ITEM NO. 7

STAFF REPORT

CITY OF OCEANSIDE

DATE: October 2, 2013

TO: Honorable Mayor and City Councilmembers

FROM: Development Services Department

SUBJECT: **APPROVAL OF THE MASTER PLAN OF DRAINAGE UPDATE**

SYNOPSIS

Staff and the Utilities Commission recommend that the City Council approve an update identifying deficiencies and recommending upgrades to the Master Plan of Drainage.

BACKGROUND

The Master Plan of Drainage (MPD) is required to be updated on a periodic basis. In order to make this possible, City Council approved a professional services agreement (PSA) to update the MPD on April 6, 2011. City Council subsequently approved an amendment to that PSA on April 4, 2012, which incorporated additional services. Attached exhibits provide detailed background information.

ANALYSIS

The MPD provides long-term solutions for existing flood-hazard locations and planning-level design for potential drainage facilities (i.e., channels, storm drains, basins, and other conveyance systems) which are intended to support future land development. The consultant conducted a complex analysis of 2,790 drainage facilities. In addition to evaluating the City's existing stormwater drainage system, this report required analysis, review, and consideration of current engineering practices within the region. The precipitation data used for the MPD update was NOAA Atlas 14, a recently released study/analysis by the National Oceanic and Atmospheric Administration (NOAA). Hydrologic methodologies, polices, and procedures published by San Diego County, Orange County, Los Angeles County, and the United States Army Corps of Engineers (USACE) were assessed regarding applicability and relevance concerning this update. Additional methodologies which were evaluated included practices developed by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) and United States Environmental Protection Agency (EPA).

The recommendations within the report serve as a basis for future drainage fees and capital improvement projects. Capacity analysis was conducted at a planning level, and sizing results are intended to be approximate. The MPD update did not perform the detailed hydrologic analyses required for final design. Therefore, detailed project level

design of new drainage facilities are not part of this update. Rivers, creeks, private drainage systems, and Caltrans facilities are not considered to be master plan facilities. Likewise, high flood risk areas impacted by coastal flooding were not considered as part of the MPD update. Oceanside's coastal flood hazard areas are currently being analyzed by the Federal Emergency Management Agency (FEMA) California Coastal Analysis and Mapping Project (CCAMP).

This report identifies preliminary cost for recommended Master Plan drainage facilities to be approximately $34 million. MPD Tables 4-1 through 4-7 and F-1 through F-7 (Exhibit C), provide additional information and respective costs relative to the 25-year and 100-year storm events.

Watershed	**Estimated Upgrade Costs**	
	25-Year	**100-Year**
Pilgrim Creek Watershed	$ 584,480	$1,018,870
San Luis Rey River Watershed	$ 286,940	$ 8,478,150
Garrison Creek Watershed	$ 600,080	$ 2,322,070
Loma Alta Creek Watershed	$ 644,610	$ 7,372,340
Buena Vista Creek Watershed	$ 1,467,490	$ 10,460,690
Agua Hedionda Head Waters Watershed	$ 0	$ 382,680
Pacific Ocean/Beach Area Watershed	$2,159,520	$ 3,754,500
Total	**$ 5,743,120**	**$ 33,789,300**

Key areas of consideration include these watersheds with the highest estimated upgrade cost, the downtown area, and the South Morro Hills Area (SMHA). This MPD update remains consistent with current City zoning requirements and land use policies. Future drainage facilities within the SMHA will primarily be constructed by developers, as development occurs within the drainage basin. Undeveloped areas with environmental concerns will most likely continue to contain natural unimproved channels. Future improvements to natural channels may potentially be limited to channel enhancements at select locations, rather than completely lining or reconstructing the channel. The MPD may be amended in the future to accommodate zoning or land use policy changes, as necessary.

Approval of the MPD document update does not conclude the overall process. The following actions must be taken.

- **Update Drainage Fees** – A list of potential project locations for drainage-related capital improvement project (CIP) expenditures has been created as part of the MPD update effort. However, this project list could be overestimated. As part of the drainage fee update, staff recommends supplementary modeling to account for surface flow capacity which is not currently credited to the system's overall capacity. Through traditional hydraulic analysis, the MPD update identifies a number of storm drain facility deficiencies. These deficiencies are locations where stormwater flow is not contained within the underground infrastructure

(the pipe system). Conventional engineering analysis of pipe flow does not address flow characteristics which may be accommodated as open channel flow within the paved street and/or right-of-way (ROW). A detailed analysis of surface flow within the City's ROW was not part of the original or amended scope of this project. The proposed supplementary modeling will account for additional capacity within the ROW and determine if a system is truly deficient. Appropriate modifications to the potential project list should enable a proper refinement of the drainage fee and subsequent presentation to City Council.

- **Document Maintenance** – The MPD is intended to be a living document. It changes with the development of land, construction of CIPs, new/additional information, and changing needs. Thus, it requires ongoing maintenance and periodic updates to stay relevant. City staff intends on funding an annual CIP for this effort.

Elements of the report are in digital format and are being integrated into the City's Geographic Information System (GIS).

FISCAL IMPACT

There is no immediate fiscal impact associated with approving the update to the Master Plan of Drainage. Fiscal impacts associated with a forthcoming drainage fee update are yet to be determined.

INSURANCE REQUIREMENTS

Does not apply.

COMMISSION OR COMMITTEE REPORT

The Utilities Commission approved staff's recommendations at its meeting on September 10, 2013.

CITY ATTORNEY'S ANALYSIS

Does not apply.

RECOMMENDATION

Staff and the Utilities Commission recommend that the City Council approve an update identifying deficiencies and recommending upgrades to the Master Plan of Drainage.

PREPARED BY:

Scott O. Smith
City Engineer

SUBMITTED BY:

Peter A. Weiss
City Manager

REVIEWED BY:

Michelle Skaggs Lawrence, Deputy City Manager

for George Buell, Development Services Director

Attachments:

Exhibit A – MPD PSA Staff Report (April 6, 2011)
Exhibit B – MPD PSA Amendment Staff Report (April 4, 2012)
Exhibit C – Master Plan of Drainage Update 2013

EXHIBIT A

ITEM NO. 9

STAFF REPORT *CITY OF OCEANSIDE*

DATE: April 6, 2011

TO: Honorable Mayor and City Councilmembers

FROM: Development Services Department

SUBJECT: **APPROVAL OF A PROFESSIONAL SERVICES AGREEMENT TO UPDATE THE MASTER PLAN OF DRAINAGE**

SYNOPSIS

Staff recommends that the City Council approve a professional services agreement with Tory R. Walker Engineering, Inc., of Vista, in the amount of $509,790 for an update to the Master Plan of Drainage, and authorize the City Manager to execute the agreement; and adopt budget appropriations in amounts totaling $250,000 from the Unassigned Fund Balances of Drainage Funds 510, 512, 514, 522, 530, 531, and 550 to complete the funding for the update to the Master Plan of Drainage.

BACKGROUND

Indentified within this year's Council-approved Capital Improvement Program (CIP) budget (FY 2010-11), is a project to update the City's Master Plan of Drainage (MPD). In general, the purpose of a MPD is to provide long-term solutions for existing flood-hazard locations and provide planning-level design (including cost estimates) for potential drainage facilities which are intended to support future land development. The MPD document also provides significant contribution to three of the City's seven mandatory General Plan elements: land use, conservation, and safety.

State law requires that the City of Oceanside employ a General Plan containing seven mandatory components or "elements" (California Government Code Sections 65300 et seq.). The following definitions are intended to provide a brief explanation of the interaction of the MPD within the subject elements.

- The ***land use element*** designates the general location and intensity of housing, business, industry, open space, education, public buildings and grounds, waste disposal facilities, and other land uses. The MPD document assists with long-range policy direction regarding community values on public safety and public facilities, site design for undeveloped and redeveloped land, supplemental information for special management areas, clarification on stormwater-related development standards, and addressing certain natural resource management topics associated with erosion and siltation control and floodplains.

- The ***conservation element*** addresses the conservation, development, and use of natural resources including water, forests, soils, rivers, and mineral deposits. The MPD will provide assistance regarding understanding, interaction, and enforcement of applicable requirements from the San Diego Regional Water Quality Control Board (SDRWQCB) and the National Pollutant Discharge Elimination System (NPDES) permit program.
- The ***safety element*** establishes policies and programs to protect the community from risks associated with seismic, geologic, flood, and wildfire hazards. Flood hazards are identified as a primary topic within the City of Oceanside Public Safety Element.

The General Plan specifically identifies the MPD as a document which directly relates to the goals and policies of the safety element. As such, a periodic update to the MPD is required per City of Oceanside Ordinance 85-23. The City's current MPD was originally adopted in 1980. Since that time, a number of relatively minor amendments have been applied. The last amendment in 2006 focused primarily on hydrology and hydraulic analysis. The maximum time allotted between MPD updates is a five-year period; therefore, a new update is due. The proposed update is intended to be comprehensive and is a much larger undertaking than previous efforts. Supplemental information will be incorporated into the MPD as a result of this update, which in turn should assist with better administration of the City's stormwater management policies and regulations.

A key function of each MPD amendment is to enable both City staff and the development community to clearly understand the City's long-term objectives and direction toward drainage infrastructure. Hence, a comprehensive evaluation of the City's current stormwater drainage conveyance system, plus an assessment of the interaction and impacts of recently adopted stormwater regulations will be an important focus of this update. The revised MPD will include future drainage facility information, including capacity, size, and cost of improvements. The term drainage facility includes stormwater transport improvements such as: channels, storm drains, levees, basins, dams, wetlands, and all other conveyance systems which are capable of economically relieving flooding problems within the City.

The intent of this project is to amend the MPD to:

1. Comply with state laws and current hydrological design criteria
2. Assess, outline, and accurately depict existing storm drain infrastructure
3. Incorporate current retention basin design information
4. Incorporate current land-use designation
5. Assess future drainage facility needs
6. Create GIS drainage maps
7. Support safety of the public through the identification of long-term solutions for flood hazard matters
8. Provide a stormwater infrastructure guide for orderly land development
9. Provide planning-level cost estimates for needed facilities

10. Calculate and amend equitable drainage impact fees, based on facility cost, so taxpayers do not bear the burden of private land development
11. Identify potential capital improvement project expenditures for future budget years
12. Prioritize the most effective and efficient use of drainage program funds.

ANALYSIS

On November 4, 2010, the City advertised a request for proposals to solicit consultant submittals for the preparation of a revision to the Master Plan of Drainage (Exhibit A).

On November 23, 2010, the City held a pre-proposal meeting with representatives from 14 consulting firms attending (Exhibit B). On December 3, 2010, three consultants submitted proposals. Engineering staff reviewed the proposals, evaluated qualifications, and selected a firm based upon proposal rating process results (Exhibit C). Staff recommends Tory R. Walker Engineering, Inc., as the RFP firm best suited to update the Master Plan of Drainage. The update shall include Tasks 10, 12, and 14.

FISCAL IMPACT

Funding for this project is solely through drainage impact fees paid by developers. Ordinance 85-23 indicates drainage impact fees can only be used for administration of the master plan program, construction of facilities, and the reimbursement of the cost of construction of authorized MPD facilities.

Funding in the amount of $350,000 is already in place for the Update of the Master Plan of Drainage as shown in the following list. The contract of $509,790 plus contingencies, administrative overhead, and staff time will bring the total cost of the project to $600,000. Staff requests $250,000 in budget appropriations from the Unassigned Fund Balances (xxx.3100.0001) of Drainage Funds 510, 512, 514, 522, 530, 531, and 550 to the existing CIP projects as noted in the chart below. These appropriations will bring the total project financing to $600,000. Therefore, sufficient funds are available.

Master Plan of Drainage Capital Accounts	Existing Available Funding	Budget Appropriations Requested	Total Available Amount
905116700510	$25,000	$25,000	$50,000
905543700512	$50,000	$50,000	$100,000
905112900513	$25,000		$25,000
905543100514	$40,000	$50,000	$90,000
905117100515	$35,000		$35,000
905117200522	$35,000	$40,000	$75,000
905117400530	$35,000	$30,000	$65,000
905117500531	$45,000	$45,000	$90,000
905117700540	$25,000		$25,000
905117800550	$35,000	$10,000	$45,000
Totals	$350,000	$250,000	$600,000

INSURANCE REQUIREMENTS

The City's standard insurance requirements will be met.

COMMISSION OR COMMITTEE REPORT

Does not apply.

CITY ATTORNEY'S ANALYSIS

The referenced documents have been reviewed by the City Attorney and approved to form.

RECOMMENDATION

Staff recommends that the City Council approve a professional services agreement with Tory R. Walker Engineering, Inc., of Vista, in the amount of $509,790 for an update to the Master Plan of Drainage, and authorize the City Manager to execute the agreement; and adopt budget appropriations in amounts totaling $250,000 from the Unassigned Fund Balances of Drainage Funds 510, 512, 514, 522, 530, 531, and 550 to complete the funding for the update to the Master Plan of Drainage.

PREPARED BY:

Scott O. Smith
City Engineer

SUBMITTED BY:

Peter A. Weiss
City Manager

REVIEWED BY:

Michelle Skaggs Lawrence, Deputy City Manager
George Buell, Development Services Director
Teri Ferro, Financial Services Director

Attachments: Exhibits A, B, and C

CITY OF OCEANSIDE

PROFESSIONAL SERVICES AGREEMENT

PROJECT: City of Oceanside Master Plan of Drainage (MPD)

THIS AGREEMENT, dated _____, 2011, for identification purposes, is made and entered into by and between the CITY OF OCEANSIDE, a municipal corporation, hereinafter designated as "CITY", and Tory Walker Engineering, Inc., hereinafter designated as "CONSULTANT."

NOW THEREFORE, THE PARTIES MUTUALLY AGREE AS FOLLOWS:

1. **SCOPE OF WORK. Amendment of the City of Oceanside Master Plan of Drainage (MPD) to reflect revisions, additions and other changes in facilities.** A more detailed Scope of Service for the project, as defined by the CONSULTANT (dated December 3, 2010), is attached hereto as **Exhibit "A"** which includes Tasks 1 through 10, Task 12 and 14. Tasks 11 and 13 are NOT included in the scope of services.

2. **INDEPENDENT CONTRACTOR.** CONSULTANT'S relationship to the CITY shall be that of an independent contractor. CONSULTANT shall have no authority, express or implied, to act on behalf of the CITY as an agent, or to bind the CITY to any obligation whatsoever, unless specifically authorized in writing by the City Engineer. The CONSULTANT shall not be authorized to communicate directly with, nor in any way direct the actions of, any bidder or the construction contractor for this project without the prior written authorization by the City Engineer. CONSULTANT shall be solely responsible for the performance of any of its employees, agents, or subcontractors under this Agreement. CONSULTANT shall report to the CITY any and all employees, agents, and consultants performing work in connection with this project, and all shall be subject to the approval of the CITY.

3. **WORKERS' COMPENSATION.** Pursuant to Labor Code section 1861, the CONSULTANT hereby certifies that the CONSULTANT is aware of the provisions of Section 3700 of the Labor Code which require every employer to be insured against liability for Workers' Compensation or to undertake self-insurance in accordance with the provisions of that Code, and the CONSULTANT will comply with such provisions, and provide certification of such compliance as a part of this Agreement.

4. **LIABILITY INSURANCE.**

City of Oceanside Master Plan of Drainage (MPD)

4.1. CONSULTANT shall, throughout the duration of this Agreement maintain comprehensive general liability and property damage insurance, or commercial general liability insurance, covering all operations of CONSULTANT, its agents and employees, performed in connection with this Agreement including but not limited to premises and automobile.

4.2 CONSULTANT shall maintain liability insurance in the following minimum limits:

Comprehensive General Liability Insurance	
(bodily injury and property damage)	
Combined Single Limit Per Occurrence	$ 1,000,000
General Aggregate	$ 2,000,000*
Commercial General Liability Insurance	
(bodily injury and property damage)	
General limit per occurrence	$ 1,000,000
General limit project specific aggregate	$ 2,000,000
Automobile Liability Insurance	$ 1,000,000

*General aggregate per year, or part thereof, with respect to losses or other acts or omissions of CONSULTANT under this Agreement.

4.3 If coverage is provided through a Commercial General Liability Insurance policy, a minimum of 50% of each of the aggregate limits shall remain available at all times. If over 50% of any aggregate limit has been paid or reserved, the CITY may require additional coverage to be purchased by the CONSULTANT to restore the required limits. The CONSULTANT shall also notify the CITY'S Project Manager promptly of all losses or claims over $25,000 resulting from work performed under this contract, or any loss or claim against the CONSULTANT resulting from any of the CONSULTANT'S work.

4.4 All insurance companies affording coverage to the CONSULTANT for the purposes of this Section shall add the City of Oceanside as "additional insured" under the designated insurance policy for all work performed under this agreement. Insurance coverage provided to the City as additional insured shall be primary insurance and other insurance maintained by the City of Oceanside, its officers, agents, and employees shall be excess only and not contributing with insurance provided pursuant to this Section.

4.5 All insurance companies affording coverage to the CONSULTANT pursuant to this agreement shall be insurance organizations admitted by the Insurance Commissioner of the State of California to transact business of insurance in the state or be rated as A-X or higher by A.M. Best.

4.6 All insurance companies affording coverage shall provide thirty (30) days written notice to the CITY should the policy be cancelled before the expiration date. For the purposes of this notice requirement, any material change in the policy prior to the expiration shall be considered a cancellation.

4.7 CONSULTANT shall provide evidence of compliance with the insurance requirements listed above by providing a Certificate of Insurance and applicable endorsements, in a form satisfactory to the City Attorney, concurrently with the submittal of this Agreement.

4.8 CONSULTANT shall provide a substitute Certificate of Insurance no later than thirty (30) days prior to the policy expiration date. Failure by the CONSULTANT to provide such a substitution and extend the policy expiration date shall be considered a default by CONSULTANT and may subject the CONSULTANT to a suspension or termination of work under the Agreement.

4.9 Maintenance of insurance by the CONSULTANT as specified in this Agreement shall in no way be interpreted as relieving the CONSULTANT of any responsibility whatsoever and the CONSULTANT may carry, at its own expense, such additional insurance as it deems necessary.

5. **PROFESSIONAL ERRORS AND OMISSIONS INSURANCE.** Throughout the duration of this Agreement and four (4) years thereafter, the CONSULTANT shall maintain professional errors and omissions insurance for work performed in connection with this Agreement in the minimum amount of One Million Dollars ($1,000,000.00).

CONSULTANT shall provide evidence of compliance with these insurance requirements by providing a Certificate of Insurance.

6. **CONSULTANT'S INDEMNIFICATION OF CITY.** To the greatest extent allowed by law, CONSULTANT shall indemnify and hold harmless the CITY and its officers, agents and employees against all claims for damages to persons or property arising out of CONSULTANT'S work, including the negligent acts, errors or omissions or wrongful acts or conduct of the CONSULTANT, or its employees, agents, subcontractors, or others in connection with the execution of the work covered by this Agreement, except for those claims arising from the willful misconduct, sole negligence or active negligence of the CITY, its officers, agents, or employees. CONSULTANT'S indemnification shall include any and all costs, expenses, attorneys' fees, expert fees and liability assessed against or incurred by the CITY, its officers, agents, or employees in defending against such claims or lawsuits, whether the same proceed to judgment or not. Further, CONSULTANT at its own expense shall, upon written request by the CITY, defend any such suit or action brought against the CITY, its officers, agents, or employees founded upon,

resulting or arising from the conduct, tortious acts or omissions of the CONSULTANT.

CONSULTANT'S indemnification of CITY shall not be limited by any prior or subsequent declaration by the CONSULTANT.

7. **OWNERSHIP OF DOCUMENTS.** All plans and specifications, including details, computations and other documents, prepared or provided by the CONSULTANT under this Agreement shall be the property of the CITY. The CITY agrees to hold the CONSULTANT free and harmless from any claim arising from any use, other than the purpose intended, of the plans and specifications and all preliminary sketches, schematics, preliminary plans, architectural perspective renderings, working drawings, including details, computation and other documents, prepared or provided by the CONSULTANT. CONSULTANT may retain a copy of all material produced under this Agreement for the purpose of documenting their participation in this project.

8. **COMPENSATION.** CONSULTANT'S compensation for all work performed in accordance with this Agreement, shall not exceed the total contract price of $509,790.00. A more detailed fee schedule, as defined by the CONSULTANT, is attached hereto in **Exhibit "B"**.

   No work shall be performed by CONSULTANT in excess of the total contract price without prior written approval of the City Engineer. CONSULTANT shall obtain approval by the City Engineer prior to performing any work that results in incidental expenses to CITY.

9. **TIMING REQUIREMENTS.** Timing requirements shall be per **Exhibit "C"**. Anticipated Timeline which shall be updated by the CONSULTANT on a regular basis and as required by the City Engineer.

10. **ENTIRE AGREEMENT.** This Agreement comprises the entire integrated understanding between CITY and CONSULTANT concerning the work to be performed for this project and supersedes all prior negotiations, representations, or agreements.

11. **INTERPRETATION OF THE AGREEMENT.** The interpretation, validity and enforcement of the Agreement shall be governed by and construed under the laws of the State of California. The Agreement does not limit any other rights or remedies available to CITY.

    The CONSULTANT shall be responsible for complying with all local, state, and federal laws whether or not said laws are expressly stated or referred to herein.

    Should any provision herein be found or deemed to be invalid, the Agreement shall

be construed as not containing such provision, and all other provisions, which are otherwise lawful, shall remain in full force and effect, and to this end the provisions of this Agreement are severable.

12. **AGREEMENT MODIFICATION**. This Agreement may not be modified orally or in any manner other than by an agreement in writing signed by the parties hereto.

13. **SIGNATURES**. The individuals executing this Agreement represent and warrant that they have the right, power, legal capacity and authority to enter into and to execute this Agreement on behalf of the respective legal entities of the CONSULTANT and the CITY.

IN WITNESS WHEREOF, the parties hereto for themselves, their heirs, executors, administrators, successors, and assigns do hereby agree to the full performance of the covenants herein contained and have caused this Professional Services Agreement to be executed by setting hereunto their signatures on the dates set forth below.

Tory Walker Engineering, Inc.
973 Vale Terrace Drive, Suite 202
Vista, CA 92084

By: Tory R Walker
Name/Title TORY R. WALKER, PRES.

Date:_____

By: Jennifer L. Walker
Name/Title JENNIFER L. WALKER, SEC.

Date:_____

33-0892309
Employer ID No.

CITY OF OCEANSIDE

By:_____
City Manager

Date:_____

APPROVED AS TO FORM:

Barbara Hamilton, ASST.
City Attorney

NOTARY ACKNOWLEDGMENTS OF CONSULTANT MUST BE ATTACHED.

EXHIBIT A

Scope of Services

As described in the Request for Proposals, the scope of services is summarized as follows:

Task 1: Obtain and Compile Hydrologic Information
Task 2: Update Inventory and Database with New Information
Task 3: Research Methodologies and Software Tools
Task 4: Review and Evaluate Existing and Proposed Detention Basins
Task 5: Hydrologic Analysis
Task 6: Revise Recommended Storm Drain Upgrades and Improvements
Task 7: Revise Construction Cost Estimates
Task 8: Capital Improvement Projects (CIP)
Task 9: Drainage Impact Fee Evaluation
Task 10: Meetings, Coordination and Delivered Product

Additional drainage tasks (optional at City discretion)
Task 11: San Luis Rey River - Flood Risk at Major Arterials
Task 12: Loma Alta Creek Watershed Studies
Task 13: Buena Vista Creek Watershed Studies
Task 14: Update City Drainage System Design Criteria

TRWE has spent time considering each task of the proposed scope of services. We have described below in more detail than described in the RFP our tentative approach, which will be further refined in meeting with and communicating with City Engineering Division staff. Our understanding of the tasks and approach to these tasks is as follows:

Task 1: Obtain and Compile Hydrologic Information

TRWE will meet with City Engineering Division staff, Public Works maintenance staff, and Clean Water Program staff to determine what information is available from the City. This will include, at a minimum, previous master plans of drainage (2005 MPD by Bureau Veritas and 1980 MPD by VTN), other hydrologic studies (associated with CIP projects, private developments, and other public agency studies available at the City), storm drain and BMP inventory and design information, detention basin design information, flood insurance studies, and watershed studies.

TRWE will also meet with (and/or coordinate with) other local, state, and federal agencies and any other pertinent sources to obtain pertinent information. Probable sources for additional information, similar to that obtained from the City of Oceanside, include the cities of Vista and Carlsbad, the County of San Diego, California Department of Transportation, the US Army Corps of Engineers, and Camp Pendleton. Pertinent information may also be available from both State and Federal agencies, such as California Department of Water Resources, Department of Conservation (e.g., the California Watershed Portal), State Water Resources Control Board (e.g., watershed studies and/or information), National Weather Service (e.g., precipitation data and/or statistical analysis), and the U. S. Geological Survey (e.g., stream gage data and analysis, geologic mapping). Additionally, pertinent information, including photographs, may also be available from some non-governmental organizations (NGOs), such as Preserve Calavera, the Center for Natural Lands Management, Friends of Loma Alta Creek, Buena Vista Audubon, and The Buena Vista Lagoon Foundation.

Task 2: Update Inventory and Database with New Information

TRWE provided review services to the City of Oceanside for the 2005 MPD prepared by Bureau Veritas. In the process of that detailed review, and because of our involvement with other drainage projects in the City, we became very familiar with many drainage systems and somewhat familiar with all the drainage systems. We will therefore only need to conduct an overview of the 2005 MPD for this task and then meet with the City to discuss the existence of newer or more accurate information that was not previously incorporated into the 2005 MPD.

We will meet with the City's Water Utilities Department to establish the base condition of the City's GIS database and mapping, as well as protocols and procedures for our team to coordinate closely with the City's GIS team. We will then incorporate the MPD and new information into the City's existing GIS database and update or revise data as necessary. Additionally, pertinent information from other sources obtained in Task 1 may be incorporated, but such information would possibly also need to be verified or noted as not yet verified. Field verification is not assumed within any of the tasks, except as specifically noted, so it will be important to make a distinction between sources of data and if the data needs to or has been verified.

Task 3: Research Methodologies and Software Tools

TRWE will research currently available methodologies and software tools for use in preparation of the amended MPD. We will evaluate the methodologies and tools and make recommendations to the City. We will submit proposed criteria for evaluation to the City and discuss the criteria with the City prior to the research. We anticipate this will result in the establishment of a system of weighting criteria that will be organized in a decision matrix. GIS compatibility and conversion of data, hydrologic and hydraulic methodologies and calculations, and updated mapping will be considered as part of the criteria. Recent use of methodologies and software for master planning purposes will also be considered. Additional criteria will be developed with this task, but will at least include considerations specific to the City of Oceanside's existing and future technological systems and capabilities and the ease of use for ongoing updates to the Master Plan.

We anticipate researching and evaluating the following software tools: XPSWMM, XPStorm, MIKE Urban, InfoSWMM and InfoWorks SD, Autodesk SSA, Hydra, and Bentley CivilStorm. We also anticipate using ESRI ArcView with ArcHydro Extension for input data generation. All of the methodologies and software tools will be compared using the weighted criteria decision matrix established by our meeting with the City. TRWE will then prepare a brief report summarizing the decision process and making recommendations. Methodologies and software will ultimately be selected by the City based upon their review of these recommendations.

Task 4: Review and Evaluate Existing and Proposed Detention Basins

The 2005 MPD did not consider the attenuation of flows in storm drain systems due to detention basins, and thus calculated peak discharges in systems downstream of these basins were likely all overestimated. TRWE will review any existing available data and as-built information related to existing detention basins within or upstream of the City. This information will be used to estimate attenuated peak flows upstream of MPD facilities. It is anticipated that 10 to 15 existing basins and up to 5 proposed basins will have to be

analyzed under this project to determine attenuated peak flows. We will use the results of the analyses to make recommendations, as appropriate, regarding possible modifications to basins. Optimization of the City's drainage infrastructure is the primary goal of this task; however, these basins will be analyzed for four discrete storm events, as defined in Task 5. The selection and number of basins to be analyzed shall be at the discretion of the City, and the result of the analysis shall be made part of the amended Master Plan. We have assumed one week of field survey to supplement and/or verify detention basin data, but a better estimate will be prepared once the basins have been identified.

To implement this task, we will meet with the cities of Oceanside and Vista to obtain as-built plans or design drawings and reports, where available. We will review the drawings and reports and follow up with site visits to each detention basin for the purpose of verifying and assessing existing conditions at the basins. The field survey will follow, with more specific information gathered, including outlet works, spillway information and dam crest information. Stage-storage relationships for the basins will be based on the City's 2-foot contour topographic mapping and supplemented as needed by the field survey. We will then use the above information to analyze the detention basins for attenuation of peak flows associated with the 100-year, 25-year, 10-year and 2-year storm events. Finally as already noted, we will make recommendations regarding possible modifications to existing detention basins and regarding proposed basins. After meeting with the City of Oceanside to discuss these recommendations, we will prepare a report incorporating analyses and final recommendations.

Detention basins that are part of the San Luis Rey River Basin Flood Control Project are excluded from this review, as they will not have any bearing on the MPD. Similarly, detention basins in Carlsbad will not be considered, as the only ones that might have relevance would be part of optional Task 13 and would thus be part of that task.

Task 5: Hydrologic Analysis

TRWE will prepare hydrologic models using the methodologies and software selected in Task 3. The geographic extents of this modeling will be approximately the same as previously prepared by Bureau Veritas in the 2005 MPD. We will extract relevant information from the Rational Method calculations prepared for the 2005 MPD. Pertinent information obtained from Tasks 1, 2 and 4 will also be incorporated into the new hydrologic model, generating results for the 100-year, 25-year, 10-year and 2-year storm events. TRWE will also produce an updated map (Appendix A, Figure 4 – 2005 MPD) including an acceptable method of geo-referencing each mapped Master Plan Facility to the appropriate hydrologic calculations.

This task will require the preparation and compilation of GIS layers, including (if available and applicable) soils, precipitation (2, 10, 25, 100-year), land use/cover, City of Oceanside storm sewer database inventory, City of Vista storm sewer, land use/cover database, Pendleton storm sewer, land use/cover database, and topography (Digital Terrain Model).

Once the preparatory work is completed, which will include the preparation and compilation of GIS layers, the extraction of information from the 2005 MPD, and the incorporation of new information into the new model, we will test and troubleshoot the model(s), verifying results for approximately 10 drainage systems, with input from City Engineering and/or maintenance staff. We will then run the model(s) for 2, 10, 25 and 100-year storms. Results for each of these storms will be useful in identifying the extent of deficiencies in different drainage systems and will thus be helpful in tasks 6 through 9.

Task 6: Revise Recommended Storm Drain Upgrades and Improvements

From the results of Tasks 4 and 5 and meetings with Public Works maintenance staff, TRWE will revise and update the 2005 MPD tables summarizing facility upgrades and improvements. Criteria previously used will likely be assumed for determining adequacy of existing facilities and for sizing new facilities. One notable addition to this will be the consideration of multiple-year (100, 25 and 10-year) frequencies.

We will meet with City Engineering staff to discuss results of Task 5 and to select storm frequencies for determining adequacy of existing and new storm drain systems for differing sizes and conditions. We will differentiate between existing and new facilities for various sizes and conditions. We will then incorporate the updated tables summarizing facility upgrades and improvements in the GIS database.

Task 7: Revise Construction Cost Estimates

From the results of Task 6, TRWE will revise and update the 2005 MPD tables summarizing construction cost estimates. Cost estimates will be based upon varying sizing criteria for different sizes and conditions (e.g., sump vs. flow by inlets). In addition to using revised facility sizes, a more current unit price list will be used.

Prior to updating the estimates, we will meet with City staff to discuss the source and desired format of the construction cost estimates. We will then incorporate the updated construction cost estimates tables in the GIS database.

Task 8: Capital Improvement Projects (CIP)

TRWE will assist the City in identifying Capital Improvement Projects under the City's Drainage Program. We will use the completed analyses from previous tasks and the input from Public Works maintenance staff to assist City Engineering staff in preparing documentation for these projects. The following criteria shall generally be used to identify and estimate CIP's:

a) Undersized Master Plan facility sizes (36-inch diameter and greater)
b) Identified chronic flood-prone areas
c) Identifying undersized CIP facilities from 18-inches up to MPD sizes
d) Identifying the need for additional inlets (CBs) and other drainage structures

It is anticipated that considerable engineering judgment, including close coordination with City staff, will be required to develop proposed Capital Improvement Projects. We plan to meet with City Engineering staff to identify probable CIP projects and criteria for selection of projects for CIP. We will prepare schematic plan drawings, using the City's 2-foot contour interval topographic mapping as a base, and cross reference the location of each CIP project on the updated map (Appendix A, Figure 4 – 2005 MPD). We will prepare separate cost estimates for each proposed CIP project using information from previous tasks. Finally, we will prepare a brief description for each CIP project and compile all information into packages. We assume up to 100 locations/projects will be identified.

Task 9: Drainage Impact Fee Evaluation

TRWE will assist the City in evaluating the City's existing Drainage Impact Fee structure based upon the results of Tasks 6, 7, and 8 and make recommendations regarding possible alternative fee structures. To accomplish this task, we will first meet with City Engineering staff to discuss pros and cons of various drainage impact fee structures based on results of

previous tasks. We will then research and evaluate various drainage impact fee structures and prepare a draft report of recommendations regarding drainage impact fee structures. We will meet with City Engineering staff once more to discuss the draft report and then revise the report of recommendations based on review comments and our meeting with the City.

Task 10: Meetings, Coordination and Delivered Product

Ongoing coordination and a number of meetings with the City Engineering staff and operations personnel are expected with the above tasks to identify chronic flood-prone areas and to obtain information. We estimate a total of 174 hours for all meetings; approximately 28 hours of that total would be with neighboring municipalities, and the remaining 146 hours would be with various City of Oceanside personnel. We estimate the total number of meetings with the City to be 32, and we estimate 9 meetings with other municipalities. Coordination for this project, including project management, is estimated to be 214 hours.

Upon completion of the above tasks, TRWE will compile the various reports into a final report and deliver to the City a minimum of 4 hard copies and a digital version of the final report, any project specific software used in the process, and a list of commercially available software required by the City to manage and maintain the amended master plan.

ADDITIONAL DRAINAGE TASKS (OPTIONAL AT CITY DISCRETION)

Task 11: San Luis Rey River - Flood Risk at Major Arterials

While the construction of levees along the San Luis Rey River has reduced some risk of flooding within the City, there still remains some risk. Part of this risk is associated with the lack of an approved Vegetation Management Plan within the river channel. If the levee is overtopped, there is the potential for major arterials, essential for passage of emergency vehicles, to be impassable.

TRWE will determine which roads classified at least as "major arterial" are subject to flooding based on water surface elevations from the FIRMs published prior to the construction of the levees. We will then evaluate the degree of flooding risk on these roads and make recommendations for each road regarding emergency vehicle travel.

For this task, we will review old (without levee) FIS information of the San Luis Rey River through the City, obtain and review the Corps' latest HEC-RAS model of the river through the City, and plot the water surface on top of City 2-foot contour interval topographic mapping. We will coordinate with the City to identify the major arterials of concern, and then review depths of flooding along those arterials with the City. We will also obtain and review road improvement plans for the affected portions of major arterials and conduct a site visit of those affected portions.

TRWE will then determine locations of greatest risk for overtopping of the levee based on the Corps' latest HEC-RAS model and the "No Vegetation Management Plan" scenario. Those locations of greatest risk for overtopping of the levee will be used to further evaluate the degree of flood risk at the affected arterials. We will use approximate (stochastic or probabilistic) means to estimate risk based on relative locations and topography. We will then make recommendations for each road regarding emergency vehicle travel and compile results into a report.

Task 12: Loma Alta Creek Watershed Studies

Based on a recent floodplain analysis of Loma Alta Creek (associated with a LOMR application package), some properties adjacent to the creek are at risk of flood damage in a 100-year storm event. TRWE will restudy the hydrology of the watershed, incorporating any pertinent results of previous tasks. One goal of this study will be to optimize the drainage system to reduce the risk of downstream flood damage from Rancho Del Oro Drive to the Pacific Ocean. This task will include the evaluation of possible new detention and modification of existing and/or planned detention basins. We will also evaluate solutions for reducing the risk of flood damage to properties along Industry Street, at the Cavalier Mobile Estates, and at the Oceanside RV Park.

TRWE is already quite familiar with the LOMR package and HEC-RAS model of Loma Alta Creek, having reviewed and commented on it for the City. We have also obtained a copy of the HEC-1 hydrology study of Loma Alta Creek and will review it in detail so as to determine where system optimization might be possible. We will import the HEC-1 model to HEC-HMS and troubleshoot the model, if necessary. We will then incorporate any pertinent results of previous tasks into the working HEC-HMS model, evaluating land use, vegetative cover, soils, lag, precipitation, and the infiltration/runoff relationship.

We will visit detention basins and possible detention basin locations in the watershed with a view of evaluating modifications of existing basins as appropriate. We will then evaluate the effects of possible new detention and existing detention basin modifications with a sensitivity analysis of the revised HEC-HMS model. The purpose of this analysis is to evaluate where detention is optimized within the watershed such that peak flow reductions are achieved.

With the optimization portion done, we will then evaluate solutions for reducing the risk of flood damage to properties along Industry Street, at the Cavalier Mobile Estates, and at the Oceanside RV Park. We will make recommendations to the City regarding possible solutions and associated constraints, costs and opportunities and then prepare a draft report. Solutions may be influenced by the outcome of the optimization study, which could result in peak reduction as at least part of a solution. Floodplain management, including channel and/or overbank/floodway fringe modifications will also likely be evaluated. We will meet with the City to initiate the study, discuss possible solutions, evaluate progress & direction, and to review the draft report. We will then revise the draft report for a final report.

Task 13: Buena Vista Creek Watershed Studies

TRWE will study the hydrology of the watershed, incorporating any pertinent results of previous tasks. Pertinent information will include, but not be limited to, our recent HEC-HMS study of the Buena Vista Creek Watershed upstream of South Melrose Drive within the City of Vista. That detailed hydrology study, which we completed for the City of Vista and incorporates possible detention basins, will be extended downstream to the Pacific Ocean. The goal of this study will be to optimize the drainage system to reduce the risk of flood damage within the City of Oceanside. This task will include the evaluation of possible new detention and modification of existing and/or planned detention basins. We will also evaluate solutions for reducing the risk of flood damage to properties upstream of Thunder Drive and at College Boulevard. At College Boulevard, we have already evaluated solutions in association with another contract and would thus be prepared to review that analysis with the City and determine if any further analyses would be beneficial.

In performance of this task, we will obtain and review any hydrology studies of Buena Vista

Creek from the cities of Oceanside and Carlsbad. As noted above, we have already completed detailed studies of Buena Vista Creek within Vista. We will extend the most recent hydrology study from Highway 78, where the current study ends, downstream to the ocean, evaluating what from the existing hydrology studies will be incorporated into the new comprehensive hydrology study.

We will incorporate any pertinent results of previous tasks into the working HEC-HMS hydrologic model, evaluating land use, vegetative cover, soils, lag, precipitation, and the infiltration/runoff relationship. We will visit Thunder Drive, College Boulevard, and possible new detention basins and existing detention basins with a view of evaluating modifications of existing basins as appropriate. We will then evaluate the effects of possible new detention and existing detention basin modifications with a sensitivity analysis of the revised HEC-HMS model. The purpose of this analysis is to evaluate where detention is optimized within the watershed such that peak flow reductions are achieved.

With the optimization portion done, we will then evaluate solutions for reducing the risk of flood damage to properties at Thunder Drive. We will evaluate channel modifications, both upstream and downstream, and evaluate road/culvert modifications. We are also prepared to further evaluate ways to reduce flooding risk at College Boulevard, if needed. As mentioned, we have completed an evaluation, which we will review with current City staff. Upon completion of this task, we will prepare a draft report. We will meet with the City to initiate the study, evaluate progress & direction, and to review the draft report. We will then revise the draft report for a final report.

Task 14: Update City Drainage System Design Criteria

TRWE will update Chapter II, Section 6 of the manual, the City's Drainage System Design Criteria. This update will incorporate requirements from the Master Plan of Drainage, current drainage design standards, hydrologic methods and regulatory requirements for storm water. We will meet with City Engineering staff on a regular basis and coordinate a public comment review to obtain input from the professional design community and the general public.

For this task, we will review the City's existing Drainage System Design Criteria, the County of San Diego's Drainage Design Manual, and up to three other similar (recent) drainage design manuals that incorporate storm water quality criteria. We will meet with City Engineering staff regularly, coordinate a public comment review, and write a draft updated Drainage System Design Criteria. We will send the draft to select reviewers (up to 10) for comments, coordinate and review City and select reviewers' comments and revise it as a final draft. We will then review final draft comments and prepare the final Drainage System Design Criteria.

EXHIBIT B

Fee Estimate

We have estimated fees for completion of the project on a task by task basis and have indicated totals below. These estimates are of course preliminary and will likely be refined in initial discussions with City Engineering staff.

Tasks 1 through 10

TASK	ESTIMATED COST
Task 1: Obtain and Compile Hydrologic Information	$ 16,250
Task 2: Update Inventory and Database with New Information	$ 29,400
Task 3: Research Methodologies and Software Tools	$ 14,000
Task 4: Review and Evaluate Existing and Proposed Detention Basins	$ 61,840
Task 5: Hydrologic Analysis	$ 72,400
Task 6: Revise Recommended Storm Drain Upgrades and Improvements	$ 12,000
Task 7: Revise Construction Cost Estimates	$ 10,000
Task 8: Capital Improvement Projects (CIP)	$ 105,000
Task 9: Drainage Impact Fee Evaluation	$ 13,750
Task 10: Meetings and Coordination	$ 56,900
ESTIMATED TOTAL OF TASKS 1 THROUGH 10	**$ 391,540**

Additional Drainage Tasks 11 through 14

TASK	ESTIMATED COST
Task 11: San Luis Rey River - Flood Risk at Major Arterials	$ 26,750
Task 12: Loma Alta Creek Watershed Studies	$ 76,500
Task 13: Buena Vista Creek Watershed Studies	$ 75,500
Task 14: Update City Drainage System Design Criteria	$ 41,750
ESTIMATED TOTAL OF TASKS 11 THROUGH 14	**$220,500**

Schedule of Hourly Rates

Below is our current schedule of hourly rates. We anticipate using this schedule through 2011.

