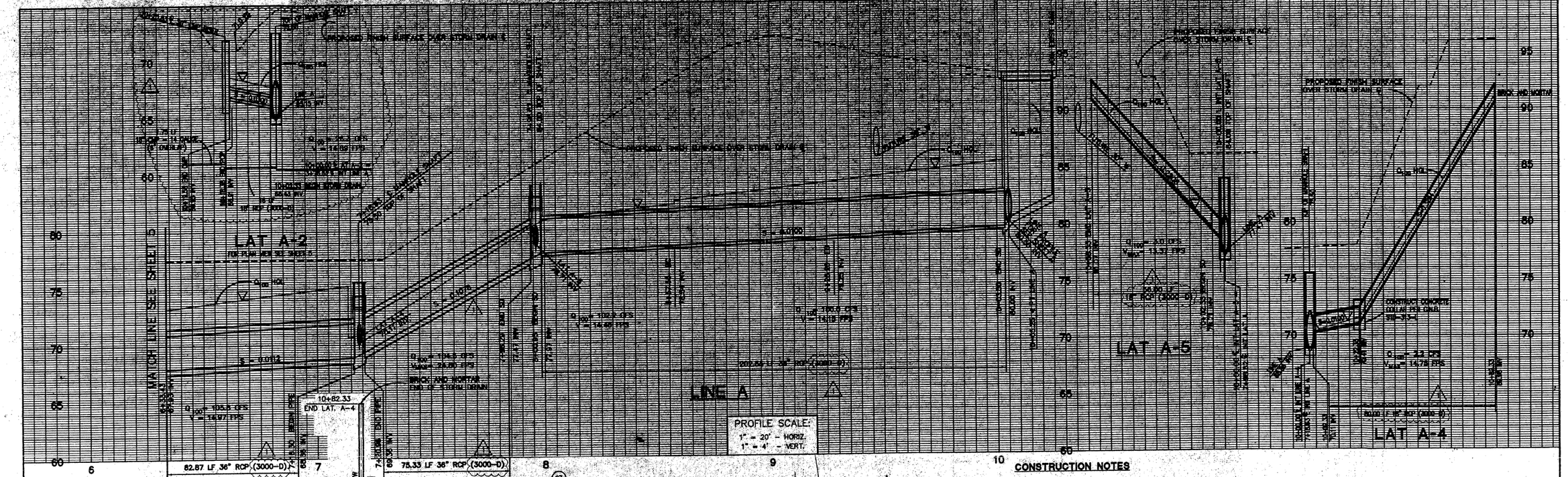
INTERIM MASS GRADING AND STORM DRAIN RELOCATION PROJECT

DETAILS AND SECTIONS

CITY OF NEWPORT BEACH
UTILITIES DEPARTMENT

M-5314-S
SHEET 7 OF 7

DWG FILE: 425/425-M7.dwg



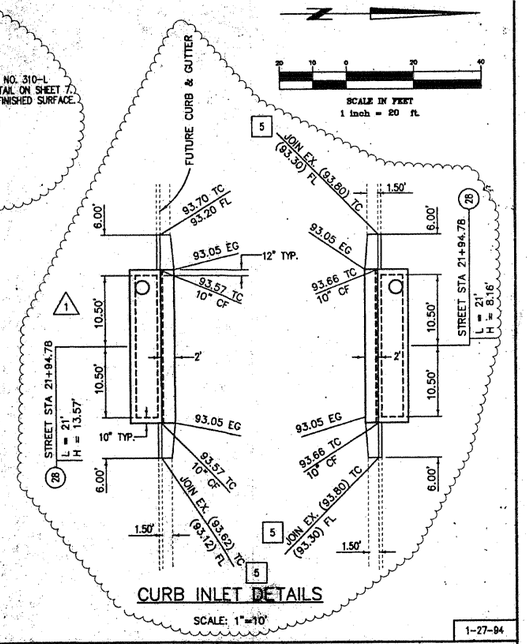
CONSTRUCTION NOTES

(22) INSTALL 36" (3000-D) RCP STORM DRAIN
(23) INSTALL 30" (2000-D) RCP STORM DRAIN
(24) INSTALL 18" (3000-D) RCP STORM DRAIN
(27) CONSTRUCT J.S. NO. 1 PER CITY OF NEWPORT BEACH STD. DWG. NO. 310-L (H PER PLAN). MODIFY THE MANHOLE SHAFT AND BASE PER DETAIL ON SHEET 7. PROVIDE 1/2" THICK STEEL PLATE COVER 2' BELOW PROPOSED FINISHED SURFACE.
(28) CONSTRUCT CURB INLET TYPE OL PER CITY OF NEWPORT BEACH STD. DWG. NO. STD-306-L (L & H PER PLAN)
(29) CONSTRUCT LOCAL DEPRESSION PER CITY OF NEWPORT BEACH STD. DWG. NO. STD-304-L, MODIFIED PER DETAIL ON SHEET 6
(31) CONSTRUCT 3" A.C. OVER 4" A.B.

KEY NOTES

1 PROTECT EXISTING WATER LINE
5 CONTRACTOR SHALL VERIFY EXISTING ELEVATIONS PRIOR TO CONSTRUCTION. CONTRACTOR TO NOTIFY CITY IF ANY DISCREPANCIES ARISE.

SCALE IN FEET
1 inch = 20 ft.



CURB INLET DETAILS
SCALE: 1"=10'