TRWE's FEE SCHEDULE
(Effective date: 1/31/2010)

Principal	$185.00/hour
Project Manager	$150.00/hour
GIS Manager	$130.00/hour
Senior Engineer	$125.00/hour
Associate Engineer	$110.00/hour
Junior Engineer	$100.00/hour
Engineering Technician	$80.00/hour
CADD/GIS Technician	$80.00/hour
Clerical	$60.00/hour

TORY R. WALKER ENGINEERING, INC.
WATER RESOURCES PLANNING & ENGINEERING

Amendment of the City of Oceanside Master Plan of Drainage Anticipated Timeline

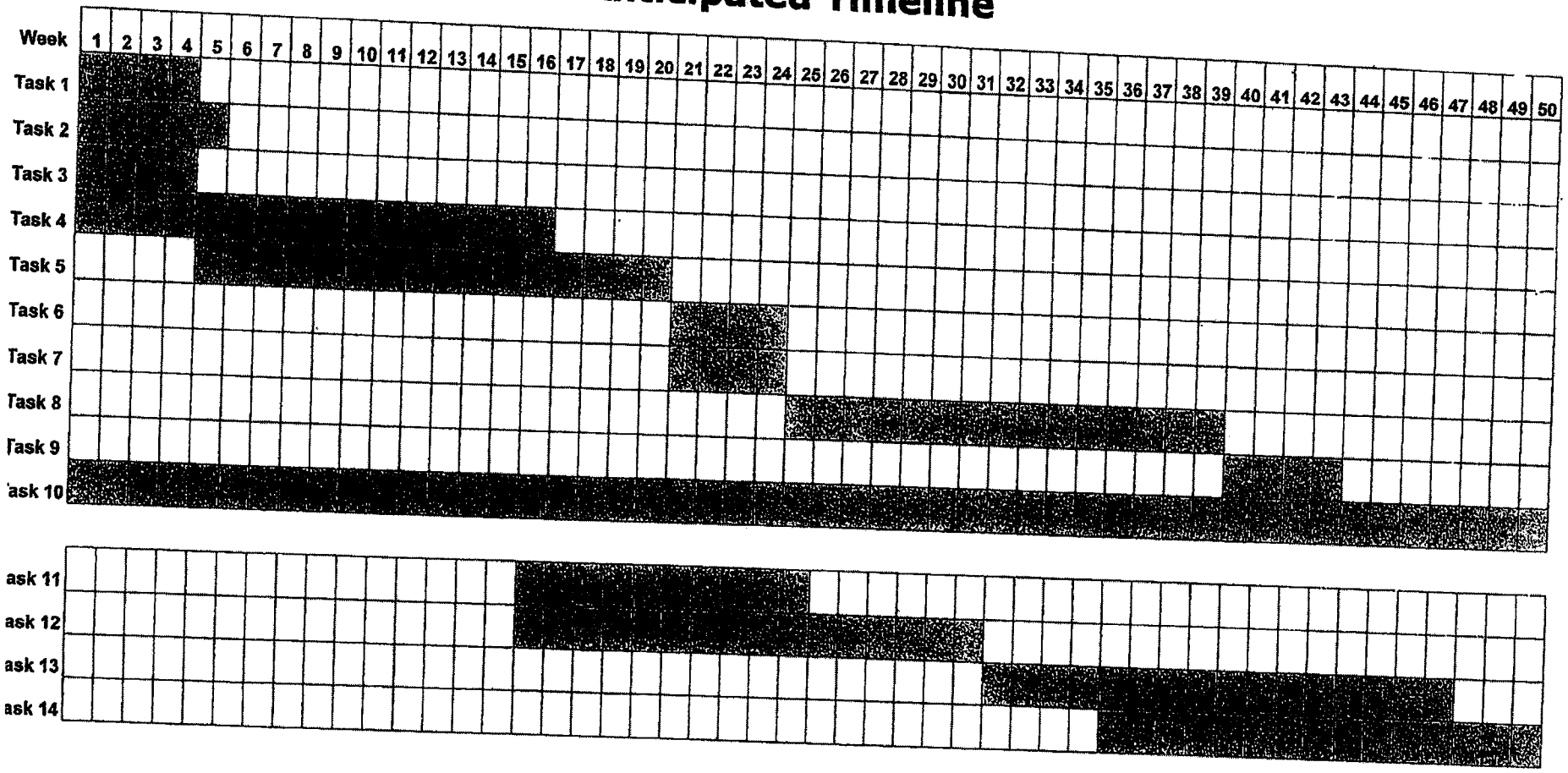

EXHIBIT C

Project Schedule

We have prepared a preliminary anticipated time for completion of the project on a task by task basis. Anticipated time for each task is shown below, and a preliminary project schedule is also included. These are preliminary and will likely be refined in initial discussions with City Engineering staff.

Tasks 1 through 10

TASK	ANTICIPATED TIME
Task 1: Obtain and Compile Hydrologic Information	4 weeks
Task 2: Update Inventory and Database with New Information	6 weeks
Task 3: Research Methodologies and Software Tools	4 weeks
Task 4: Review and Evaluate Existing and Proposed Detention Basins	16 weeks
Task 5: Hydrologic Analysis	16 weeks
Task 6: Revise Recommended Storm Drain Upgrades and Improvements	4 weeks
Task 7: Revise Construction Cost Estimates	4 weeks
Task 8: Capital Improvement Projects (CIP)	15 weeks
Task 9: Drainage Impact Fee Evaluation	4 weeks
Task 10: Meetings and Coordination	ongoing
ESTIMATED TOTAL OF TASKS 1 THROUGH 10	**50 weeks**

Additional Drainage Tasks 11 through 14

TASK	ANTICIPATED TIME
Task 11: San Luis Rey River - Flood Risk at Major Arterials	10 weeks
Task 12: Loma Alta Creek Watershed Studies	16 weeks
Task 13: Buena Vista Creek Watershed Studies	16 weeks
Task 14: Update City Drainage System Design Criteria	15 weeks
ESTIMATED TOTAL OF TASKS 11 THROUGH 14	**35 weeks**

Exhibit A

CITY OF OCEANSIDE

DEVELOPMENT SERVICES DEPARTMENT / ENGINEERING DIVISION

November 2, 2010

Subject: REQUEST FOR PROPOSAL – Amendment of the City of Oceanside Master Plan of Drainage (MPD) to reflect revisions, additions and other changes in facilities.

The City of Oceanside requests proposals from the engineering firms to amend the City Master Plan of Drainage to reflect revisions, additions and other changes in drainage facilities. The selected firm will use the draft Master Plan of Drainage (MPD) prepared by Bureau Veritas, to serve as the basis for amending this City of Oceanside Master Plan of Drainage. Besides the enclosed DVD, a printed copy of the Bureau Veritas MPD is available upon request at the City of Oceanside, City Hall South- Engineering Counter. Additional copies may be requested from the Engineering Counter staff, and cost paid for by the requestor. The City desires to retain a firm that demonstrates recent local experience in San Diego County and has successfully completed similar projects.

The scope of services is summarized as follows:

Task 1: Obtain and Compile Hydrologic Information
Task 2: Update Inventory and Database with New Information
Task 3: Research Methodologies and Software Tools
Task 4: Review and Evaluate Existing and Proposed Detention Basins
Task 5: Hydrologic Analysis
Task 6: Revise Recommended Storm Drain Upgrades and Improvements
Task 7: Revise Construction Cost Estimates
Task 8: Capital Improvement Projects (CIP)
Task 9: Drainage Impact Fee Evaluation
Task 10: Meetings, Coordination and Delivered Product

Additional drainage tasks (optional at City discretion)

Task 11: San Luis Rey River - Flood Risk at Major Arterials
Task 12: Loma Alta Creek Watershed Studies
Task 13: Buena Vista Creek Watershed Studies
Task 14: Update City Drainage System Design Criteria

Proposals for this project will be accepted up to 4:00 p.m. on December 03, 2010

- **hand delivery, or**
- **via mail at City of Oceanside Development Services 300 North Coast Highway, Oceanside, CA 92054 Attn: Scott O. Smith**

Please contact Ulf Fagerborn at 760-435-5073 or by email at ufagerborn@ci.oceanside.ca.us if you have any questions related to this request.

The project scope of services to be provided is more particularly described as follows:

Task 1: Obtain and Compile Hydrologic Information

The selected consultant will meet with City Engineering Division staff to determine what information is available from the City. This will include, but may not be limited to, previous master plans of drainage, other hydrologic studies, storm drain inventory and design information, detention basin design information, flood insurance studies, and watershed studies. Similarly, the CONSULTANT will obtain pertinent information from other local, state, and federal agencies and any other pertinent sources. Proposal should identify probable sources for hydrologic information and list probable information to be gathered.

Task 2: Update Inventory and Database with New Information

The CONSULTANT will review the Master Plan of Drainage (MPD) prepared by Bureau Veritas, as presented in their final report to the City in December 2005. In the process of review and meeting with City, some newer or more accurate information may be available that was not previously incorporated into the 2005 MPD. The CONSULTANT will incorporate the MPD and new information into the City's existing GIS database and update or revise data as necessary. Additionally, some information from other sources, obtained in Task 1, may also need to be incorporated.

Task 3: Research Methodologies and Software Tools

The CONSULTANT will research currently available methodologies and software tools for use in preparation of the amended MPD. The CONSULTANT will evaluate the methodologies and tools and make recommendations to the City. Proposed criteria for evaluation shall be submitted to the City and discussed prior to the research. GIS compatibility and conversion of data, calculations and updated mapping will be considered as part of the criteria. Methodologies and software will be selected by the City based upon their review of these recommendations.

Task 4: Review and Evaluate Existing and Proposed Detention Basins

The CONSULTANT will obtain and review any existing available data and as-built information related to existing detention basins within or upstream of the City. This information will be used to estimate attenuated peak flows upstream of MPD facilities. It is anticipated that 10 to 15 existing basins and up to 5 proposed basins will have to be analyzed by the CONSULTANT under this project to determine attenuated peak flows. The CONSULTANT will use the results of the analyses to make recommendations, as appropriate, regarding possible modifications to basins. Optimization of the City's drainage infrastructure is the primary goal of this task; however, these basins will be analyzed for four discrete storm events, as defined in Task 5. The selection and number of basins to be analyzed shall be at the discretion of the City, and the result of the analysis shall be made part of the amended Master Plan. Proposal should assume one week of field survey to supplement and/or verify detention basin data.

Task 5: Hydrologic Analysis

The CONSULTANT will prepare hydrologic models using the methodologies and software selected in Task 3. The geographic extents of this modeling will be approximately the same as previously prepared by Bureau Veritas, as presented in their final report to the City in December 2005. The CONSULTANT will extract information from the Rational Method calculations prepared for the 2005 MPD. Pertinent information obtained from Tasks 1, 2 and 4 will also be incorporated into the new hydrologic model, generating results for the 100-year, 25-year, 10-year, and 2-year storm events. The CONSULTANT shall also produce an updated map (Appendix A, Figure 4 – 2005 MPD) including an acceptable method of referencing each mapped Master Plan Facility to the appropriate hydrologic calculations.

Task 6: Revise Recommended Storm Drain Upgrades and Improvements

From the results of Tasks 4 and 5, the CONSULTANT will revise and update the 2005 MPD tables summarizing facility upgrades and improvements. Criteria previously used will likely be assumed for determining adequacy of existing facilities and for sizing new facilities. One notable addition to this will be the consideration of multiple-year (100, 25, 10) frequencies.

Task 7: Revise Construction Cost Estimates

From the results of Task 6, the CONSULTANT will revise and update the 2005 MPD tables summarizing construction cost estimates. Cost estimates will be based upon varying sizing criteria for different sizes and conditions (e.g., sump vs. flow by inlets). In addition to using revised facility sizes, a more current unit price list will be used.

Task 8: Capital Improvement Projects (CIP)

The CONSULTANT will assist the City in identifying Capital Improvement Projects under the City's Drainage Program. The CONSULTANT will use the completed analyses to assist engineering staff in preparing documentation for these projects. The following criteria shall generally be used to identify and estimate CIPs:

a) Undersized Master Plan facility sizes (36-inch diameter and greater)
b) Identified chronic flood-prone areas
c) Identifying undersized CIP facilities from 18-inches up to MPD sizes
d) Identifying the need for additional inlets (CBs) and other drainage structures

It is anticipated that considerable engineering judgment, including close coordination with City staff, will be required to develop proposed Capital Improvement Projects. Schematic plan drawings shall a be provided for each proposed CIP and the location cross referenced on the updated map (Appendix A, Figure 4 – 2005 MPD). Separate cost estimates shall also be provided for each proposed CIP. The CONSULTANT should assume up to 100 locations/projects will be identified.

Task 9: Drainage Impact Fee Evaluation

The CONSULTANT will assist the City in evaluating the City's Drainage Impact Fee structure based upon the results of Tasks 6, 7, and 8 and make recommendations regarding possible alternative fee structures.

Task 10: Meetings, Coordination and Delivered Product

Meetings and coordination are expected with the above tasks. Ongoing coordination and a number of meetings with the City engineering staff and operations personnel to identify chronic flood-prone areas and to obtain information are anticipated. Total hours anticipated for meetings and for coordination should be estimated separately from the other tasks. No less than 20 meetings should be assumed; specify if more than 20 are anticipated.

The CONSULTANT shall deliver to the City a minimum of 4 hard copies and a digital version of the final report, any project specific software used by the consultant and acceptable to the CITY, and a list of commercially available software required by the City to manage and maintain the amended master plan.

ADDITIONAL DRAINAGE TASKS (OPTIONAL AT CITY DISCRETION)

Task 11: San Luis Rey River - Flood Risk at Major Arterials

While the construction of levees along the San Luis Rey River has reduced some risk of flooding within the City, there still remains some risk. Part of this risk is associated with the lack of an approved Vegetation Management Plan within the river channel. If the levee is overtopped, there is the potential for major arterials, essential for passage of emergency vehicles, to be impassable. The CONSULTANT will determine which roads classified at least as "major arterial" are subject to flooding based on water surface elevations from the FIRMs published prior to the construction of the levees. The CONSULTANT will then evaluate the degree of flooding risk on these roads and make recommendations for each road regarding emergency vehicle travel.

Task 12: Loma Alta Creek Watershed Studies

Based on a recent floodplain analysis of Loma Alta Creek, some properties adjacent to the creek are at risk of flood damage in a 100-year storm event. The CONSULTANT will restudy the hydrology of the watershed, incorporating any pertinent results of previous tasks. One goal of this study will be to optimize the drainage system to reduce the risk of downstream flood damage from Rancho Del Oro Drive to the Pacific Ocean. This task will include the evaluation of possible new detention and modification of existing and/or planned detention basins. The CONSULTANT will also evaluate solutions for reducing the risk of flood damage to properties along Industry Street, at the Cavalier Mobile Estates, and at the Oceanside RV Park.

Task 13: Buena Vista Creek Watershed Studies

The CONSULTANT will study the hydrology of the watershed, incorporating any pertinent results of previous tasks. Pertinent information will include, but not be limited to, a recent study of the Buena Vista Creek Watershed upstream of South Melrose Drive within the City of Vista. That study, which incorporates possible detention basins, should be evaluated and if appropriate, extended downstream to the Pacific Ocean. The goal of this study will be to optimize the drainage system to reduce the risk of flood damage within the City of Oceanside. This task will include the evaluation of possible new detention and modification of existing and/or planned detention basins. The CONSULTANT will also evaluate solutions for reducing the risk of flood damage to properties upstream of Thunder Drive and at College Boulevard.

Task 14: Update City Drainage System Design Criteria

The City is in the process of updating its Engineers Design and Processing Manual. The selected engineer will update Chapter II, Section 6 of the manual, the City's Drainage System Design Criteria. This update will incorporate requirements from the Master Plan of Drainage, current drainage design standards, hydrologic methods and regulatory requirements for storm water. The CONSULTANT will meet with City Engineering staff on a regular basis and coordinate a public comment review to obtain input from the professional design community and the general public.

A mandatory pre-submittal meeting is scheduled at the City of Oceanside, 300 N. Coast Highway, Oceanside, CA 92054 on Tuesday, November 23, 2010, from 10:30 a.m. to 12:00 noon at the City Council Chambers. Reservations for the meeting shall be made to: Vida at 760-435-3528. The purpose of the meeting is to discuss any clarifications.

Please reply with the following minimum information:

Demonstrated local recent experience in San Diego County area of successful completion of similar projects, include client name and contact phone numbers for verification purpose.

Provide a list and relevant experience of key staff which shall be available to perform the actual work on this proposed project.

Provide a fee estimate for completion of the project on a task-by-task basis and totals as follows:

Tasks 1 through 10 (estimate task-by-task and total cost)
Additional Drainage Tasks 11 trough 14 (estimate task-by-task and total cost).
Note: The City may choose to include any or none of tasks 11 through 14.

Preliminary anticipated time for completion of the project on a task-by-task basis.

Provide a current and anticipated schedule of hourly rates.

Exhibit B

The following firms attended the pre-proposal meeting:

Ninyo & Moore

Cornerstone Eng.

Rick Eng.

I.E.C.

VA Consulting, Inc.

URS Corporation

West Consultants, Inc.

RBF Consulting

Bureau Veritas

AECOM

Kimley-Horn & Assoc.

Tory R. Walker Engineering

PSOMAS

DUDEK

Exhibit C

PROPOSAL RATINGS
for
MASTER PLAN OF DRAINAGE UPDATE

CONSULTANT	***CITY***	***TOTAL POINTS***
1. Tory Walker Engineering	Vista	336
2. Rick Engineering	San Diego	322
3. RBF Consulting	San Diego	302

EXHIBIT B

ITEM NO. 5

STAFF REPORT

CITY OF OCEANSIDE

DATE: April 4, 2012

TO: Honorable Mayor and City Councilmembers

FROM: Development Services Department

SUBJECT: **APPROVAL OF AN AMENDMENT TO A PROFESSIONAL SERVICES AGREEMENT TO UPDATE THE MASTER PLAN OF DRAINAGE**

SYNOPSIS

Staff recommends that the City Council approve Amendment 1 in the amount of $175,000 to the professional services agreement with Tory R. Walker Engineering, Inc., for an update to the City's Master Plan of Drainage for additional compilation of Geographic Information System (GIS) database records, detailed analysis of local historic precipitation, and establishment of precipitation time series for continuous simulation analysis; and authorize the City Manager to execute the Amendment; and approve budget appropriations totaling $175,000 from the Unassigned Fund Balances of Drainage Funds 510, 514, 515, 522, 530, and 531 to the project accounts.

BACKGROUND

On April 6, 2011, the City Council approved a professional services agreement (PSA) with Tory R. Walker Engineering, Inc., to update the City's Master Plan of Drainage (MPD). A key function of the MPD update is to enable both City staff and the development community to clearly understand the City's long-term objectives and direction toward drainage infrastructure. Hence, the comprehensive evaluation of the City's current stormwater drainage conveyance system and an assessment of the interaction and impacts of recently adopted stormwater regulations are an important focus of this effort.

ANALYSIS

One of the key tasks of this update is the incorporation of an existing GIS database and the expansion of that database. The data within that database is approximate, two-dimensional and generally suitable just for a master plan of drainage level analysis, not useful for other purposes. However, recent advances in technology, coupled with more stringent State-mandated stormwater regulations, provides justification for building a more detailed database (three-dimensional digital model) of MPD facilities; one that is geospatially referenced (identified by coordinates and vertical datum) and therefore useful for other municipal programs. The programs and projects that will benefit from a geospatially referenced database include the City's Capital Improvement Program, the Water Utilities Department, and the Clean Water Program, as well as future private development projects within the City.

More detailed geospatially referenced data allows for an enhanced hydrologic and hydraulic analysis of existing drainage systems, which in turn provides better information needed to assess and prioritize CIPs. This data will also be more reliable for identifying potential conflicts with other utilities, such as water and sewer, which are also mapped throughout the City. Finally, if a geospatially referenced database is used in the MPD, the hydrologic and hydraulic model may be used in the Clean Water Program to help meet forthcoming Federal and State stormwater requirements, such as the Total Maximum Daily Load (TMDL) Implementation Plan. All of these benefits should ultimately result in cost savings to the City over the upcoming years. The draft MPD is anticipated to be completed the first quarter of 2013.

At the November 9, 2011 City Council meeting, the South Morro Hills Association (SMHA) expressed specific interest regarding the direction of the future water and sewer master plan update and the in progress master plan of drainage update. It is anticipated that the MPD update will remain consistent with previously adopted MPD's, current City zoning requirements, and current land use policies. Existing MPD documents specify that proposed facilities within the SMHA area will primarily be constructed by developers, as development occurs within the drainage basin. Undeveloped areas with environmental concerns will most likely continue to contain natural unimproved channels. Future improvements to natural channels may potentially be limited to channel enhancements at select locations, rather than completely lining or reconstruction the channel. The MPD may be amended in the future to accommodate zoning or land use policy changes, as necessary.

FISCAL IMPACT

Funding for this project is through drainage impact fees paid by developers. City Ordinance 85-23 indicates drainage impact fees can only be used for administration of the master plan program, construction of facilities, and the reimbursement of the cost of construction of authorized MPD facilities. See Attachment 1 for additional details regarding the benefits of the proposed amendment.

Staff requests $175,000 in budget appropriations from the Unassigned Fund Balances (xxx.3100.0001) of Drainage Funds 510, 514, 515, 522, 530, and 531 to the existing CIP projects as noted in the chart below. These appropriations will bring the total project financing to $775,000, therefore, sufficient funds are available.

Master Plan of Drainage Capital Accounts	Allocated Funding	Budget Appropriations Requested	Total Funding Amount
905116700510	$50,000	$30,000	$80,000
905543700512	$100,000		$100,000
905112900513	$25,000		$25,000
905573100514	$90,000	$10,000	$100,000
905117100515	$35,000	$65,000	$100,000
905117200522	$75,000	$25,000	$100,000
905117400530	$65,000	$35,000	$100,000

905117500531	$90,000	$10,000	$100,000
905117700540	$25,000		$25,000
905117800550	$45,000		$45,000
Totals	$600,000	$175,000	$775,000

INSURANCE REQUIREMENTS

The City's standard insurance requirements will be met.

COMMISSION OR COMMITTEE REPORT

Does not apply.

CITY ATTORNEY'S ANALYSIS

The referenced documents have been reviewed by the City Attorney and approved to form.

RECOMMENDATION

Staff recommends that the City Council approve Amendment 1 in the amount of $175,000 to the professional services agreement with Tory R. Walker Engineering, Inc., for an update to the City's Master Plan of Drainage for additional compilation of Geographic Information System (GIS) database records, detailed analysis of local historic precipitation, and establishment of precipitation time series for continuous simulation analysis; and authorize the City Manager to execute the Amendment; and approve budget appropriations totaling $175,000 from the Unassigned Fund Balances of Drainage Funds 510, 514, 515, 522, 530, and 531 to the project accounts.

PREPARED BY:

Scott O. Smith
City Engineer

SUBMITTED BY:

Peter A. Weiss
City Manager

REVIEWED BY:

Michelle Skaggs Lawrence, Deputy City Manager
George Buell, Development Services Director
Teri Ferro, Financial Services Director

Attachments:

1. Oceanside Master Plan of Drainage - Benefits of Proposed Amendment
2. PSA with Tory R. Walker Engineering, Inc. - dated April 6, 2011
   Exhibit A. Scope of Work - dated December 3, 2010
3. Amendment 1 to PSA with Tory R. Walker Engineering, Inc.
   Exhibit A. Scope of Work for Amendment 1

ATTACHMENT 1

Oceanside Master Plan of Drainage
Benefits of Proposed Amendment

The purpose of this amendment is to build the master plan storm drain network using a more accurate GIS database, similar to that currently being done for other utilities in the City, and which have additional benefits for reasons stated below.

The Scope of Work in the Request for Proposals, and in the December 3, 2010, proposal submitted by Tory R. Walker Engineering, Inc. (TRWE) included incorporating the existing GIS database and mapping, which represents an approximation of data that is generally suitable for a master plan level, but not accurate enough for other purposes.

The current effort at the City (with existing staff and interns) to compile the more detailed GIS database will not be completed in time for use by the Master Plan of Drainage. It is therefore proposed that TRWE be authorized to amend their contract to build a GIS data base containing Master Plan storm drain facilities and General Plan land use designations. This would be in a format that is consistent with protocols established by the City.

Additional benefits for incorporating the more detailed GIS database into the Master Plan of Drainage include:

1) ***Storm Water Quality*** – An inventory of the City's storm water facilities is required under the City's storm water municipal permit, including facilities that are not master plan facilities, but tie into master plan facilities. Vertical data that are obtained for master plan analyses will be required in the coming years (to support TMDL studies and watershed studies). The City's existing storm water program will also benefit from the more detailed GIS data by organizing and simplifying monitoring and tracking tasks.

   For example, sediment TMDLs are anticipated in some watersheds in the near future. Sediment transport within drainage systems will be easier to track with GIS data that identifies elevations of key points, such as tops of channels, cleanout and inlet rim elevations. These "control points" will allow field measurements of sediment buildup, if invert and flow line elevations are known.

2) ***Detailed Analyses*** - The detailed (more accurate) GIS data will provide a skeletal framework for more detailed analyses and/or design of the City's storm drain systems.

   a) XPSWMM, the hydrologic/hydraulic model the City has chosen at TRWE's recommendation, gives modelers the ability to analyze overland flow (e.g., streets) and underground storm drains concurrently. This will allow the City to perform very detailed analyses of any system, giving greater accuracy of system deficiencies. The combination of soil type and land use will give a reliable rainfall runoff coefficient for each watershed.

   b) This will also aid in the prioritization of CIPs. For example, areas of likely flooding can be identified on the basis of whether the combined conveyance capacity of the subsurface storm drain and the overland street section can convey design flows while still maintaining a computed hydraulic grade line or water surface elevation less than a standard gutter section depth. Storm drains that result in flow depths greater than the street section can be categorized as potential problem areas, and CIPs can

be developed with greater confidence. Detailed elevation information in GIS is essential for modeling these dual drainage systems.

c) Traditional hydraulic modeling software is limited, in that it cannot also model hydrology, and in that dual drainage systems cannot be easily modeled. Since these older/traditional models do not adequately represent surface drainage patterns (such as at street intersections), complex analyses have almost never been attempted, which results in much guesswork, but with the surface topography in GIS and accurate storm drain data in GIS, such modeling can be done with much greater ease and accuracy.

d) Accurate storm drain information will allow detailed analyses of storm drain systems where downstream tail water conditions have an impact on the hydraulics of the system.

e) Actual storms and continuous simulations can be modeled and analyzed with a more accurate GIS database. Actual storm events with precipitation and stream gage data (or documented data) can provide accurate data and valuable information for calibration of models. Continuous simulation with accurate vertical data will allow analysis and/or design of BMPs and IMPs.

3) ***Utility Conflicts*** - More accurate GIS datum will be more reliable for identifying potential conflicts with other utilities. As Subsurface Utility Engineering (SUE) is quickly becoming a standard of care (as opposed to the traditional "potholing" approach), accurate GIS information is essential for the cost savings that are expected with SUE.

ATTACHMENT 2

City Original
Document No. 11-D-0217-1
4/6/11 (9)

CITY OF OCEANSIDE

PROFESSIONAL SERVICES AGREEMENT

PROJECT: City of Oceanside Master Plan of Drainage (MPD)

THIS AGREEMENT, dated April 6, 2011, for identification purposes, is made and entered into by and between the CITY OF OCEANSIDE, a municipal corporation, hereinafter designated as "CITY", and Tory Walker Engineering, Inc., hereinafter designated as "CONSULTANT."

NOW THEREFORE, THE PARTIES MUTUALLY AGREE AS FOLLOWS:

1. **SCOPE OF WORK. Amendment of the City of Oceanside Master Plan of Drainage (MPD) to reflect revisions, additions and other changes in facilities.** A more detailed Scope of Service for the project, as defined by the CONSULTANT (dated December 3, 2010), is attached hereto as **Exhibit "A"** which includes Tasks 1 through 10, Task 12 and 14. Tasks 11 and 13 are NOT included in the scope of services.

2. **INDEPENDENT CONTRACTOR.** CONSULTANT'S relationship to the CITY shall be that of an independent contractor. CONSULTANT shall have no authority, express or implied, to act on behalf of the CITY as an agent, or to bind the CITY to any obligation whatsoever, unless specifically authorized in writing by the City Engineer. The CONSULTANT shall not be authorized to communicate directly with, nor in any way direct the actions of, any bidder or the construction contractor for this project without the prior written authorization by the City Engineer. CONSULTANT shall be solely responsible for the performance of any of its employees, agents, or subcontractors under this Agreement. CONSULTANT shall report to the CITY any and all employees, agents, and consultants performing work in connection with this project, and all shall be subject to the approval of the CITY.

3. **WORKERS' COMPENSATION.** Pursuant to Labor Code section 1861, the CONSULTANT hereby certifies that the CONSULTANT is aware of the provisions of Section 3700 of the Labor Code which require every employer to be insured against liability for Workers' Compensation or to undertake self-insurance in accordance with the provisions of that Code, and the CONSULTANT will comply with such provisions, and provide certification of such compliance as a part of this Agreement.

4. **LIABILITY INSURANCE.**

City of Oceanside Master Plan of Drainage (MPD)

4.1. CONSULTANT shall, throughout the duration of this Agreement maintain comprehensive general liability and property damage insurance, or commercial general liability insurance, covering all operations of CONSULTANT, its agents and employees, performed in connection with this Agreement including but not limited to premises and automobile.

4.2 CONSULTANT shall maintain liability insurance in the following minimum limits:

Comprehensive General Liability Insurance	
(bodily injury and property damage)	
Combined Single Limit Per Occurrence	$ 1,000,000
General Aggregate	$ 2,000,000*
Commercial General Liability Insurance	
(bodily injury and property damage)	
General limit per occurrence	$ 1,000,000
General limit project specific aggregate	$ 2,000,000
Automobile Liability Insurance	$ 1,000,000

*General aggregate per year, or part thereof, with respect to losses or other acts or omissions of CONSULTANT under this Agreement.

4.3 If coverage is provided through a Commercial General Liability Insurance policy, a minimum of 50% of each of the aggregate limits shall remain available at all times. If over 50% of any aggregate limit has been paid or reserved, the CITY may require additional coverage to be purchased by the CONSULTANT to restore the required limits. The CONSULTANT shall also notify the CITY'S Project Manager promptly of all losses or claims over $25,000 resulting from work performed under this contract, or any loss or claim against the CONSULTANT resulting from any of the CONSULTANT'S work.

4.4 All insurance companies affording coverage to the CONSULTANT for the purposes of this Section shall add the City of Oceanside as "additional insured" under the designated insurance policy for all work performed under this agreement. Insurance coverage provided to the City as additional insured shall be primary insurance and other insurance maintained by the City of Oceanside, its officers, agents, and employees shall be excess only and not contributing with insurance provided pursuant to this Section.

4.5 All insurance companies affording coverage to the CONSULTANT pursuant to this agreement shall be insurance organizations admitted by the Insurance Commissioner of the State of California to transact business of insurance in the state or be rated as A-X or higher by A.M. Best.

4.6 All insurance companies affording coverage shall provide thirty (30) days written notice to the CITY should the policy be cancelled before the expiration date. For the purposes of this notice requirement, any material change in the policy prior to the expiration shall be considered a cancellation.

4.7 CONSULTANT shall provide evidence of compliance with the insurance requirements listed above by providing a Certificate of Insurance and applicable endorsements, in a form satisfactory to the City Attorney, concurrently with the submittal of this Agreement.

4.8 CONSULTANT shall provide a substitute Certificate of Insurance no later than thirty (30) days prior to the policy expiration date. Failure by the CONSULTANT to provide such a substitution and extend the policy expiration date shall be considered a default by CONSULTANT and may subject the CONSULTANT to a suspension or termination of work under the Agreement.

4.9 Maintenance of insurance by the CONSULTANT as specified in this Agreement shall in no way be interpreted as relieving the CONSULTANT of any responsibility whatsoever and the CONSULTANT may carry, at its own expense, such additional insurance as it deems necessary.

5. **PROFESSIONAL ERRORS AND OMISSIONS INSURANCE.** Throughout the duration of this Agreement and four (4) years thereafter, the CONSULTANT shall maintain professional errors and omissions insurance for work performed in connection with this Agreement in the minimum amount of One Million Dollars ($1,000,000.00).

CONSULTANT shall provide evidence of compliance with these insurance requirements by providing a Certificate of Insurance.

6. **CONSULTANT'S INDEMNIFICATION OF CITY.** To the greatest extent allowed by law, CONSULTANT shall indemnify and hold harmless the CITY and its officers, agents and employees against all claims for damages to persons or property arising out of CONSULTANT'S work, including the negligent acts, errors or omissions or wrongful acts or conduct of the CONSULTANT, or its employees, agents, subcontractors, or others in connection with the execution of the work covered by this Agreement, except for those claims arising from the willful misconduct, sole negligence or active negligence of the CITY, its officers, agents, or employees. CONSULTANT'S indemnification shall include any and all costs, expenses, attorneys' fees, expert fees and liability assessed against or incurred by the CITY, its officers, agents, or employees in defending against such claims or lawsuits, whether the same proceed to judgment or not. Further, CONSULTANT at its own expense shall, upon written request by the CITY, defend any such suit or action brought against the CITY, its officers, agents, or employees founded upon,

resulting or arising from the conduct, tortious acts or omissions of the CONSULTANT.

CONSULTANT'S indemnification of CITY shall not be limited by any prior or subsequent declaration by the CONSULTANT.

7. **OWNERSHIP OF DOCUMENTS**. All plans and specifications, including details, computations and other documents, prepared or provided by the CONSULTANT under this Agreement shall be the property of the CITY. The CITY agrees to hold the CONSULTANT free and harmless from any claim arising from any use, other than the purpose intended, of the plans and specifications and all preliminary sketches, schematics, preliminary plans, architectural perspective renderings, working drawings, including details, computation and other documents, prepared or provided by the CONSULTANT. CONSULTANT may retain a copy of all material produced under this Agreement for the purpose of documenting their participation in this project.

8. **COMPENSATION**. CONSULTANT'S compensation for all work performed in accordance with this Agreement, shall not exceed the total contract price of $509,790.00. A more detailed fee schedule, as defined by the CONSULTANT, is attached hereto in **Exhibit "B"**.

No work shall be performed by CONSULTANT in excess of the total contract price without prior written approval of the City Engineer. CONSULTANT shall obtain approval by the City Engineer prior to performing any work that results in incidental expenses to CITY.

9. **TIMING REQUIREMENTS.** Timing requirements shall be per **Exhibit "C"**. Anticipated Timeline which shall be updated by the CONSULTANT on a regular basis and as required by the City Engineer.

10. **ENTIRE AGREEMENT**. This Agreement comprises the entire integrated understanding between CITY and CONSULTANT concerning the work to be performed for this project and supersedes all prior negotiations, representations, or agreements.

11. **INTERPRETATION OF THE AGREEMENT**. The interpretation, validity and enforcement of the Agreement shall be governed by and construed under the laws of the State of California. The Agreement does not limit any other rights or remedies available to CITY.

The CONSULTANT shall be responsible for complying with all local, state, and federal laws whether or not said laws are expressly stated or referred to herein.

Should any provision herein be found or deemed to be invalid, the Agreement shall

be construed as not containing such provision, and all other provisions, which are otherwise lawful, shall remain in full force and effect, and to this end the provisions of this Agreement are severable.

12. **AGREEMENT MODIFICATION**. This Agreement may not be modified orally or in any manner other than by an agreement in writing signed by the parties hereto.

13. **SIGNATURES**. The individuals executing this Agreement represent and warrant that they have the right, power, legal capacity and authority to enter into and to execute this Agreement on behalf of the respective legal entities of the CONSULTANT and the CITY.

IN WITNESS WHEREOF, the parties hereto for themselves, their heirs, executors, administrators, successors, and assigns do hereby agree to the full performance of the covenants herein contained and have caused this Professional Services Agreement to be executed by setting hereunto their signatures on the dates set forth below.

Tory Walker Engineering, Inc.
973 Vale Terrace Drive, Suite 202
Vista, CA 92084

By: Tory R Walker
Name/Title TORY R. WALKER, PRES.

Date:

By: Jennifer L. Walker
Name/Title JENNIFER L. WALKER, SEC.

Date:

33-0892309
Employer ID No.

CITY OF OCEANSIDE

By: Peter Weiss
City Manager

Date: 4-7-11

APPROVED AS TO FORM:

Barbara Hamilton, ASST.
City Attorney

NOTARY ACKNOWLEDGMENTS OF CONSULTANT MUST BE ATTACHED.

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

State of California }
County of San Diego }

On 03-30-2011 (Date) before me, Traci L. Andrews (Here Insert Name and Title of the Officer),
personally appeared Tory Walker + Jennifer Walker (Name(s) of Signer(s)),

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

TRACI L. ANDREWS
Commission # 1764008
Notary Public - California
San Diego County
My Comm. Expires Aug 27, 2011

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature _____ (Signature of Notary Public)

Place Notary Seal Above

OPTIONAL

Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of this form to another document.

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Capacity(ies) Claimed by Signer(s)

Signer's Name: _____
☐ Individual
☐ Corporate Officer — Title(s): _____
☐ Partner — ☐ Limited ☐ General
☐ Attorney in Fact
☐ Trustee
☐ Guardian or Conservator
☐ Other: _____

Signer Is Representing: _____

RIGHT THUMBPRINT OF SIGNER
Top of thumb here

Signer's Name: _____
☐ Individual
☐ Corporate Officer — Title(s): _____
☐ Partner — ☐ Limited ☐ General
☐ Attorney in Fact
☐ Trustee
☐ Guardian or Conservator
☐ Other: _____

Signer Is Representing: _____

RIGHT THUMBPRINT OF SIGNER
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EXHIBIT A

TORY R. WALKER ENGINEERING, INC.
WATER RESOURCES PLANNING & ENGINEERING

December 3, 2010

Mr. Scott O. Smith
City of Oceanside Engineering Department
300 N. Coast Hwy.
Oceanside, CA 92054

SUBJECT: Proposal to Amend the City of Oceanside Master Plan of Drainage

Dear Mr. Smith:

The Tory R. Walker Engineering, Inc. (TRWE) team is delighted to present our Professional Consulting Services Proposal to you. We appreciate the opportunity to demonstrate our qualifications, experience, and project approach to amend the City of Oceanside Master Plan of Drainage. We previously provided detailed review services to the City for the 2005 Master Plan of Drainage. We have discussed this project with City Engineering staff and thought through the process you are about to undertake. We have prepared our proposal to best help you navigate the way ahead. We are confident that we offer you the best team for working with the City of Oceanside to prepare the most useful Master Plan of Drainage in San Diego County.

TRWE is very familiar with the watersheds and the drainage systems that drain these watersheds through the City of Oceanside. We are also very familiar with most of the contributing drainage systems upstream of the City, primarily in the City of Vista, where we have carefully studied the watersheds and drainage systems in detail. We understand the hydrology of the project area, from both a localized and regional perspective. We have studied many of the creeks, channels and floodplains in and upstream of the City of Oceanside. We have analyzed and designed flood detention systems throughout the area and have prepared sensitivity analyses to optimize networks of detention basins. Since 2004, we have provided valuable review and support services to the City of Oceanside for a number of drainage projects.

Building upon our experience and understanding of the City's drainage systems and the watersheds that drain through the City, we are very well prepared to work with the City of Oceanside to amend the master plan of drainage and complete all of the tasks described in the Request for Proposal. We are the premier North San Diego County water resources firm and are equipped to perform these tasks in-house with the personnel we currently have. We have added to our team Mike Klinefelter, an independent GIS expert, who is also very familiar with watershed, habitat and drainage issues. He will assist our in-house team with GIS tools and provide guidance where needed. An organizational chart is included with our proposal to indicate how the team will work together.

Each member of the team has the specific experience needed to see this project successfully completed. TRWE personnel have studied, analyzed and designed numerous and varied flood conveyance and detention facilities for over 25 years. Also, each member of the team is committed to be available for this project's duration, which we have anticipated to be at least through the end of 2011.

Mr. Scott O. Smith
Proposal to Amend the City of Oceanside Master Plan of Drainage
December 3, 2010

We greatly appreciate this opportunity to present our proposal to you and count it a privilege to offer our professional consulting services to the City of Oceanside. We also welcome the opportunity to discuss any aspect of this proposal with you, and we trust you will allow us to demonstrate how our vision, talent, flexibility, understanding and integrity work together to give you the best value of any team offering these services.

I as the undersigned offer this proposal, having the authority to commit to a Professional Service Agreement (PSA) with the City of Oceanside on behalf of Tory R. Walker Engineering, Inc.

Sincerely,

TORY R. WALKER ENGINEERING, INC.

Tory R. Walker, PE, CFM, LEED GA
President

enclosures

Scope of Services

As described in the Request for Proposals, the scope of services is summarized as follows:

Task 1: Obtain and Compile Hydrologic Information
Task 2: Update Inventory and Database with New Information
Task 3: Research Methodologies and Software Tools
Task 4: Review and Evaluate Existing and Proposed Detention Basins
Task 5: Hydrologic Analysis
Task 6: Revise Recommended Storm Drain Upgrades and Improvements
Task 7: Revise Construction Cost Estimates
Task 8: Capital Improvement Projects (CIP)
Task 9: Drainage Impact Fee Evaluation
Task 10: Meetings, Coordination and Delivered Product

Additional drainage tasks (optional at City discretion)
Task 11: San Luis Rey River - Flood Risk at Major Arterials
Task 12: Loma Alta Creek Watershed Studies
Task 13: Buena Vista Creek Watershed Studies
Task 14: Update City Drainage System Design Criteria

TRWE has spent time considering each task of the proposed scope of services. We have described below in more detail than described in the RFP our tentative approach, which will be further refined in meeting with and communicating with City Engineering Division staff. Our understanding of the tasks and approach to these tasks is as follows:

Task 1: Obtain and Compile Hydrologic Information

TRWE will meet with City Engineering Division staff, Public Works maintenance staff, and Clean Water Program staff to determine what information is available from the City. This will include, at a minimum, previous master plans of drainage (2005 MPD by Bureau Veritas and 1980 MPD by VTN), other hydrologic studies (associated with CIP projects, private developments, and other public agency studies available at the City), storm drain and BMP inventory and design information, detention basin design information, flood insurance studies, and watershed studies.

TRWE will also meet with (and/or coordinate with) other local, state, and federal agencies and any other pertinent sources to obtain pertinent information. Probable sources for additional information, similar to that obtained from the City of Oceanside, include the cities of Vista and Carlsbad, the County of San Diego, California Department of Transportation, the US Army Corps of Engineers, and Camp Pendleton. Pertinent information may also be available from both State and Federal agencies, such as California Department of Water Resources, Department of Conservation (e.g., the California Watershed Portal), State Water Resources Control Board (e.g., watershed studies and/or information), National Weather Service (e.g., precipitation data and/or statistical analysis), and the U. S. Geological Survey (e.g., stream gage data and analysis, geologic mapping). Additionally, pertinent information, including photographs, may also be available from some non-governmental organizations (NGOs), such as Preserve Calavera, the Center for Natural Lands Management, Friends of Loma Alta Creek, Buena Vista Audubon, and The Buena Vista Lagoon Foundation.

Task 2: Update Inventory and Database with New Information

TRWE provided review services to the City of Oceanside for the 2005 MPD prepared by Bureau Veritas. In the process of that detailed review, and because of our involvement with other drainage projects in the City, we became very familiar with many drainage systems and somewhat familiar with all the drainage systems. We will therefore only need to conduct an overview of the 2005 MPD for this task and then meet with the City to discuss the existence of newer or more accurate information that was not previously incorporated into the 2005 MPD.

We will meet with the City's Water Utilities Department to establish the base condition of the City's GIS database and mapping, as well as protocols and procedures for our team to coordinate closely with the City's GIS team. We will then incorporate the MPD and new information into the City's existing GIS database and update or revise data as necessary. Additionally, pertinent information from other sources obtained in Task 1 may be incorporated, but such information would possibly also need to be verified or noted as not yet verified. Field verification is not assumed within any of the tasks, except as specifically noted, so it will be important to make a distinction between sources of data and if the data needs to or has been verified.

Task 3: Research Methodologies and Software Tools

TRWE will research currently available methodologies and software tools for use in preparation of the amended MPD. We will evaluate the methodologies and tools and make recommendations to the City. We will submit proposed criteria for evaluation to the City and discuss the criteria with the City prior to the research. We anticipate this will result in the establishment of a system of weighting criteria that will be organized in a decision matrix. GIS compatibility and conversion of data, hydrologic and hydraulic methodologies and calculations, and updated mapping will be considered as part of the criteria. Recent use of methodologies and software for master planning purposes will also be considered. Additional criteria will be developed with this task, but will at least include considerations specific to the City of Oceanside's existing and future technological systems and capabilities and the ease of use for ongoing updates to the Master Plan.

We anticipate researching and evaluating the following software tools: XPSWMM, XPStorm, MIKE Urban, InfoSWMM and InfoWorks SD, Autodesk SSA, Hydra, and Bentley CivilStorm. We also anticipate using ESRI ArcView with ArcHydro Extension for input data generation. All of the methodologies and software tools will be compared using the weighted criteria decision matrix established by our meeting with the City. TRWE will then prepare a brief report summarizing the decision process and making recommendations. Methodologies and software will ultimately be selected by the City based upon their review of these recommendations.

Task 4: Review and Evaluate Existing and Proposed Detention Basins

The 2005 MPD did not consider the attenuation of flows in storm drain systems due to detention basins, and thus calculated peak discharges in systems downstream of these basins were likely all overestimated. TRWE will review any existing available data and as-built information related to existing detention basins within or upstream of the City. This information will be used to estimate attenuated peak flows upstream of MPD facilities. It is anticipated that 10 to 15 existing basins and up to 5 proposed basins will have to be

analyzed under this project to determine attenuated peak flows. We will use the results of the analyses to make recommendations, as appropriate, regarding possible modifications to basins. Optimization of the City's drainage infrastructure is the primary goal of this task; however, these basins will be analyzed for four discrete storm events, as defined in Task 5. The selection and number of basins to be analyzed shall be at the discretion of the City, and the result of the analysis shall be made part of the amended Master Plan. We have assumed one week of field survey to supplement and/or verify detention basin data, but a better estimate will be prepared once the basins have been identified.

To implement this task, we will meet with the cities of Oceanside and Vista to obtain as-built plans or design drawings and reports, where available. We will review the drawings and reports and follow up with site visits to each detention basin for the purpose of verifying and assessing existing conditions at the basins. The field survey will follow, with more specific information gathered, including outlet works, spillway information and dam crest information. Stage-storage relationships for the basins will be based on the City's 2-foot contour topographic mapping and supplemented as needed by the field survey. We will then use the above information to analyze the detention basins for attenuation of peak flows associated with the 100-year, 25-year, 10-year and 2-year storm events. Finally as already noted, we will make recommendations regarding possible modifications to existing detention basins and regarding proposed basins. After meeting with the City of Oceanside to discuss these recommendations, we will prepare a report incorporating analyses and final recommendations.

Detention basins that are part of the San Luis Rey River Basin Flood Control Project are excluded from this review, as they will not have any bearing on the MPD. Similarly, detention basins in Carlsbad will not be considered, as the only ones that might have relevance would be part of optional Task 13 and would thus be part of that task.

Task 5: Hydrologic Analysis

TRWE will prepare hydrologic models using the methodologies and software selected in Task 3. The geographic extents of this modeling will be approximately the same as previously prepared by Bureau Veritas in the 2005 MPD. We will extract relevant information from the Rational Method calculations prepared for the 2005 MPD. Pertinent information obtained from Tasks 1, 2 and 4 will also be incorporated into the new hydrologic model, generating results for the 100-year, 25-year, 10-year and 2-year storm events. TRWE will also produce an updated map (Appendix A, Figure 4 – 2005 MPD) including an acceptable method of geo-referencing each mapped Master Plan Facility to the appropriate hydrologic calculations.

This task will require the preparation and compilation of GIS layers, including (if available and applicable) soils, precipitation (2, 10, 25, 100-year), land use/cover, City of Oceanside storm sewer database inventory, City of Vista storm sewer, land use/cover database, Pendleton storm sewer, land use/cover database, and topography (Digital Terrain Model).

Once the preparatory work is completed, which will include the preparation and compilation of GIS layers, the extraction of information from the 2005 MPD, and the incorporation of new information into the new model, we will test and troubleshoot the model(s), verifying results for approximately 10 drainage systems, with input from City Engineering and/or maintenance staff. We will then run the model(s) for 2, 10, 25 and 100-year storms. Results for each of these storms will be useful in identifying the extent of deficiencies in different drainage systems and will thus be helpful in tasks 6 through 9.

Task 6: Revise Recommended Storm Drain Upgrades and Improvements

From the results of Tasks 4 and 5 and meetings with Public Works maintenance staff, TRWE will revise and update the 2005 MPD tables summarizing facility upgrades and improvements. Criteria previously used will likely be assumed for determining adequacy of existing facilities and for sizing new facilities. One notable addition to this will be the consideration of multiple-year (100, 25 and 10-year) frequencies.

We will meet with City Engineering staff to discuss results of Task 5 and to select storm frequencies for determining adequacy of existing and new storm drain systems for differing sizes and conditions. We will differentiate between existing and new facilities for various sizes and conditions. We will then incorporate the updated tables summarizing facility upgrades and improvements in the GIS database.

Task 7: Revise Construction Cost Estimates

From the results of Task 6, TRWE will revise and update the 2005 MPD tables summarizing construction cost estimates. Cost estimates will be based upon varying sizing criteria for different sizes and conditions (e.g., sump vs. flow by inlets). In addition to using revised facility sizes, a more current unit price list will be used.

Prior to updating the estimates, we will meet with City staff to discuss the source and desired format of the construction cost estimates. We will then incorporate the updated construction cost estimates tables in the GIS database.

Task 8: Capital Improvement Projects (CIP)

TRWE will assist the City in identifying Capital Improvement Projects under the City's Drainage Program. We will use the completed analyses from previous tasks and the input from Public Works maintenance staff to assist City Engineering staff in preparing documentation for these projects. The following criteria shall generally be used to identify and estimate CIP's:

a) Undersized Master Plan facility sizes (36-inch diameter and greater)
b) Identified chronic flood-prone areas
c) Identifying undersized CIP facilities from 18-inches up to MPD sizes
d) Identifying the need for additional inlets (CBs) and other drainage structures

It is anticipated that considerable engineering judgment, including close coordination with City staff, will be required to develop proposed Capital Improvement Projects. We plan to meet with City Engineering staff to identify probable CIP projects and criteria for selection of projects for CIP. We will prepare schematic plan drawings, using the City's 2-foot contour interval topographic mapping as a base, and cross reference the location of each CIP project on the updated map (Appendix A, Figure 4 – 2005 MPD). We will prepare separate cost estimates for each proposed CIP project using information from previous tasks. Finally, we will prepare a brief description for each CIP project and compile all information into packages. We assume up to 100 locations/projects will be identified.

Task 9: Drainage Impact Fee Evaluation

TRWE will assist the City in evaluating the City's existing Drainage Impact Fee structure based upon the results of Tasks 6, 7, and 8 and make recommendations regarding possible alternative fee structures. To accomplish this task, we will first meet with City Engineering staff to discuss pros and cons of various drainage impact fee structures based on results of

previous tasks. We will then research and evaluate various drainage impact fee structures and prepare a draft report of recommendations regarding drainage impact fee structures. We will meet with City Engineering staff once more to discuss the draft report and then revise the report of recommendations based on review comments and our meeting with the City.

Task 10: Meetings, Coordination and Delivered Product

Ongoing coordination and a number of meetings with the City Engineering staff and operations personnel are expected with the above tasks to identify chronic flood-prone areas and to obtain information. We estimate a total of 174 hours for all meetings; approximately 28 hours of that total would be with neighboring municipalities, and the remaining 146 hours would be with various City of Oceanside personnel. We estimate the total number of meetings with the City to be 32, and we estimate 9 meetings with other municipalities. Coordination for this project, including project management, is estimated to be 214 hours.

Upon completion of the above tasks, TRWE will compile the various reports into a final report and deliver to the City a minimum of 4 hard copies and a digital version of the final report, any project specific software used in the process, and a list of commercially available software required by the City to manage and maintain the amended master plan.

ADDITIONAL DRAINAGE TASKS (OPTIONAL AT CITY DISCRETION)

Task 11: San Luis Rey River - Flood Risk at Major Arterials

While the construction of levees along the San Luis Rey River has reduced some risk of flooding within the City, there still remains some risk. Part of this risk is associated with the lack of an approved Vegetation Management Plan within the river channel. If the levee is overtopped, there is the potential for major arterials, essential for passage of emergency vehicles, to be impassable.

TRWE will determine which roads classified at least as "major arterial" are subject to flooding based on water surface elevations from the FIRMs published prior to the construction of the levees. We will then evaluate the degree of flooding risk on these roads and make recommendations for each road regarding emergency vehicle travel.

For this task, we will review old (without levee) FIS information of the San Luis Rey River through the City, obtain and review the Corps' latest HEC-RAS model of the river through the City, and plot the water surface on top of City 2-foot contour interval topographic mapping. We will coordinate with the City to identify the major arterials of concern, and then review depths of flooding along those arterials with the City. We will also obtain and review road improvement plans for the affected portions of major arterials and conduct a site visit of those affected portions.

TRWE will then determine locations of greatest risk for overtopping of the levee based on the Corps' latest HEC-RAS model and the "No Vegetation Management Plan" scenario. Those locations of greatest risk for overtopping of the levee will be used to further evaluate the degree of flood risk at the affected arterials. We will use approximate (stochastic or probabilistic) means to estimate risk based on relative locations and topography. We will then make recommendations for each road regarding emergency vehicle travel and compile results into a report.

Task 12: Loma Alta Creek Watershed Studies

Based on a recent floodplain analysis of Loma Alta Creek (associated with a LOMR application package), some properties adjacent to the creek are at risk of flood damage in a 100-year storm event. TRWE will restudy the hydrology of the watershed, incorporating any pertinent results of previous tasks. One goal of this study will be to optimize the drainage system to reduce the risk of downstream flood damage from Rancho Del Oro Drive to the Pacific Ocean. This task will include the evaluation of possible new detention and modification of existing and/or planned detention basins. We will also evaluate solutions for reducing the risk of flood damage to properties along Industry Street, at the Cavalier Mobile Estates, and at the Oceanside RV Park.

TRWE is already quite familiar with the LOMR package and HEC-RAS model of Loma Alta Creek, having reviewed and commented on it for the City. We have also obtained a copy of the HEC-1 hydrology study of Loma Alta Creek and will review it in detail so as to determine where system optimization might be possible. We will import the HEC-1 model to HEC-HMS and troubleshoot the model, if necessary. We will then incorporate any pertinent results of previous tasks into the working HEC-HMS model, evaluating land use, vegetative cover, soils, lag, precipitation, and the infiltration/runoff relationship.

We will visit detention basins and possible detention basin locations in the watershed with a view of evaluating modifications of existing basins as appropriate. We will then evaluate the effects of possible new detention and existing detention basin modifications with a sensitivity analysis of the revised HEC-HMS model. The purpose of this analysis is to evaluate where detention is optimized within the watershed such that peak flow reductions are achieved.

With the optimization portion done, we will then evaluate solutions for reducing the risk of flood damage to properties along Industry Street, at the Cavalier Mobile Estates, and at the Oceanside RV Park. We will make recommendations to the City regarding possible solutions and associated constraints, costs and opportunities and then prepare a draft report. Solutions may be influenced by the outcome of the optimization study, which could result in peak reduction as at least part of a solution. Floodplain management, including channel and/or overbank/floodway fringe modifications will also likely be evaluated. We will meet with the City to initiate the study, discuss possible solutions, evaluate progress & direction, and to review the draft report. We will then revise the draft report for a final report.

Task 13: Buena Vista Creek Watershed Studies

TRWE will study the hydrology of the watershed, incorporating any pertinent results of previous tasks. Pertinent information will include, but not be limited to, our recent HEC-HMS study of the Buena Vista Creek Watershed upstream of South Melrose Drive within the City of Vista. That detailed hydrology study, which we completed for the City of Vista and incorporates possible detention basins, will be extended downstream to the Pacific Ocean. The goal of this study will be to optimize the drainage system to reduce the risk of flood damage within the City of Oceanside. This task will include the evaluation of possible new detention and modification of existing and/or planned detention basins. We will also evaluate solutions for reducing the risk of flood damage to properties upstream of Thunder Drive and at College Boulevard. At College Boulevard, we have already evaluated solutions in association with another contract and would thus be prepared to review that analysis with the City and determine if any further analyses would be beneficial.

In performance of this task, we will obtain and review any hydrology studies of Buena Vista

Creek from the cities of Oceanside and Carlsbad. As noted above, we have already completed detailed studies of Buena Vista Creek within Vista. We will extend the most recent hydrology study from Highway 78, where the current study ends, downstream to the ocean, evaluating what from the existing hydrology studies will be incorporated into the new comprehensive hydrology study.

We will incorporate any pertinent results of previous tasks into the working HEC-HMS hydrologic model, evaluating land use, vegetative cover, soils, lag, precipitation, and the infiltration/runoff relationship. We will visit Thunder Drive, College Boulevard, and possible new detention basins and existing detention basins with a view of evaluating modifications of existing basins as appropriate. We will then evaluate the effects of possible new detention and existing detention basin modifications with a sensitivity analysis of the revised HEC-HMS model. The purpose of this analysis is to evaluate where detention is optimized within the watershed such that peak flow reductions are achieved.

With the optimization portion done, we will then evaluate solutions for reducing the risk of flood damage to properties at Thunder Drive. We will evaluate channel modifications, both upstream and downstream, and evaluate road/culvert modifications. We are also prepared to further evaluate ways to reduce flooding risk at College Boulevard, if needed. As mentioned, we have completed an evaluation, which we will review with current City staff. Upon completion of this task, we will prepare a draft report. We will meet with the City to initiate the study, evaluate progress & direction, and to review the draft report. We will then revise the draft report for a final report.

Task 14: Update City Drainage System Design Criteria

TRWE will update Chapter II, Section 6 of the manual, the City's Drainage System Design Criteria. This update will incorporate requirements from the Master Plan of Drainage, current drainage design standards, hydrologic methods and regulatory requirements for storm water. We will meet with City Engineering staff on a regular basis and coordinate a public comment review to obtain input from the professional design community and the general public.

For this task, we will review the City's existing Drainage System Design Criteria, the County of San Diego's Drainage Design Manual, and up to three other similar (recent) drainage design manuals that incorporate storm water quality criteria. We will meet with City Engineering staff regularly, coordinate a public comment review, and write a draft updated Drainage System Design Criteria. We will send the draft to select reviewers (up to 10) for comments, coordinate and review City and select reviewers' comments and revise it as a final draft. We will then review final draft comments and prepare the final Drainage System Design Criteria.

ATTACHMENT 3

CITY OF OCEANSIDE
AMENDMENT TO
PROFESSIONAL SERVICES AGREEMENT

PROJECT: AMENDMENT #1 TO THE MASTER PLAN OF DRAINAGE PROFESSIONAL SERVICES AGREEMENT - 425412598 (906404500598)

THIS AMENDMENT TO PROFESSIONAL SERVICES AGREEMENT (hereinafter "Amendment"), dated _____, 2012, for identification purposes, is made and entered into by and between the CITY OF OCEANSIDE, a municipal corporation, hereinafter designated as "CITY", and Tory Walker Engineering, Inc., hereinafter designated as "CONSULTANT."

RECITALS

WHEREAS, City and Consultant are the parties to that certain Professional Services Agreement dated April 6, 2011, hereinafter referred to as the "Agreement", wherein Consultant agreed to provide certain services to the City as set forth therein; and

WHEREAS, the parties desire to amend the Agreement to provide for changes and/or modifications to the scope of work and CONSULTANT's compensation.

AMENDMENT

NOW, THEREFORE, as set forth herein, the parties hereto do mutually agree that the Agreement shall be amended as follows:

1. SECTION 1, **SCOPE OF WORK**, IS HEREBY AMENDED TO INCLUDE THE FOLLOWING ADDITIONAL WORK:

   Amendment #1 expands the scope of the contract to include Additional GIS Services, Precipitation Analysis, and Precipitation Time Series for Continuous Simulation Analysis.

   A detailed description of the additional scope of work, **Exhibit A**, is attached hereto and incorporated herein by this reference.

2. SECTION 8, **COMPENSATION**, IS HEREBY AMENDED BY ADDING A NOT TO EXCEED AMOUNT OF $175,000 FOR THE ADDITIONAL WORK, FOR A TOTAL NOT TO EXCEED CONTRACT AMOUNT OF $684,790.

AMENDMENT #1 TO THE MASTER PLAN OF DRAINAGE PROFESSIONAL SERVICES AGREEMENT - 425412598 (906404500598)

3. EXCEPT AS EXPRESSLY SET FORTH IN THIS AMENDMENT, THE AGREEMENT SHALL REMAIN IN FULL FORCE AND EFFECT AND IS HEREBY RATIFIED AND REAFFIRMED.

SIGNATURES. The individuals executing this Amendment represent and warrant that they have the right, power, legal capacity and authority to enter into and to execute this Amendment on behalf of the respective legal entities of the CONSULTANT and the CITY.

IN WITNESS WHEREOF the parties hereto being duly authorized on behalf of their respective entities to execute this Amendment, do hereby agree to the covenants contained in the Agreement, including this Amendment and have caused this Amendment to be executed by setting hereunto their signatures on the dates set forth below.

Tory Walker Engineering, Inc.
122 Civic Center Drive, Suite 206
Vista, CA 92084

By: Tory R. Walker
Tory R. Walker, President

Date: 3/21/12

By: Jennifer L. Walker
Jennifer L. Walker, Secretary

Date: 3/21/12

33-0892309
Employer ID No.

CITY OF OCEANSIDE

By: _____
Peter Weiss, City Manager

Date: _____

APPROVED AS TO FORM:

John P. Mullen
City Attorney

NOTARY ACKNOWLEDGMENTS OF CONSULTANT MUST BE ATTACHED.

G:\ADMIN\Admin Docs - Specs and Staff Reports\Professional Services Agreements\Amendment 1 Master Plan of Drainage.doc

(Revised 11-2008)

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

State of California

County of San Diego

On March 21, 2012 (Date) before me, Troy G. Stephens, Notary Public (Here Insert Name and Title of the Officer),

personally appeared Tony R. Walker and Jennifer L. Walker (Name(s) of Signer(s)),

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) ~~is~~/are subscribed to the within instrument and acknowledged to me that ~~he/she~~/they executed the same in ~~his/her~~/their authorized capacity(ies), and that by ~~his/her~~/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

TROY G. STEPHENS
Commission # 1899980
Notary Public - California
San Diego County
My Comm. Expires Sep 12, 2014

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature _____ (Signature of Notary Public)

Place Notary Seal Above

OPTIONAL

Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of this form to another document.

Description of Attached Document

Title or Type of Document: City of Oceanside: Amendment to Professional Services Agreement

Document Date: March 21, 2012 Number of Pages: 2

Signer(s) Other Than Named Above: _____

Capacity(ies) Claimed by Signer(s)

Signer's Name: _____
- ☐ Individual
- ☐ Corporate Officer — Title(s): _____
- ☐ Partner — ☐ Limited ☐ General
- ☐ Attorney in Fact
- ☐ Trustee
- ☐ Guardian or Conservator
- ☐ Other: _____

Signer Is Representing: _____

RIGHT THUMBPRINT OF SIGNER
Top of thumb here

Signer's Name: _____
- ☐ Individual
- ☐ Corporate Officer — Title(s): _____
- ☐ Partner — ☐ Limited ☐ General
- ☐ Attorney in Fact
- ☐ Trustee
- ☐ Guardian or Conservator
- ☐ Other: _____

Signer Is Representing: _____

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Scope of Services - Amendment Number 1

The scope of services for the additional tasks is summarized as follows:

Task 15: Additional GIS Services

Tory R. Walker Engineering (TRWE) will populate the City's existing geoDB (geodatabase) with data required for the XPSWMM model used in the City of Oceanside Storm Drain Master Plan. We will carefully follow the schema of the City's existing geoDB, so that it can be easily merged with the City's existing database. The building of the database will include transferring data from various plan drawings into links and nodes in ArcGIS. TRWE will supplement the plan drawings with field GPS data collected by the City of Oceanside.

The drainage features in the geoDB will include Storm Drain Master Plan level pipes (36-inch and greater diameter), channels and boxes (equivalent flow capacity equal or greater than a 36-inch diameter pipe), and cleanouts (associated with 36-inch and greater pipes); we will also include 30-inch diameter pipe, but not drain inlets. The attributes attached to each drainage feature will include only those necessary to complete the Storm Drainage Master Plan modeling. This may include, but not be limited to:

- Upstream flow elevation
- Downstream flow elevation
- Rim Elevation
- Feature size
- Type & Subtype
- Plan Date
- As-built date
- Editor & Date
- Comments
- Improvement plan/grading plan number

The Land Use geoDB will have the assessor's parcels as the base map with each parcel labeled with the land use per the City's current designation. Roadways will be separate features.

Assumptions:
The City of Oceanside will provide all plans and requested GPS data. Only drainage feature classes and fields required for the Storm Drain Master Plan modeling will be built by TRWE. Because there is no accurate measure of how many drainage features need to be created for the Storm Drain Master Plan modeling, we have estimated 6,500 drainage features, with their respected attributes, will be created as a part of this amendment. This estimate is based on the initial review of previous GIS data and a comparison of recent data creation in the Loma Alta Creek watershed.

Task 16a: Precipitation Analysis

We propose to analyze the existing hourly precipitation data to determine a more realistic intensity-duration frequency curve based upon measurements taken since 1951 in Oceanside. Data for our analysis will come from hourly data used for continuous simulations, obtained from the Project Clean Water (PCW) web site (*http://projectcleanwater.org/html/wg_susmp.html*), as well as average data obtained from the Western Regional Climate Center (WRCC) on its web page (*http://wrcc.dri.edu/summary/Climsmsca.html*), combined with detailed hourly data that can be purchased from WRCC. Also, correlation analysis from the Oceanside data and the best data in the County (San Diego Lindbergh Station, and to a lesser degree the Fallbrook Station) will help to improve the data analysis to fill gaps and to establish better values of intensities valid for Oceanside.

Justification for this detailed analysis is born from the extreme differences found in peak flows obtained from continuous simulations (2-year, 5-year, 10-year, 25-year up to 50-year peak flows) and the peak flows obtained from synthetic storm analysis in the *San Diego County Hydrology Manual* (SDCHM). Such differences can be more than 1 order of magnitude in some cases, and are due to multiple factors, some of which are:

1) Extremely conservative approach to determine intensities for durations of less than 1 hour by adjusting the data to a power law function in the SDCHM. The mathematical equation recommended in the SDCHM ($I = k/tn$) not only does not correspond with the best possible adjustment of the data, but also has the inconvenience of infinite intensity when the time of duration t reduces to zero. The *Handbook of Hydrology* recommends a better approach to avoid this mathematical obstacle: $I = k/(tn + c)$. The additional constant c will force the intensity I to have a finite maximum value even for a duration $t=0$, which is in line with physical observations. TRWE will obtain a better adjustment of the data that will reduce the exceedingly large intensities associated with short durations, intensities that have not been observed in real data.
2) Single storm analyses are highly dependent on the time of concentration, which most of the time is smaller than 15 minutes, while continuous simulation analysis is associated with hourly data and consequently hourly peak flows. In other words, continuous simulation peak flows are hourly in duration, while single storm event peak flows are instantaneous in duration.
3) Elimination of the artificial disaggregation of the data in Oceanside. Seven percent of the data used for continuous simulation in Oceanside has been improperly disaggregated in the recent HMP effort; this percentage increases to 11% for intensities larger than 0.5 in/hr. TRWE will perform a proper disaggregation of the data that preserves the statistical properties of the original data and does not generate artificial storms with a synthetic distribution that does not occur in nature.
4) Elimination of the aggregation of the data at the 0.1 inch level. This process artificially generates hourly intensities that can only occur in 0.1 in/hr increments and distorts the intensity distribution. TRWE will use an improved statistical analysis that takes into consideration the intensity-duration curve of the time periods where the data was collected with greater precision.

As part of this task, we propose to study in detail the "n,d" largest extreme events, with "n" being the number of years where data was properly obtained, and "d" the duration value selected. Those events will be analyzed at different durations in order to properly extrapolate the intensity

at shorter time intervals, and generate an adequate intensity-duration curve.

Additionally, we will correct many discrepancies between the PCW and the WRCC data sets. Those differences have an effect in the proper determination of the 2-year to 100-year intensities associated with peak flows for design purposes. For example, of the 10 wettest days from 1951 to 2008, 7 have differences in precipitation larger than 20% in both data sets, while such differences are almost non-existent in the San Diego Lindbergh Station data.

Task 16b: Precipitation Time Series for Continuous Simulation Analysis

As most of the time series analysis of precipitation performed for the previous task can be useful for continuous simulation purposes, we recommend adding as a task the improvement of the intensity-duration curve at an hourly level plus the extrapolation analysis that will allow building continuous time series with a time interval of 15-minutes and 30-minutes. Those times series will be generated in such a way that the statistical properties of the rainfall distribution are preserved, and those series can be used for continuous simulation depending on the time of concentration of the potential project. Establishment of time series with shorter time interval will increase the peak flows and generate more realistic values for the range of analysis of hydromodification BMPs, and will significantly reduce differences between continuous analysis and single storm analysis.

Fee Estimate – Amendment Number 1

We have estimated fees for completion of the additional tasks and have indicated totals below.

TASK	ESTIMATED COST
Task 15: Additional GIS Services	$ 160,000
Task 16a: Precipitation Analysis	$ 10,000
Task 16b: Precipitation Time Series for Continuous Simulation Analysis	$ 5,000
ESTIMATED TOTAL OF TASKS 15 AND 16	**$ 175,000**

Project Schedule – Amendment Number 1

We have anticipated time for completion of these additional tasks. Anticipated time for each task is shown below, and a preliminary project schedule is also included. These are preliminary and will likely be refined in discussions with City Engineering staff.

TASK	ANTICIPATED TIME
Task 15: Additional GIS Services	30 weeks
Task 16a: Precipitation Analysis	3 weeks
Task 16b: Precipitation Time Series for Continuous Simulation Analysis	2 weeks

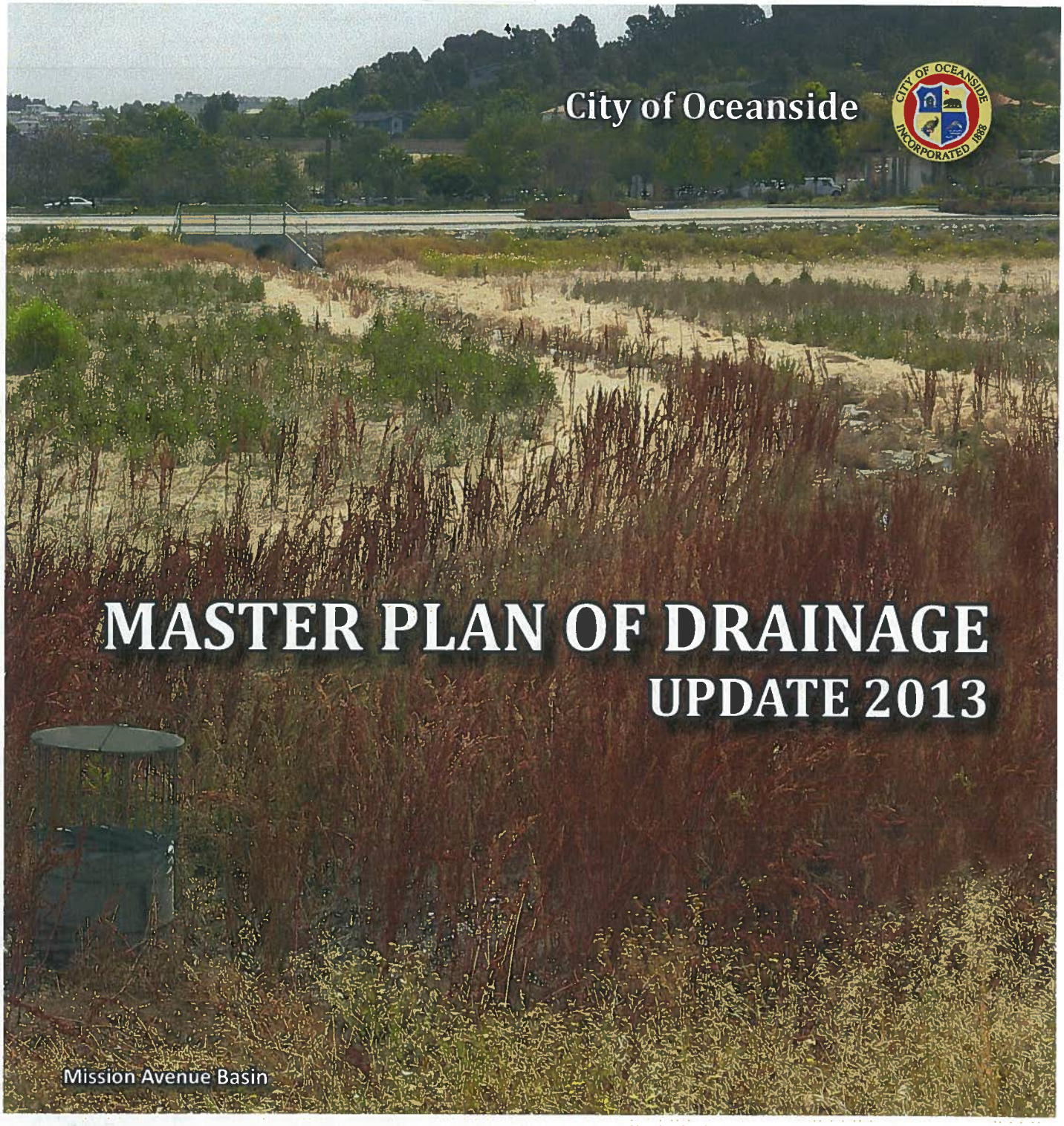
Schedule of Hourly Rates

Below is our current schedule of hourly rates. We anticipate using this schedule through 2011.

TRWE's FEE SCHEDULE
(Effective date: 1/31/2010)

Principal	$185.00/hour
Project Manager	$150.00/hour
GIS Manager	$130.00/hour
Senior Engineer	$125.00/hour
Associate Engineer	$110.00/hour
Junior Engineer	$100.00/hour
Engineering Technician	$80.00/hour
CADD/GIS Technician	$80.00/hour
Clerical	$60.00/hour

EXHIBIT C



MASTER PLAN OF DRAINAGE
UPDATE 2013

Prepared by:

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October 2013

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STORM DRAIN ATLAS

1. EXECUTIVE SUMMARY

Background

Since the 2005 City of Oceanside (City) Master Plan of Drainage (MPD), various developments have affected storm runoff flow patterns, and new drainage facilities have been added to the City's storm drainage system. These factors and their impacts to the City's overall drainage system were considered in this MPD update.

The City of Oceanside hired Tory R. Walker Engineering, Inc. (TRWE) to update the 2005 MPD. The following tasks were completed:

- Researched background hydrologic information
- Updated database with new information
- Analyzed and selected modeling software
- Reviewed existing and proposed detention basins
- Performed capacity analysis of existing drainage system
- Recommended drainage system upgrades
- Updated estimated construction costs
- Identified potential capital improvement projects
- Addressed potential drainage impact fee revisions
- Analyzed flow in Loma Alta Creek (see Appendix)
- Reviewed City drainage system design criteria (see Appendix)
- Created MPD specific GIS database
- Analyzed Oceanside precipitation data (see Appendix)

Buena Vista Creek

Objectives

The objectives of this study were to model the City's master planned drainage facilities, and then identify deficiencies and recommended upgrades which could be constructed as future development occurs.

TRWE strove to develop reasonable, optimized solutions to drainage system deficiencies. By choosing alternatives that are neither under-designed nor over-designed, the City will be able to address drainage requirements more cost effectively. Under-designed facilities will not provide adequate flood protection, while over-designed facilities will have a lesser probability of ever being constructed (**Figure 1-1**). The results of this study can be used to provide the basis for the City to update drainage development fees and to identity and prioritize drainage capital improvement projects. This Master Plan optimizes risk by focusing on the 25-year storm based on NOAA Atlas 14 tables (**Figure 1-2**). This design criteria applies to MPD facilities only, not to major watercourse facilities, which are typically designed for a 100-year storm.

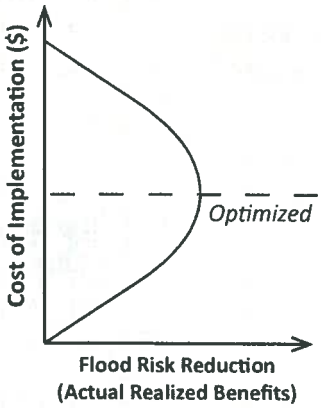


FIGURE 1-1

MPD facilities were defined as drainage facilities having flow capacity equal to or greater than a 36-inch reinforced concrete pipe under similar hydraulic conditions. TRWE also modeled 30-inch pipes - if they should be upsized to 36-inch they became a MPD facility. In addition, this study also considered peak flow attenuation using existing and planned detention basins. Private drainage systems, Caltrans facilities, and creeks and rivers were not considered to be master plan facilities.

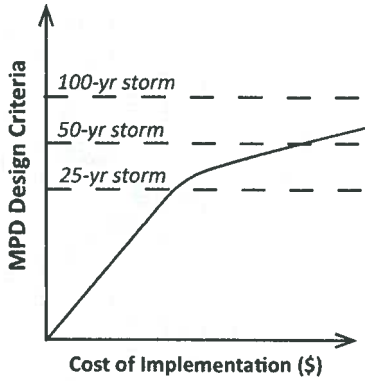


FIGURE 1-2

This master plan update identified:

- Existing MPD facilities that were not adequate in a 10-, 25-, and 100-year storms
- Possible MPD drainage facilities needed in undeveloped areas at build-out
- MPD facilities with maintenance concerns

New and upsized storm drains will typically either be constructed as a capital improvement project, or as part of a new development or redevelopment. Thus, facilities are constructed by a developer, or by City contract using the drainage fees for that particular district, as development occurs. The funds collected within a drainage district must be used for the benefit of that drainage district.

Detailed design of new drainage facilities is not a part of this study. The recommendations in this report serve as a basis for future drainage fees and capital improvement projects. The capacity analysis was conducted at a planning level, and sizing results were only intended to be approximate. This MPD did not perform the detailed hydrologic analyses required for design.

Summary Results

TRWE analyzed 2,790 drainage facilities (30-inches and greater) for 2-, 10-, 25-and 100-year size storms. For this MPD, a facility is defined as a portion of a drainage system separated by cleanouts, manholes, or changes in size, slope, or material. A drainage facility is considered inadequate if it overflows the ground elevation for a particular sized storm. **Table 1-1** summaries those facilities by watershed.

Table 1-1
MPD Facilities Summary by Watershed

Watershed Number	Watershed Name	Total Length Analyzed (ft)	Inadequate Facilities	
			Length (ft)	Percent
1	Pilgrim Creek	34,550	1,470	4.3
2	San Luis Rey River	183,450	10,930	6.0
3	Garrison Creek	44,150	2,140	4.8
4	Loma Alta Creek	112,830	8,600	7.6
5	Buena Vista Creek	61,670	12,530	20.3
6	Aqua Hedionda Head Waters	30,360	590	1.9
7	Pacific Ocean/Beach Area	10,440	4,680	44.8
	Total	**477,450**	**40,940**	**8.6**

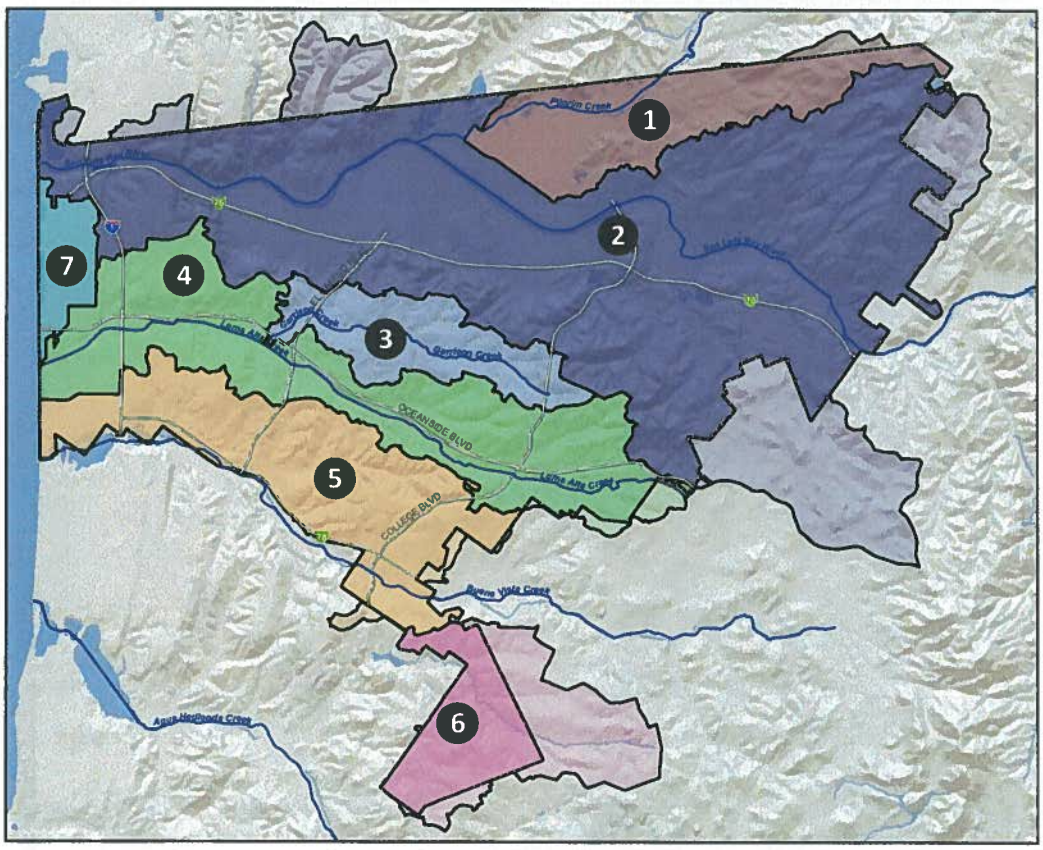


Figure 1-3
Watershed Boundaries

2. OVERVIEW

Study Area

Oceanside has experienced mild growth over the last decade. Between 2000 and 2010, the population grew about 4% to 167,086, and housing units increased 8% to 59,581.

The City is bordered by Marine Corps Base Camp Pendleton to the north, the City of Vista to the east, the Pacific Ocean to the west, and the City of Carlsbad to the south. Unincorporated areas are also east of the City. Interstate Highway 5 runs north-south along the western edge and State Routes 78 and 76 bisect the City running east-west. Oceanside is the third most populous City in San Diego County.