REGISTERED PROFESSIONAL ENGINEER
PATRICK J. McGREGOR
No. 38453
Exp. 3-31-97
CIVIL
STATE OF CALIFORNIA

1-27-94

2-14-94	DSG	1	ADDENDA NO. 1	
DATE	BY		DESCRIPTION	APP'D

REVISIONS

APPROVED
UTILITIES DIRECTOR R.C.E. NO. 38799
DATE 1-24-94

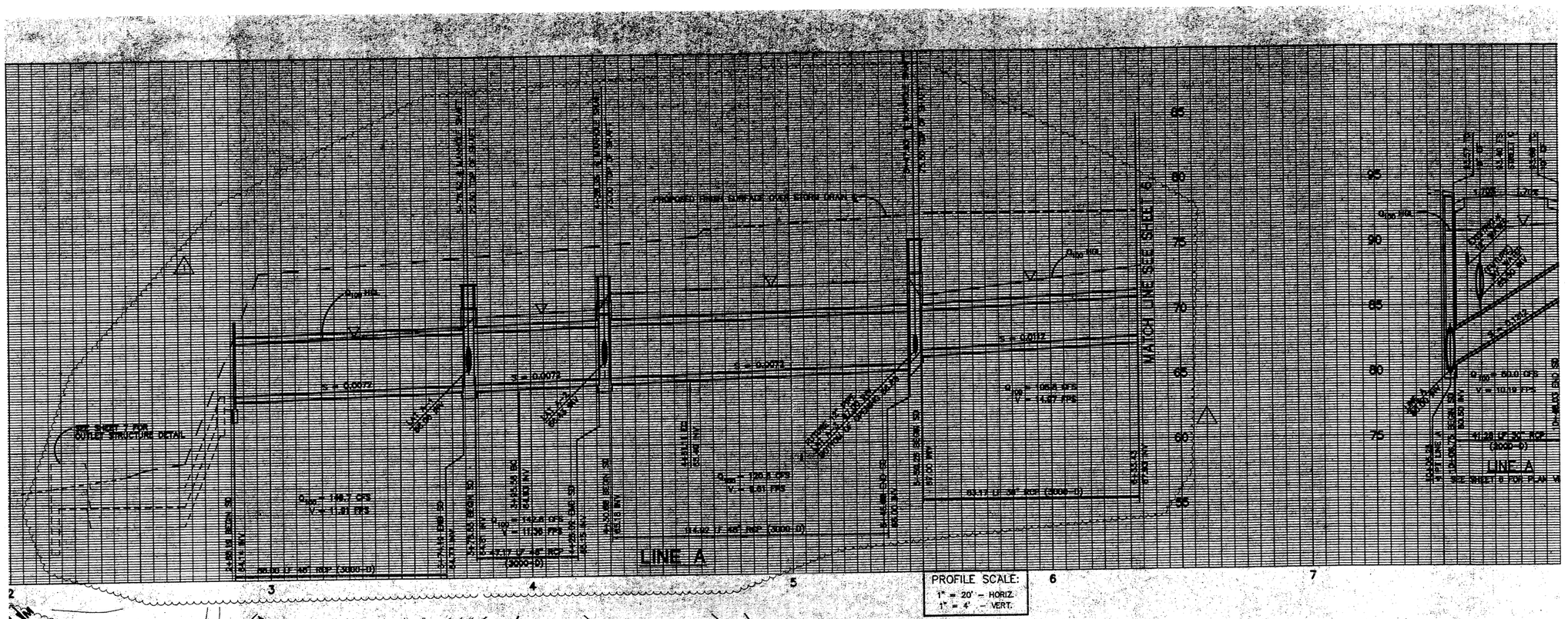
DESIGNED H.K. DRAWN E.A.T.
CHECKED D.J.M. DATE 1-21-94

INTERIM MASS GRADING AND STORM DRAIN RELOCATION PROJECT

STORM DRAIN RELOCATION PLAN

CITY OF NEWPORT BEACH
UTILITIES DEPARTMENT

M-5314-S
SHEET 6 OF 7



CURVE DATA

	Δ	R	L	T
A	41°43'13"	45.00'	32.77'	17.15'

CONSTRUCTION NOTES

21. INSTALL 48" (3000-D) RCP STORM DRAIN
22. INSTALL 36" (3000-D) RCP STORM DRAIN
24. INSTALL 18" (3000-D) RCP STORM DRAIN
25. CONSTRUCT C.M.P. RISER PER DETAIL ON SHEET 7
26. CONSTRUCT OUTLET HEADWALL PER DETAIL ON SHEET 7
27. CONSTRUCT J.S. NO. 1 PER CITY OF NEWPORT BEACH STD. DWG. NO. 310-L (H PER PLAN). MODIFY THE MANHOLE SHAFT AND BASE PER DETAIL ON SHEET 7. PROVIDE 1/2" THICK STEEL PLATE COVER 2' BELOW PROPOSED FINISHED SURFACE
30. CONSTRUCT 23' WIDE x 70' LONG OUTLET STRUCTURE PER DETAIL ON SHEET 7

KEY NOTES

4. CONTRACTOR TO VERIFY LOCATION PRIOR TO BEGINNING STORM DRAIN CONSTRUCTION

REGISTERED PROFESSIONAL ENGINEER DEREK J. McGREGOR No. 38483 Exp. 3-31-97 CIVIL STATE OF CALIFORNIA

DMC Engineering
Civil • Surveying • Planning
18 Technology Drive, Suite 100
Irvine, CA 92718
(714) 753-9393 fax (714) 753-9322

PLANS PREPARED UNDER THE SUPERVISION OF:
DEREK J. McGREGOR RCE 38483
1-24-94 DATE

DATE	BY		REVISIONS	APP'D
2-14-94	DSC	1	ADDENDA NO. 1	

APPROVED
UTILITIES DIRECTOR R.C.E. NO. 38799
DATE 1-24-94
DESIGNED H.K. DRAWN E.A.T.
CHECKED D.J.M. DATE 1-21-94

INTERIM MA
STORM DRAIN F
STORM DRAI
CITY OF NEWPOR
UTILITIES DEPART

SHT 05

REFERENCES

SECTION 4

LEGEND

	MAJOR DRAINAGE BOUNDARY
	MINOR DRAINAGE BOUNDARY
A-1 / 0.58	AREA DESIGNATION / AREA ACREAGE (IN ACRES)
D	SOIL GROUP
Q_{100} = 2.8 cfs	100-YR PEAK RUNOFF IN CUBIC FEET PER SECOND
t = 6.3 MIN	TIME OF CONCENTRATION MINUTES
	FLOW DIRECTION
	PROPOSED STORM DRAIN
	EXISTING STORM DRAIN

PREPARED BY:

H&A

HUNSAKER & ASSOCIATES
IRVINE, INC.
PLANNING • ENGINEERING • SURVEYING
Three Hughes - Irvine, CA 92618
FX: (949) 583-0759 - PH: (949) 583-1010

PREPARED FOR:

MW Bluffs Owner, LLC
A Delaware Limited Liability Co.

4100 MacArthur Blvd.
Suite 330
Newport Beach, CA 92660
ATTN: Matt Hamilton (855) 773-3223
matt@preface.com

PROPOSED CONDITION HYDROLOGY MAP TTM 17747

SCALE : 1"=40'

GRAPHIC SCALE 1"=40'