Figure 2-1
Oceanside Census

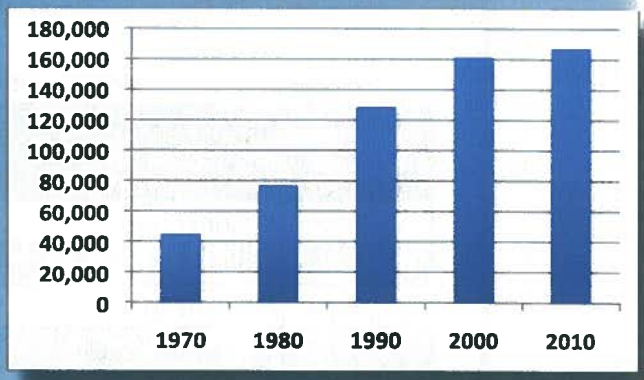
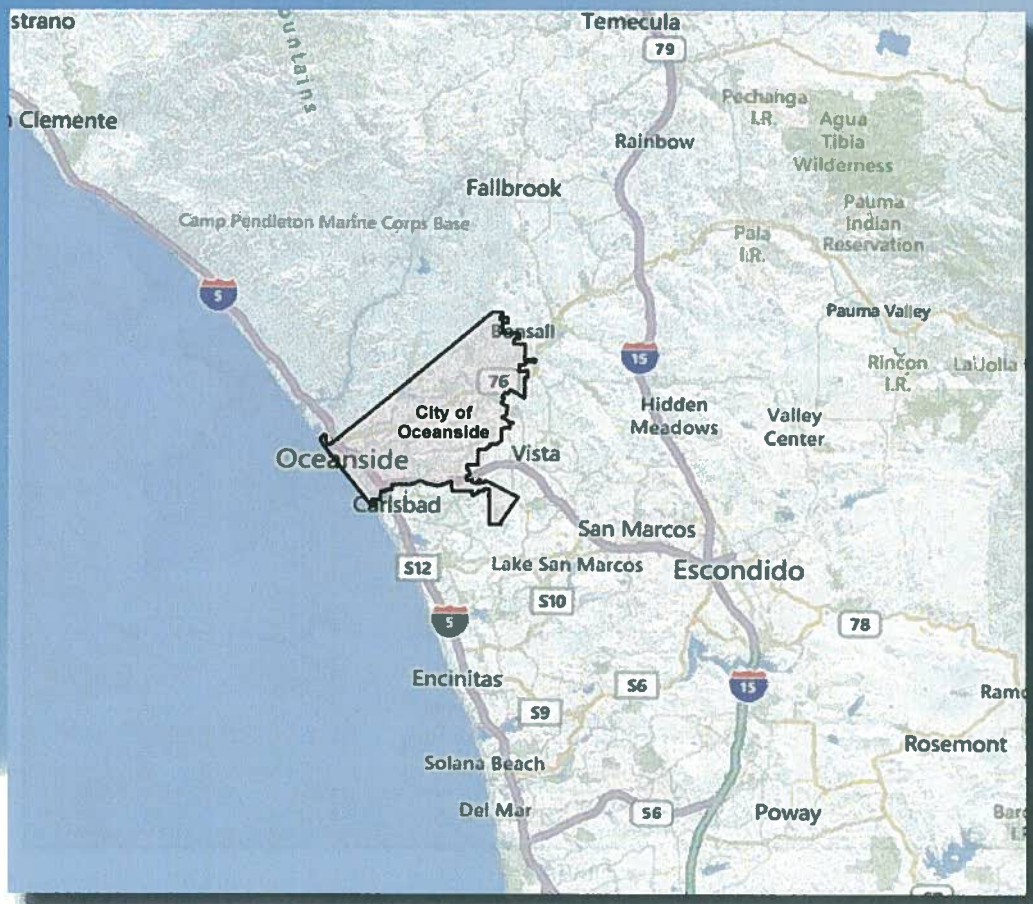


Figure 2-2
Oceanside Location Map



Oceanside is a coastal Southern California charter City governed by an elected council. It has an area of 42 square miles and is divided into seven major watersheds (**Table 2-1**). Most of the basins drain to rivers that flow to the Pacific Ocean. For this study, each watershed was divided into minor basins and sub-basins based on topography and existing drainage systems.

Table 2-1
Oceanside Watersheds

Watershed Number	Watershed Name	Area w/in City (sq. miles)
1	Pilgrim Creek	3.6
2	San Luis Rey River	21.2
3	Garrison Creek	2.4
4	Loma Alta Creek	7.1
5	Buena Vista Creek	5.3
6	Aqua Hedionda Head Waters	1.8
7	Pacific Ocean/Beach Area	0.9
	Total	**42.2 sq. miles**

The rainfall runoff flow rate and volume that reaches the drainage system depends on the following:

- The topography (slope and flow length)
- The type of underlying soil (infiltration capacity)
- The land use (imperviousness)
- The size and duration of the storm (volume and distribution of rainfall)
- The type and extent of vegetative cover (retention)

Steeper slopes do not allow as much time for infiltration as shallower slopes. Clay soils will generate higher runoff volumes than sandy porous soils. Also, rainfall runoff is higher on saturated soils than dry soils. Land use with more paved areas will have higher runoff than natural open spaces. Vegetation also retains more rainfall than bare ground. The model takes all of these factors into account to calculate the percentage of runoff for a particular sub-basin.

Topography

Hydrology studies start with a topographic map showing elevation contour lines and natural features. For this study, 2009 aerial topography (**Figure 2-3**) was obtained from the City. The topography is based on the NAVD-88 datum. Since most of the storm drain facilities in the City were constructed on the NGVD-29 datum, TRWE used Geographic Information System (GIS) software to lower the recent topography by two feet to more closely match the older facility datum. This approximately adjusted topography allowed modeling of underground (e.g., pipe) and aboveground (e.g., street flows) at the same time.

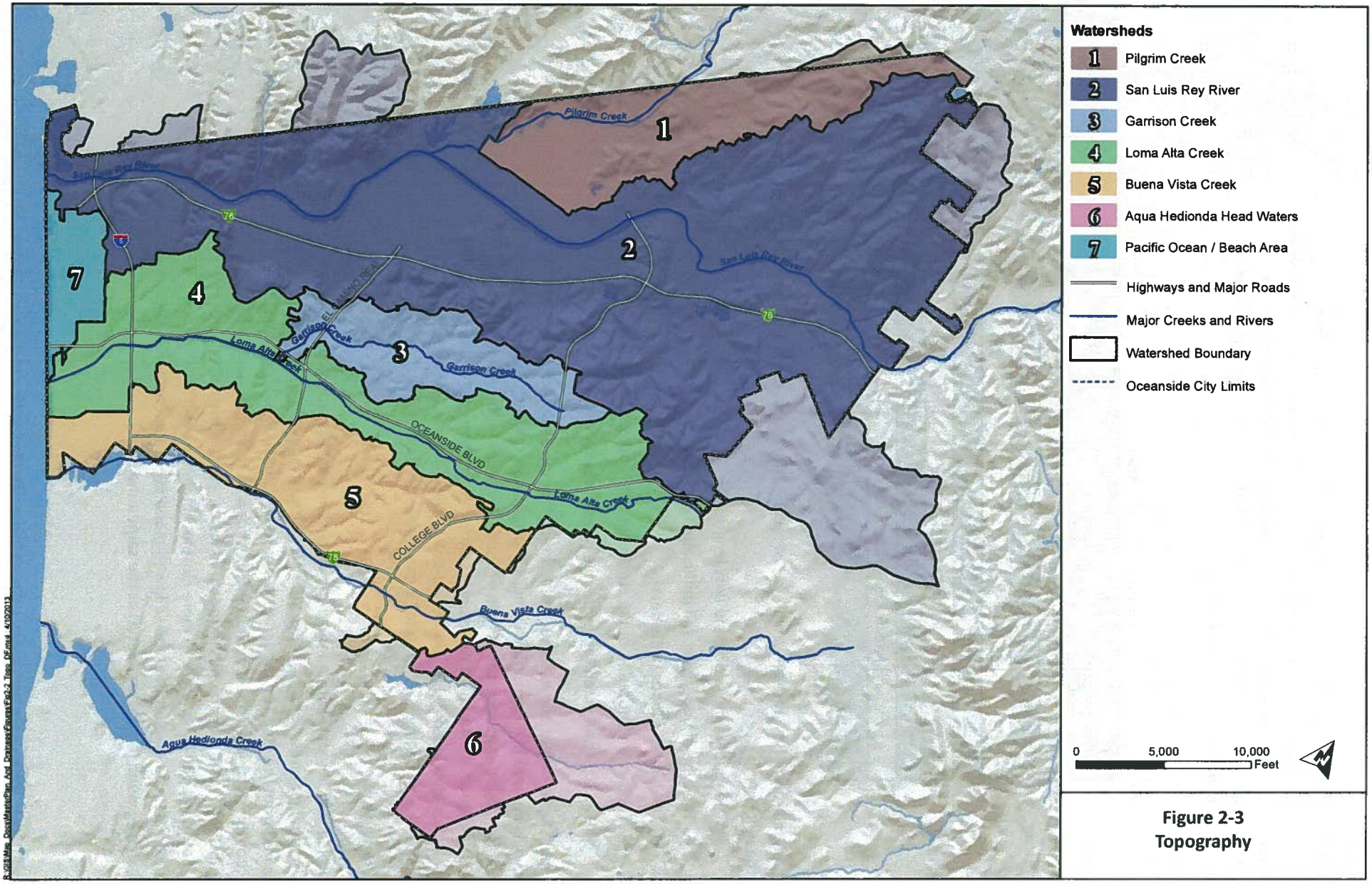


Figure 2-3
Topography

Soils

Soil types directly affect the amount of runoff from a particular site. This infiltration capacity, along with the slope and type of development on the site, directly correlates to the percentage of rainfall that reaches the drainage system.

The Natural Resources Conservation Service (NRCS), formerly Soil Conservation Service (SCS), defines four hydrologic soils groups:

Group A - *Soils have high infiltration rate when thoroughly wetted; chiefly deep, well-drained to excessively drained sand, gravel, or both. Rate of water transmission is high; thus runoff potential is low.*

Group B - *Soils have moderate infiltration rate when thoroughly wetted; chiefly soils that are moderately deep to deep, moderately well drained to well drained, and moderately coarse textured. Rate of water transmission is moderate.*

Group C - *Soils have slow infiltration rate when thoroughly wetted; chiefly soils that have a layer impeding downward movement of water, or moderately fine to fine textured soils that have a slow infiltration rate. Rate of water transmission is slow.*

Group D - *Soils have very slow infiltration rate when thoroughly wetted; chiefly clays that have a high shrink-swell potential, soils that have a high permanent water table, soils that have a clay pan or clay layer at or near the surface, or soils that are shallow over nearly impervious material. Rate of water transmission is very slow.*

Figure 2-4 on the following page shows the soil groups and their percentage within Oceanside's boundaries. As shown, Group D is the predominant soil type within the City. Because of more clay type soils, there will obviously be higher runoff and less infiltration.

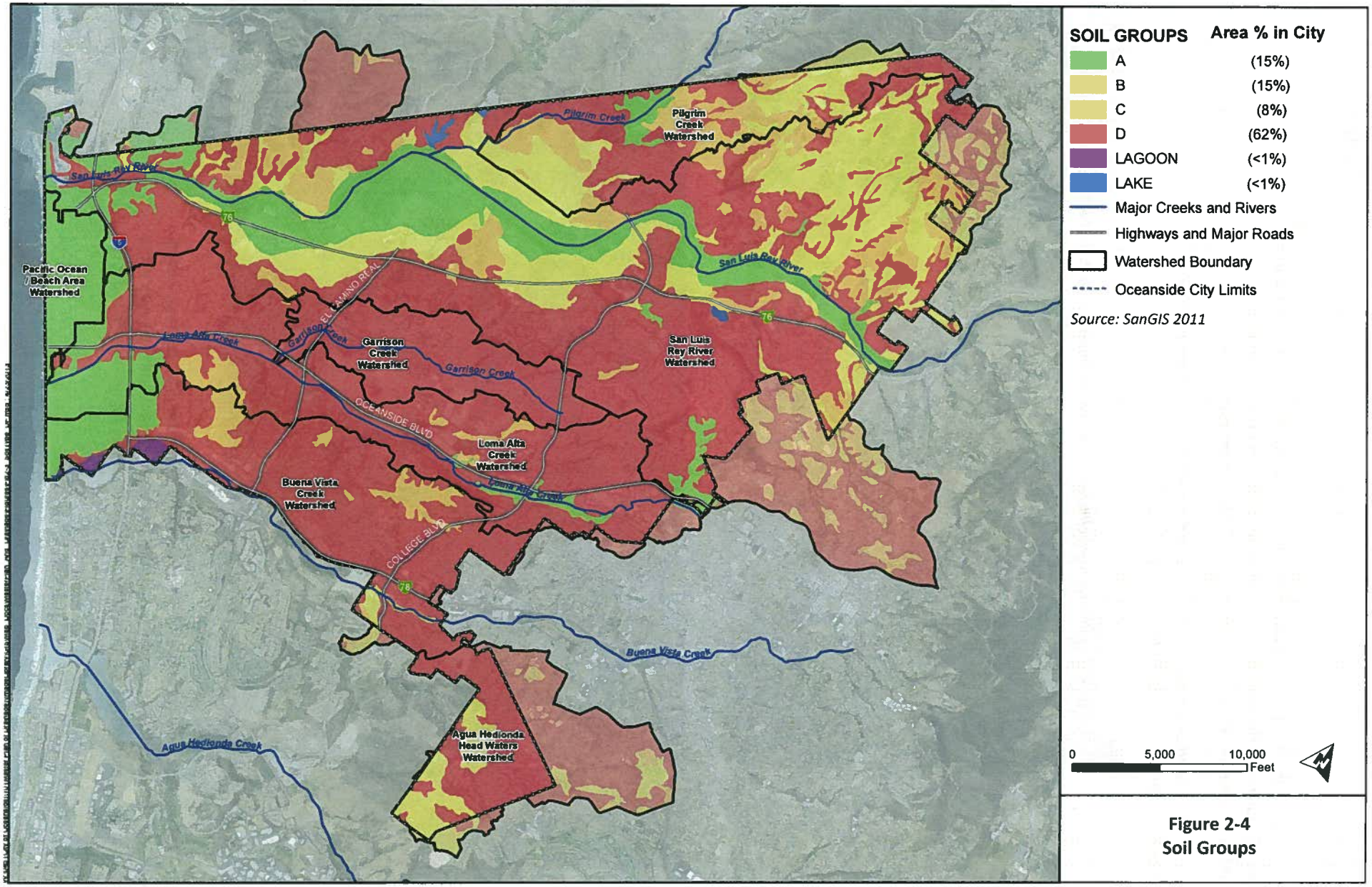


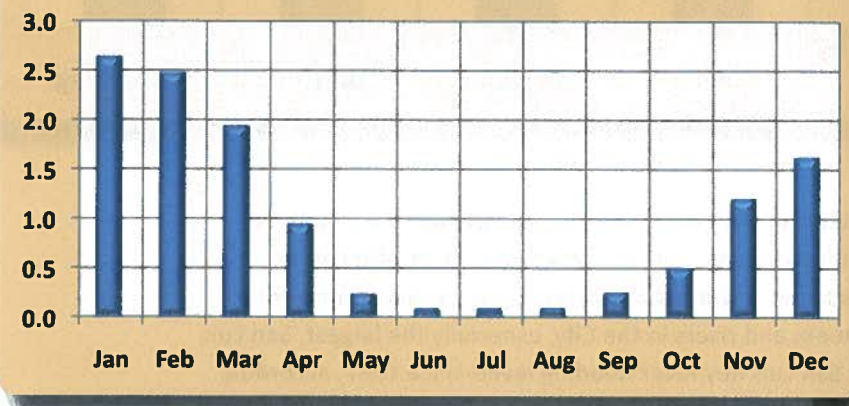
Figure 2-4
Soil Groups

Climate

Rainfall

Oceanside rainfall is highly seasonal, as shown in **Figure 2-5**, with approximately 60% occurring during the wettest months of January, February and March, and only 2% during the driest months of June, July and August. Apart from the seasonal cycle, long-term variations in precipitation associated with El Niño and La Niña phenomena have been observed in Oceanside (and are common to all of Southern California).

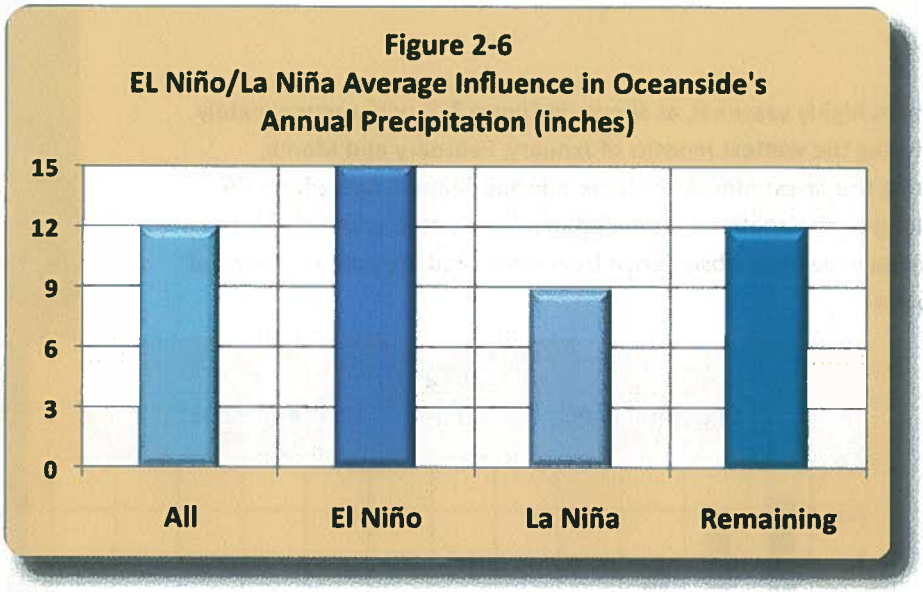
Figure 2-5
Seasonal Precipitation In Oceanside (inches)



El Niño–Southern Oscillation (ENSO), or El Niño/La Niña–Southern Oscillation, is a quasi-periodic climate pattern that occurs across the tropical Pacific Ocean roughly every five years. The Southern Oscillation refers to variations in the temperature of the surface of the tropical eastern Pacific Ocean (warming and cooling known as El Niño and La Niña respectively) and in surface air pressure in the tropical western Pacific. The two variations are coupled: the warm oceanic phase, El Niño, accompanies high air surface pressure in the western Pacific, while the cold phase, La Niña, accompanies low surface air pressure in the eastern Pacific.

From 1952 to 2011, the eight strongest El Niño events (nine years total) averaged annual rainfall of 15.0-inches, while the seven strongest La Niña events (nine years total) averaged an annual rainfall of 8.7-inches. The remaining 42 years (weak or absent El Niño / La Niña effects) have an average of 11.9-inches, the same value measured when all years were considered (**Figure 2-6**).

ENSO is responsible for precipitation variations in many regions of the world, including Southern California. Here, El Niño years are usually associated with above-normal precipitation (sometimes it may not occur, as during the strong El Niño year from August 1986 to July 1987 with 10.0-inches of rain), while La Niña years are usually associated with below-normal precipitation (the only exception in the last 60 years being the strong La Niña year of May 2010 to April 2011, with 20.3-inches of rain).



Flooding

Flooding events in Oceanside can often be localized and associated with intense storms overwhelming the local drainage system, which may be insufficient in certain areas. Flooding is also more widespread and large-scale, associated with the flooding of the main creeks and rivers in the City, especially the largest, San Luis Rey River. The two highest San Luis Rey River flooding levels since 1937, according to NOAA, occurred January 16, 1993, after more than 10-inches of rain in the City during the previous 20 days, and likely due to higher precipitation levels in the upstream portions of the watershed.

Additionally, flooding occurred in January 11, 2005, after about 8.5-inches of rain the previous 15 days, and persistent rain since December 14, 2004, in the watershed. Although rainfall is the main contributing factor to flooding, other factors, including antecedent soil moisture conditions before the storm, potentially occurring snow melt in the high mountains, and initial level of the upstream reservoirs may increase flooding conditions downstream.

Buena Vista Creek

Land Use

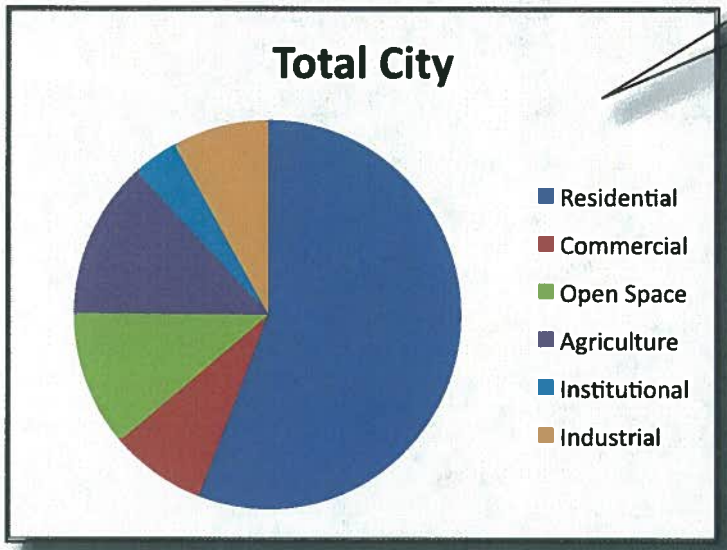
As previously noted, ultimate land use is an important indicator of runoff potential. One of the tasks for this MPD, therefore, was to create a GIS based land use map showing the ultimate build-out condition per the General Plan.

TRWE started with parcel boundaries, then overlaid a CAD land use map, used GIS to create land use shape files, and labeled these areas according to the City's 2007 Generalized Land Use Map designations. The coastal region was defined by the City's Local Coastal Program Map. For drainage areas that extended beyond the city limits, TRWE used the surrounding area's land use designations (SanGIS, Carlsbad, Vista) to generate runoff potential for this study.

The results of the GIS land use data yielded the results shown in **Table 2-2** and **Figure 2-7**.

Table 2-2
Ultimate Land Use by Watershed

Land Use Class	Pilgrim Creek	San Luis Rey River	Garrison Creek	Loma Alta Creek	Buena Vista Creek	Agua Hedionda Head Waters	Pacific Ocean / Beach Area	Total City
Residential	71%	48%	62%	52%	69%	89%	59%	56%
Commercial	0%	6%	2%	9%	19%	5%	32%	8%
Open Space	12%	16%	8%	6%	7%	3%	6%	11%
Agriculture	16%	23%	0%	0%	0%	0%	0%	13%
Institutional	1%	4%	8%	3%	5%	3%	2%	4%
Industrial	0%	3%	20%	30%	0%	0%	1%	8%



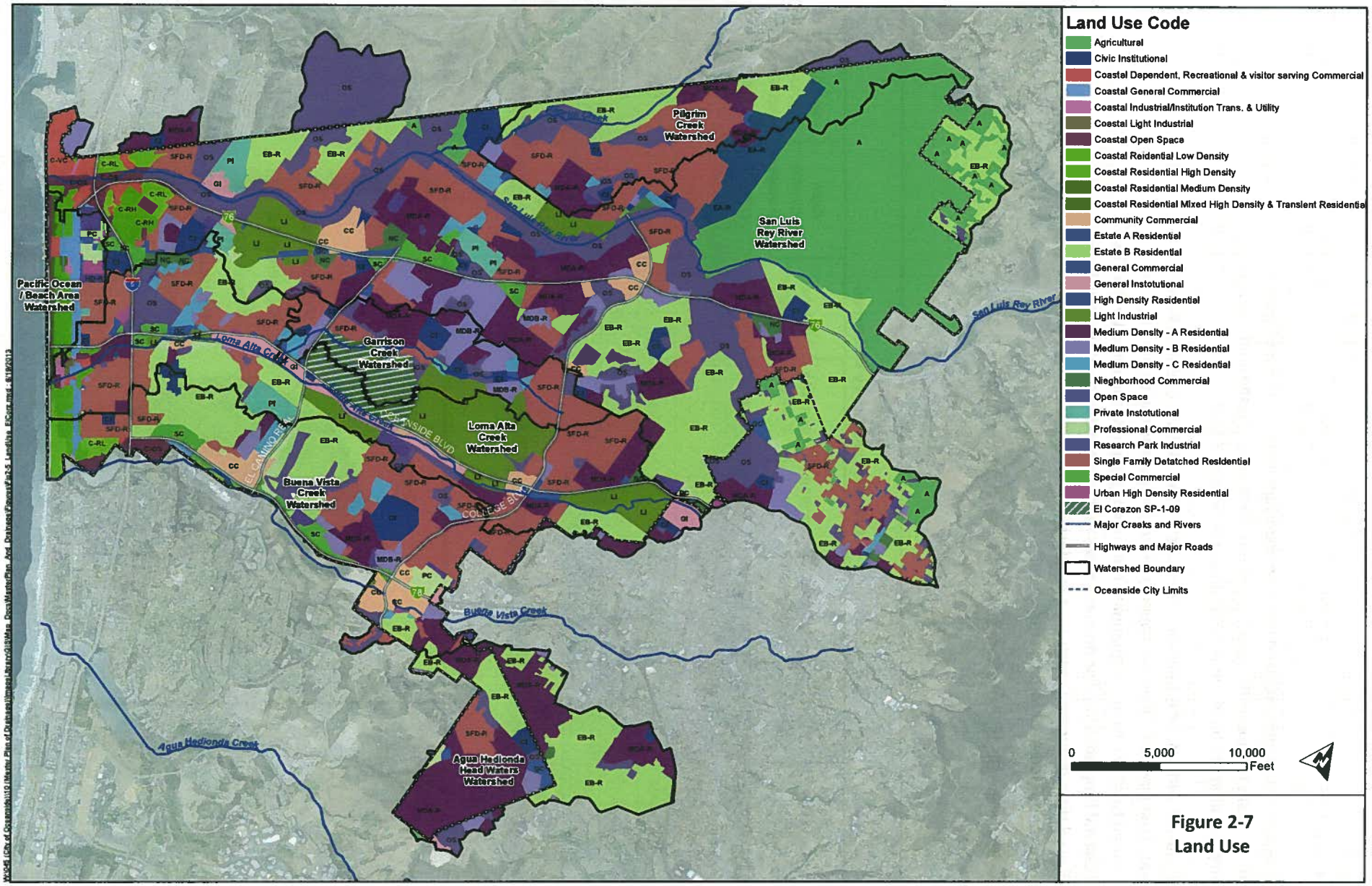


Figure 2-7
Land Use

3. ANALYSIS

Hydrologic and Hydraulic Analysis

A hydrologic and hydraulic model was created in xpstorm© to assess the capacity of the MPD system facilities. The model, using the runoff potential and precipitation for each sub-basin, generated a runoff peak flow and volume. These volumes and peak flows were routed through existing MPD facilities to check for their adequacy.

The hydrology methodology employed for this MPD was the Soil Conservation Service (SCS) Unit Hydrograph (UH) hydrologic method. SCS UH methodology was selected due to its applicability to large scale watersheds and the ability to model peak flows and volumes. The SCS UH method requires the following input:

- Tributary basin area
- Runoff potential [Curve Numbers (CN)]
- Time to peak (T_p)
- Precipitation

Once these inputs have been incorporated within the SCS UH analysis, rainfall precipitation is routed over a tributary basin whose infiltration and surface routing characteristics have been defined by the corresponding CN and T_p calculations. This routing over the basin then results in a hydrograph, providing a detailed analysis of flow experienced over the duration of a storm event.

The generated hydrographs were then routed via a hydraulic network consisting of MPD storm drains, culverts, detention basins and urban open channels. An underground storm drain was deemed hydraulically sufficient if the drain was able to contain the hydraulic grade line (HGL) beneath the rim elevation of the upstream and downstream cleanout structure, effectively ensuring that there was no surface drainage experienced during the storm event.

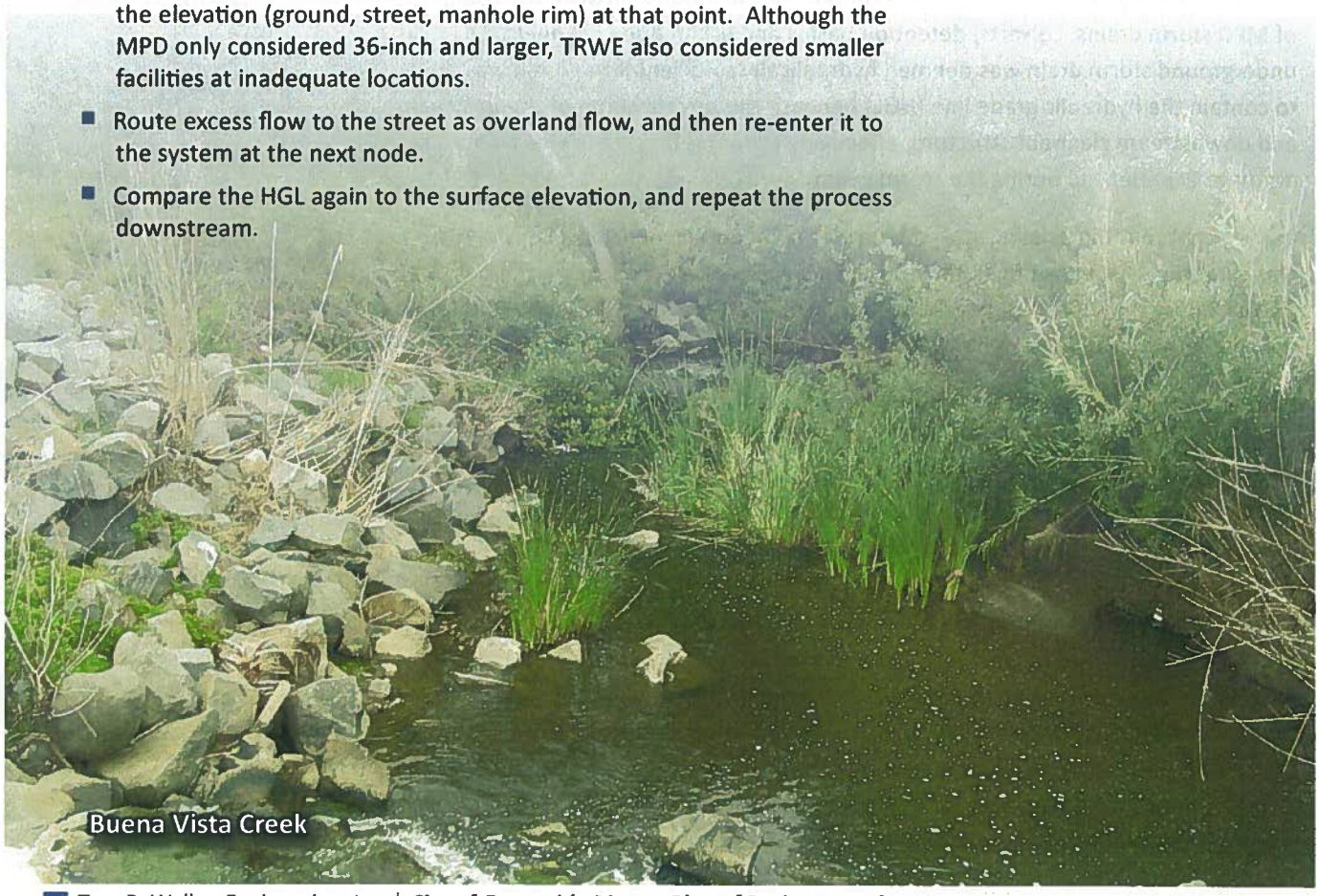
In the event that the existing storm drain was hydraulically deficient (i.e. the HGL was exceeding rim elevations), the excess flow was modeled via an overland flow route. This was undertaken to ensure that, not only were all flows accounted for, but that locations of potential surface flooding could be easily identified.

For the purpose of this master planning effort, TRWE have made a general assumption that underground storm drain facilities will be considered adequate (in terms of capacity only) when they have the capacity to convey at least a 25-year design storm. It is common policy and practice for many public agencies to adopt a 25-year frequency for design of public and private underground storm drain systems (e.g., Orange County and Los Angeles County). Where such policies exist, there is usually also a limit to the size or type of structure, beyond which a 50-year or 100-year storm is required for design. The reasoning behind this policy is in the recognition that these underground storm drain systems typically are under streets, which are also designed to convey storm flows and often have more capacity than the underground systems. As it is also important to maintain vehicular capacity and safety in streets, and especially for emergency vehicles, it is also common to require designs to ensure at least one dry lane in major storm events.

Analysis Methodology

Using the previous master plan as a guide, the City's major watersheds were first divided into basins, then those basins were further divided into sub-basins. The following procedure, graphically illustrated in **Figure 3-1**, was used to prepare each sub-basin for analysis:

- Utilize the previous MPD sub-basin drainage area delineation as a starting point.
- Adjust sub-basin boundaries where new construction altered drainage patterns. Smaller sub-basins areas from the previous study were combined to allow for more efficient modeling.
- Tabularize average Curve Numbers (CN) with Oceanside's land use designations. **Table 3-1** lists the average CN values for this study.
- Calculate weighted CNs in GIS based on the area of land use overlaying the soils group. **Figures 3-2 and 3-3** are GIS plots of the weighted CN values.
- Compile flow lengths and slopes in GIS for each sub-basin and export the data for hydrologic analysis.
- Generate rainfall volumes and peaks for the 2-, 10-, 25-, and 100-yr storms, using NOAA Atlas 14 precipitation (see **Appendix**).
- Route flow downstream by node. Nodes were defined where the facility began, where the size, material or slope changed, or where additional flows entered the system. Manning's roughness of 0.014 was used for concrete pipes and 0.025 for corrugated metal pipes.
- Flag existing pipe as undersized if the hydraulic grade line (HGL) exceeds the elevation (ground, street, manhole rim) at that point. Although the MPD only considered 36-inch and larger, TRWE also considered smaller facilities at inadequate locations.
- Route excess flow to the street as overland flow, and then re-enter it to the system at the next node.
- Compare the HGL again to the surface elevation, and repeat the process downstream.


Buena Vista Creek

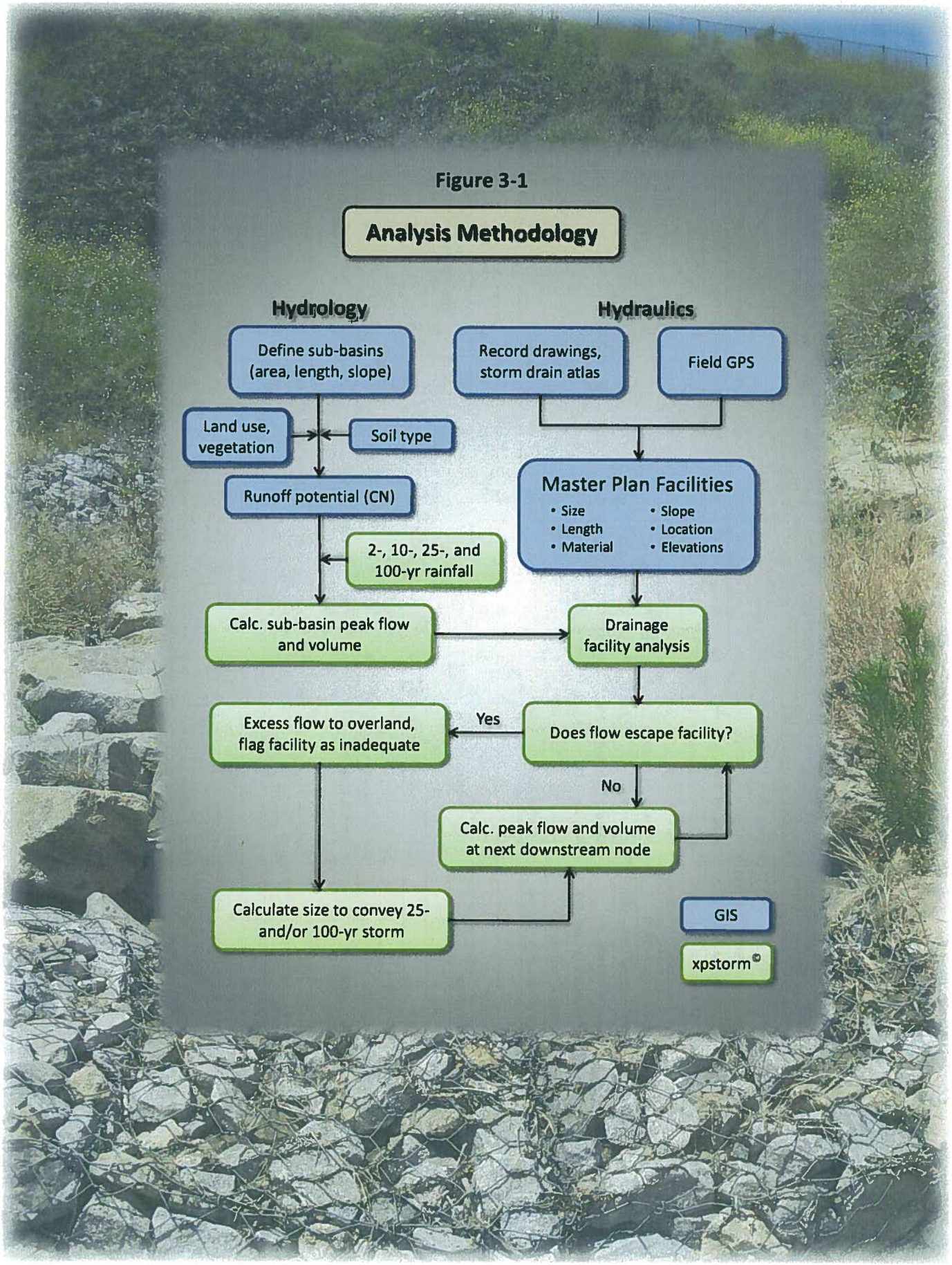

Analysis Methodology
Hydrology
Hydraulics
Define sub-basins (area, length, slope)
Record drawings, storm drain atlas
Field GPS
Land use, vegetation
Soil type
Runoff potential (CN)
Master Plan Facilities
• Size
• Length
• Material
• Slope
• Location
• Elevations
2-, 10-, 25-, and 100-yr rainfall
Calc. sub-basin peak flow and volume
Drainage facility analysis
Excess flow to overland, flag facility as inadequate
Yes
Does flow escape facility?
No
Calc. peak flow and volume at next downstream node
Calculate size to convey 25- and/or 100-yr storm
GIS
xpstorm©

Figure 3-1

Table 3-1, Land Use Loss Rates

City of Oceanside General and Coastal Plan Land Use		San Diego County 2003 Hydrology Manual *(For Reference Only)*		Rational Method "C"				SCS UH Method Curve Number "CN" 50, 100-year storm				SCS UH Method Curve Number "CN" 2, 5, 10, 25-year storm			
Residential			*% Impervious*	*Soil A*	*Soil B*	*Soil C*	*Soil D*	*Soil A*	*Soil B*	*Soil C*	*Soil D*	*Soil A*	*Soil B*	*Soil C*	*Soil D*
EA-R	Estate A Residential (0.5 - 0.9 DU/A)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41	44	64	77	82	35	54	68	74
EB-R	Estate B Residential (1.0 - 3.5)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49	53	70	80	85	43	60	71	77
SFD-R	Single Family Detached Residential (3.6 - 5.9)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52	57	72	81	86	47	62	73	79
MDA-R	Medium Density - A Residential (6.0 - 9.9)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57	61	75	83	88	51	66	75	81
MDB-R	Medium Density - B Residential (10.0 - 15.0)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60	64	77	85	89	54	68	77	83
MDC-R	Medium Density - C Residential (15.1 - 20.9)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63	67	79	86	90	57	70	79	84
HD-R	High Density Residential (21.0 - 28.9)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71	77	85	90	92	68	77	84	87
UHD-R	Ultra High Density Residential (29.0 - 43.0)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79	86	90	93	94	79	84	88	90
C-RL	Low Density Residential (coastal), R-1	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57	61	75	83	88	51	66	75	81
C-RM	Medium Density Residential (coastal), R-2	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63	67	79	86	90	57	70	79	84
C-RH	High Density Residential (coastal), R-3	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79	86	90	93	94	79	84	88	90
C-RMHT	Mixed High Density & Trans. Res. (coastal)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79	86	90	93	94	79	84	88	90
Commercial															
CC	Community Commercial	Neighborhood Commercial	80	0.76	0.77	0.78	0.79	86	90	93	94	79	84	88	90
NC	Neighborhood Commercial	Neighborhood Commercial	80	0.76	0.80	0.78	0.79	86	90	93	94	79	84	88	90
GC	General Commercial	General Commercial	85	0.80	0.84	0.81	0.82	89	92	94	95	83	87	90	91
SC	Special Commercial	Office Professional/Commercial	90	0.83	0.84	0.84	0.85	92	94	96	96	87	90	93	93
PC	Professional Commercial	Office Professional/Commercial	90	0.83	0.80	0.84	0.85	92	94	96	96	87	90	93	93
C-GC	General Commercial (coastal)	General Commercial	85	0.83	0.80	0.81	0.82	89	92	94	95	83	87	90	91
C-VC	Commercial Visitor (coastal)	General Commercial	85	0.80	0.80	0.81	0.82	89	92	94	95	83	87	90	91
Open Space															
OS	Open Space	Permanent Open Space	0	0.20	0.25	0.30	0.35	55	72	81	86	45	62	73	79
C-OS	Open Space (coastal)	Permanent Open Space	0	0.20	0.25	0.30	0.35	55	72	81	86	45	62	73	79
Agriculture															
A	Agricultural	Permanent Open Space	0	0.20	0.25	0.30	0.35	55	72	81	86	45	62	73	79
Institutional															
CI	Civic Institutional	Neighborhood Commercial	80	0.76	0.77	0.78	0.79	86	90	93	94	79	84	88	90
PI	Private Institutional	Neighborhood Commercial	80	0.76	0.77	0.78	0.79	86	90	93	94	79	84	88	90
Industrial															
GI	General Industrial	General Industrial	95	0.87	0.87	0.87	0.87	95	96	97	97	91	93	94	94
LI	Light Industrial	Limited Industrial	90	0.83	0.84	0.84	0.85	92	94	96	96	87	90	93	93
RP-I	Research Park Industrial	General Industrial	95	0.87	0.87	0.87	0.87	95	96	97	97	91	93	94	94
C-LI	Light Industrial (coastal)	Limited Industrial	90	0.83	0.84	0.84	0.85	92	94	96	96	87	90	93	93
C-TU	Transportation & Utility (coastal)	General Industrial	95	0.87	0.87	0.87	0.87	95	96	97	97	91	93	94	94

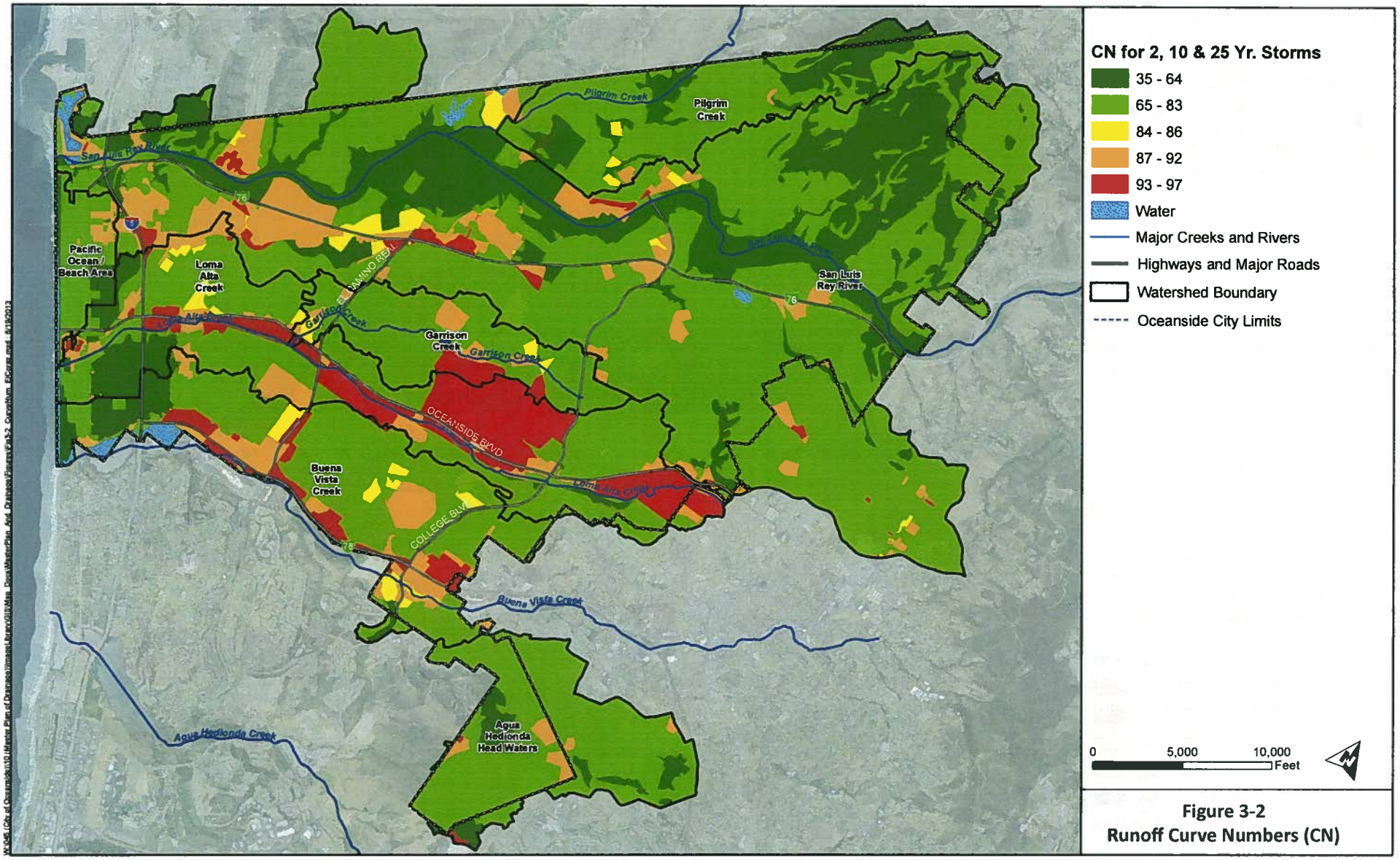


Figure 3-2
Runoff Curve Numbers (CN)

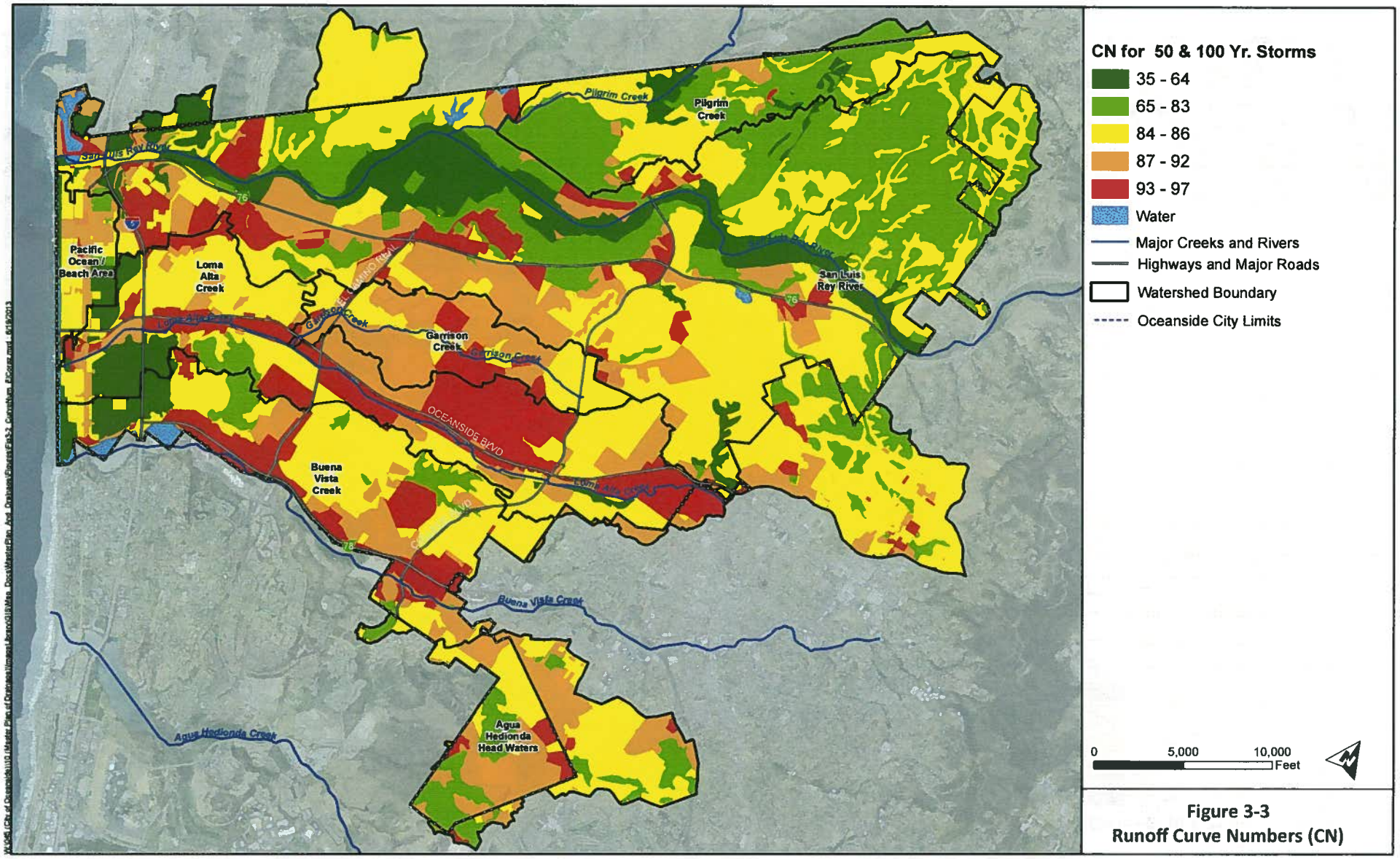


Figure 3-3
Runoff Curve Numbers (CN)

Chosen Method: NOAA Atlas 14

The third intensity distribution considered is the analysis of the National Oceanic and Atmospheric Administration (NOAA) data. The NOAA methodology is an improvement over the SDCHM Methodology, and it is based on the NOAA web-page Tables (**Appendix D**). An analysis of the intensity values suggest that a power-law extrapolation has been performed for intensities smaller than 1 hour, as there are not known long-extended records of precipitation measured in less than 60 minute time intervals (at least not known by the authors of this study).

For this analysis, TRWE divided Oceanside into three precipitation regions from east to west. Precipitation for each region was obtained by selecting a representative point on the NOAA Precipitation Frequency Data Server (PFDS).

Comparison of Results

Figure 3-4 shows the distribution of a 6-hour, 100-year storm event using the nested methodology and the intensity equations (or tables in the case of NOAA) explained here. It is clear that the SDCHM rainfall values are the highest, followed by the NOAA tables, and then by the TRWE Method.

Figure 3-4
Comparison of 6hr-100yr Precipitation (2.75 inches), 10 Minute Interval

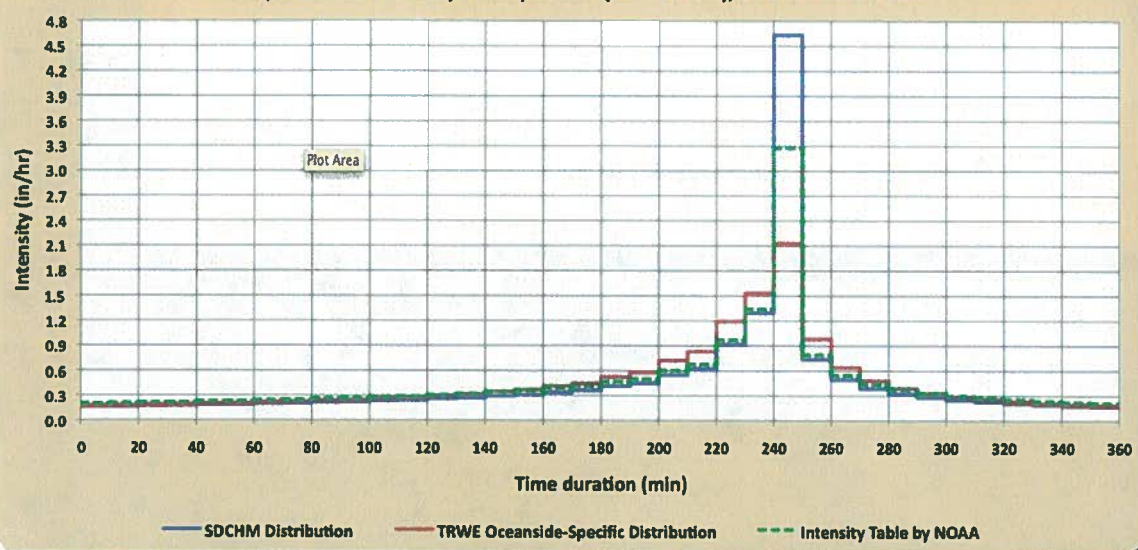
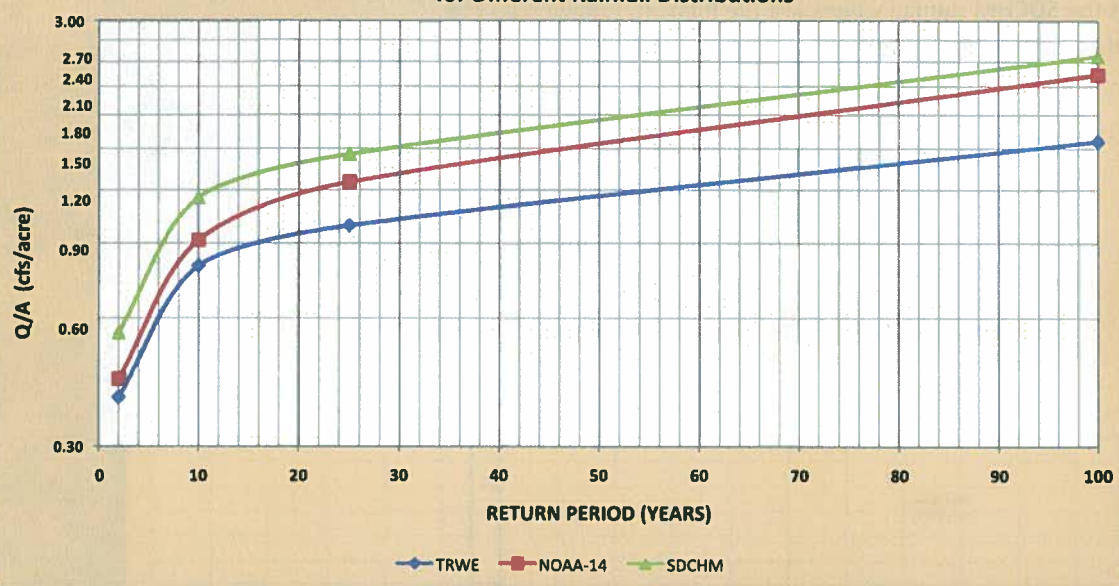


Figure 3-5 illustrates variation of the peak flow estimates per unit area in Garrison Creek depending on the intensity equation selected. In all cases the TRWE Method determines the lowest values, followed by NOAA and then the SDCHM equation, which generates the largest results. NOAA values are closer to TRWE values than to SDCHM values for return periods smaller than 25 years and closer to SDCHM values than to TRWE values for return period equal to or larger than 25 years.

For reasons already discussed, the NOAA information is used for the MPD, which generates intermediate results between the two other methods, and is an improvement over the current estimates obtained with the SDCHM. NOAA is also a nationally recognized authority on weather analysis, and their method is being incorporated into other southern California public agencies' methods.

Figure 3-5: Comparison of Peak Flow for Garrison Creek at Different Return Periods for Different Rainfall Distributions



Geographic Information System (GIS)

One of the tasks for this study was to develop a Master Plan specific GIS database of MPD facilities. GIS is a program that stores and visually portrays data. By querying the data with specific requests, the user can visualize data in ways to quickly reveal relationships, patterns, and trends. This more detailed geo-spatially referenced data allows for better hydrologic and hydraulic analysis of the storm drainage system. This data could also be used in the future for water quality studies, more detailed system analysis, and to identify potential utility conflicts.

The storm drain facility data was organized according to a GIS template developed by the City. TRWE populated the fields that pertained to the MPD, including the facility size, material, length, slope, invert elevations, as-built plan and date, and editor comments. ESRI's ArcGIS© program was used for this study.

The following steps were used to build the City's storm drain GIS database:

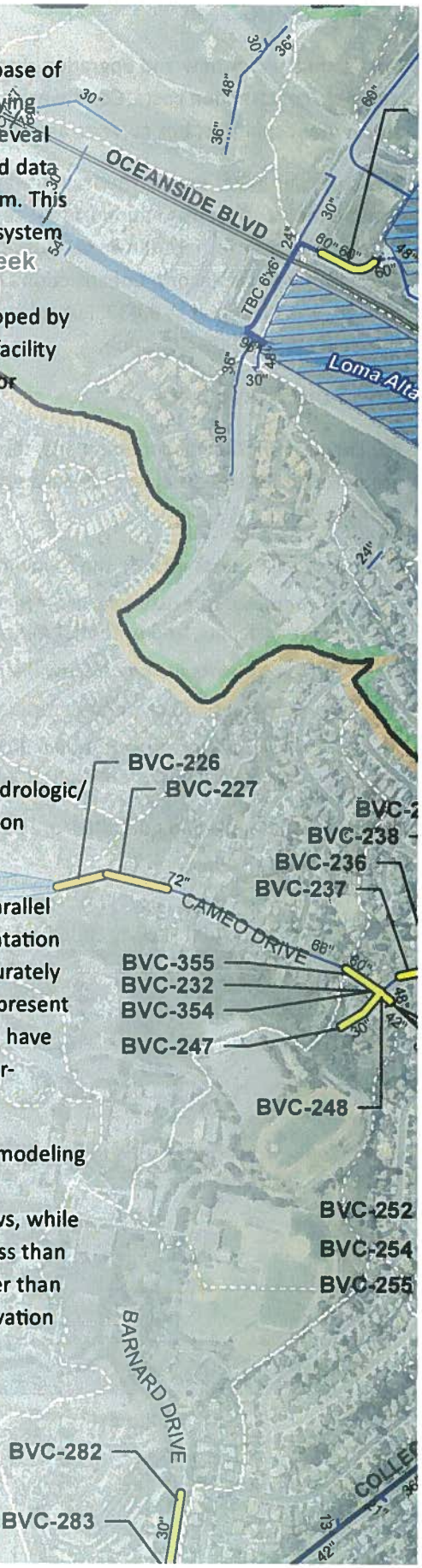
- Utilize the City's GIS template and field GPS data
- Use the City's map atlas to locate as-built plans
- Reference the existing facilities to the aerial mapping
- Locate the facility plans and input the MPD specific data
- Verify data and export to the modeling program

Computer Modeling

At TRWE's recommendation, the City selected xpstorm© (by xp software), a hydrologic/ hydraulic model. It is a dynamic modeling tool for storm water systems based on SWMM that was originally developed by the EPA.

This model identifies system deficiencies, optimizes pond detention, routes parallel flows, and models the timing of hydrographs to give a more accurate representation of flows. Previous master plans used a limited static model that could not accurately model peak flows. Since these older/ traditional models do not adequately represent dual drainage systems (e.g., pipe and street flows together), complex analyses have almost never been attempted, which sometimes results in guesswork and over-designed facilities.

With the surface topography and accurate storm drain data both in GIS, such modeling can be done with greater accuracy. The combined conveyance capacity of the subsurface storm drain and the overland street section can convey design flows, while still maintaining a computed hydraulic grade line or water surface elevation less than a standard gutter section depth. Storm drains that result in flow depths greater than the street section can be categorized as potential problem areas. Detailed elevation information in GIS is essential for modeling these dual drainage systems.



Cost Estimate Basis

Cost estimates for new and upgraded storm drain facilities were based on an opinion of probable construction costs. Costs were estimated on a per linear foot basis for circular storm drain conduits, box culverts and channels (where applicable).

The costs per linear foot of the facility were developed using approximate current construction costs, information from recent construction bid estimates, and from cost information gathered from various agencies and sources. In addition, the current Engineering News Record, Construction Cost Index (ENR CCI) for Los Angeles for January 2013 is noted as 9,437. Future construction cost opinions can be adjusted on the then current ENR CCI value.

Storm Drain Unit Costs

For circular reinforced concrete pipes, the base unit construction costs per linear foot are noted in **Table 3-1** below. The base unit costs for reinforced box culverts are shown in **Table 3-2**.

The total facility costs include the following:

- Removal of existing facility, trenching, bedding, compaction, backfill, trench resurfacing, and potential relocation of existing minor utilities.
- Box culverts include headwall and wing walls.
- Curb inlet and catch basin upgrades, additions, and/or modifications.
- Markups were an additional 50% of base construction cost (see the description of the anticipated markups at the end of this section).

Construction details and quantities are based on the *San Diego Regional Standard Drawings*.

Table 3-1
RCP Storm Drain Facility Unit Cost

Diameter (inches)	Total Facility Costs (per LF)
36	$530
42	$620
48	$720
54	$800
60	$870
66	$920
72	$990
78	$1,040
84	$1,120
90	$1,160
96	$1,220

Table 3-2
RCB Storm Drain Facility Unit Cost

Ht x W (feet)	Total Facility Costs (per LF)
2 x 3	$420
Dbl 3 x 6	$1,390
Dbl 3 x 8	$1,730
Tri 5 x 8	$2,700
5 x 8	$1,080
6 x 8	$1,170

Precipitation

This section summarizes TRWE's examination of alternative precipitation distribution methods by analyzing intensity values which are site-specific to the City of Oceanside. Three methods were analyzed: the SDCHM Method, the TRWE Method (developed specifically for this MPD and explained below), and the NOAA Atlas 14 Method. Although the TRWE Method is site specific and statistically solid, the NOAA Method was selected, as it produces intermediate results and comes from tables provided by a well-established weather source.

Background: SDCHM Method

Since its adoption by the County in 2003, the *San Diego County Hydrology Manual* (SDCHM) has been the guide followed by most engineers and designers to estimate extreme precipitation events in San Diego County. The SDCHM focuses on the 6-hour storm event (P_6) at a given period of return. As long as P_6 is between 45% to 65% of the 24–hour precipitation event, P_{24}, a condition that always occurs within the limits of the City of Oceanside (mathematically $0.45 \cdot P_{24} < P_6 < 0.65 \cdot P_{24}$), there is no need to apply any correction to the 6-hour precipitation value. The maximum intensity is then obtained with the following power-law equation:

$$I_T = 7.44 \cdot P_{6,T} \cdot t^{-0.645} \qquad \textbf{(1)}$$

where, I_T (in inches per hour) is the intensity at a given return period T, with duration of t minutes, as a function of the 6-hour storm event with a return period T.

In order to estimate the precipitation distribution, **equation (1)** is used in 5 or 10 minute intervals. The maximum intensity is calculated with the nested-storm procedure, assuming that the precipitation peak occurs after 2/3 of the storm has passed. In other words, the highest 5 minute intensity in a 6-hour storm beginning at noon, occurs between 4:00 p.m. to 4:05 p.m.; while the highest 5 minute intensity in a 24-hour storm analysis starting at midnight, also occurs between 4:00 p.m. and 4:05 p.m.

San Luis Rey River Watershed

For this method, modification of the nested storm procedure has not been attempted. The peak flow will occur at the beginning of the 4th hour in a 6-hour storm analysis, and the remaining intensities would be positioned as explained in the SDCHM. However, there have been significant discrepancies in terms of the adequacy of the intensity equation, as the values of intensity for short durations (which are the ones that generate the peak flows of most analyses) are unrealistically large and not supported by the precipitation data. For this reason, two additional methods were a part of this study: first, an analysis of 57 years of Oceanside hourly precipitation time series data as published by the clean water web page (***http://projectcleanwater.org/html/wg_susmp.html***) and as used for continuous simulation analysis in hydromodification studies (known from this point forward as the TRWE Method); and second, precipitation frequency estimates as assigned by NOAA as a function of the location (known from this point forward as the NOAA Method).

Additional Intensity Calculations: the TRWE Method

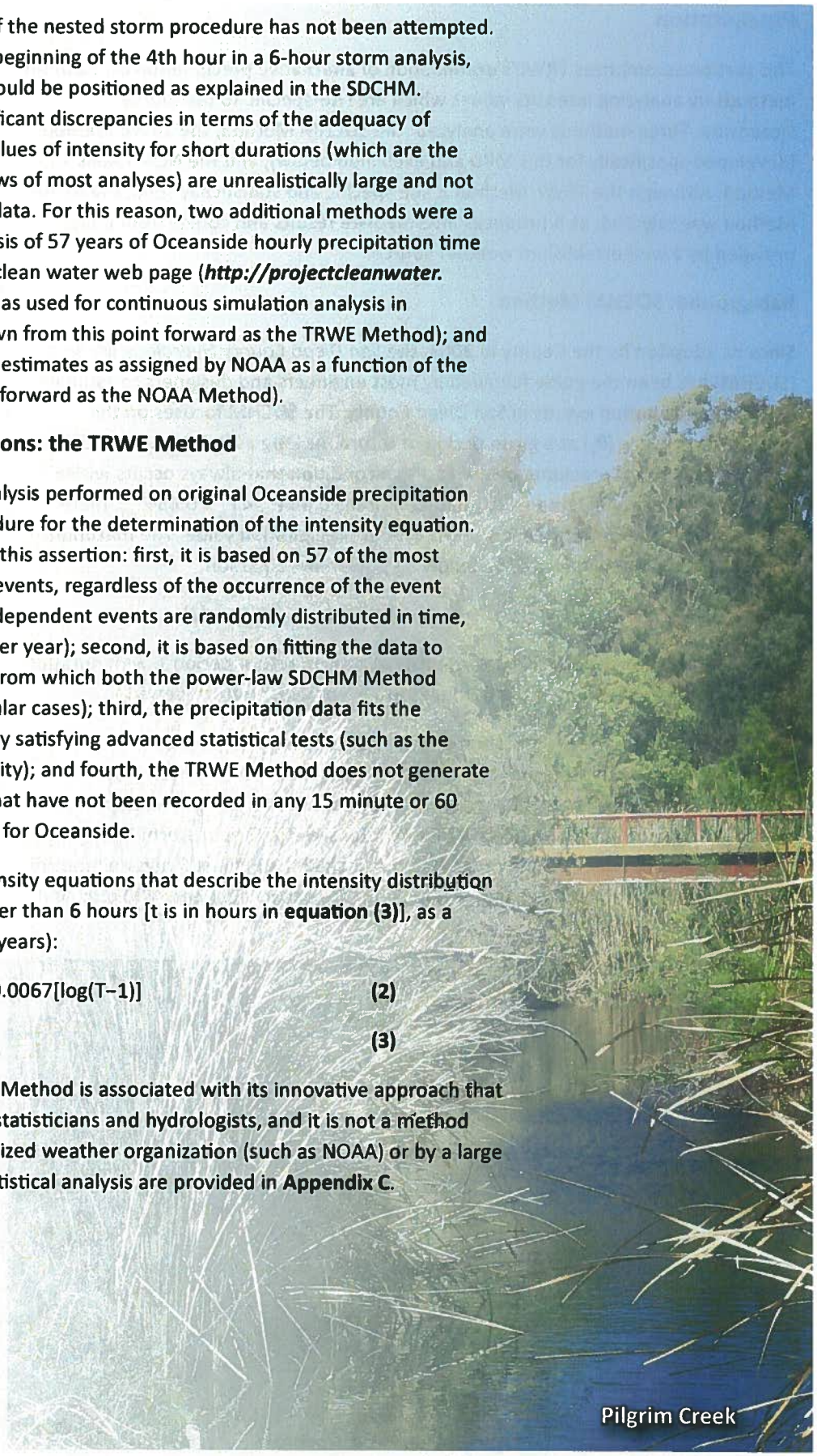
It is TRWE's opinion that the analysis performed on original Oceanside precipitation data is the most accurate procedure for the determination of the intensity equation. There are four main reasons for this assertion: first, it is based on 57 of the most extreme independent intensity events, regardless of the occurrence of the event (meaning that the 57 highest independent events are randomly distributed in time, and not assigned as one event per year); second, it is based on fitting the data to the general intensity equation (from which both the power-law SDCHM Method and the NOAA Tables are particular cases); third, the precipitation data fits the statistical distribution selected by satisfying advanced statistical tests (such as the Anderson-Darling test of normality); and fourth, the TRWE Method does not generate unreasonably large intensities that have not been recorded in any 15 minute or 60 minute measurements available for Oceanside.

The following are the set of intensity equations that describe the intensity distribution I (in/hr) for time durations smaller than 6 hours [t is in hours in **equation (3)**], as a function of the return period T (years):

$$B = 0.407+0.027[\log(T-1)]^2-0.0067[\log(T-1)] \qquad \textbf{(2)}$$

$$I = (P_6/6)+[(6+B)/(t+B)]^{0.675} \qquad \textbf{(3)}$$

The only drawback of the TRWE Method is associated with its innovative approach that has not been peer-reviewed by statisticians and hydrologists, and it is not a method published by a nationally recognized weather organization (such as NOAA) or by a large public agency. Details of the statistical analysis are provided in **Appendix C**.


Pilgrim Creek

Markups

Markups totaling 50% were applied to the costs for both circular storm drains and box culverts/channels as follows:

Design Services – 25%

- Agency processing and permitting
- Facility design
- Construction drawings and specifications
- As-built plans

Construction Services – 15%

- Contract management
- Utility location services
- Coordination with other utility agencies
- Construction inspection

Contingencies – 10%

- Unforeseen project conditions

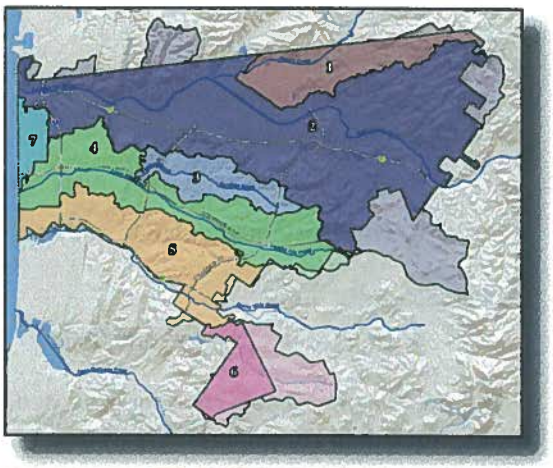
This opinion of probable costs for proposed facility upgrades does not include procurement of easements, right-of-way, environmental costs, and difficult locations. For facilities that were impacted by these potential costs, an additional 20% to 80% cost should be applied on a case-by-case basis.

The opinion of probable costs provided in this MPD update were planning level/ conceptual project estimates, with markups added as noted to account for some of the unknowns. Actual construction costs for new and upgraded facilities may vary due to more detailed site-specific variables typically encountered at final design and construction phase. TRWE does not guarantee the accuracy of the opinion as compared to actual bids or costs to the City.

4. FINDINGS

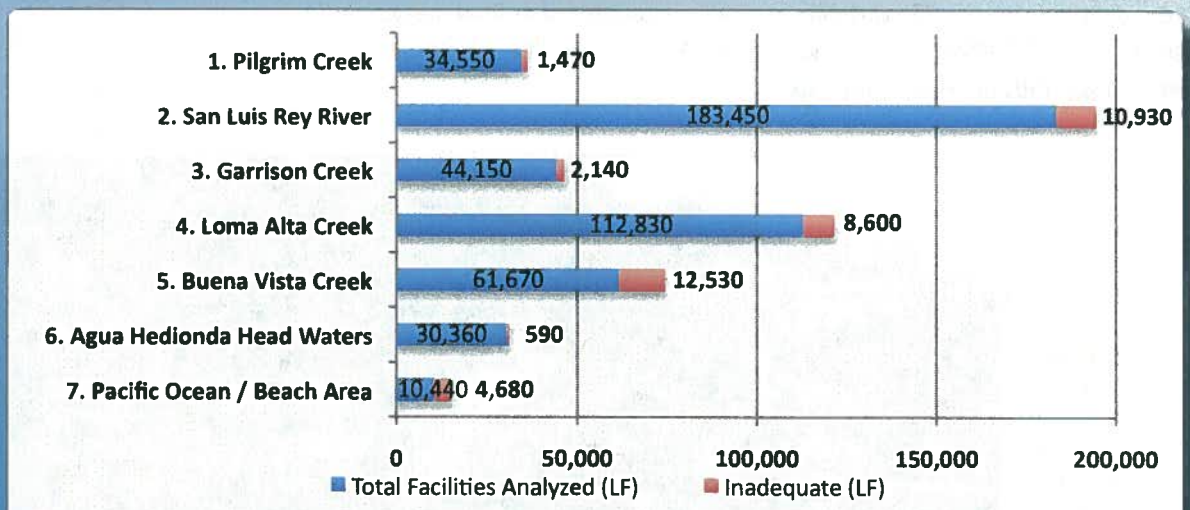
Summary

This section summarizes results of TRWE's analysis for the City's MPD facilities. Existing drainage facilities, 30-inches and larger, were analyzed for the 2-, 10-, 25-, and 100-year storms. Those facilities that overflowed during 2-, 10- and 25-year storms were upsized to carry the 25-year and 100-year storms. Facilities that overflowed during a 100-year storm were upsized to convey the 100-year storm. No facitlities analyzed were inadequate for the 2-year storm. Recommended facility sizes listed are minimum sizes based on hydraulic analysis only; and therefore might be larger in some cases. The following tables, organized by drainage watershed, list the inadequate facilities along with the calculated larger sizes to convey that storm.



At the end of this report is the **Storm Drain Atlas**. This collection of 11" x 17" maps show only the existing storm drain facilities used in this analysis and if they are adequate to convey the study storms. Existing facilities that were found to be undersized are color-coded for the size of storm that the computer model showed overflowing. The label on the maps corresponds to the facilities on the following tables. Unless otherwise noted, circular facilities include arch and ellipse pipes.

Figure 4-1
Summary of Storm Drain Analysis



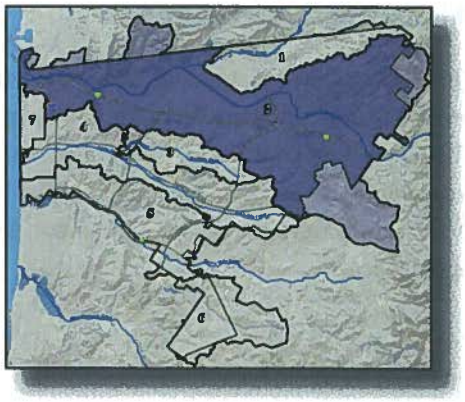
Pilgrim Creek Watershed

The Pilgrim Creek watershed is in the northern part of the City, and receives some drainage from Marine Corps Base Camp Pendleton. The watershed contains nature preserves along with housing. Flow from Pilgrim Creek joins the San Luis Rey River, west of Douglas Drive. The watershed is 71% residential, 16% agriculture use and 12% open space.

Table 4-1
Pilgrim Creek Watershed
Recommended Storm Drain Facility Improvements

Facility ID	Atlas Page	Existing			Min. Storm for Inadequate Facility			Recommended Size to Convey	
		Facility Type	Size (inches)	Length (feet)	10-year	25-year	100-year	25-year	100-year
PC-148	D	CIPP	30	242			●		36
PC-149	D	CIPP	30	498		◆		36	42
PC-179	C	RCP	36	213			●		42
PC-200	D	CIPP	30	517	■			42	60

San Luis Rey River Watershed



The San Luis Rey River watershed is the largest drainage watershed in the city. It drains approximately 560 square miles, with its headwaters at Hot Springs Mountain (elevation 6,400 feet). Upstream flow is controlled by the Lake Henshaw Dam. The US Army Corps of Engineers (Corps) has conducted numerous studies of the river. Corps levees along portions of the river control the higher flows. Within the city, the watershed is 48% residential, 23% agriculture use, and 16% open space.

Table 4-2
San Luis Rey River Watershed
Recommended Storm Drain Facility Improvements

Facility ID	Atlas Page	Existing			Min. Storm for Inadequate Facility			Recommended Size to Convey	
		Facility Type	Size (inches)	Length (feet)	10-year	25-year	100-year	25-year	100-year
SLR-7	O	RCP	36	664			●		42
SLR-42	O	Unknown	36	100			●		42
SLR-51	J	Parallel RCPs	42	100			●		48
SLR-52	J		42	100			●		48
SLR-72	I	RCP	33	181			●		42
SLR-90	I	CIPP	72	233			●		78
SLR-92	I	CIPP	72	258			●		78
SLR-120	I	RCP	48	54			●		84
SLR-121	I	RCP	36	37			●		54
SLR-122	I	RCP	30	253			●		36
SLR-123	I	RCP	30	219			●		42
SLR-124	I	RCP	60	522			●		66
SLR-125	I	RCP	60	537			●		66
SLR-127	I	RCP	60	97			●		66
SLR-153	I	Single Box Culvert	6'x8'	68			●		6'x8'
SLR-154	I	Single Box Culvert	6'x8'	20			●		6'x8'

Table 4-2
San Luis Rey River Watershed
Recommended Storm Drain Facility Improvements

Facility ID	Atlas Page	Existing			Min. Storm for Inadequate Facility			Recommended Size to Convey	
		Facility Type	Size (inches)	Length (feet)	10-year	25-year	100-year	25-year	100-year
SLR-155	I	RCP	66	428			●		72
SLR-158	I	RCP	60	275			●		66
SLR-188	I	RCP	30	232			●		36
SLR-267	N	CIPP	30	337			●		36
SLR-288	I	RCP	30	296			●		36
SLR-289	I	RCP	30	197			●		36
SLR-300	I	RCP	48	468			●		60
SLR-311	H	RCP	36	346			●		42
SLR-319	H	RCP	30	289			●		36
SLR-320	I	RCP	30	246			●		36
SLR-321	I	RCP	30	257			●		42
SLR-379	H	RCP	60	264			●		66
SLR-424	I	RCP	30	216			●		42
SLR-556	H	RCP	36	148			●		48
SLR-558	H	RCP	36	443			●		48
SLR-559	H	RCP	30	160			●		42
SLR-560	H	RCP	30	104			●		36
SLR-563	H	RCP	30	328			●		48
SLR-603	H	RCP	36	66			●		42
SLR-678	H	RCP	30	98			●		42
SLR-679	H	RCP	30	98			●		42
SLR-680	H	RCP	30	98			●		42
SLR-681	H	Parallel RCPs	24	98			●		48
SLR-685	H		24	98			●		48

Table 4-2
San Luis Rey River Watershed
Recommended Storm Drain Facility Improvements

Facility ID	Atlas Page	Existing			Min. Storm for Inadequate Facility			Recommended Size to Convey	
		Facility Type	Size (inches)	Length (feet)	10-year	25-year	100-year	25-year	100-year
SLR-707	C	RCP	30	183			●		42
SLR-725	G	CMP	36	131		◆		42	48
SLR-727	G	CMP	36	28		◆		42	60
SLR-728	G	CMP	36	118		◆		42	60
SLR-732	G	RCP	30	160		◆		48	60
SLR-738	G	RCP	30	37			●		54
SLR-845	H	RCP	36	36			●		42
SLR-861	G	Double Box Culvert	2.5'x5' ea	54			●		Dbl 3' x 6'
SLR-863	G	Single Box Culvert	2'x6'	75			●		Dbl 3' x 6'
SLR-866	A	RCP	33	247			●		48
SLR-885	H	Unknown	30	530			●		36
SLR-909	H	RCP	48	249			●		54

Garrison Creek Watershed

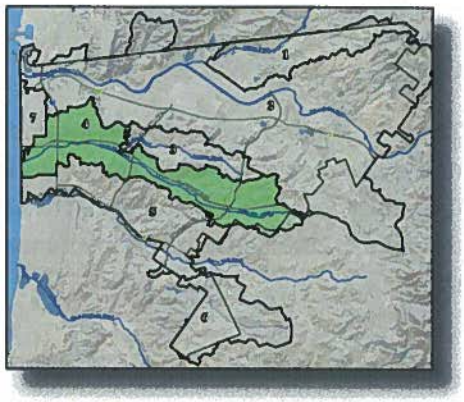
The Garrison Creek watershed is located at the center of the city. It a smaller basin and drains into Loma Alta Creek just west of El Camino Real. The watershed is 62% residential, 20% industrial, 8% institutional and 8% open space.

Table 4-3
Garrison Creek Watershed
Recommended Storm Drain Facility Improvements

Facility ID	Atlas Page	Existing			Min. Storm for Inadequate Facility			Recommended Size to Convey	
		Facility Type	Size (inches)	Length (feet)	10-year	25-year	100-year	25-year	100-year
GC-97	H	RCP	36	280			●		72
GC-98	H	RCP	36	325			●		60
GC-99	H	RCP	36	50			●		60
GC-170	H	RCP	60	208			●		96
GC-176	G	CIPP (Parallel to 84")	72	500			●		78
GC-177	G	CIPP (Parallel to 84")	72	577		◆		78	84
GC-178	H	CIPP	66	171			●		96
GC-191	G	Trapezoidal channel under road	54" deep	31			●		(1)

(1) requires detailed analysis

Loma Alta Creek Watershed



The Loma Alta Creek watershed is over seven square miles in size and is almost all contained within Oceanside. It extends over seven miles inland to an elevation of 640 feet. The watershed is 52% residential, 30% industrial, 9% commercial and 6% open space.

Table 4-4
Loma Alta Creek Watershed
Recommended Storm Drain Facility Improvements

Facility ID	Atlas Page	Existing			Min. Storm for Inadequate Facility			Recommended Size to Convey	
		Facility Type	Size (inches)	Length (feet)	10-year	25-year	100-year	25-year	100-year
LAC-43	M	RCP	30	124			●		42
LAC-44	M	RCP	30	45			●		36
LAC-45	M	RCP	30	183			●		36
LAC-46	M	RCP	30	33			●		36
LAC-70	M	CIPP	48	414			●		54
LAC-75	M	CP	48	354			●		54
LAC-76	M	CP	48	233			●		78
LAC-149	M	CIPP	36	78			●		42
LAC-150	M	CIPP	36	194			●		42
LAC-193	L	Rock Lined Channel	60" deep	323			●		(1)
LAC-247	M	Triple Box Culvert	5' x 6' ea	53			●		5' x 8' ea

(1) requires detailed analysis

Table 4-4
Loma Alta Creek Watershed
Recommended Storm Drain Facility Improvements

Facility ID	Atlas Page	Existing			Min. Storm for Inadequate Facility			Recommended Size to Convey	
		Facility Type	Size (inches)	Length (feet)	10-year	25-year	100-year	25-year	100-year
LAC-422	M	RCP	30	147			●		36
LAC-489	G	CMPE	42	446	■			54	66
LAC-490	G	RCP	36	56	■			48	60
LAC-501	F	RCP	30	207		◆		42	48
LAC-502	F	RCP	30	68			●		42
LAC-504	F	RCP	36	40			●		42
LAC-505	F	RCP	36	56			●		48
LAC-507	F	RCP	36	87			●		48
LAC-528	F	RCP	30	41	■			42	54
LAC-529	F	RCP	30	71	■			42	54
LAC-530	F	CMP	24	18	■			30	36
LAC-557	F	RCP	60	152			●		66
LAC-558	F	RCP	60	607			●		78
LAC-559	F	RCP	60	200			●		66
LAC-562	F	RCP	72	325			●		78
LAC-563	F	RCP	72	342			●		78
LAC-565	F	Single Box Culvert	5' x 6'	43			●		5' x 8'
LAC-570	F	Single Box Culvert	5' x 6'	142			●		5' x 8'
LAC-572	F	RCP	36	30			●		42
LAC-578	F	Parallel RCPs	24	99			●		60
LAC-579	F		24	99			●		60
LAC-587	F	RCP	36	138			●		42
LAC-601	F	RCP	54	237			●		60
LAC-602	F	RCP	54	109			●		60
LAC-603	F	RCP	48	242			●		60

Table 4-4
Loma Alta Creek Watershed
Recommended Storm Drain Facility Improvements

Facility ID	Atlas Page	Existing			Min. Storm for Inadequate Facility			Recommended Size to Convey	
		Facility Type	Size (inches)	Length (feet)	10-year	25-year	100-year	25-year	100-year
LAC-604	F	RCP	48	139			●		72
LAC-605	F	RCP	54	306			●		60
LAC-606	F	RCP	54	214			●		72
LAC-617	F	RCP	30	140			●		36
LAC-630	F	Double Box Culvert	3' x 5 ' ea	76			●		3' x 8' ea
LAC-634	F	Single Box Culvert	5' x 6'	187			●		5' x 8'
LAC-636	F	Parallel CMPEs	42	78			●		48
LAC-637	F		27	78			●		36
LAC-638	F		42	78			●		48
LAC-639	F		27	78			●		36
LAC-689	F	RCP	30	150			●		42
LAC-717	G	CMPE	36	23	■			36	42
LAC-718	G	CMPE	36	307			●		66
LAC-719	G	CMPE	36	41	■			48	60
LAC-730	F	Concrete Open Channel	48 deep	674			●		54

Buena Vista Creek Watershed

The Buena Vista Creek watershed is in the southern portion of the city. This watershed also receives part of its flow from the City of Carlsbad to the south. Buena Vista Creek generally follows State Route 78, which is predominately commercial development. The watershed is 69% residential land, 19% commercial and 7% open space.