WO: 3974-1 TTM -- AMETEK BIN: -- RM: -- DOC.: ----

JUN 20 2014 F:\0847\Engineering\SY_Hydro\Pro_Hydrology.dwg JUN 20 2014

```
 FLOW PROCESS FROM NODE     10.00 TO NODE     10.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    8.06
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.705
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 RESIDENTIAL
 "11+ DWELLINGS/ACRE"        D        1.16      0.20      0.200    91
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
 SUBAREA AREA(ACRES) =    1.16      SUBAREA RUNOFF(CFS) =    4.87
 EFFECTIVE AREA(ACRES) =     12.75   AREA-AVERAGED Fm(INCH/HR) =  0.03
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.17
 TOTAL AREA(ACRES) =       12.9       PEAK FLOW RATE(CFS) =      53.60

****************************************************************************
 FLOW PROCESS FROM NODE     10.00 TO NODE     11.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    85.00  DOWNSTREAM(FEET) =    84.71
 FLOW LENGTH(FEET) =    35.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  36.0 INCH PIPE IS  27.5 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   9.26
 ESTIMATED PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      53.60
 PIPE TRAVEL TIME(MIN.) =   0.06    Tc(MIN.) =    8.13
 LONGEST FLOWPATH FROM NODE      1.00 TO NODE     11.00 =    1298.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     11.00 TO NODE     11.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    8.13
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.684
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 NATURAL POOR COVER
 "BARREN"                    D        1.00      0.20      1.000    98
 COMMERCIAL                  D        4.94      0.20      0.100    91
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.252
 SUBAREA AREA(ACRES) =    5.94      SUBAREA RUNOFF(CFS) =   24.77
 EFFECTIVE AREA(ACRES) =     18.69   AREA-AVERAGED Fm(INCH/HR) =  0.04
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.20
 TOTAL AREA(ACRES) =       18.8       PEAK FLOW RATE(CFS) =      78.14

 ** PEAK FLOW RATE TABLE **
  STREAM       Q      Tc    Intensity   Fp(Fm)      Ap      Ae      HEADWATER
  NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)           (ACRES)     NODE
     1       79.32    6.71    5.228  0.20( 0.04) 0.20       17.0        6.10
     2       78.14    8.13    4.684  0.20( 0.04) 0.20       18.7        4.10
     3       75.31    8.77    4.483  0.20( 0.04) 0.20       18.8        1.00
 NEW PEAK FLOW DATA ARE:
 PEAK FLOW RATE(CFS) =      79.32  Tc(MIN.) =    6.71
 AREA-AVERAGED Fm(INCH/HR) =  0.04  AREA-AVERAGED Fp(INCH/HR) =  0.20
 AREA-AVERAGED Ap =  0.20  EFFECTIVE AREA(ACRES) =      16.99
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)      =       18.8  TC(MIN.) =      6.71
 EFFECTIVE AREA(ACRES) =     16.99  AREA-AVERAGED Fm(INCH/HR)=  0.04
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap = 0.200
 PEAK FLOW RATE(CFS)   =      79.32

 ** PEAK FLOW RATE TABLE **
  STREAM       Q      Tc    Intensity   Fp(Fm)      Ap      Ae      HEADWATER
  NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)           (ACRES)     NODE
     1       79.32    6.71    5.228  0.20( 0.04) 0.20       17.0        6.10
     2       78.14    8.13    4.684  0.20( 0.04) 0.20       18.7        4.10
     3       75.31    8.77    4.483  0.20( 0.04) 0.20       18.8        1.00
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

```
 ELEVATION DATA: UPSTREAM(FEET) =    96.00  DOWNSTREAM(FEET) =    90.00
 FLOW LENGTH(FEET) =    40.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  21.0 INCH PIPE IS  13.7 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  26.62
 ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      44.16
 PIPE TRAVEL TIME(MIN.) =   0.03    Tc(MIN.) =    7.52
 LONGEST FLOWPATH FROM NODE      1.00 TO NODE      7.00 =     934.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      7.00 TO NODE      7.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    7.52
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.896
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 RESIDENTIAL
 "11+ DWELLINGS/ACRE"        D        0.57      0.20      0.200    91
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
 SUBAREA AREA(ACRES) =     0.57      SUBAREA RUNOFF(CFS) =     2.49
 EFFECTIVE AREA(ACRES) =     10.54   AREA-AVERAGED Fm(INCH/HR) =  0.03
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.16
 TOTAL AREA(ACRES) =       10.7       PEAK FLOW RATE(CFS) =      46.14

****************************************************************************
 FLOW PROCESS FROM NODE      7.00 TO NODE      8.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    90.00  DOWNSTREAM(FEET) =    89.00
 FLOW LENGTH(FEET) =   160.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  36.0 INCH PIPE IS  27.3 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   8.03
 ESTIMATED PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      46.14
 PIPE TRAVEL TIME(MIN.) =   0.33    Tc(MIN.) =    7.86
 LONGEST FLOWPATH FROM NODE      1.00 TO NODE      8.00 =    1094.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      8.00 TO NODE      8.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    7.86
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.776
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 PUBLIC PARK                 D        0.05      0.20      0.850    91
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
 SUBAREA AREA(ACRES) =     0.05      SUBAREA RUNOFF(CFS) =     0.21
 EFFECTIVE AREA(ACRES) =     10.59   AREA-AVERAGED Fm(INCH/HR) =  0.03
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.16
 TOTAL AREA(ACRES) =       10.7       PEAK FLOW RATE(CFS) =      46.14
 NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

****************************************************************************
 FLOW PROCESS FROM NODE      8.00 TO NODE      9.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    89.00  DOWNSTREAM(FEET) =    88.00
 FLOW LENGTH(FEET) =    42.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  30.0 INCH PIPE IS  19.7 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  13.49
 ESTIMATED PIPE DIAMETER(INCH) =  30.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      46.14
 PIPE TRAVEL TIME(MIN.) =   0.05    Tc(MIN.) =    7.91
 LONGEST FLOWPATH FROM NODE      1.00 TO NODE      9.00 =    1136.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      9.00 TO NODE      9.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    7.91
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.758
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 RESIDENTIAL
 "11+ DWELLINGS/ACRE"        D        1.00      0.20      0.200    91
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
 SUBAREA AREA(ACRES) =     1.00      SUBAREA RUNOFF(CFS) =     4.25
 EFFECTIVE AREA(ACRES) =     11.59   AREA-AVERAGED Fm(INCH/HR) =  0.03
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.17
 TOTAL AREA(ACRES) =       11.7       PEAK FLOW RATE(CFS) =      49.28

****************************************************************************
 FLOW PROCESS FROM NODE      9.00 TO NODE     10.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    88.00  DOWNSTREAM(FEET) =    85.00
 FLOW LENGTH(FEET) =   127.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  30.0 INCH PIPE IS  20.7 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  13.61
 ESTIMATED PIPE DIAMETER(INCH) =  30.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      49.28
 PIPE TRAVEL TIME(MIN.) =   0.16    Tc(MIN.) =    8.06
 LONGEST FLOWPATH FROM NODE      1.00 TO NODE     10.00 =    1263.00 FEET.