Table 4-5
Buena Vista Creek Watershed
Recommended Storm Drain Facility Improvements

Facility ID	Atlas Page	Existing			Min. Storm for Inadequate Facility			Recommended Size to Convey	
		Facility Type	Size (inches)	Length (feet)	10-year	25-year	100-year	25-year	100-year
BVC-2	K	Single Box Culvert	1'x3'	90			●		2' x 3'
BVC-78	K	RCP	60	356		◆			72
BVC-79	K	RCP	60	142			●		72
BVC-81	L	CIPP	48	100		◆		54	72
BVC-82	L	CIPP	48	106			●		72
BVC-85	L	CIPP	48	325			●		72
BVC-89	K	RCP	36	128			●		48
BVC-102	L	RCP	42	52		◆		54	66
BVC-103	L	RCP	42	20		◆		54	66
BVC-109	L	RCP	30	273			●		48
BVC-126	P	RCP	30	72			●		42
BVC-127	P	RCP	30	118			●		36
BVC-129	P	RCP	30	40			●		48
BVC-134	P	RCP	30	112			●		36
BVC-136	P	RCP	36	355			●		42
BVC-138	L	SRSP	72	496			●		84
BVC-139	L	SRSP	72	311			●		84
BVC-140	L	SRSP	72	193			●		84

Table 4-5
Buena Vista Creek Watershed
Recommended Storm Drain Facility Improvements

Facility ID	Atlas Page	Existing			Min. Storm for Inadequate Facility			Recommended Size to Convey	
		Facility Type	Size (inches)	Length (feet)	10-year	25-year	100-year	25-year	100-year
BVC-141	L	SRSP	72	503			●		84
BVC-179	L	RCP	30	225			●		36
BVC-183	L	RCP	30	260		◆		36	42
BVC-184	L	RCP	30	191		◆		36	42
BVC-185	L	RCP	30	281	■			42	48
BVC-186	L	RCP	30	175	■			42	54
BVC-187	L	RCP	36	168		◆		48	54
BVC-188	L	RCP	36	108		◆		54	60
BVC-189	L	RCP	42	294			●		60
BVC-190	L	RCP	42	108			●		54
BVC-191	L	RCP	42	61			●		54
BVC-198	L	RCP	48	96			●		54
BVC-199	L	RCP	48	17			●		60
BVC-224	L	CIPP	36	248			●		42
BVC-226	L	RCP	72	279			●		84
BVC-227	L	CIPP	72	341		◆		78	84
BVC-231	L	CIPP	48	76			●		72
BVC-232	L	CIPP	60	105			●		72
BVC-236	L	CIPP	30	37			●		36
BVC-237	L	CIPP	30	162			●		36
BVC-238	L	CIPP	30	241			●		36
BVC-239	L	CIPP	30	271			●		36
BVC-243	M	RCP	30	50			●		42
BVC-247	L	RCP	30	143			●		36
BVC-248	L	RCP	30	151			●		36

Table 4-5
Buena Vista Creek Watershed
Recommended Storm Drain Facility Improvements

Facility ID	Atlas Page	Existing			Min. Storm for Inadequate Facility			Recommended Size to Convey	
		Facility Type	Size (inches)	Length (feet)	10-year	25-year	100-year	25-year	100-year
BVC-252	L	CIPP	42	361			●		54
BVC-254	L	CIPP	42	90			●		54
BVC-255	L	CIPP	42	87			●		48
BVC-258	M	RCP	36	274			●		54
BVC-259	M	RCP	30	57		◆	●	42	54
BVC-264	P	RCP	42	127			●		48
BVC-282	L	RCP	30	351			●		36
BVC-283	L	RCP	33	380			●		36
BVC-287	P	CMP	72	57			●		78
BVC-289	P	CMP	72	709			●		78
BVC-321	P	RCP	42	25			●		48
BVC-322	P	RCP	36	290		◆		42	54
BVC-323	P	RCP	36	15		◆		42	48
BVC-324	P	RCP	36	202			●		48
BVC-325	P	RCP	30	35		◆		42	54
BVC-326	P	RCP	30	40			●		54
BVC-330	P	RCP	48	210			●		54
BVC-353	L	CIPP	60	68			●		72
BVC-354	L	CIPP	60	105			●		72
BVC-355	L	CIPP	60	116			●		72

Agua Hedionda Head Waters Watershed

This drainage area tributary to Aqua Hedionda Creek (south of the city) is in the very southern portion of Oceanside. Drainage is into Calavera Creek and Little Encinas Creek, which also run through the City of Carlsbad to Agua Hedionda Creek and then to the Pacific Ocean. This watershed is predominately residential (89%) that has been mostly developed.

Table 4-6
Agua Hedionda Head Waters Watershed
Recommended Storm Drain Facility Improvements

Facility ID	Atlas Page	Existing			Min. Storm for Inadequate Facility			Recommended Size to Convey	
		Facility Type	Size (inches)	Length (feet)	10-year	25-year	100-year	25-year	100-year
AH-1	P	RCP	30	29			●		36
AH-2	P	RCP	30	115			●		36
AH-10	P	RCP	60	174			●		66
AH-98	Q	RCP	30	276			●		36

Pacific Ocean/Beach Area Watershed

The Pacific Ocean/Beach Area is located at the western edge of the city, along the Pacific Ocean. This one square mile area is an older section of the city with many smaller homes and apartments. Most of the drainage is carried by street flow in steeper areas and by pipes in the flatter areas. This older area of the city is 59% residential and 32% commercial land use.

Table 4-7
Pacific Ocean/Beach Area Watershed
Computed Storm Drain Facility Improvements

Facility ID	Atlas Page	Existing			Min. Storm for Inadequate Facility			Recommended Size to Convey	
		Facility Type	Size (inches)	Length (feet)	10-year	25-year	100-year	25-year	100-year
PO-9	F	RCP	42	41			●		48
PO-10	F	RCP	48	111			●		54
PO-11	F	CIPP	48	26			●		66
PO-13	F	CIPP	42	450			●		48
PO-15	F	CIPP	48	85			●		54
PO-16	F	RCP	48	61			●		54
PO-18	A	RCP	36	285			●		42
PO-19	A	RCP	30	584			●		36
PO-22	A	RCP	36	52	■			48	66
PO-23	A	RCP	36	364	■			54	66
PO-24	A	RCP	36	139		◆		48	66
PO-25	A	RCP	36	422		◆		42	60
PO-26	A	RCP	36	234	■			48	66
PO-27	A	RCP	30	52	■			36	48
PO-36	A	RCP	36	338	■			54	60
PO-37	A	RCP	36	756	■			72	72
PO-38	A	RCP	36	384	■			54	66
PO-39	A	RCP	30	301			●		36

Drainage District Fees

Periodically, a city needs to re-examine fees charged for drainage improvements. This updated MPD may be used to adjust or confirm drainage district fees. California Assembly Bill 1600 (Gov. Code, Sec 66000 et. seq.) requires that a public agency determine a reasonable relationship between the fees collected and the cost of public facilities.

The cost for drainage improvements have traditionally divided into two components; major watercourse facilities necessary to provide for the river/creek storm water runoff to the Pacific Ocean, and local facilities which carry runoff from the smaller drainage basins to the major watercourse. A local facility is defined as a MPD facility, having an equivalent conveyance to a 36-inch RCP or larger.

Existing drainage fees by Drainage District have been adopted by Ordinance No. 85-23 and Resolution No. 06-R0335-1. It is recommended, for now, that those fees remain the same, as shown below. This MPD is a stand alone document and does not attempt to update the fee structure.

Table 4-9
Drainage District Fees (per acre)

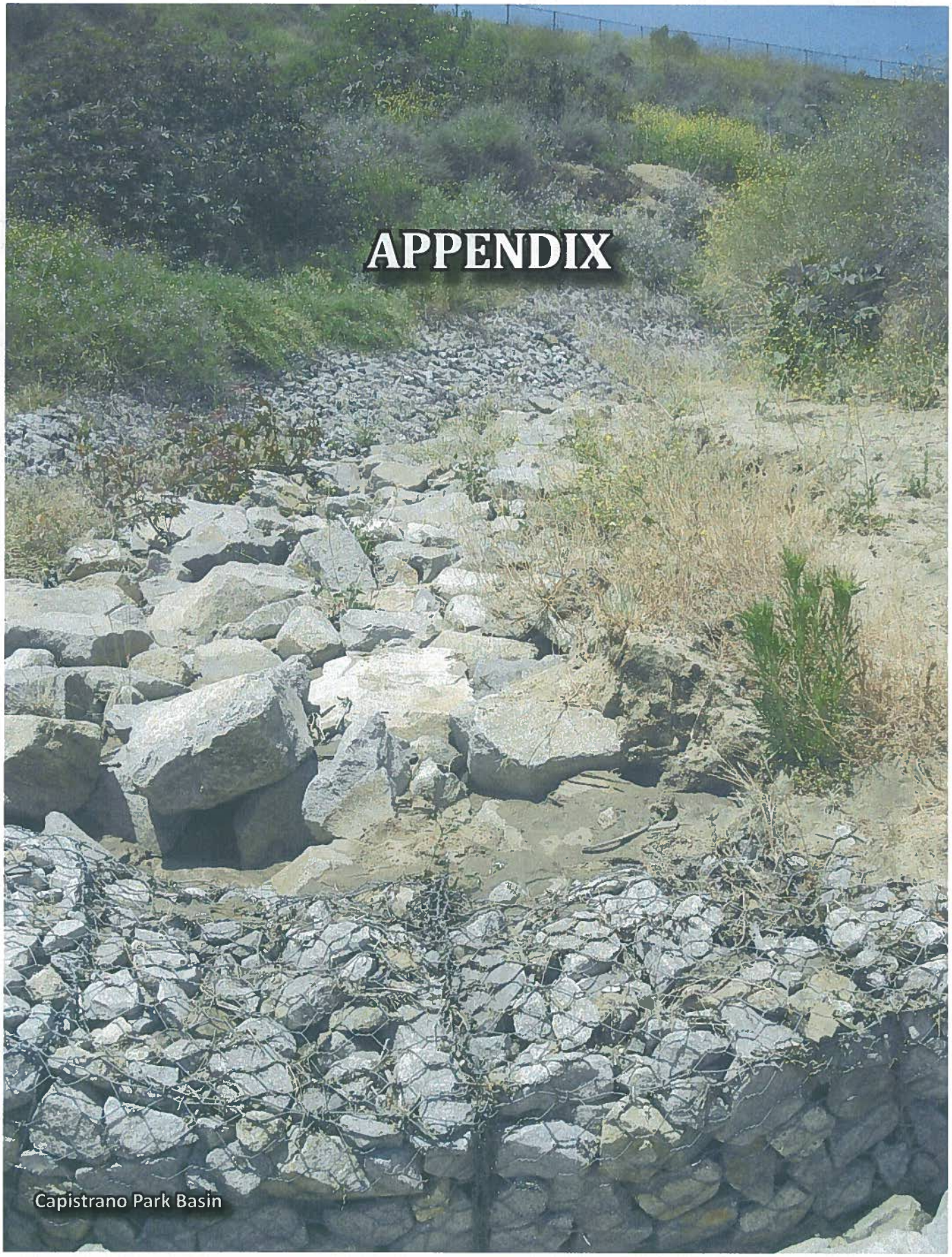
Drainage District	General Watershed Location	Major Watercourse Component	Local Facility Component	Total
I-a	San Luis Rey River	$3,842	$7,500	$11,342
I-b	San Luis Rey River	$3,842	$3,842	$7,684
I-c	San Luis Rey River	$3,842	$0	$3,842
I-d	San Luis Rey River, Pilgrim Creek	$3,842	$4,870	$8,712
II-a	Loma Alta Creek, Garrison Creek	$8,611	$7,353	$15,964
II-b	Loma Alta Creek	$8,611	$4,766	$13,377
III-a	Buena Vista Creek	$1,459	$2,460	$3,919
IV	Agua Hedionda Head Waters	$0	$5,988	$5,988
V	Pacific Ocean / Beach Area	$0	$2,843	$2,843

Drainage facilities required by new development should be financed by new development. As conditions of approval of a final Subdivision Map or building permits, the City may require the developer to construct all Master Plan facilities located on site at the developer's expense, with possible partial reimbursement from fees collected previously from other developers in the watershed.

In addition, the developer should fulfill one of the following alternatives to finance offsite drainage facilities:

1. Pay development impact fees for planned local drainage facilities established by local ordinance under the Subdivision Map Act.
2. Participate in formation of a drainage improvement district. If an improvement district is formed, a portion of the assessments may be credited against impact fees.
3. The developer may construct, as his/her expense, all those facilities required to serve his/her project and connect to any existing adequate facilities. Portions of these expenses may be reimbursed later if an improvement district is formed. The cost of construction of Master Plan facilities may be credited against assessments or fees.

APPENDIX



Capistrano Park Basin

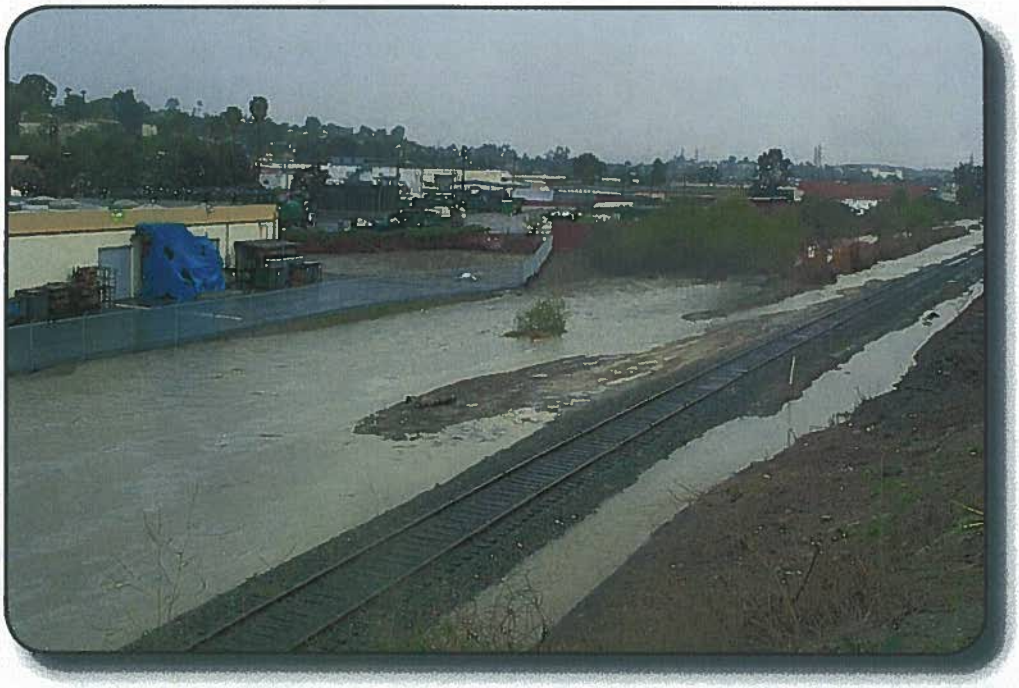
Appendix A

Loma Alta Creek – Optimization Study

Loma Alta Creek has a history of periodically overtopping its banks and flooding adjacent properties. A vast majority of the more flood prone areas are downstream (west) of El Camino Real. These areas include commercial and industrial properties along Industry Street and Oceanside Boulevard, adjacent to the creek. Many properties west of Interstate 5, mostly residential, are also prone to flooding in major storm events.

This problem was identified and studied years ago, and subsequently, three regional detention basins were designed to reduce the flood risks. Two of the detention basins have been designed and constructed (Garrison and El Camino Real); one remains to be constructed (Rancho Del Oro).

The frequency of flooding along Loma Alta Creek has increased with new development within the watershed and with encroachment within the floodplain and floodway. TRWE prepared an initial evaluation of ways to reduce flood risks along Loma Alta Creek, and primarily downstream of El Camino Real. Generally, the two primary means to reduce flood risk within a watershed are to reduce flood peak flows and/or to increase flood conveyance capacity. Therefore, possible solutions could include one or both means in some combination. The goal of this study was to identify an optimal approach to reduce flood risks by studying both means.



Toward that end, TRWE prepared several analyses that would assist in our evaluation. We prepared a precipitation analysis, which is summarized in **Section 3** and **Appendix C** of the MPD. We also prepared a new hydrologic analysis of the watershed, using xpswmm, which will also be useful for any future watershed studies. Lastly, TRWE prepared an optimization analysis, which consisted of two parts: a peak flow reduction optimization and a flow conveyance optimization. The precipitation and hydrologic analyses were used for the peak flow reduction analysis.

The peak flow reduction optimization analysis evaluated a number of modifications (and combinations of those modifications) to the three regional detention basins and to the Collins detention basins. Other potential detention basin locations were also evaluated. Our study found that any significant reductions in peak flows as a result of modifications to detention basins were essentially canceled out by a number of constraints:

1. The designs of the existing and proposed detention basins maximized the storage volumes of floodwater, based on a previous hydrologic methodology and criteria, which although acceptable at the time of design, presented a constraint for expanding the volumes of the basins.
2. Flow-through detention basins constructed in series are generally less efficient than basins constructed in parallel, since flow reductions tend to diminish as water is conveyed downstream.
3. The lower portion of the watershed is mostly built out. Much of the flow conveyed in Loma Alta Creek is generated from these downstream areas of the watershed, which reduces the effectiveness of upstream detention. No feasible locations for new detention in the lower portion of the watershed were identified, due to the built-out condition, including existing encroachment into the floodplain.

Our flow conveyance optimization analysis evaluated a number of alternative channel sections downstream of El Camino Real. Due to the lack of significant peak flow reduction from the other analyses, however, we determined that the opportunities for reducing flood risks through flow conveyance optimization were minimal without loss of property. This analysis also clearly demonstrated that the improvements made by the North County Transit District (NCTD) to the rail have significantly affected capacity and conveyance options. NCTD is the majority property owner of Special Flood Hazard Area (SFHA) designated land, located adjacent to Loma Alta Creek within the Optimization Study area. Therefore, City staff has recommended and encouraged NCTD staff to respond to the SPRINTER project impacts by forming and administering a Loma Alta Creek vegetation management assessment district. Annual financial contributions toward vegetation management within the assessment district should be divided proportionally; taking into consideration the land owner's percentage share land within the total assessment district area, as well as all respective benefits realized.

One additional analysis we performed was a very preliminary analysis that would incorporate the El Corazon pit at the northeast corner of El Camino Real and Oceanside Boulevard. This existing pit could retain a significant volume of storm flow and could feasibly be connected to either (or both) the Garrison Creek or El Camino Real detention basins. This concept is based on setting an overflow elevation in one of (or both) detention basins, such that the pit would receive flow only in very rare and severe storms (e.g., greater than 25-year or 50-year). Our preliminary analysis indicates this concept could greatly reduce downstream flooding impacts of extreme storm events. We recommend this concept be studied in more detail to determine the actual flow reduction that could be achieved.

In summary, the Loma Alta Creek optimization study indicates that a number of constraints combine to make potential flood risk reduction solutions problematic on a systematic basis. Flood protection measures on a property by property basis remain viable in many cases, however. Further study to incorporate the use of the El Corazon pit could yield a significant reduction in flood risk for extreme storm events.

Appendix B

Drainage System Design Criteria Memo

The City of Oceanside's "Drainage System Design Criteria" was last revised in 1992. It is incorporated into the City's "Engineers Design and Processing Manual" as Section 6. TRWE has reviewed this section and recommends its replacement with the more recent San Diego County Drainage Design Manual (DDM). Reasons for this recommendation include the fact that there have been a number of changes in methods and materials since 1992; also, the DDM was a rather thorough county-wide effort, carefully prepared by a team of engineering consultants and a Technical Advisory Committee (TAC).

The initial effort to prepare the DDM was completed in 2005, and the DDM was just recently updated, again with a project consultant and a TAC. Tory Walker was actively involved on the TAC for both efforts. The stated purpose of the DDM is as follows:

1.1 PURPOSE AND SCOPE

This Drainage Design Manual (Manual) establishes design standards and procedures for stormwater drainage and flood management facilities in San Diego County, California. These design standards and procedures provide guidance to local jurisdictions, design engineers, developers, contractors, and others in the selection, design, construction, and maintenance of stormwater drainage and flood management facilities. This Manual covers the following topics:

- Street Drainage and Inlets
- Storm Drains
- Culverts
- Open Channels
- Detention Basins
- Energy Dissipaters
- Debris Basins and Barriers

This manual limits its content to the planning and design infrastructure in the context of stormwater conveyance and flood management. For issues of stormwater quality, readers are directed to other resources, specifically the San Diego County Stormwater Standards Manual.

As noted above, the DDM was prepared with the intention of establishing design standards and procedures that would provide guidance throughout San Diego County. As part of the TAC, first in 2004 and 2005, then again in 2011 and 2012, Tory Walker and other TAC members spent many hours reviewing and making recommendations to incorporate into the DDM design standards, procedures and methods commonly used elsewhere in southern California. Most of these recommendations were accepted and were incorporated into the DDM.

Some of the publications reviewed for the DDM were included in the references (Section 5.3), but in addition to those listed in the references, the TAC reviewed and considered all the other southern California county drainage design manuals.

Because Los Angeles County's "Hydraulic Design Manual" was generally understood to be the standard by which to compare, and most other county manuals borrowed heavily from that manual, the TAC recommended limiting the list of references. Additional publications reviewed and considered included ones from Caltrans, Clark County (NV), Federal Highway Administration, U.S. Army Corps of Engineers, and American Public Works Association.

The extensive review of the various design standards, procedures and methods generated hours of discussion, drafts and revisions to the DDM. It is our opinion that, with the completion of the most recent revision, the DDM meets the goal of establishing drainage design criteria standards and procedures that should be used county-wide. Thus, it is our recommendation that the most recent DDM be adopted by the City and replace the 1992 "Drainage System Design Criteria."

Appendix C

TRWE Precipitation Analysis

The precipitation intensity-duration-frequency (IDF) curve most widely used in San Diego County (contained in the 2003 *San Diego County Hydrology Manual*) has been shown to be not supported by a statistical analysis of hourly rainfall data, and consequently, unrealistic and overly conservative for durations of less than one hour. Therefore, TRWE analyzed the existing Oceanside hourly precipitation data to determine a more realistic IDF curve based upon precipitation gauge measurements taken since 1951.

Data for our analysis came from hourly data used for continuous simulations, obtained from the Project Clean Water (PCW) web site (***http://projectcleanwater.org/html/wg_susmp.html***), as well as average data obtained from the Western Regional Climate Center (WRCC) on its web page (***http://wrcc.dri.edu/summary/Climsmsca.html***), combined with detailed hourly data purchased from WRCC. We also used a correlation analysis from different data sets in Oceanside and the best data in the County (San Diego Lindbergh Station) to improve the data analysis. These improvements included filling gaps and establishing better values of intensities valid for Oceanside.

The reason for this detailed analysis is clearly seen from the extreme differences found in peak flows obtained from continuous simulations (2-, 5-, 10-, 25-and 50-year peak flows) and the peak flows estimated from synthetic storm analysis in the *San Diego County Hydrology Manual* (SDCHM). In some cases, such differences can be more than one order of magnitude. These differences are due to multiple factors, including:

1. Extremely conservative approach to the determination of intensities for durations of less than one hour. The mathematical power-law equation recommended in the SDCHM ($I = k/t_n$) does not correspond with the best possible adjustment of the data, but also has the inconvenience of infinite intensity when the time of duration "t" reduces to zero. The *Handbook of Hydrology* recommends a better approach to avoid this mathematical obstacle: $I = k/(t + c)^n$. The additional constant "c" will force the intensity "I" to have a finite maximum value, even for a duration t=0 minutes, which is consistent with physical observations. Also, the addition of a constant c makes the power law equation a particular case of the more general intensity equation, and significantly reduces the intensity when the time of concentration is very low (10 minutes or less).
2. Single storm analyses were highly dependent on the time of concentration, which is most often smaller than 15 minutes for sub-areas, while continuous simulation analysis is associated with hourly data and consequently hourly peak flows. In other words, continuous simulation models using hourly precipitation data generate peak flows that were hourly in duration, while single storm event peak flows were instantaneous in duration. As there is a underestimation in continuous simulation associated with a 1-hour time interval, and as there is an overestimation associated with the power law intensity (especially for times of concentration less than 15 minutes), these modeling approaches

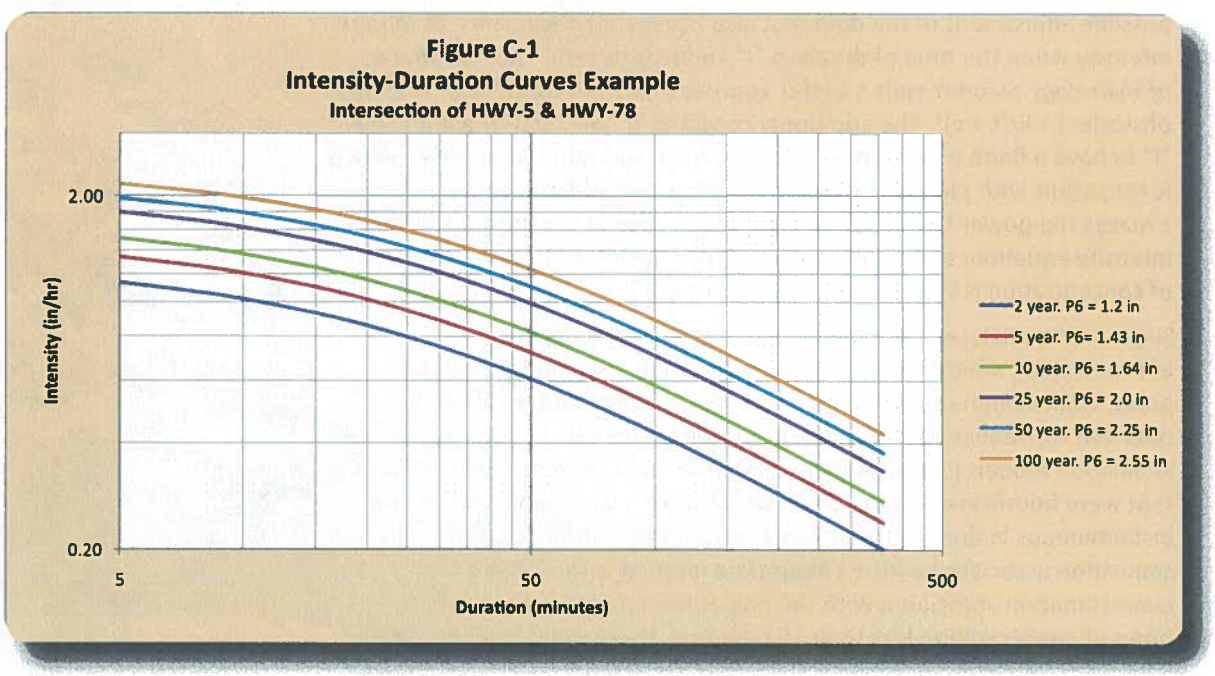
generate significant differences in peak flow.

3. Elimination of the artificial disaggregation of the precipitation data in Oceanside. Seven percent of the data used for continuous simulation in Oceanside was improperly disaggregated in the recent HMP county-wide effort; this percentage increases to 11% for intensities larger than 0.5 in/hr. We performed a proper disaggregation of the data that preserves the statistical properties of the original data and does not generate artificial storms with a synthetic distribution that does not actually occur in nature.
4. Elimination of the aggregation of the data at the 0.1 inch level. This process artificially generates hourly intensities that can only occur in 0.1 in/hr increments and distorts the real intensity distribution. We used improved statistical analysis that takes into consideration the intensity-duration curve of the time periods where the data was collected with greater precision.
5. Inexact nature of the runoff (C) coefficient in single storm analysis. The C coefficient according to the SDCHM is independent of the intensity, which differs from all other hydrology manuals in Southern California (Los Angeles, Orange County, Riverside, San Bernardino and Ventura). A better definition of the C coefficient would give a more accurate estimation of the peak flow, especially for smaller storms.

As part of this task, TRWE studied in detail the "n, d" largest extreme events, with "n" being the number of years where data was properly obtained, and "d" the duration value selected (1, 2, 3, 4, 5, 6, 8, 10, 12, 15, 18, 21 and 24 hours). Those events were analyzed at different durations in order to properly extrapolate the intensity at shorter time intervals, and generate an adequate intensity-duration curve.

Figure C-1 shows the complete intensity-duration curves obtained for Oceanside for a specific location with values of P_6 given by the SDCHM Maps.

The



mathematical representation of the intensity vs. duration curves, as a function of the Period of Return T (from 2 to 100 years), the 6-hour precipitation value P_6 obtained from the SDCHM isopluvial Maps (inches), and the duration desired (t in hours) can be summarized by the following equations:

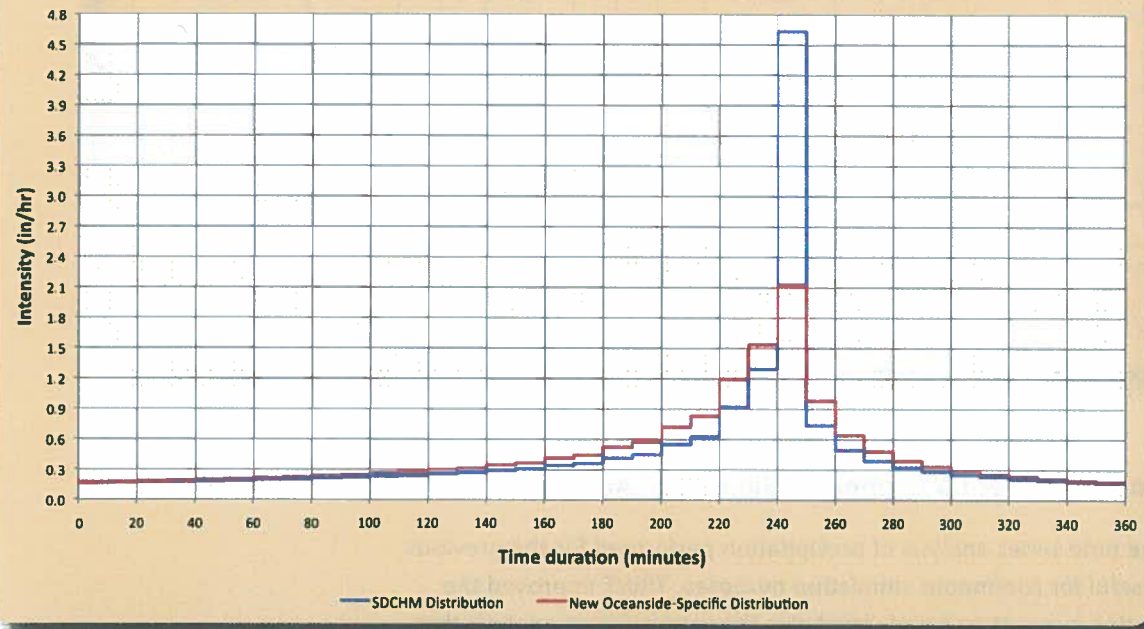
$I = A \cdot P_6 \cdot (t+B)^{-0.675}$; A and B were obtained with equations below:

$A = 0.1667 \cdot (6+B)^{0.675}$; $B = 0.407 + 0.027(\log(T-1))^2 - 0.0067(\log(T-1))$

It is evident from the equations that for t = 6 hours, $I = P_6/6$.

Figure C-2 shows a comparison of the precipitation distribution obtained with the proposed equation vs. the current SDCHM distribution. It is clear that the new distribution significantly reduces the extremely large intensity values that were obtained as a consequence of a power-law model.

Figure C-2
Comparison of 6hr-100yr Precipitation (2.75 inches), 10 Minute Interval



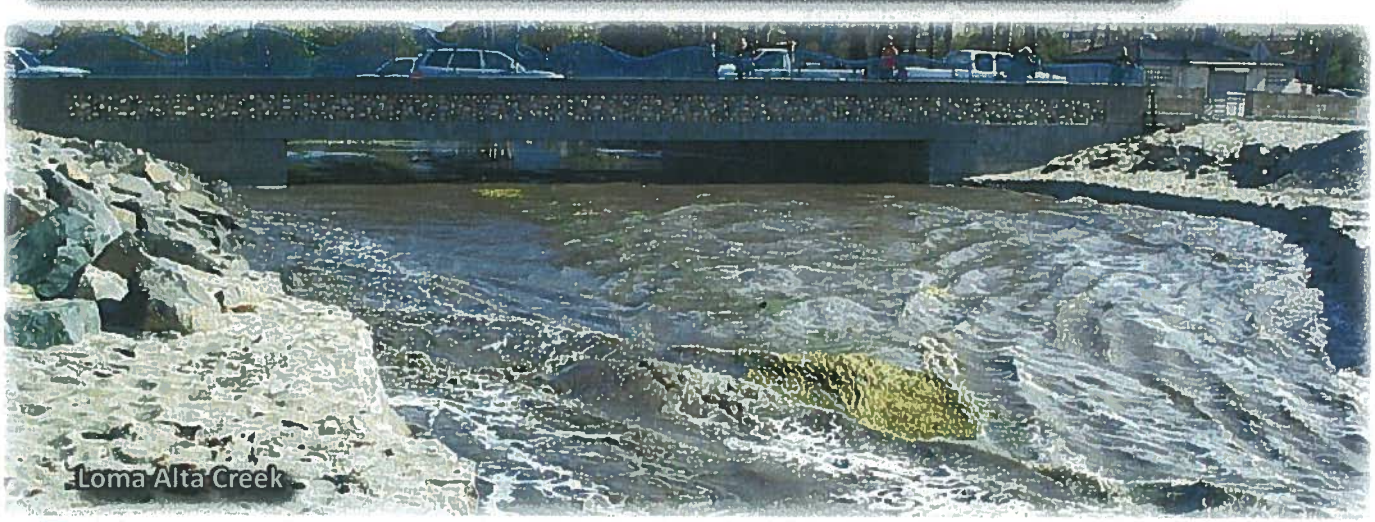
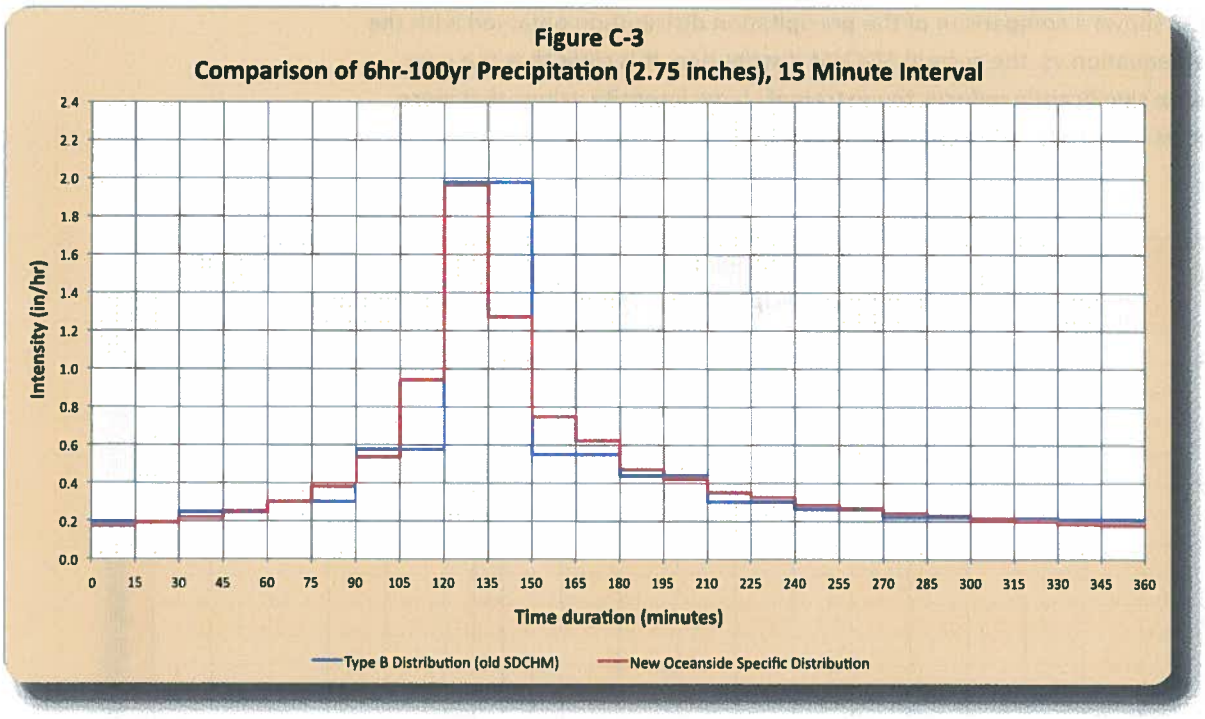


Figure C-3 shows a comparison of the new precipitation distribution vs. the previous Type B distribution from the 1993 SDCHM. It is interesting to note the similarity between the peaks. However, our statistical analysis suggests that the placement of the peak is closer to the 2/3 principle of the current SDCHM (after 4 hours for a 6-hour storm and after 16 hours for a 24-hour storm). Therefore, the use of the intensity equation suggested here for Oceanside, coupled with the Synthetic Precipitation Distribution Methodology of the SDCHM, is the best alternative to simulate precipitation conditions in Oceanside.



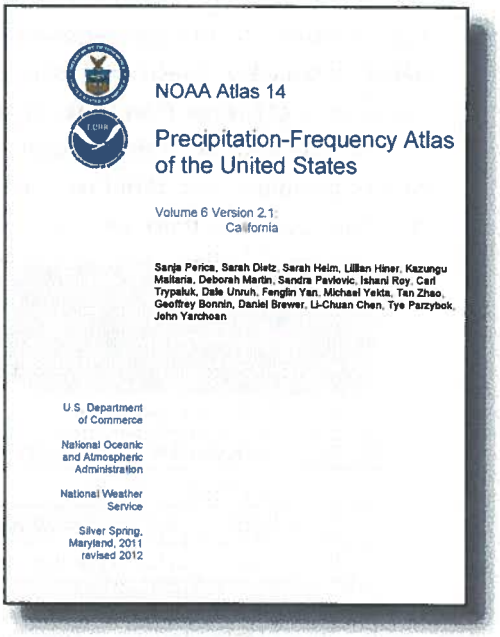
Precipitation Time Series for Continuous Simulation Analysis

As most of the time series analysis of precipitation performed for the previous task can be useful for continuous simulation purposes, TRWE improved the intensity-duration curve at an hourly level plus the extrapolation analysis that allowed building continuous time series with a time interval of 15-minutes and 30-minutes. Those time series were generated in such a way that the statistical properties of the rainfall distribution were preserved, and those series can be used for continuous simulation depending on the time of concentration of the potential project. Establishment of time series with shorter time interval increased the peak flows and generated more realistic values, and significantly reduced differences between continuous analysis and single storm analysis.

Appendix D

NOAA Method Reference Materials

For this MPD update it was decided to use the rainfall analysis method as detailed in ***"NOAA Atlas 14, Precipitation-Frequency Atlas of the United States, Volume 6 Version 2.1: California, revised 2012."*** This document provides information on the underlying data and functioning of the PFDS.



NOAA Atlas 14

Precipitation-Frequency Atlas of the United States

Volume 6 Version 2.1: California

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

U.S. Department of Commerce

National Oceanic and Atmospheric Administration

National Weather Service

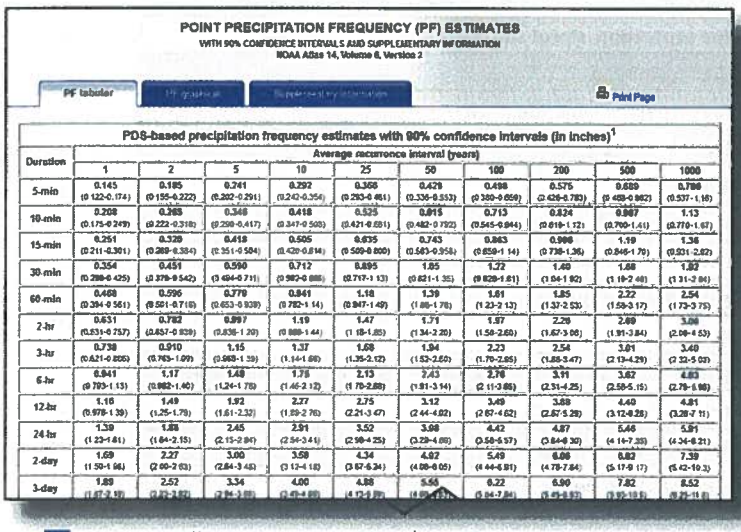
Silver Spring, Maryland, 2011 revised 2012

Data is kept on NOAA's Precipitation Frequency Data Server (PFDS), which is described as:

> *"The Precipitation Frequency Data Server (PFDS) is a point-and-click interface developed to deliver NOAA Atlas 14 precipitation frequency estimates and associated information. Upon clicking a state on the map above or selecting a state name from the drop-down menu, an interactive map of that state will be displayed. From there, a user can identify a location for which precipitation frequency estimates are needed.*
>
> *"Estimates and their confidence intervals can be displayed directly as tables or graphs via separate tabs. Links to supplementary information (such as ASCII grids of estimates, associated temporal distributions of heavy rainfall, time series data at observation sites, cartographic maps, etc.) can also be found."*

The following procedure may be used for obtaining NOAA Atlas 14 rainfall data:

- Go to NOAA's PFDS at, ***http://hdsc.nws.noaa.gov/hdsc/pfds/index.html***
- Select California from the drop down menu, or from the figure.
- Navigate to your desired location by entering latitude and longitude, selecting a rain gage station, or by zooming and double clicking on the map.
- After selecting a point location on the map, Point Precipitation Frequency Estimates will be displayed in a table for the selected point. The data may be printed or exported to a file in csv format.