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

```
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    99.50  DOWNSTREAM(FEET) =    98.00
 FLOW LENGTH(FEET) =   104.00   MANNING'S N =  0.013
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   5.1 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   5.10
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       2.10
 PIPE TRAVEL TIME(MIN.) =   0.34    Tc(MIN.) =    5.34
 LONGEST FLOWPATH FROM NODE      6.10 TO NODE      6.30 =     248.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      6.30 TO NODE      6.30 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    5.34
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.958
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 RESIDENTIAL
 "11+ DWELLINGS/ACRE"        D        0.39      0.20      0.200    91
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
 SUBAREA AREA(ACRES) =    0.39      SUBAREA RUNOFF(CFS) =    2.08
 EFFECTIVE AREA(ACRES) =      0.77   AREA-AVERAGED Fm(INCH/HR) =  0.04
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.20
 TOTAL AREA(ACRES) =        0.8       PEAK FLOW RATE(CFS) =       4.10

****************************************************************************
 FLOW PROCESS FROM NODE      6.30 TO NODE      6.30 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    5.34
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.958
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  D        0.23      0.20      0.100    91
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =    0.23      SUBAREA RUNOFF(CFS) =    1.23
 EFFECTIVE AREA(ACRES) =      1.00   AREA-AVERAGED Fm(INCH/HR) =  0.04
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.18
 TOTAL AREA(ACRES) =        1.0       PEAK FLOW RATE(CFS) =       5.33

****************************************************************************
 FLOW PROCESS FROM NODE      6.30 TO NODE      6.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    98.00  DOWNSTREAM(FEET) =    96.00
 FLOW LENGTH(FEET) =   237.00   MANNING'S N =  0.013
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   9.9 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   5.37
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       5.33
 PIPE TRAVEL TIME(MIN.) =   0.73    Tc(MIN.) =    6.08
 LONGEST FLOWPATH FROM NODE      6.10 TO NODE      6.00 =     485.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      6.00 TO NODE      6.00 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.) =    6.08
 RAINFALL INTENSITY(INCH/HR) =   5.53
 AREA-AVERAGED Fm(INCH/HR) =  0.04
 AREA-AVERAGED Fp(INCH/HR) =  0.20
 AREA-AVERAGED Ap =  0.18
 EFFECTIVE STREAM AREA(ACRES) =       1.00
 TOTAL STREAM AREA(ACRES) =       1.00
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       5.33

 ** CONFLUENCE DATA **
  STREAM       Q      Tc   Intensity   Fp(Fm)      Ap      Ae      HEADWATER
  NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)           (ACRES)     NODE
     1       39.44    7.50    4.905  0.20( 0.03) 0.16       9.0        4.10
     1       38.19    8.14    4.679  0.20( 0.03) 0.16       9.1        1.00
     2        5.33    6.08    5.534  0.20( 0.04) 0.18       1.0        6.10

 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       41.40    6.08    5.534  0.20( 0.03) 0.16       8.3        6.10
     2       44.16    7.50    4.905  0.20( 0.03) 0.16      10.0        4.10
     3       42.69    8.14    4.679  0.20( 0.03) 0.16      10.1        1.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      44.16    Tc(MIN.) =     7.50
 EFFECTIVE AREA(ACRES) =       9.97   AREA-AVERAGED Fm(INCH/HR) =  0.03
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.16
 TOTAL AREA(ACRES) =       10.1
 LONGEST FLOWPATH FROM NODE      1.00 TO NODE      6.00 =     894.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      6.00 TO NODE      7.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
```

```
 STREAM        Q      Tc    Intensity   Fp(Fm)      Ap      Ae      HEADWATER
 NUMBER      (CFS)   (MIN.) (INCH/HR) (INCH/HR)            (ACRES)     NODE
    1         7.29    7.69    4.835  0.20( 0.03) 0.17        1.7        1.00
    2        30.62    7.05    5.083  0.20( 0.03) 0.15        6.7        4.10

  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        37.65    7.05    5.083  0.20( 0.03) 0.15        8.2        4.10
    2        36.41    7.69    4.835  0.20( 0.03) 0.15        8.4        1.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      37.65    Tc(MIN.) =     7.05
  EFFECTIVE AREA(ACRES) =       8.23   AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.15
  TOTAL AREA(ACRES) =         8.4
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      4.00 =     708.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.00 TO NODE      5.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    98.50  DOWNSTREAM(FEET) =    98.00
  FLOW LENGTH(FEET) =   153.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  39.0 INCH PIPE IS  27.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.05
  ESTIMATED PIPE DIAMETER(INCH) =  39.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      37.65
  PIPE TRAVEL TIME(MIN.) =   0.42    Tc(MIN.) =    7.47
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      5.00 =     861.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      5.00 TO NODE      5.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    7.47
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.916
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"        D        0.74      0.20      0.200     91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =     0.74      SUBAREA RUNOFF(CFS) =     3.25
  EFFECTIVE AREA(ACRES) =       8.97   AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.16
  TOTAL AREA(ACRES) =         9.1       PEAK FLOW RATE(CFS) =      39.44

****************************************************************************
  FLOW PROCESS FROM NODE      5.00 TO NODE      6.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    98.00  DOWNSTREAM(FEET) =    96.00
  FLOW LENGTH(FEET) =    33.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  15.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  18.44
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      39.44
  PIPE TRAVEL TIME(MIN.) =   0.03    Tc(MIN.) =    7.50
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      6.00 =     894.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      6.00 TO NODE      6.00 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.) =    7.50
  RAINFALL INTENSITY(INCH/HR) =   4.91
  AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.16
  EFFECTIVE STREAM AREA(ACRES) =       8.97
  TOTAL STREAM AREA(ACRES) =       9.11
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      39.44

****************************************************************************
  FLOW PROCESS FROM NODE      6.10 TO NODE      6.20 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   144.00
  ELEVATION DATA: UPSTREAM(FEET) =    106.50  DOWNSTREAM(FEET) =    99.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  6.187
  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.)
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"        D        0.38      0.20      0.200     91    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      2.10