POINT PRECIPITATION FREQUENCY (PF) ESTIMATES
WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 6, Version 2

PF tabular | Print Page

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.145 (0.122-0.174)	0.185 (0.155-0.222)	0.241 (0.202-0.291)	0.292 (0.242-0.354)	0.366 (0.293-0.461)	0.429 (0.336-0.553)	0.498 (0.380-0.659)	0.575 (0.426-0.783)	0.689 (0.488-0.962)	0.786 (0.537-1.16)
10-min	0.208 (0.175-0.249)	0.265 (0.222-0.318)	0.346 (0.288-0.417)	0.418 (0.347-0.503)	0.525 (0.421-0.651)	0.615 (0.482-0.792)	0.713 (0.545-0.944)	0.824 (0.619-1.12)	0.987 (0.700-1.41)	1.13 (0.770-1.67)
15-min	0.251 (0.211-0.301)	0.320 (0.268-0.384)	0.418 (0.351-0.504)	0.505 (0.420-0.614)	0.635 (0.509-0.800)	0.743 (0.583-0.958)	0.863 (0.659-1.14)	0.996 (0.748-1.36)	1.19 (0.846-1.70)	1.36 (0.931-2.02)
30-min	0.354 (0.298-0.425)	0.451 (0.378-0.542)	0.590 (0.494-0.711)	0.712 (0.592-0.866)	0.895 (0.717-1.13)	1.05 (0.821-1.35)	1.22 (0.929-1.61)	1.40 (1.04-1.92)	1.68 (1.19-2.48)	1.92 (1.31-2.84)
60-min	0.468 (0.394-0.561)	0.596 (0.501-0.715)	0.779 (0.653-0.939)	0.941 (0.782-1.14)	1.18 (0.947-1.49)	1.39 (1.09-1.76)	1.61 (1.23-2.12)	1.85 (1.37-2.53)	2.22 (1.58-3.17)	2.54 (1.73-3.75)
2-hr	0.631 (0.531-0.757)	0.782 (0.657-0.939)	0.997 (0.836-1.20)	1.19 (0.988-1.44)	1.47 (1.18-1.85)	1.71 (1.34-2.20)	1.97 (1.50-2.60)	2.29 (1.67-3.06)	2.69 (1.91-3.84)	3.00 (2.09-4.53)
3-hr	0.738 (0.621-0.885)	0.910 (0.763-1.09)	1.15 (0.963-1.39)	1.37 (1.14-1.66)	1.68 (1.35-2.12)	1.94 (1.53-2.60)	2.23 (1.70-2.95)	2.54 (1.88-3.47)	3.01 (2.13-4.29)	3.40 (2.32-5.03)
6-hr	0.941 (0.793-1.13)	1.17 (0.982-1.40)	1.48 (1.24-1.78)	1.75 (1.46-2.12)	2.13 (1.70-2.88)	2.43 (1.91-3.14)	2.76 (2.11-3.86)	3.11 (2.31-4.25)	3.62 (2.58-5.15)	4.03 (2.79-6.98)
12-hr	1.16 (0.978-1.39)	1.49 (1.25-1.79)	1.92 (1.61-2.32)	2.27 (1.89-2.76)	2.75 (2.21-3.47)	3.12 (2.44-4.02)	3.49 (2.67-4.62)	3.88 (2.67-5.28)	4.40 (3.12-6.28)	4.81 (3.28-7.11)
24-hr	1.39 (1.23-1.61)	1.88 (1.64-2.15)	2.45 (2.15-2.84)	2.91 (2.56-3.41)	3.52 (2.98-4.25)	3.98 (3.29-4.88)	4.42 (3.58-5.57)	4.87 (3.84-6.30)	5.46 (4.14-7.28)	5.91 (4.34-8.21)
2-day	1.69 (1.50-1.96)	2.27 (2.00-2.63)	3.00 (2.64-3.45)	3.58 (3.12-4.18)	4.34 (3.67-5.24)	4.92 (4.08-6.05)	5.49 (4.44-6.91)	6.06 (4.79-7.64)	6.82 (5.17-9.17)	7.39 (5.42-10.3)
3-day	1.89 (1.67-2.19)	2.52 (2.23-2.92)	3.34 (2.94-3.88)	4.00 (3.49-4.69)	4.86 (4.12-5.89)	5.56 (4.69-7.01)	6.22 (5.04-7.84)	6.90 (5.43-8.93)	7.82 (5.92-10.5)	8.52 (6.25-11.8)

Appendix E

Maintenance Concerns

In 2011, TRWE engineers and Oceanside Maintenance staff visited areas in the City with maintenance concerns. That information from those visits and further conversations with City staff are summarized below in **Table E-1**. These areas of concern were considered during the analysis of Master Plan storm drains. **Figure E-1** shows the approximate location of those maintenance sites. It is probable that current conditions may differ since time has elapsed and City crews continue to address these and other sites.

Table E-1
2011 Maintenance Concerns

ID	Location	Description
1A	Half pipe drains	Downtown area pipe failures
1B	San Luis Rey River@ Pacific Street	Outfall to the ocean/flooded bike path
1C	Bike Path @ Neptune	Slope failure/grated basin
1D	Tremont-Seagaze to Surfrider	RCP undersized
1E	Center Ave @ Ocean High School	Flooding in 2010
2A	Loma Alta Creek @ railroad	Debris on trestle
2B	Loma Alta Creek @ Coast Highway	Channel next to mobile home park
2C	Buccaneer @ Pacific Street	Outfall to ocean
2D	Buena Vista Lagoon @ Weir	Outfall to ocean
2E	Buena Vista Lagoon @ Coast Highway	Flooding on roadway
2F	Cassidy @ Pacific Street	Grates pack with debris
2G	Lucky Street	CMP Failure
2H	2100 block of Nevada	Private drain floods street
3A	Pala @ Los Arbolitos	Flooding in road
3B	Coco Palms	Flooding in road
3C	Airport spillway (middle pond)	Debris in channel at headwall
3D	Rivertree easement	54-inch RCP failure
3E	Capistrano Basin	Silt and erosion
3F	Capistrano Park storm drain outfall @ river	Outlet pipe failure at river
3G	Storm drain @ Camp Pendleton boundary	Pipe separation, street subsidence, outlet not found
3H	Breeze Street Canyon	Pipe separation, street subsidence, outlet not found
4A	Las Vegas	Flooding in road
4B	El Monte	Pipe into slope concrete ditch
4C	Hacienda Drive	Flooding in road
4D	Mesa west of Butler	CMP failure
4E	Parnassus @ Fowles	Pipe undersized
4F	Tonapah	Silt in ditch - street flooding
4G	Garrison @ Oceanside Blvd	Creek floods into road
4H	Garrison between Oceanside and Industrial	Silt
5A	Haymar west of El Camino Real	Road lower than Buena Vista Creek, some historic inundation
5B	Ridgeway south of Grandview	Curb inlet not complete
5C	Loma Alta Creek east of Crouch	Debris on box culverts
5D	Ups Street cul de sac	Pipe clogs with debris

Table E-1 2011 Maintenance Concerns		
ID	Location	Description
5E	El Camino @ Basil	CMP obstruction
5F	Skylark east of Downs	Slope failure
5G	Magdalena Basin	Debris on outlet
5H	Loma Alta Creek @ Cavalier Mobile Home Park	Historic flooding
6A	San Luis Rey River Bridges	Debris on bridge supports
6B	Valley Heights @ Mission	Debris in roadway
6C	Old Grove @ Frazee Basin	Some historic sediment deposition and overflow
6D	Oleander Bridge and Basin	Some reconstruction needed, stagnant water
7A	Mesa @ El Camino Real	Clear debris from basin inlet
7B	El Corazon	Erosion into road
7C	Garrison Detention Basin Wall	Some scour and periodic repair
8A	Valley @ Skyline	Curb doesn't drain
8B	Rancho Del Oro @ RR crossing	Guillotine gates debris
8C	Oceanside Blvd @ Ready Mix	Dig out pipes
8D	Rancho Del Oro Sprinter Station	Flooding
8F	College @ Marvin Street	Street floods
9A	Wilshire Road Basin	Sediment/ silt
9B	Hollowglen Basin	Debris on Standpipe
9C	North River Road east of Sleeping Indian	Small aging bridge
9D	Via Puerta Del Sol	Small aging bridge/ slope erosion
9E	Sleeping Indian Area	Farmland Erosion into road
9F	Noirth River road - 2 Culverts	CMP with corrosion
10A	Guajome Lake Road	Dirt Road needs grading
10B	Wendela Basin	Debris on standpipe
10C	Mesa @ North Santa Fe	Earthen Channel silt
10D	Masters @ Silverbluff	Drain clogs
10E	North Santa Fe	Dig Out pipes
10F	Melrose @ North Santa Fe	Runoff overflows onto intersection
11A	North Ave Earthen Channel	Slope erosion
12A	Buena Vista Creek @ College	Box Culvert undersized
12B	San Fran-Peak Station	Sediment and dissipater Failure
12C	Tiberon Channel	Debris on box culverts
12D	Lake Channel Erosion	Ongoing channel and drop-structure degradation
12E	East end of Tiberon	Erosion at concrete and rip rap boundary
12F	Miramonte Culvert	Historic failure/repair

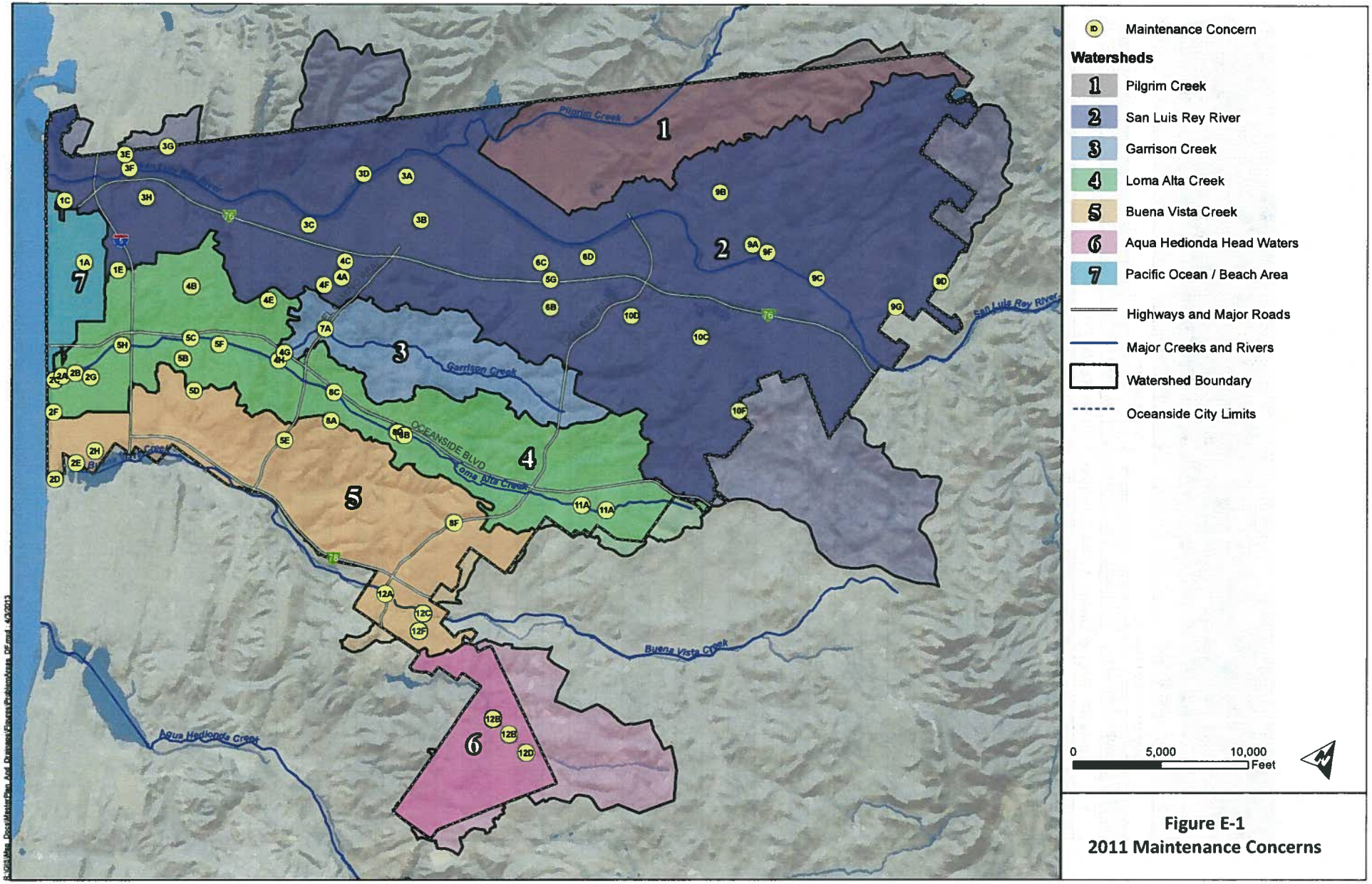


Figure E-1
2011 Maintenance Concerns

Appendix F

Preliminary Upgrade Costs

For this MPD upgrade costs are summarized below. These costs are based on unit costs as listed in Section 3, and facilities as listed in Section 4. As stated earlier, these costs are only for planning purposes. Recommended facility sizes listed are minimum sizes based on hydraulic analysis only; and therefore might be larger in some cases.

Watershed	Estimated Upgrade Costs	
	25-Year	100-Year
Pilgrim Creek Watershed	$ 584,480	$ 1,018,870
San Luis Rey River Watershed	$ 286,940	$ 8,403,090
Garrison Creek Watershed	$ 600,080	$ 2,322,070
Loma Alta Creek Watershed	$ 644,610	$ 7,372,340
Buena Vista Creek Watershed	$ 1,467,490	$ 9,436,013
Agua Hedionda Head Waters Watershed	$ 0	$ 382,680
Pacific Ocean/Beach Area Watershed	$ 2,159,520	$ 3,754,500
Totals	**$ 5,743,120**	**$ 32,689,563**

Table F-1
Pilgrim Creek Watershed
Recommended Storm Drain Facility Improvements

Facility ID	Atlas Page	Existing			Recommended Size to Convey		Estimated Upgrade Cost	
		Facility Type	Size (inches)	Length (feet)	25-year	100-year	25-year	100-year
PC-148	D	CIPP	30	242		36		$ 128,260
PC-149	D	CIPP	30	498	36	42	$ 263,940	$ 308,760
PC-179	C	RCP	36	213		42		$ 132,060
PC-200	D	CIPP	30	517	42	60	$ 320,540	$ 449,790
Subtotal Pilgrim Creek Watershed							**$ 584,480**	**$ 1,018,870**

Table F-2
San Luis Rey River Watershed
Recommended Storm Drain Facility Improvements

Facility ID	Atlas Page	Existing			Recommended Size to Convey		Estimated Upgrade Cost	
		Facility Type	Size (inches)	Length (feet)	25-year	100-year	25-year	100-year
SLR-7	O	RCP	36	664		42		$ 411,680
SLR-7	O	RCP	36	664		42		$ 411,680
SLR-42	O	Unknown	36	100		42		$ 62,000
SLR-51	J	Parallel RCPs	42	100		48		$ 72,000
SLR-52	J		42	100		48		$ 72,000
SLR-72	I	RCP	33	181		42		$ 112,220
SLR-90	I	CIPP	72	233		78		$ 242,320
SLR-92	I	CIPP	72	258		78		$ 268,320
SLR-120	I	RCP	48	54		84		$ 60,480
SLR-121	I	RCP	36	37		54		$ 29,600
SLR-122	I	RCP	30	253		36		$ 134,090
SLR-123	I	RCP	30	219		42		$ 135,780
SLR-124	I	RCP	60	522		66		$ 480,240
SLR-125	I	RCP	60	537		66		$ 494,040
SLR-127	I	RCP	60	97		66		$ 89,240
SLR-153	I	Single Box Culvert	6'x8'	68		6'x8'		$ 79,560
SLR-154	I	Single Box Culvert	6'x8'	20		6'x8'		$ 23,400
SLR-155	I	RCP	66	428		72		$ 423,720
SLR-158	I	RCP	60	275		66		$ 253,000
SLR-188	I	RCP	30	232		36		$ 122,960
SLR-267	N	CIPP	30	337		36		$ 178,610
SLR-288	I	RCP	30	296		36		$ 156,880
SLR-289	I	RCP	30	197		36		$ 104,410
SLR-300	I	RCP	48	468		60		$ 407,160
SLR-311	H	RCP	36	346		42		$ 214,520
SLR-319	H	RCP	30	289		36		$ 153,170
SLR-320	I	RCP	30	246		36		$ 130,380
SLR-321	I	RCP	30	257		42		$ 159,340

Table F-2
San Luis Rey River Watershed
Recommended Storm Drain Facility Improvements

Facility ID	Atlas Page	Existing			Recommended Size to Convey		Estimated Upgrade Cost	
		Facility Type	Size (inches)	Length (feet)	25-year	100-year	25-year	100-year
SLR-379	H	RCP	60	264		66		$ 242,880
SLR-424	I	RCP	30	216		42		$ 133,920
SLR-556	H	RCP	36	148		48		$ 106,560
SLR-558	H	RCP	36	443		48		$ 318,960
SLR-559	H	RCP	30	160		42		$ 99,200
SLR-560	H	RCP	30	104		36		$ 55,120
SLR-563	H	RCP	30	328		48		$ 236,160
SLR-603	H	RCP	36	66		42		$ 40,920
SLR-678	H	RCP	30	98		42		$ 60,760
SLR-679	H	RCP	30	98		42		$ 60,760
SLR-680	H	RCP	30	98		42		$ 60,760
SLR-681	H	Parallel RCPs	24	98		48		$ 70,560
SLR-685	H		24	98		48		$ 70,560
SLR-707	C	RCP	30	183		42		$ 113,460
SLR-725	G	CMP	36	131	42	48	$ 81,220	$ 94,320
SLR-727	G	CMP	36	28	42	60	$ 17,360	$ 24,360
SLR-728	G	CMP	36	118	42	60	$ 73,160	$ 102,660
SLR-732	G	RCP	30	160	48	60	$ 115,200	$ 139,200
SLR-738	G	RCP	30	37		54		$ 29,600
SLR-845	H	RCP	36	36		42		$ 22,320
SLR-861	G	Double Box Culvert	2.5'x5' ea	54		Dbl 3' x 6'		$ 75,060
SLR-863	G	Single Box Culvert	2'x6'	75		Dbl 3' x 6'		$ 104,250
SLR-866	A	RCP	33	247		48		$ 177,840
SLR-885	H	Unknown	30	530		36		$ 280,900
SLR-909	H	RCP	48	249		54		$ 199,200
Subtotal San Luis Rey River Watershed							**$ 286,940**	**$ 8,403,090**

Table F-3
Garrison Creek Watershed
Recommended Storm Drain Facility Improvements

Facility ID	Atlas Page	Existing			Recommended Size to Convey		Estimated Upgrade Cost	
		Facility Type	Size (inches)	Length (feet)	25-year	100-year	25-year	100-year
GC-97	H	RCP	36	280		72		$ 277,200
GC-98	H	RCP	36	325		60		$ 282,750
GC-99	H	RCP	36	50		60		$ 43,500
GC-170	H	RCP	60	208		96		$ 253,760
GC-176	G	CIPP (Parallel to 84")	72	500		78		$ 520,000
GC-177	G	CIPP (Parallel to 84")	72	577	78	84	$ 600,080	$ 646,240
GC-178	H	CIPP	66	171		96		$ 208,620
GC-191	G	Trapezoidal channel under road	54" deep	31		Design		$ 90,000
Subtotal Garrison Creek Watershed							**$ 600,080**	**$ 2,322,070**

Table F-4
Loma Alta Creek Watershed
Recommended Storm Drain Facility Improvements

Facility ID	Atlas Page	Existing			Recommended Size to Convey		Estimated Upgrade Cost	
		Facility Type	Size (inches)	Length (feet)	25-year	100-year	25-year	100-year
LAC-43	M	RCP	30	124		42		$ 76,880
LAC-44	M	RCP	30	45		36		$ 23,850
LAC-45	M	RCP	30	183		36		$ 96,990
LAC-46	M	RCP	30	33		36		$ 17,490
LAC-70	M	CIPP	48	414		54		$ 331,200
LAC-75	M	CP	48	354		54		$ 283,200
LAC-76	M	CP	48	233		78		$ 242,320
LAC-149	M	CIPP	36	78		42		$ 48,360
LAC-150	M	CIPP	36	194		42		$ 120,280
LAC-193	L	Rock lined Channel	60" deep	323		design		$ 300,000
LAC-247	M	Triple Box Culvert	5' x 6' ea	53		5' x 8' ea		$ 57,240
LAC-422	M	RCP	30	147		36		$ 77,910
LAC-489	G	CMPE	42	446	54	66	$ 356,800	$ 410,320
LAC-490	G	RCP	36	56	48	60	$ 40,320	$ 48,720
LAC-501	F	RCP	30	207	42	48	$ 128,340	$ 149,040
LAC-502	F	RCP	30	68		42		$ 42,160
LAC-504	F	RCP	36	40		42		$ 24,800
LAC-505	F	RCP	36	56		48		$ 40,320
LAC-507	F	RCP	36	87		48		$ 62,640
LAC-528	F	RCP	30	41	42	54	$ 25,420	$ 32,800
LAC-529	F	RCP	30	71	42	54	$ 44,020	$ 56,800
LAC-530	F	CMP	24	18	30	36	$ 8,000	$ 9,540
LAC-557	F	RCP	60	152		66		$ 139,840
LAC-558	F	RCP	60	607		78		$ 631,280
LAC-559	F	RCP	60	200		66		$ 184,000
LAC-562	F	RCP	72	325		78		$ 338,000
LAC-563	F	RCP	72	342		78		$ 355,680
LAC-565	F	Single Box Culvert	5' x 6'	43		5' x 8'		$ 46,440

Table F-4
Loma Alta Creek Watershed
Recommended Storm Drain Facility Improvements

Facility ID	Atlas Page	Existing			Recommended Size to Convey		Estimated Upgrade Cost	
		Facility Type	Size (inches)	Length (feet)	25-year	100-year	25-year	100-year
LAC-570	F	Single Box Culvert	5' x 6'	142		5' x 8'		$ 153,360
LAC-572	F	RCP	36	30		42		$ 18,600
LAC-578	F	Parallel RCPs	24	99		60		$ 86,130
LAC-579	F		24	99		60		$ 86,130
LAC-587	F	RCP	36	138		42		$ 85,560
LAC-601	F	RCP	54	237		60		$ 206,190
LAC-602	F	RCP	54	109		60		$ 94,830
LAC-603	F	RCP	48	242		60		$ 210,540
LAC-604	F	RCP	48	139		72		$ 137,610
LAC-605	F	RCP	54	306		60		$ 266,220
LAC-606	F	RCP	54	214		72		$ 211,860
LAC-617	F	RCP	30	140		36		$ 74,200
LAC-630	F	Double Box Culvert	3' x 5 ' ea	76		3' x 8' ea		$ 131,480
LAC-634	F	Single Box Culvert	5' x 6'	187		5' x 8'		$ 201,960
LAC-636	F	Parallel CMPEs	42	78		48		$ 56,160
LAC-637	F		27	78		36		$ 41,340
LAC-638	F		42	78		48		$ 56,160
LAC-639	F		27	78		36		$ 41,340
LAC-689	F	RCP	30	150		42		$ 93,000
LAC-717	G	CMPE	36	23	36	42	$ 12,190	$ 14,260
LAC-718	G	CMPE	36	307		66		$ 282,440
LAC-719	G	CMPE	36	41	48	60	$ 29,520	$ 35,670
LAC-730	F	Concrete Open Channel	48" deep	674		54		$ 539,200
Subtotal Loma Alta Creek Watershed							**$ 644,610**	**$ 7,372,340**

Table F-5
Buena Vista Creek Watershed
Recommended Storm Drain Facility Improvements

Facility ID	Atlas Page	Existing			Recommended Size to Convey		Estimated Upgrade Cost	
		Facility Type	Size (inches)	Length (feet)	25-year	100-year	25-year	100-year
BVC-2	K	Single Box Culvert	1'x3'	90		2' x 3'		$ 37,800
BVC-78	K	RCP	60	356		72		$ 352,440
BVC-79	K	RCP	60	142		72		$ 140,580
BVC-81	L	CIPP	48	100	54	72	$ 80,000	$ 99,000
BVC-82	L	CIPP	48	106		72		$ 104,940
BVC-85	L	CIPP	48	325		72		$ 321,750
BVC-89	K	RCP	36	128		48		$ 92,160
BVC-102	L	RCP	42	52	54	66	$ 41,600	$ 47,840
BVC-103	L	RCP	42	20	54	66	$ 16,000	$ 18,400
BVC-109	L	RCP	30	273		48		$ 196,560
BVC-126	P	RCP	30	72		42		$ 44,640
BVC-127	P	RCP	30	118		36		$ 62,540
BVC-129	P	RCP	30	40		48		$ 28,800
BVC-134	P	RCP	30	112		36		$ 59,360
BVC-136	P	RCP	36	355		42		$ 220,100
BVC-138	L	SRSP	72	496		84		$ 555,520
BVC-139	L	SRSP	72	311		84		$ 348,320
BVC-140	L	SRSP	72	193		84		$ 216,160
BVC-141	L	SRSP	72	503		84		$ 563,360
BVC-179	L	RCP	30	225		36		$ 119,250
BVC-183	L	RCP	30	260	36	42	$ 137,800	$ 161,200
BVC-184	L	RCP	30	191	36	42	$ 101,230	$ 118,420
BVC-185	L	RCP	30	281	42	48	$ 174,220	$ 202,320
BVC-186	L	RCP	30	175	42	54	$ 108,500	$ 140,000
BVC-187	L	RCP	36	168	48	54	$ 120,960	$ 134,400
BVC-188	L	RCP	36	108	54	60	$ 86,400	$ 93,960
BVC-189	L	RCP	42	294		60		$ 255,780
BVC-190	L	RCP	42	108		54		$ 86,400

Table F-5
Buena Vista Creek Watershed
Recommended Storm Drain Facility Improvements

Facility ID	Atlas Page	Existing			Recommended Size to Convey		Estimated Upgrade Cost	
		Facility Type	Size (inches)	Length (feet)	25-year	100-year	25-year	100-year
BVC-191	L	RCP	42	61		54		$ 48,800
BVC-198	L	RCP	48	96		54		$ 76,800
BVC-199	L	RCP	48	17		60		$ 14,790
BVC-224	L	CIPP	36	248		42		$ 153,760
BVC-226	L	RCP	72	279		84		$ 312,480
BVC-227	L	CIPP	72	341	78	84	$ 354,640	$ 381,920
BVC-231	L	CIPP	48	76		72		$ 75,240
BVC-232	L	CIPP	60	105		72		$ 103,950
BVC-236	L	CIPP	30	37		36		$ 19,610
BVC-237	L	CIPP	30	162		36		$ 85,860
BVC-238	L	CIPP	30	241		36		$ 127,730
BVC-239	L	CIPP	30	271		36		$ 143,630
BVC-243	M	RCP	30	50		42		$ 31,000
BVC-247	L	RCP	30	143		36		$ 75,790
BVC-248	L	RCP	30	151		36		$ 80,030
BVC-252	L	CIPP	42	361		54		$ 288,800
BVC-254	L	CIPP	42	90		54		$ 72,000
BVC-255	L	CIPP	42	87		48		$ 62,640
BVC-258	M	RCP	36	274		54		$ 219,200
BVC-259	M	RCP	30	57	42	54	$ 35,340	$ 45,600
BVC-264	P	RCP	42	127		48		$ 91,440
BVC-282	L	RCP	30	351		36		$ 186,030
BVC-283	L	RCP	33	380		36		$ 201,400
BVC-287	P	CMP	72	57		78		$ 59,280
BVC-289	P	CMP	72	709		78		$ 737,360
BVC-321	P	RCP	42	25		48		$ 18,000
BVC-322	P	RCP	36	290	42	54	$ 179,800	$ 232,000
BVC-323	P	RCP	36	15	42	48	$ 9,300	$ 10,800

Table F-5
Buena Vista Creek Watershed
Recommended Storm Drain Facility Improvements

Facility ID	Atlas Page	Existing			Recommended Size to Convey		Estimated Upgrade Cost	
		Facility Type	Size (inches)	Length (feet)	25-year	100-year	25-year	100-year
BVC-324	P	RCP	36	202		48		$ 145,440
BVC-325	P	RCP	30	35	42	54	$ 21,700	$ 28,000
BVC-326	P	RCP	30	40		54		$ 32,000
BVC-330	P	RCP	48	210		54		$ 168,000
BVC-353	L	CIPP	60	68		72		$ 67,320
BVC-354	L	CIPP	60	105		72		$ 103,950
BVC-355	L	CIPP	60	116		72		$ 114,840
Subtotal Buena Vista Creek Watershed							**$ 1,467,490**	**$ 9,436,013**

Table F-6
Agua Hedionda Head Waters Watershed
Recommended Storm Drain Facility Improvements

Facility ID	Atlas Page	Existing			Recommended Size to Convey		Estimated Upgrade Cost	
		Facility Type	Size (inches)	Length (feet)	25-year	100-year	25-year	100-year
AH-1	P	RCP	30	29		36		$ 15,370
AH-2	P	RCP	30	115		36		$ 60,950
AH-10	P	RCP	60	174		66		$ 160,080
AH-98	Q	RCP	30	276		36		$ 146,280
Subtotal Agua Hedionda Head Waters Watershed							**$ 0**	**$ 382,680**

Table F-7
Pacific Ocean/Beach Area Watershed
Recommended Storm Drain Facility Improvements

Facility ID	Atlas Page	Existing			Recommended Size to Convey		Estimated Upgrade Costs	
		Facility Type	Size (inches)	Length (feet)	25-year	100-year	25-year	100-year
PO-9	F	RCP	42	41		48		$ 29,520
PO-10	F	RCP	48	111		54		$ 88,800
PO-11	F	CIPP	48	26		66		$ 23,920
PO-13	F	CIPP	42	450		48		$ 324,000
PO-15	F	CIPP	48	85		54		$ 68,000
PO-16	F	RCP	48	61		54		$ 48,800
PO-18	A	RCP	36	285		42		$ 176,700
PO-19	A	RCP	30	584		36		$ 309,520
PO-22	A	RCP	36	52	48	66	$ 37,440	$ 47,840
PO-23	A	RCP	36	364	54	66	$ 291,200	$ 334,880
PO-24	A	RCP	36	139	48	66	$ 100,080	$ 127,880
PO-25	A	RCP	36	422	42	60	$ 261,640	$ 367,140
PO-26	A	RCP	36	234	48	66	$ 168,480	$ 215,280
PO-27	A	RCP	30	52	36	48	$ 27,560	$ 37,440
PO-36	A	RCP	36	338	54	60	$ 270,400	$ 294,060
PO-37	A	RCP	36	756	66	72	$ 695,520	$ 748,440
PO-38	A	RCP	36	384	54	66	$ 307,200	$ 353,280
PO-39	A	RCP	30	301		36		$ 159,000
Subtotal Pacific Ocean/Beach Area Watershed							**$ 2,159,520**	**$ 3,754,500**

Appendix G

Table G-1 Abbreviations	
CAD	Computer Aided Drafting
CIPP	Cast-In-Place Pipe
CMP	Corrugated Metal Pipe
CMPA	Corrugated Metal Pipe Arch
CMPE	Corrugated Metal Pipe Elliptical
CN	Curve Number
CP	Concrete Pipe
DBC	Double Box Culvert
ENR CCI	Engineering News Record Construction Cost Index
DDM	Drainage Design Manual
ENSO	El Niño - Southern Oscillation
GIS	Geographic Information System
HGL	Hydraulic Grade Line
GPS	Global Positioning System
HMP	Hydromodification Management Plan
IDF	Intensity-Duration-Frequency
in/hr	inches per hour
MPD	Master Plan of Drainage
NAVD	North American Vertical Datum
NGVD	National Geodetic Vertical Datum
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
OBC	Other Box Culvert (greater than 3 barrels)
PCW	Project Clean Water
PFCS	Precipitation Frequency Data Server
RCB	Reinforced Concrete Box
RCP	Reinforced Concrete Pipe
SanGIS	San Diego Geographic Information Source
SBC	Single Box Culvert
SCS	Soil Conservation Service
SDCHM	San Diego County Hydrology Manual
SRSP	Spiral Rib Steel Pipe
TAC	Technical Advisory Committee
TBC	Triple Box Culvert
Tp	Time to peak
TRWE	Tory R. Walker Engineering, Inc.
UH	Unit Hydrograph
X-year	A storm event which has a 1/X chance of being equaled or exceeded in any given year.

Appendix H

Acknowledgements

City of Oceanside
Scott Smith, PE, PLS - *City Engineer*
Ulf Fagerborn, PE - *Engineering*
Mark Sabelis - *Public Works*
Maryam Wagner - *Engineering GIS Project Manager*
Bill Tuck - *Engineering GPS, GIS Facilities*

Tory R. Walker Engineering, Inc.
Tory Walker, PE, CFM, LEED GA - *Project Manager*
Leland Womack, MS, PE - *Assistant PM*
John Duewel, PE - *Civil Engineer*
Luis Parra, PhD, PE, CPSWQ, D.WRE, ToR - *Hydrology*
David Edwards, PE - *Hydraulics*
Edward Drury, EIT - *xpstorm Modeling*
Robin Brush - *GIS*
Victor Castellanos, EIT - *Facilities*
Tyler Schemper, PE
Dane Summers
Monique Bottger
Kelly Lipin

Others
Tobias Wolf, GIS Manager - *HDR*
Dillon Fitch, GIS Specialist - *HDR*
Charles Willess, PLS - *Gold Coast Surveying, Inc.*
Bruce Bonde, PLS - *Gold Coast Surveying, Inc.*
Nicholas Willess - *Gold Coast Surveying, Inc.*

Seacliff Terrace - Scoping Meeting Attendees 9-16-2013

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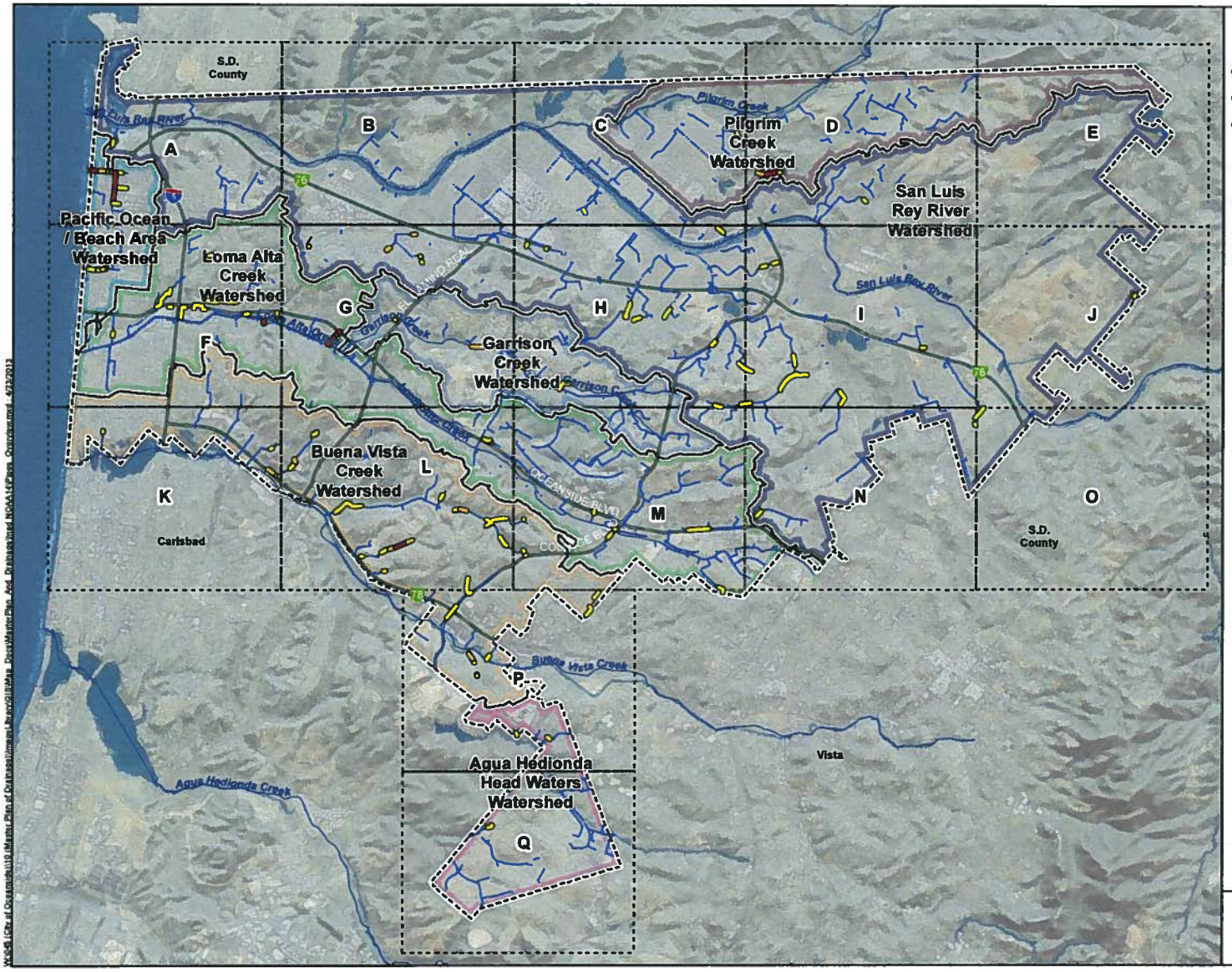
Tom Woods	1019 Costa Pacifica #1408	woodsey49@hotmail.com	
Peggy Graham	1019 Costa Pacifica #1406	queenpeggy316@cox.net	
Doreen Pottios	1021 Costa Pacifica #2413	dpottios@gmail.com	760-275-6674
Gene Edick	939 N. Coast Highway		



Storm Drain Inadequacies For:

- 10-Year Storm Event
- 25-Year Storm Event
- 100-Year Storm Event

Legend

- Existing Storm Drains
- Open Channel (Lined)
- Major Creeks and Rivers
- Highways and Major Roads
- Watershed Boundary
- Oceanside City Limits

0 5,000 10,000 Feet

Oceanside MPD 2012
Atlas Map Index

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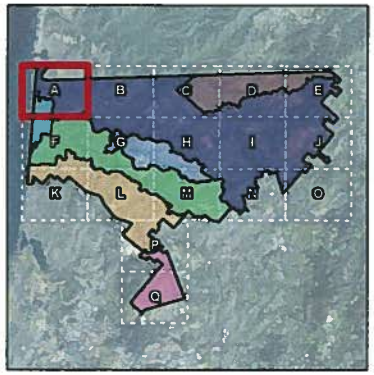
H' x W' for each barrel



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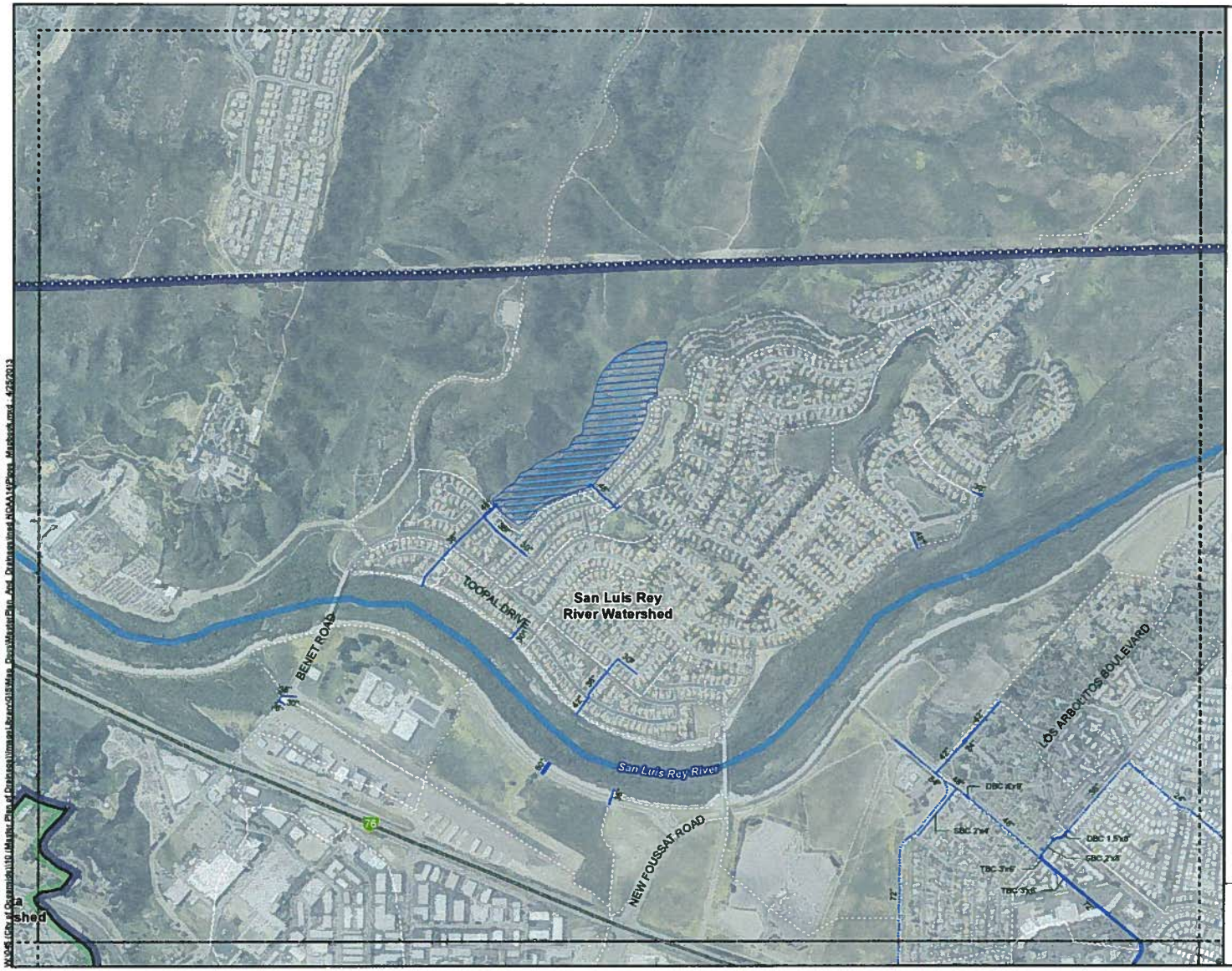
Oceanside MPD Update 2012
Existing Storm Drains
Atlas Page A