  TOTAL AREA(ACRES) =      0.38   PEAK FLOW RATE(CFS) =      2.10

****************************************************************************
  FLOW PROCESS FROM NODE      6.20 TO NODE      6.30 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
```

```
 FLOW LENGTH(FEET) =    28.00   MANNING'S N =  0.013
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   9.5 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   7.71
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       7.29
 PIPE TRAVEL TIME(MIN.) =   0.06    Tc(MIN.) =    7.69
 LONGEST FLOWPATH FROM NODE      1.00 TO NODE      4.00 =     708.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      4.00 TO NODE      4.00 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.) =    7.69
 RAINFALL INTENSITY(INCH/HR) =   4.84
 AREA-AVERAGED Fm(INCH/HR) =  0.03
 AREA-AVERAGED Fp(INCH/HR) =  0.20
 AREA-AVERAGED Ap =  0.17
 EFFECTIVE STREAM AREA(ACRES) =       1.68
 TOTAL STREAM AREA(ACRES) =       1.68
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       7.29

****************************************************************************
 FLOW PROCESS FROM NODE      4.10 TO NODE      4.20 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   303.00
 ELEVATION DATA: UPSTREAM(FEET) =    107.80  DOWNSTREAM(FEET) =    102.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.593
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.281
 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        4.52      0.20      0.100    91    6.59
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =     21.40
 TOTAL AREA(ACRES) =      4.52   PEAK FLOW RATE(CFS) =     21.40

****************************************************************************
 FLOW PROCESS FROM NODE      4.20 TO NODE      4.30 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   102.00  DOWNSTREAM(FEET) =   101.00
 FLOW LENGTH(FEET) =   153.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  27.0 INCH PIPE IS  20.0 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   6.76
 ESTIMATED PIPE DIAMETER(INCH) =  27.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      21.40
 PIPE TRAVEL TIME(MIN.) =   0.38    Tc(MIN.) =    6.97
 LONGEST FLOWPATH FROM NODE      4.10 TO NODE      4.30 =     456.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      4.30 TO NODE      4.30 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    6.97
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.115
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 MOBILE HOME PARK            D        2.17      0.20      0.250    91
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.250
 SUBAREA AREA(ACRES) =     2.17      SUBAREA RUNOFF(CFS) =     9.89
 EFFECTIVE AREA(ACRES) =      6.69   AREA-AVERAGED Fm(INCH/HR) =  0.03
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.15
 TOTAL AREA(ACRES) =       6.7       PEAK FLOW RATE(CFS) =      30.62

****************************************************************************
 FLOW PROCESS FROM NODE      4.30 TO NODE      4.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   101.00  DOWNSTREAM(FEET) =    98.50
 FLOW LENGTH(FEET) =    67.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  24.0 INCH PIPE IS  15.3 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  14.44
 ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      30.62
 PIPE TRAVEL TIME(MIN.) =   0.08    Tc(MIN.) =    7.05
 LONGEST FLOWPATH FROM NODE      4.10 TO NODE      4.00 =     523.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      4.00 TO NODE      4.00 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.) =    7.05
 RAINFALL INTENSITY(INCH/HR) =   5.08
 AREA-AVERAGED Fm(INCH/HR) =  0.03
 AREA-AVERAGED Fp(INCH/HR) =  0.20
 AREA-AVERAGED Ap =  0.15
 EFFECTIVE STREAM AREA(ACRES) =       6.69
 TOTAL STREAM AREA(ACRES) =       6.69
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      30.62

 ** CONFLUENCE DATA **
```

```
**************************************************************************
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
         (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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 ************************* DESCRIPTION OF STUDY *************************
* AMETEK STUDY                                                          *
* 100-YEAR STORM,PROPOSED STUDY                                         *
* DRAINAGE AREA "A" AT WEST 16TH STREET                                 *
 ************************************************************************

  FILE NAME: PRO.DAT
  TIME/DATE OF STUDY: 08:57 06/17/2014
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *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 0.0313 0.167 0.0150
  2   20.0     15.0    0.017/0.020/0.020   0.50    1.50 0.0313 0.125 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

**************************************************************************
  FLOW PROCESS FROM NODE       1.00 TO NODE       2.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   268.00
  ELEVATION DATA: UPSTREAM(FEET) =    109.00  DOWNSTREAM(FEET) =    104.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.309
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.415
  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        0.58      0.20      0.100    91    6.31
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      2.82
  TOTAL AREA(ACRES) =      0.58   PEAK FLOW RATE(CFS) =      2.82

**************************************************************************
  FLOW PROCESS FROM NODE       2.00 TO NODE       3.00 IS CODE =  31
--------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
==========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   104.00  DOWNSTREAM(FEET) =    99.00
  FLOW LENGTH(FEET) =   412.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   6.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.21
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      2.82
  PIPE TRAVEL TIME(MIN.) =   1.32    Tc(MIN.) =    7.63
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      3.00 =     680.00 FEET.

**************************************************************************
  FLOW PROCESS FROM NODE       3.00 TO NODE       3.00 IS CODE =  81
--------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==========================================================================
  MAINLINE Tc(MIN.) =    7.63
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.857
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"        D        1.10      0.20      0.200    91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =    1.10      SUBAREA RUNOFF(CFS) =    4.77
  EFFECTIVE AREA(ACRES) =      1.68   AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.17
  TOTAL AREA(ACRES) =        1.7       PEAK FLOW RATE(CFS) =       7.29

**************************************************************************
  FLOW PROCESS FROM NODE       3.00 TO NODE       4.00 IS CODE =  31
--------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
==========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    99.00  DOWNSTREAM(FEET) =    98.50
```
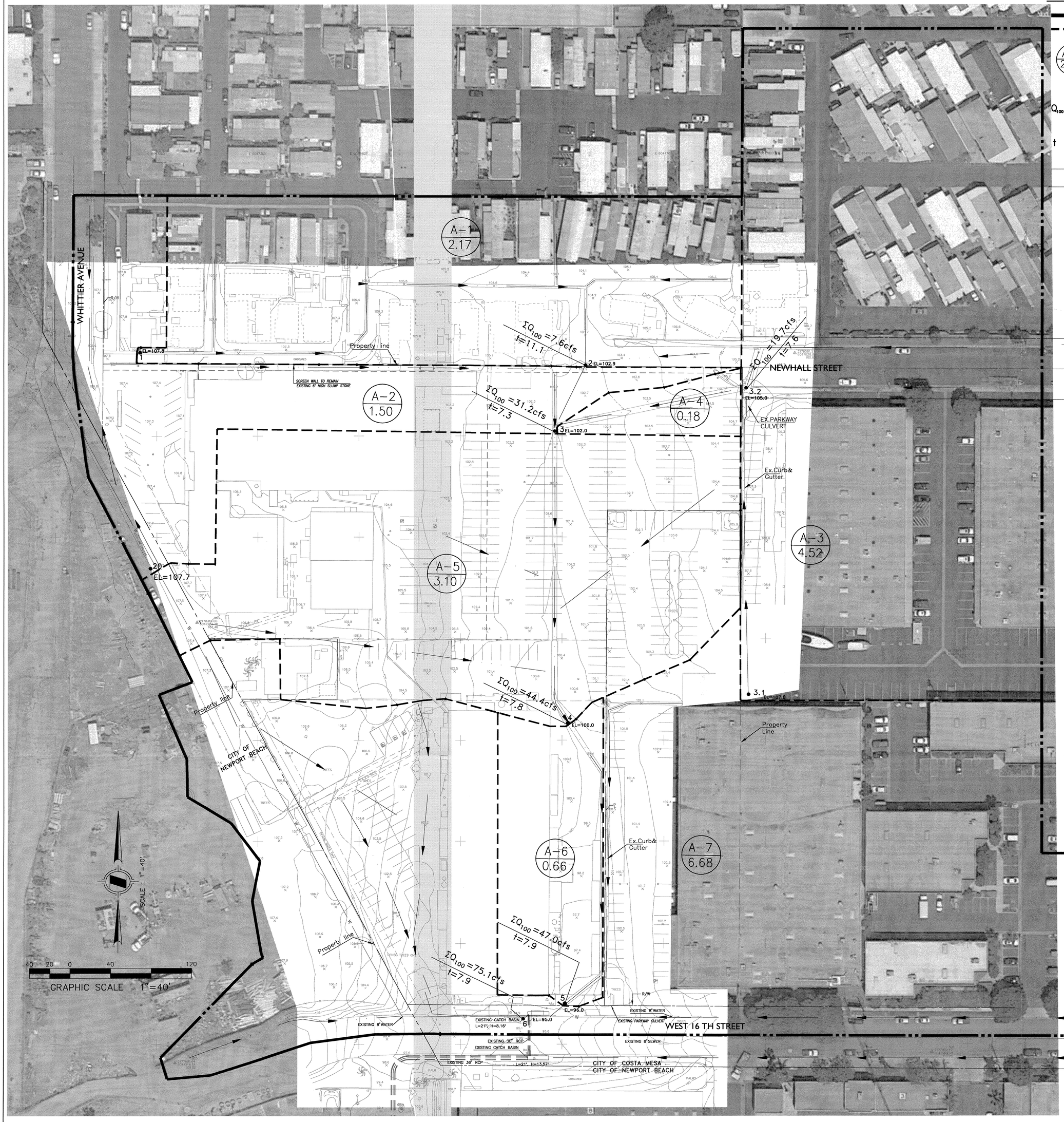

PROPOSED CONDITION HYDROLOGY CALCULATIONS & MAP

SECTION 3

LEGEND

——·——·——	MAJOR DRAINAGE BOUNDARY
– – – –	MINOR DRAINAGE BOUNDARY
A–1 / 2.17	AREA DESIGNATION / AREA ACREAGE (IN ACRES)
D	SOIL GROUP
Q_{100} = 7.6 cfs	100–YR PEAK RUNOFF IN CUBIC FEET PER SECOND
t = 11.0 MIN	TIME OF CONCENTRATION MINUTES
→	FLOW DIRECTION
— — —	EXISTING STORM DRAIN



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EXISTING CONDITION HYDROLOGY MAP TTM 17747

WO: 3974–1 TTM -- AMETEK BIN: -- RM: -- DOC.: ----

JUN 20 2014 F:\0847\Engineering\SY_Hydro\Exi. Hydrology.dwg
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SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.20
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.235
SUBAREA AREA(ACRES) = 6.68 SUBAREA RUNOFF(CFS) = 28.27
EFFECTIVE AREA(ACRES) = 17.68 AREA-AVERAGED Fm(INCH/HR) = 0.03
AREA-AVERAGED Fp(INCH/HR) = 0.20 AREA-AVERAGED Ap = 0.16
TOTAL AREA(ACRES) = 18.8 PEAK FLOW RATE(CFS) = 75.05

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) = 0.56 HALFSTREET FLOOD WIDTH(FEET) = 23.12
FLOW VELOCITY(FEET/SEC.) = 7.11 DEPTH*VELOCITY(FT*FT/SEC.) = 4.00
LONGEST FLOWPATH FROM NODE 1.00 TO NODE 6.00 = 1166.00 FEET.

==========

END OF STUDY SUMMARY:
TOTAL AREA(ACRES) = 18.8 TC(MIN.) = 7.94
EFFECTIVE AREA(ACRES) = 17.68 AREA-AVERAGED Fm(INCH/HR)= 0.03
AREA-AVERAGED Fp(INCH/HR) = 0.20 AREA-AVERAGED Ap = 0.164
PEAK FLOW RATE(CFS) = 75.05

** PEAK FLOW RATE TABLE **

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	75.05	7.94	4.748	0.20(0.03)	0.16	17.7	3.10
2	64.84	11.38	3.863	0.20(0.03)	0.17	18.8	1.00

==========

==========

END OF RATIONAL METHOD ANALYSIS

```
****************************************************************************
 FLOW PROCESS FROM NODE       3.00 TO NODE       4.00 IS CODE =  91
----------------------------------------------------------------------------
 >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM NODE ELEVATION(FEET) =    102.00
 DOWNSTREAM NODE ELEVATION(FEET) =    100.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   290.00
 "V" GUTTER WIDTH(FEET) =   4.00   GUTTER HIKE(FEET) =  0.125
 PAVEMENT LIP(FEET) =  0.031   MANNING'S N = .0150
 PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
 MAXIMUM DEPTH(FEET) =   0.20
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.791
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  D        3.10      0.20      0.100    91
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     37.90
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  58.72
 AVERAGE FLOW DEPTH(FEET) =   0.20   FLOOD WIDTH(FEET) =    8.37
 "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.08   Tc(MIN.) =    7.81
 SUBAREA AREA(ACRES) =    3.10       SUBAREA RUNOFF(CFS) =   13.31
 EFFECTIVE AREA(ACRES) =   10.34     AREA-AVERAGED Fm(INCH/HR) =   0.02
 AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.12
 TOTAL AREA(ACRES) =       11.5          PEAK FLOW RATE(CFS) =      44.37

       ==>>ERROR:FLOW EXCEEDS CAPACITY OF CHANNEL WITH
           NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM ALLOWABLE DEPTH.
           AS AN APPROXIMATION, TRAVEL TIME CALCULATIONS ARE BASED
           ON FLOW DEPTH EQUAL TO THE SPECIFIED MAXIMUM ALLOWABLE DEPTH.


 END OF SUBAREA "V" GUTTER HYDRAULICS:
 DEPTH(FEET) =  0.20   FLOOD WIDTH(FEET) =    8.37
 FLOW VELOCITY(FEET/SEC.) =  68.74   DEPTH*VELOCITY(FT*FT/SEC) =  13.75
 LONGEST FLOWPATH FROM NODE      1.00 TO NODE      4.00 =     936.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE       4.00 TO NODE       5.00 IS CODE =  91
----------------------------------------------------------------------------
 >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM NODE ELEVATION(FEET) =    100.00
 DOWNSTREAM NODE ELEVATION(FEET) =     96.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   200.00
 "V" GUTTER WIDTH(FEET) =   4.00   GUTTER HIKE(FEET) =  0.125
 PAVEMENT LIP(FEET) =  0.031   MANNING'S N = .0150
 PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
 MAXIMUM DEPTH(FEET) =   0.20
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.775
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  D        0.66      0.20      0.100    91
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     45.79
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  70.93
 AVERAGE FLOW DEPTH(FEET) =   0.20   FLOOD WIDTH(FEET) =    8.37
 "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.05   Tc(MIN.) =    7.86
 SUBAREA AREA(ACRES) =    0.66       SUBAREA RUNOFF(CFS) =    2.82
 EFFECTIVE AREA(ACRES) =   11.00     AREA-AVERAGED Fm(INCH/HR) =   0.02
 AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.12
 TOTAL AREA(ACRES) =       12.1          PEAK FLOW RATE(CFS) =      47.04

       ==>>ERROR:FLOW EXCEEDS CAPACITY OF CHANNEL WITH
           NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM ALLOWABLE DEPTH.
           AS AN APPROXIMATION, TRAVEL TIME CALCULATIONS ARE BASED
           ON FLOW DEPTH EQUAL TO THE SPECIFIED MAXIMUM ALLOWABLE DEPTH.


 END OF SUBAREA "V" GUTTER HYDRAULICS:
 DEPTH(FEET) =  0.20   FLOOD WIDTH(FEET) =    8.37
 FLOW VELOCITY(FEET/SEC.) =  72.88   DEPTH*VELOCITY(FT*FT/SEC) =  14.58
 LONGEST FLOWPATH FROM NODE      1.00 TO NODE      5.00 =    1136.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE       5.00 TO NODE       6.00 IS CODE =  62
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  2 USED)<<<<<
============================================================================
 UPSTREAM ELEVATION(FEET) =   96.00  DOWNSTREAM ELEVATION(FEET) =   95.00
 STREET LENGTH(FEET) =    30.00   CURB HEIGHT(INCHES) =  6.0
 STREET HALFWIDTH(FEET) = 20.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  15.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.017
 OUTSIDE STREET CROSSFALL(DECIMAL) =  0.020

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

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      61.18
   ***STREET FLOWING FULL***
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
   STREET FLOW DEPTH(FEET) =  0.53
   HALFSTREET FLOOD WIDTH(FEET) =   21.66
   AVERAGE FLOW VELOCITY(FEET/SEC.) =    6.62
   PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    3.53
 STREET FLOW TRAVEL TIME(MIN.) =   0.08   Tc(MIN.) =    7.94
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.748
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  D        5.68      0.20      0.100    91
 NATURAL POOR COVER
 "BARREN"                    D        1.00      0.20      1.000    98
```

```
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
==============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =   11.15
 RAINFALL INTENSITY(INCH/HR) =   3.91
 AREA-AVERAGED Fm(INCH/HR) =  0.04
 AREA-AVERAGED Fp(INCH/HR) =  0.20
 AREA-AVERAGED Ap =  0.19
 EFFECTIVE STREAM AREA(ACRES) =       3.67
 TOTAL STREAM AREA(ACRES) =       3.67
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      12.78

****************************************************************************
 FLOW PROCESS FROM NODE      3.10 TO NODE      3.20 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   303.00
 ELEVATION DATA: UPSTREAM(FEET) =    107.80  DOWNSTREAM(FEET) =    105.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.626
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.858
 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        4.52      0.20      0.100    91    7.63
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =     19.68
 TOTAL AREA(ACRES) =      4.52   PEAK FLOW RATE(CFS) =     19.68

****************************************************************************
 FLOW PROCESS FROM NODE      3.20 TO NODE      3.00 IS CODE =  91
----------------------------------------------------------------------------
 >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM NODE ELEVATION(FEET) =    105.00
 DOWNSTREAM NODE ELEVATION(FEET) =    102.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   195.00
 "V" GUTTER WIDTH(FEET) =   4.00   GUTTER HIKE(FEET) =  0.125
 PAVEMENT LIP(FEET) =  0.031   MANNING'S N = .0150
 PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
 MAXIMUM DEPTH(FEET) =   0.20
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.820
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  D        0.18      0.20      0.100    91
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     20.07
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  31.09
 AVERAGE FLOW DEPTH(FEET) =   0.20   FLOOD WIDTH(FEET) =    8.37
 "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.10   Tc(MIN.) =    7.73
 SUBAREA AREA(ACRES) =    0.18      SUBAREA RUNOFF(CFS) =    0.78
 EFFECTIVE AREA(ACRES) =    4.70    AREA-AVERAGED Fm(INCH/HR) =   0.02
 AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.10
 TOTAL AREA(ACRES) =        4.7       PEAK FLOW RATE(CFS) =      20.30

       ==>>ERROR:FLOW EXCEEDS CAPACITY OF CHANNEL WITH
           NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM ALLOWABLE DEPTH.
           AS AN APPROXIMATION, TRAVEL TIME CALCULATIONS ARE BASED
           ON FLOW DEPTH EQUAL TO THE SPECIFIED MAXIMUM ALLOWABLE DEPTH.


 END OF SUBAREA "V" GUTTER HYDRAULICS:
 DEPTH(FEET) =  0.20   FLOOD WIDTH(FEET) =    8.37
 FLOW VELOCITY(FEET/SEC.) =  31.46   DEPTH*VELOCITY(FT*FT/SEC) =   6.29
 LONGEST FLOWPATH FROM NODE      3.10 TO NODE      3.00 =     498.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 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.) =    7.73
 RAINFALL INTENSITY(INCH/HR) =   4.82
 AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20
 AREA-AVERAGED Ap =  0.10
 EFFECTIVE STREAM AREA(ACRES) =       4.70
 TOTAL STREAM AREA(ACRES) =       4.70
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      20.30

 ** CONFLUENCE DATA **
  STREAM       Q      Tc   Intensity   Fp(Fm)      Ap      Ae      HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)           (ACRES)     NODE
    1       12.78   11.15    3.907  0.20( 0.04) 0.19       3.7        1.00
    2       20.30    7.73    4.820  0.20( 0.02) 0.10       4.7        3.10

 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       31.25    7.73    4.820  0.20( 0.03) 0.13       7.2        3.10
    2       29.22   11.15    3.907  0.20( 0.03) 0.14       8.4        1.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      31.25    Tc(MIN.) =     7.73
 EFFECTIVE AREA(ACRES) =       7.24   AREA-AVERAGED Fm(INCH/HR) =  0.03
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.13
 TOTAL AREA(ACRES) =        8.4
 LONGEST FLOWPATH FROM NODE      1.00 TO NODE      3.00 =     646.00 FEET.
```

```
**************************************************************************
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
         (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
       (c) Copyright 1983-2013 Advanced Engineering Software (aes)
           Ver. 20.0  Release Date: 06/01/2013  License ID 1239

                        Analysis prepared by:

                        HUNSAKER & ASSOCIATES
                              Irvine,Inc
                    Planning * Engineering * Surveying
             Three Hughes * Irvine, California 92618 * (949)583-1010

 ************************* DESCRIPTION OF STUDY *************************
* AMETEK STUDY                                                          *
* 100-YEAR STORM,EXISTINF STUDY                                         *
* DRAINAGE AREA "A" AT WEST 16TH STREET                                 *
 ************************************************************************

  FILE NAME: EXISTING.DAT
  TIME/DATE OF STUDY: 11:56 06/19/2014
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *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 0.0313 0.167 0.0150
  2   20.0     15.0    0.017/0.020/0.020   0.50    1.50 0.0313 0.125 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

**************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   576.00
  ELEVATION DATA: UPSTREAM(FEET) =    107.80  DOWNSTREAM(FEET) =    102.90

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   11.080
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.922
  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.)
  MOBILE HOME PARK            D        2.17      0.20      0.250    91   11.08
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.250
  SUBAREA RUNOFF(CFS) =      7.56
  TOTAL AREA(ACRES) =      2.17   PEAK FLOW RATE(CFS) =      7.56

**************************************************************************
  FLOW PROCESS FROM NODE      2.00 TO NODE      3.00 IS CODE =  91
--------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
==========================================================================
  UPSTREAM NODE ELEVATION(FEET) =    102.90
  DOWNSTREAM NODE ELEVATION(FEET) =    102.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    70.00
  "V" GUTTER WIDTH(FEET) =   4.00   GUTTER HIKE(FEET) =  0.125
  PAVEMENT LIP(FEET) =  0.031   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   0.20
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.907
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  D        1.50      0.20      0.100    91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     10.19
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  15.78
  AVERAGE FLOW DEPTH(FEET) =   0.20   FLOOD WIDTH(FEET) =    8.38
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.07   Tc(MIN.) =   11.15
  SUBAREA AREA(ACRES) =    1.50       SUBAREA RUNOFF(CFS) =    5.25
  EFFECTIVE AREA(ACRES) =    3.67     AREA-AVERAGED Fm(INCH/HR) =   0.04
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.19
  TOTAL AREA(ACRES) =        3.7          PEAK FLOW RATE(CFS) =      12.78

        ==>>ERROR:FLOW EXCEEDS CAPACITY OF CHANNEL WITH
            NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM ALLOWABLE DEPTH.
            AS AN APPROXIMATION, TRAVEL TIME CALCULATIONS ARE BASED
            ON FLOW DEPTH EQUAL TO THE SPECIFIED MAXIMUM ALLOWABLE DEPTH.


  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.20   FLOOD WIDTH(FEET) =    8.38
  FLOW VELOCITY(FEET/SEC.) =  19.79   DEPTH*VELOCITY(FT*FT/SEC) =   3.96
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      3.00 =     646.00 FEET.

**************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE =   1
--------------------------------------------------------------------------
```

EXISTING CONDITION HYDROLOGY CALCULATIONS & MAP

SECTION 2

SUBJECT TO FURTHER REVISION

LEGEND

City Boundaries

Hydrologic Soil Groups

- A Soils
- B Soils
- C Soils
- D Soils

Source:
Soils: Natural Resources Conservation Service (NRCS)
Soil Survey - soil_ca678, Orange County & Western Riverside
Date of publication: 2006-02-08
http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm

Project Site

0 2.5 5 10 Kilometers
0 1.8 3.6 7.2 Miles

P:\9526EV6-GIS\Mxds\Reports\Infiltration Feasability_20110215\9526E_FigureXVI-2a_HydroSoils_20110215.mxd

TITLE: NRCS HYDROLOGIC SOILS GROUPS

ORANGE COUNTY INFILTRATION STUDY

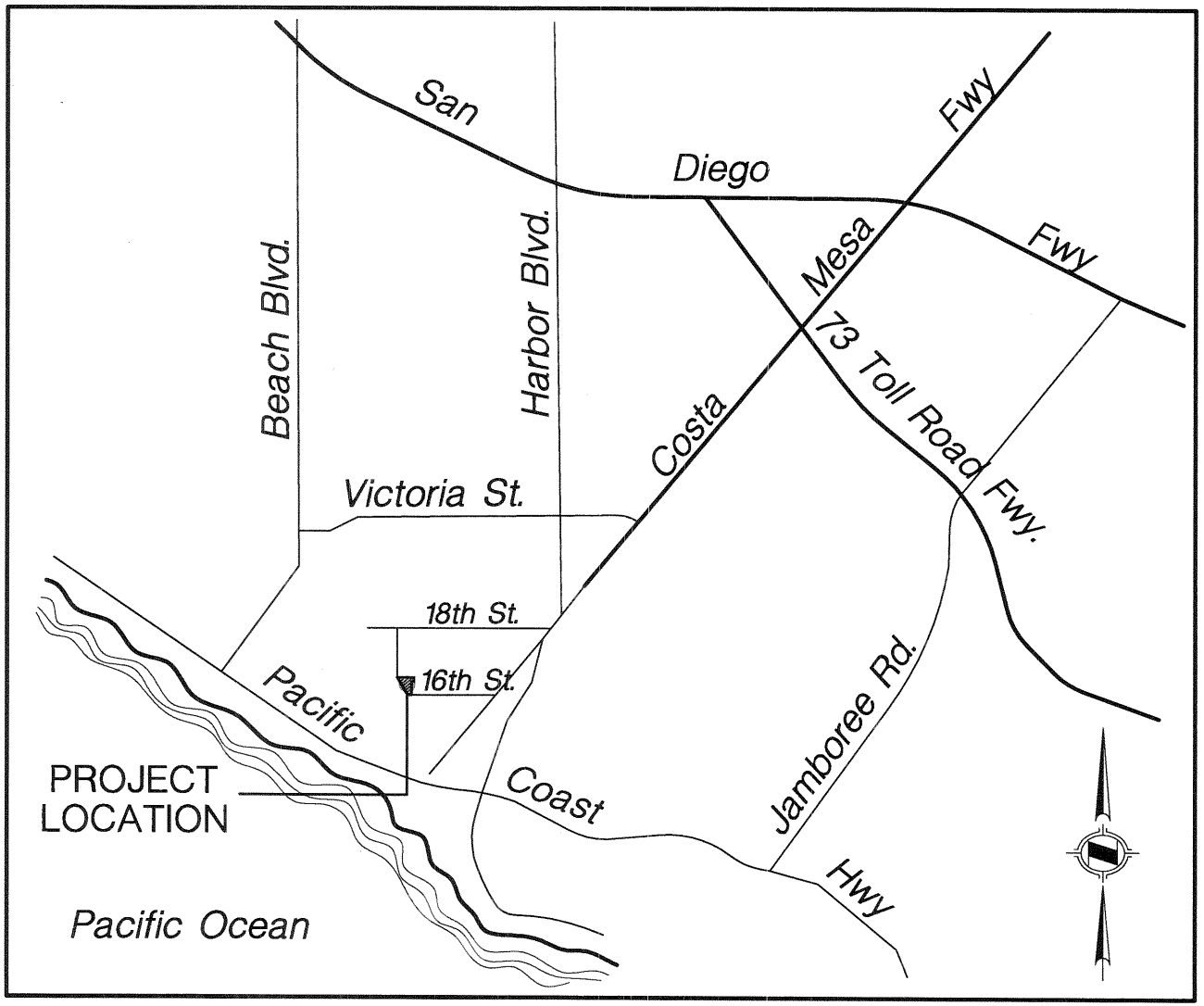
CA

JOB: ORANGE CO.

SCALE	1" = 1.8 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	02/09/11
JOB NO.	9526-E

PACE Advanced Water Engineering

FIGURE XVI-2a



VICINITY MAP

EXHIBIT 1

NOT TO SCALE

D. Proposed Condition.

Under proposed condition, the land use in the project will be single-family residential with a density of approximately eleven (11) lots per acre. The Q_{100} runoff generated under proposed condition is 79.3cfs at the exit node at West 16th street (Node 11) as shown in the Proposed Condition Hydrology Map in Section 3.

E. Methodology.

The hydrology calculations were prepared using the 1986 Orange County Hydrology Manual as incorporated in the Advanced Engineering Software (AES) "RATSC" program. The hydrologic calculation of soils map contained in the Orange County Hydrology Manual was used to determine the hydrologic soils type and for our study soil type D was determined.

A. PROJECT LOCATION

The proposed project (Project) is Tentative Tract Map 17747 in the City of Costa Mesa, County 0f Orange. The Project is bounded by the City of Newport Beach to the west, a mobile home park to the north, an industrial development to the east, and West 16th Street to the south.
(See attached Exhibit 1. For Vicinity Map)

B. STUDY PURPOSE

The purpose of this hydrology study is to determine the amount of runoff flows generated from the Project site under existing (pre-project) and proposed (post-project) conditions during 100-year frequency storm events. It will serve as the basis for designing storm drain improvements required for the Project.
Water treatment BMP's will also be provided to treat the first flush flows generated in the Project site prior to discharging into the downstream storm drain system. Water quality flow calculations have been included in the WQMP.

C. Existing Condition

The Project site is comprised of approximately 5.7 acres that drain towards an existing 21-foot wide catch basin in West 16th Street. The existing catch basin connects to an existing 36" diameter storm drain pipe which drains south to the City of Newport Beach.

The total drainage area tributary to the downstream system is approximately 18.8 acres of which 13.1 acres are from offsite areas.

Under existing condition the land use is light industrial that generates 100-year storm runoff (Q_{100}) of approximately 75.1cfs from the total drainage area tributary to the exit node at West 16th street (Node 6) as shown in the Existing Condition Hydrology Map in Section 2.

INTRODUCTION

SECTION 1

TABLE OF CONTENTS

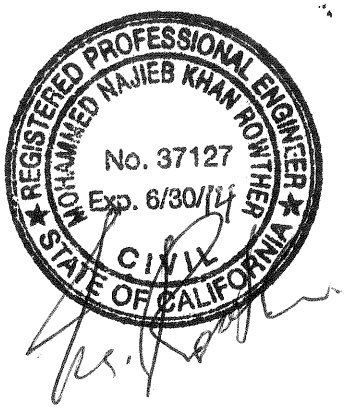
HYDROLOGY ANALYSIS

FOR

TRACT 17747

City of Costa Mesa

County of Orange



PREPARED UNDER THE SUPERVISION OF:

Mohammed Rowther 6/20/2014

Mohammed Rowther, R.C.E. 37127, Exp. 06/30/14

June 2014

PRELIMINARY HYDROLOGY ANALYSIS

Tentative Tract 17747

City of Costa Mesa | County of Orange

Prepared For:

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A Delaware Limited Liability Company
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Suite 330
Newport Beach, CA 92660

Prepared By:
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Three Hughes, Irvine, CA 92618 | 949.583.1010

WO#: 3974-1-Prelim-HydroAnal-TT17747