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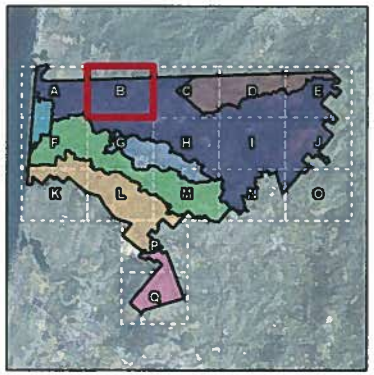

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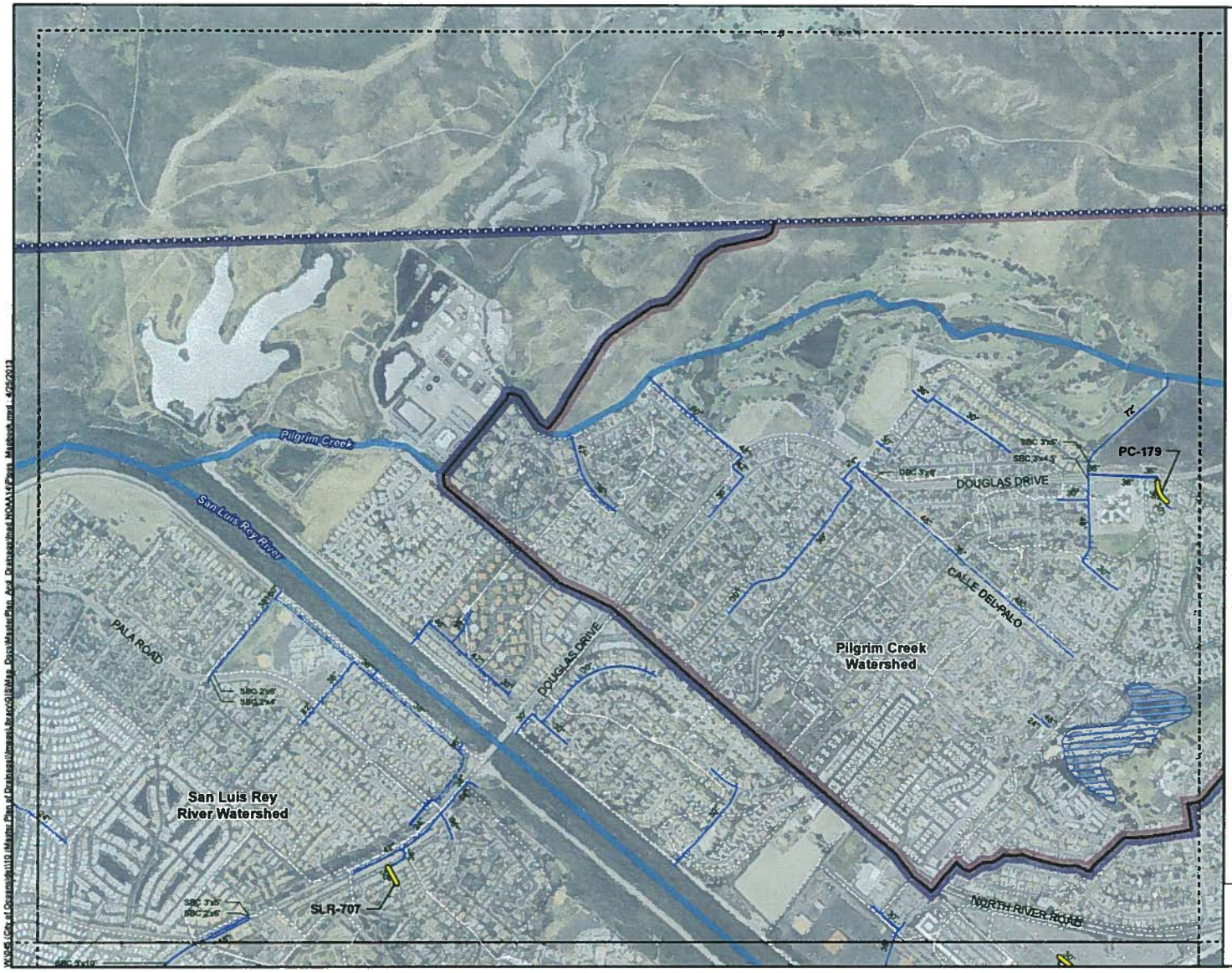
Oceanside MPD Update 2012
Existing Storm Drains
Atlas Page B



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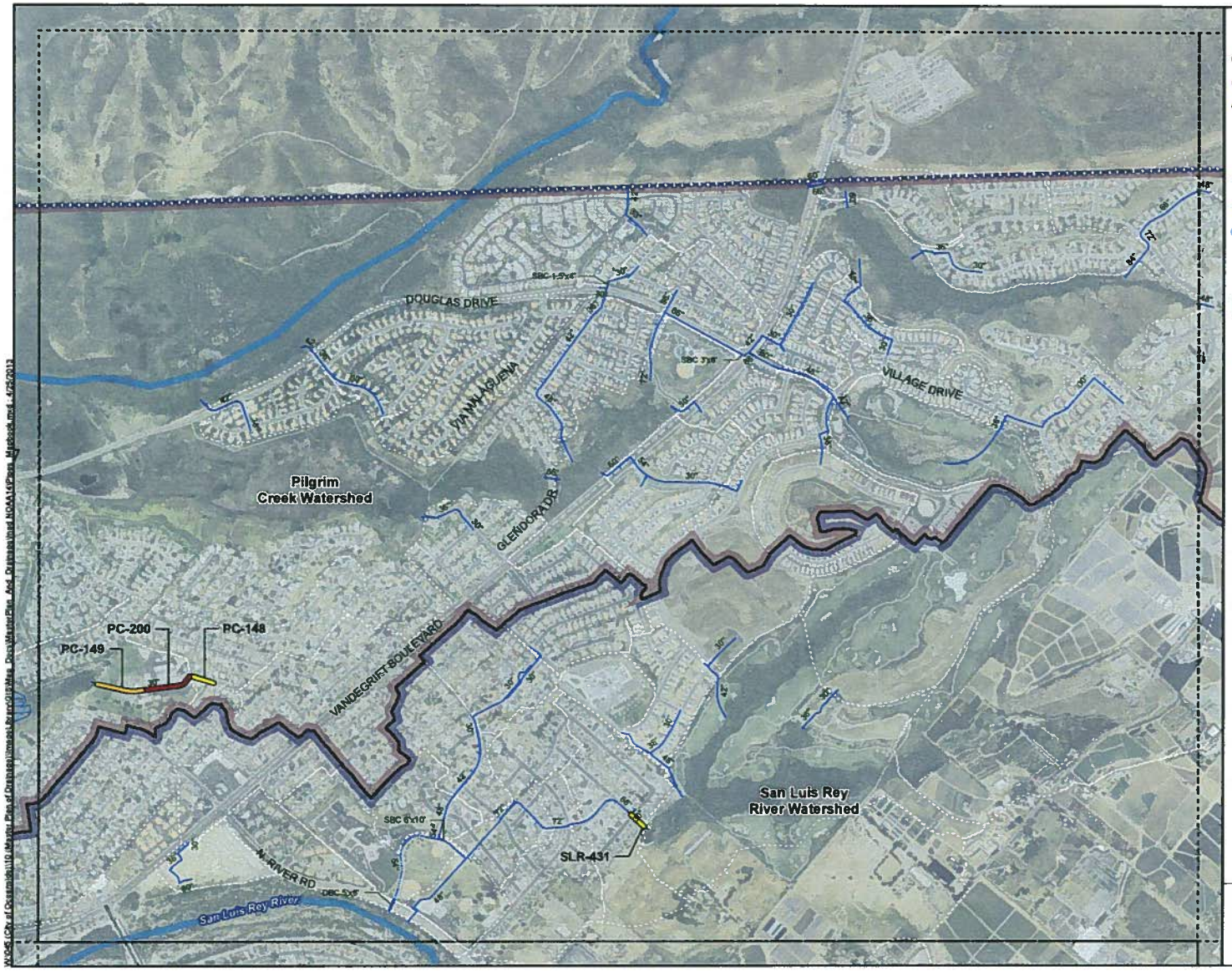
Oceanside MPD Update 2012
Existing Storm Drains
Atlas Page C



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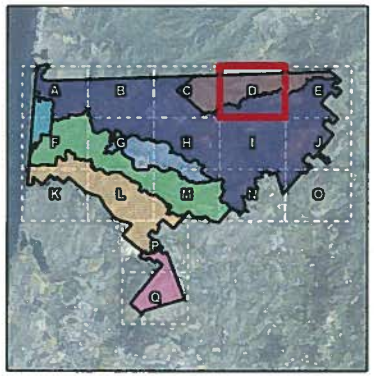

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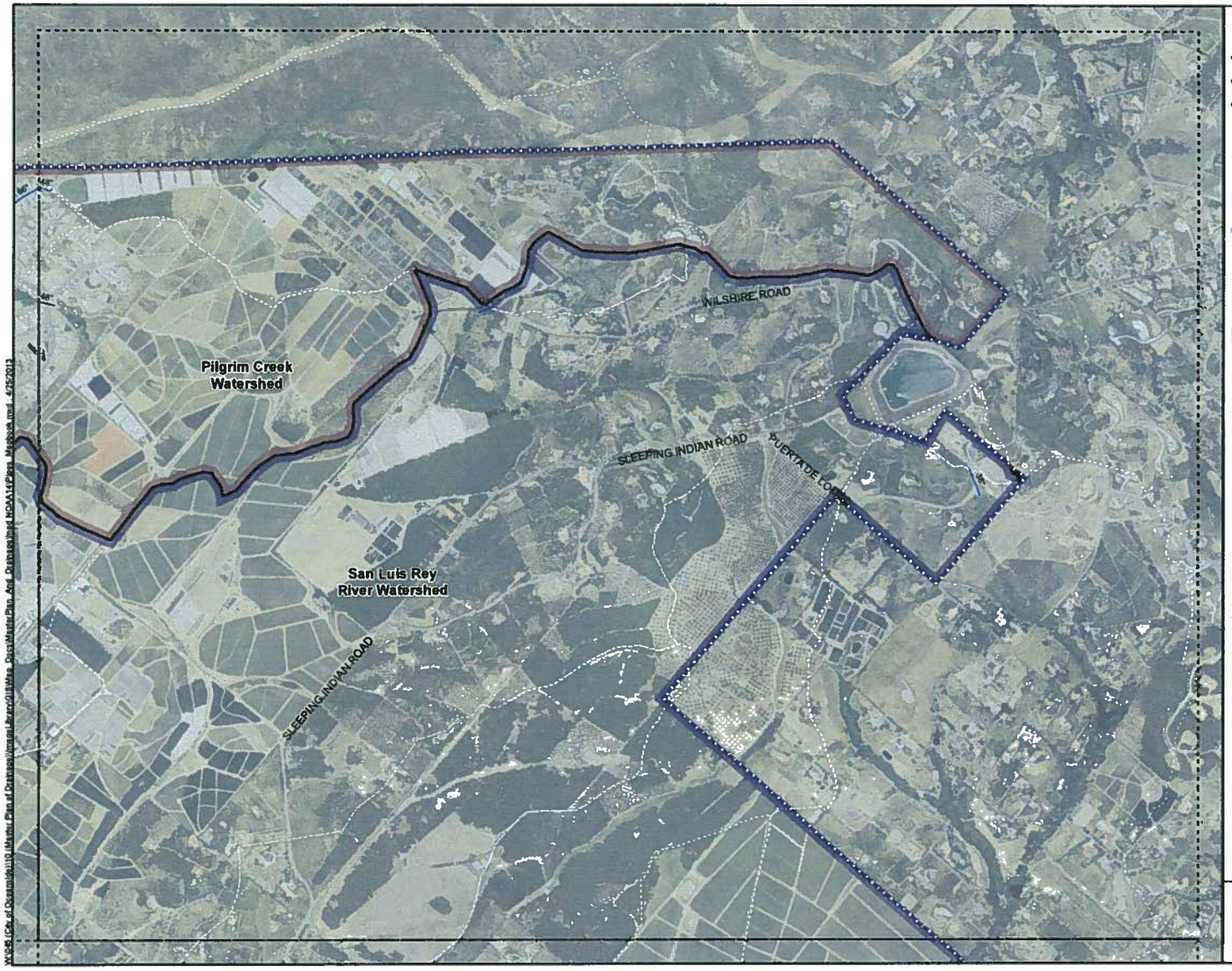
Oceanside MPD Update 2012
Existing Storm Drains
Atlas Page D



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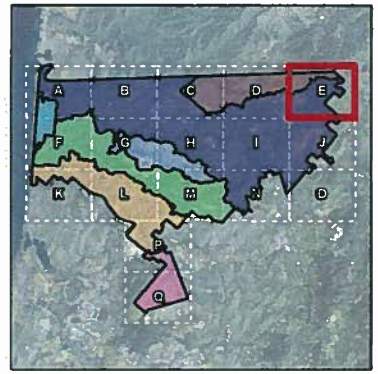

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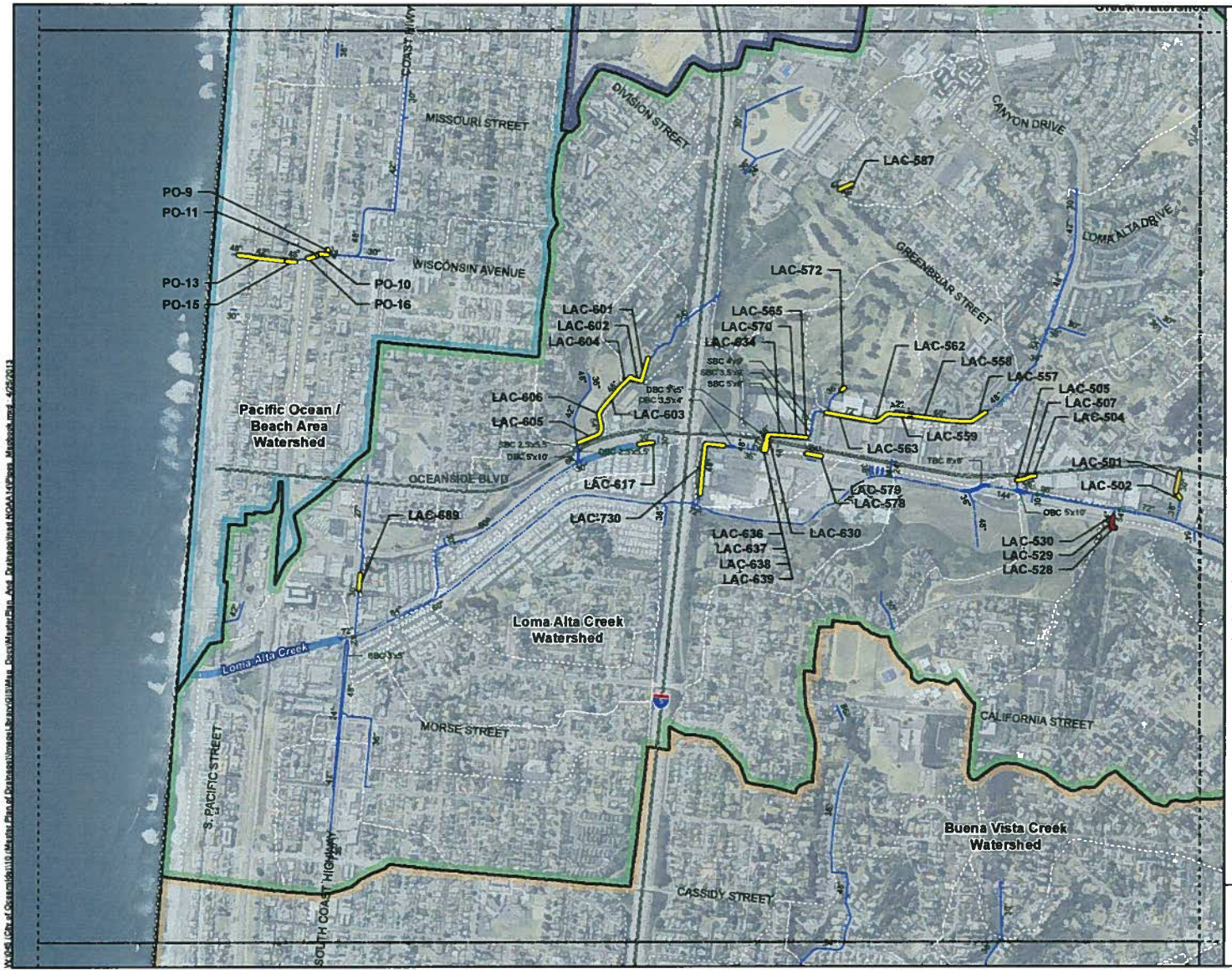
Oceanside MPD Update 2012
Existing Storm Drains
Atlas Page E



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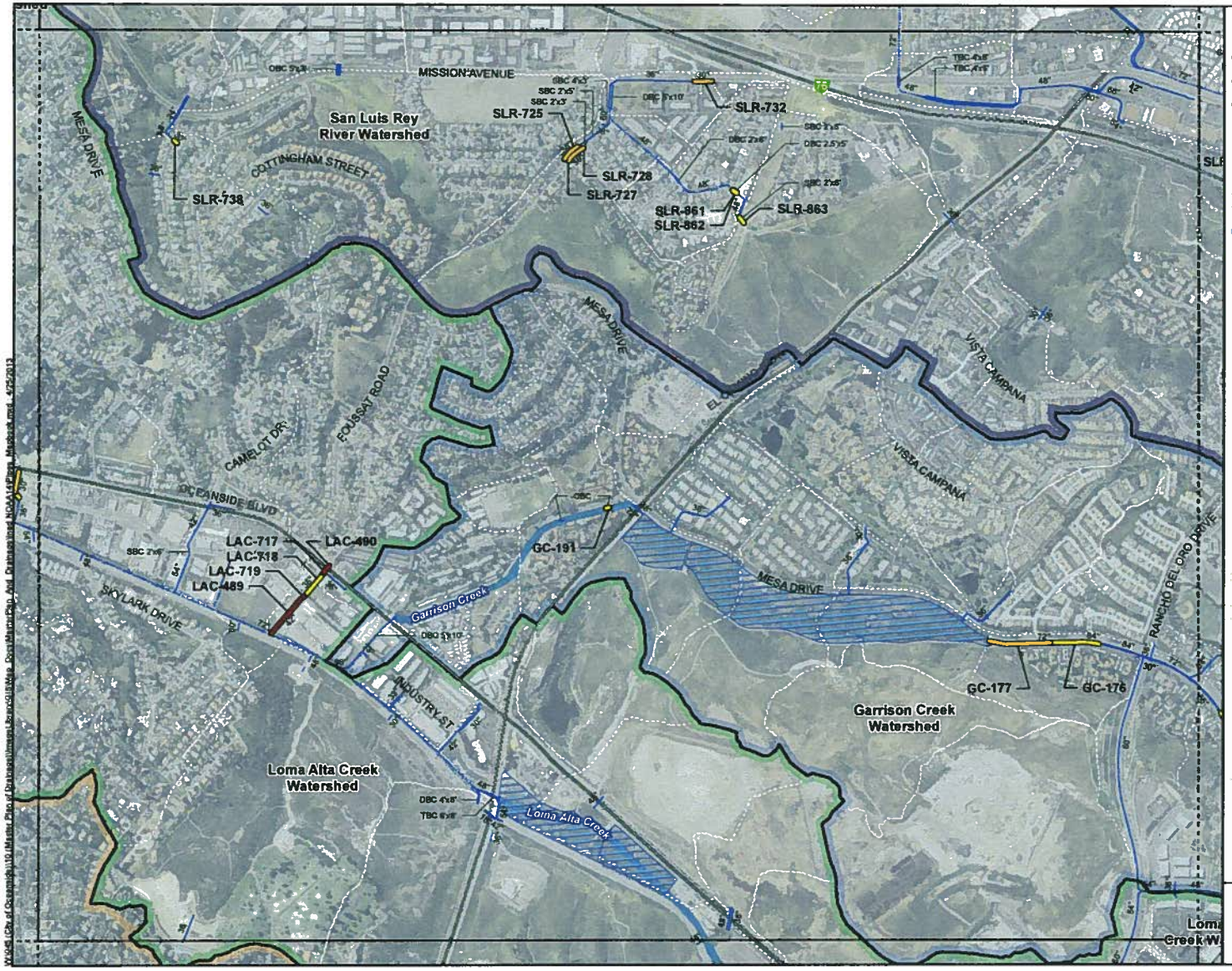
Existing Storm Drains
Atlas Page F



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Existing Storm Drains
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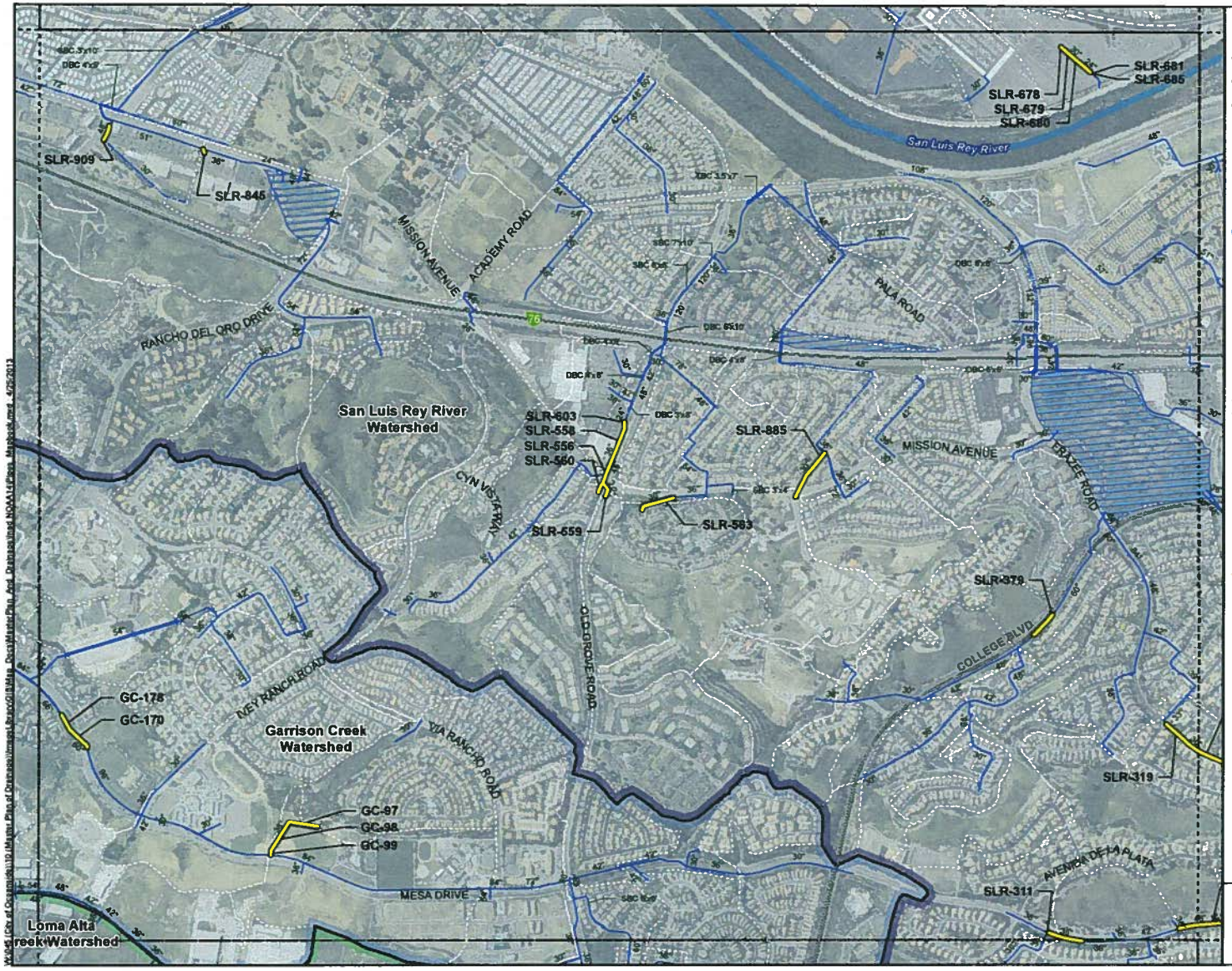

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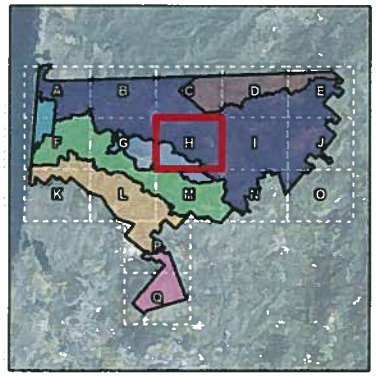

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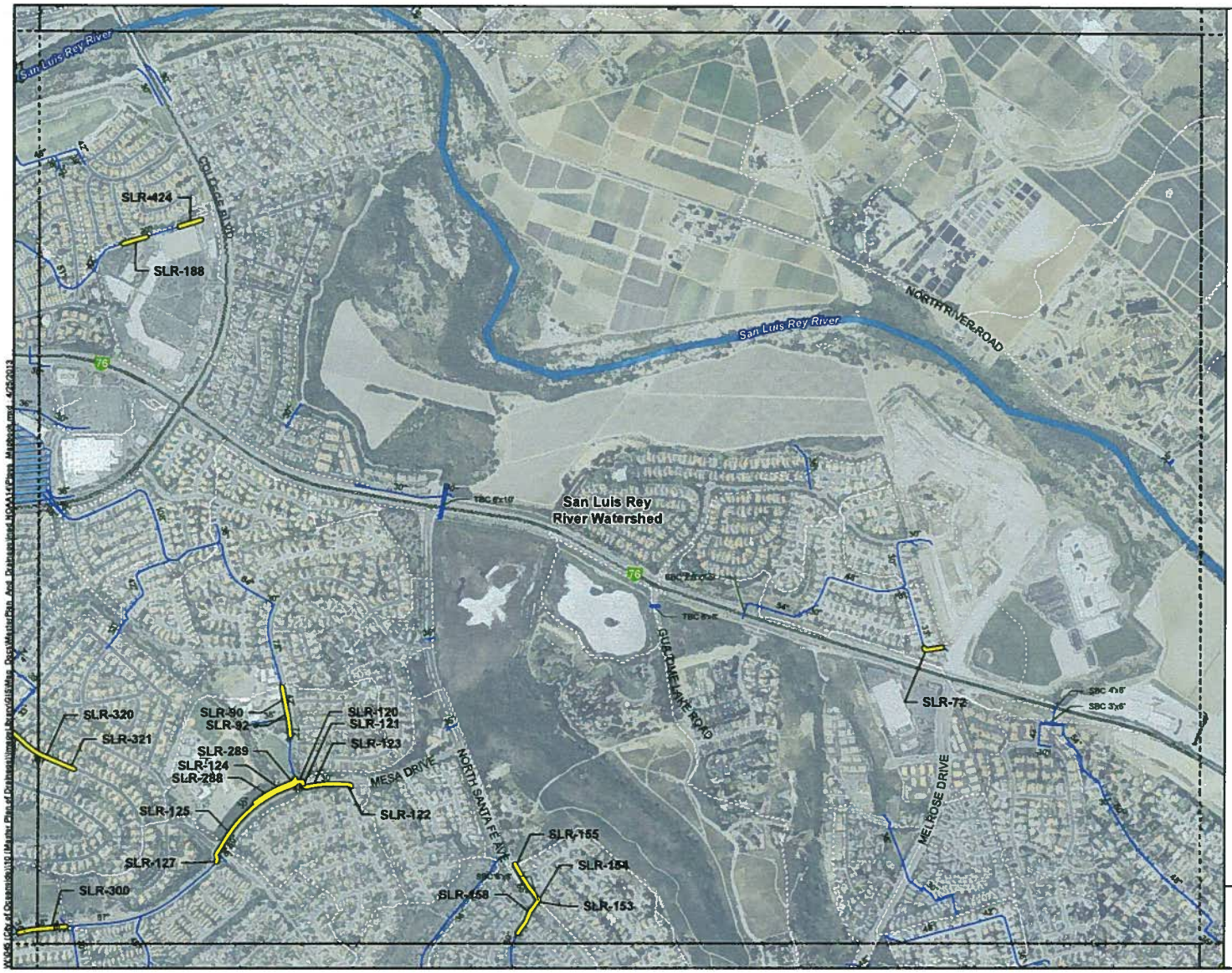
Oceanside MPD Update 2012
Existing Storm Drains
Atlas Page H



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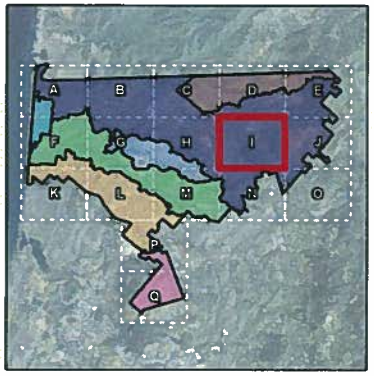

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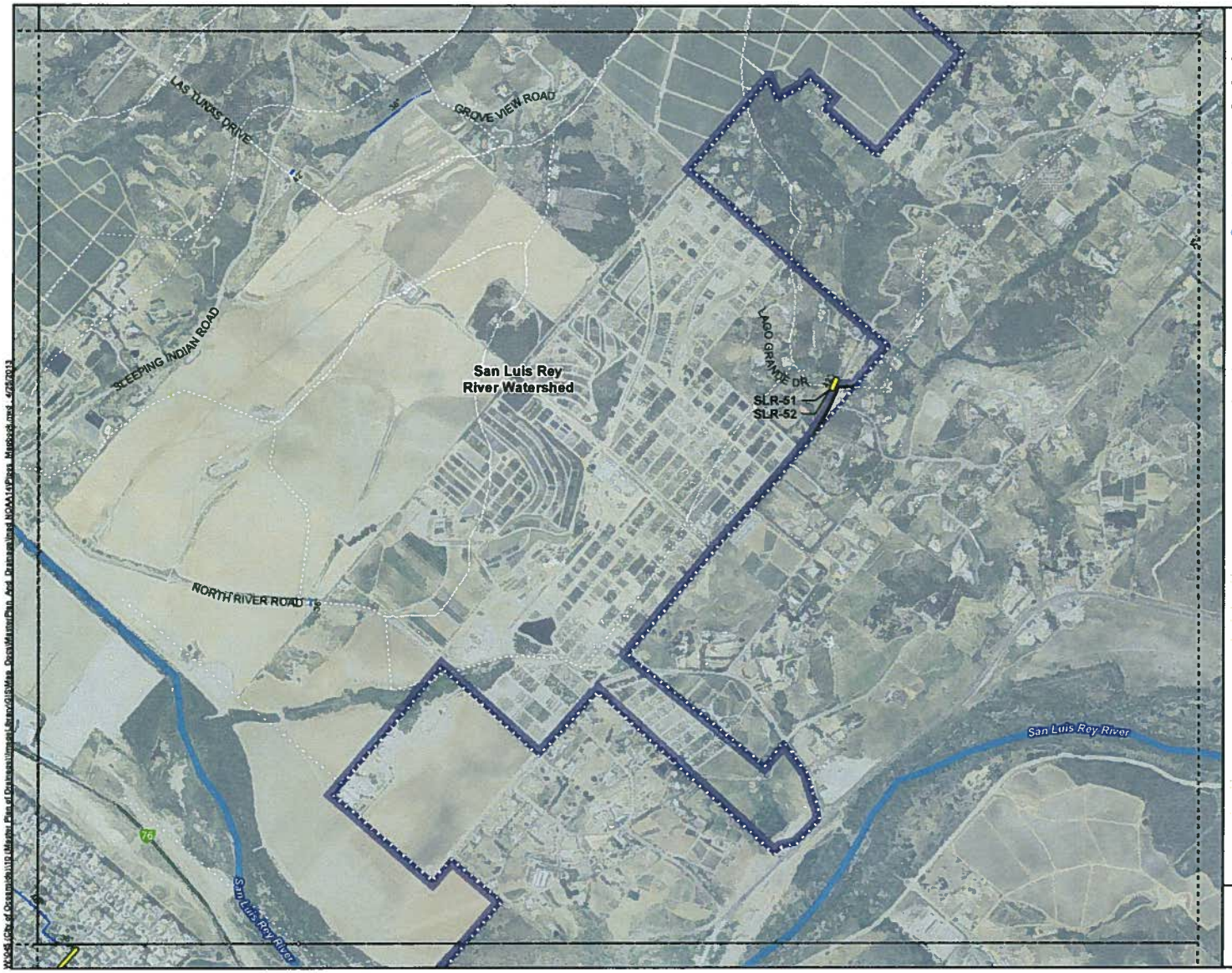
Oceanside MPD Update 2012
Existing Storm Drains
Atlas Page I



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Existing Storm Drains
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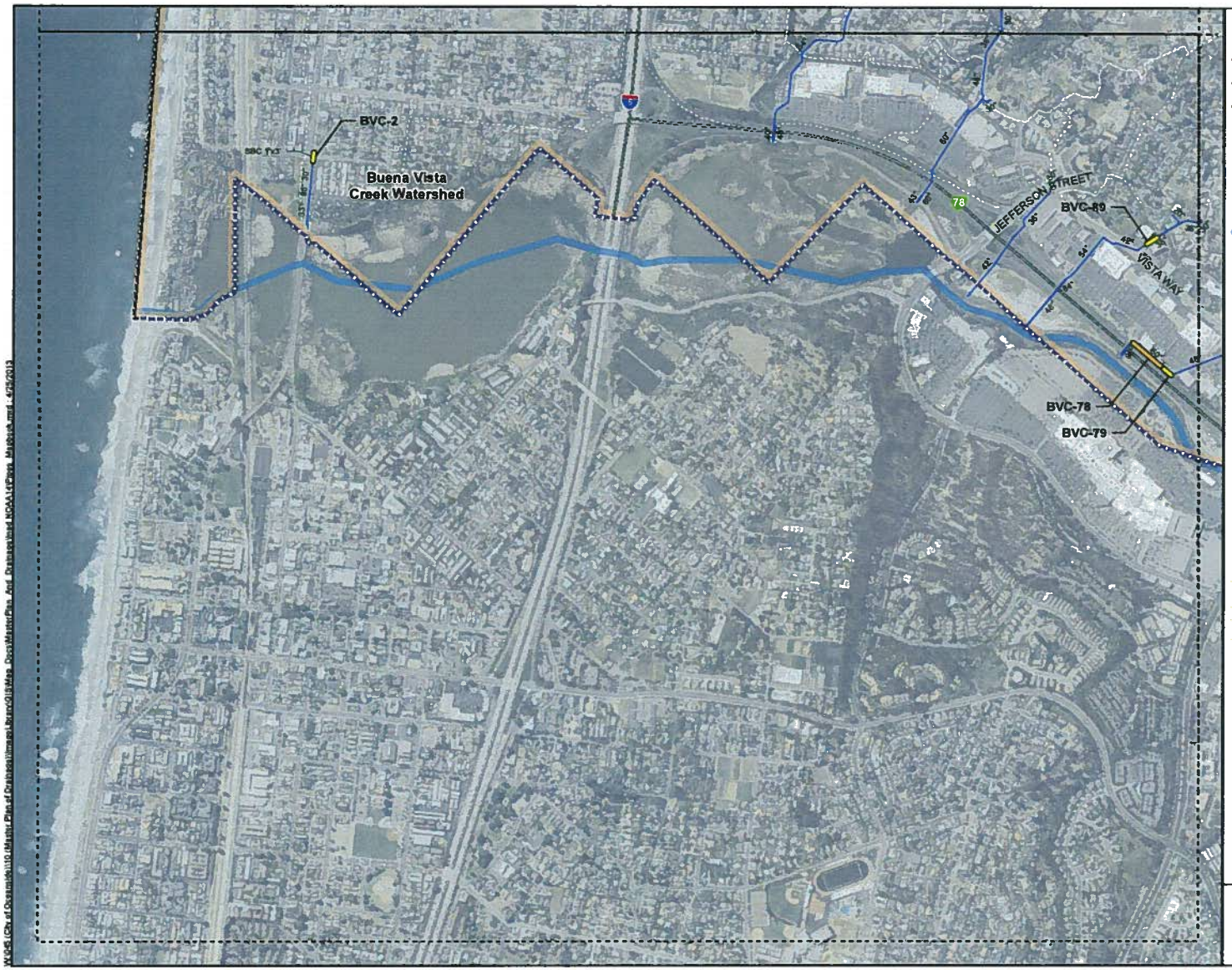

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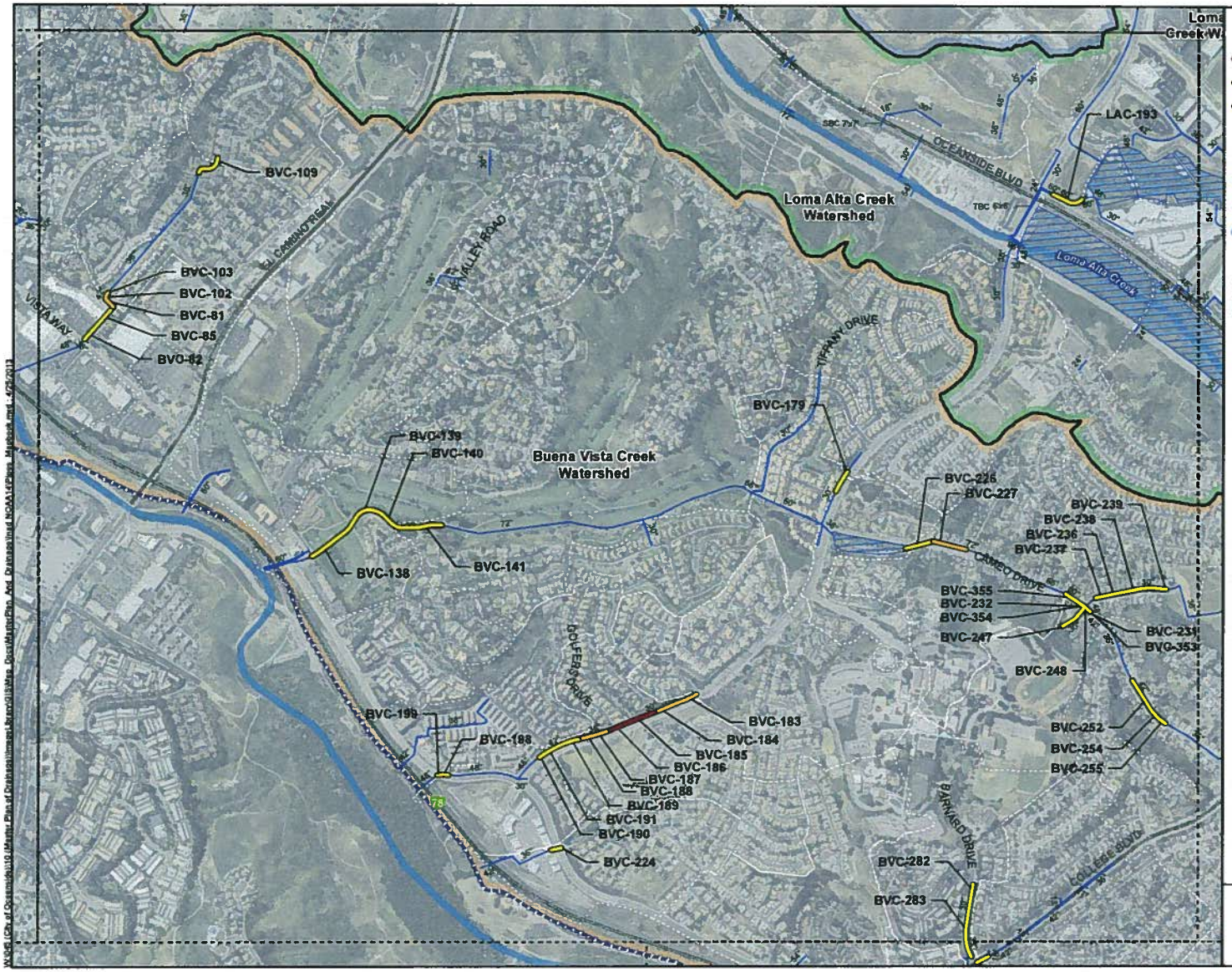
Existing Storm Drains
Atlas Page K



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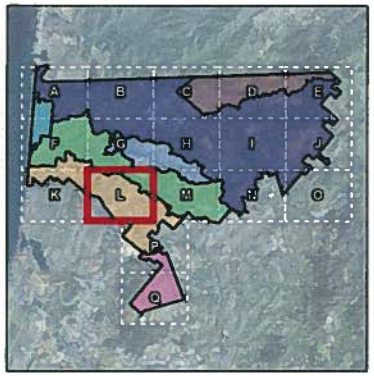

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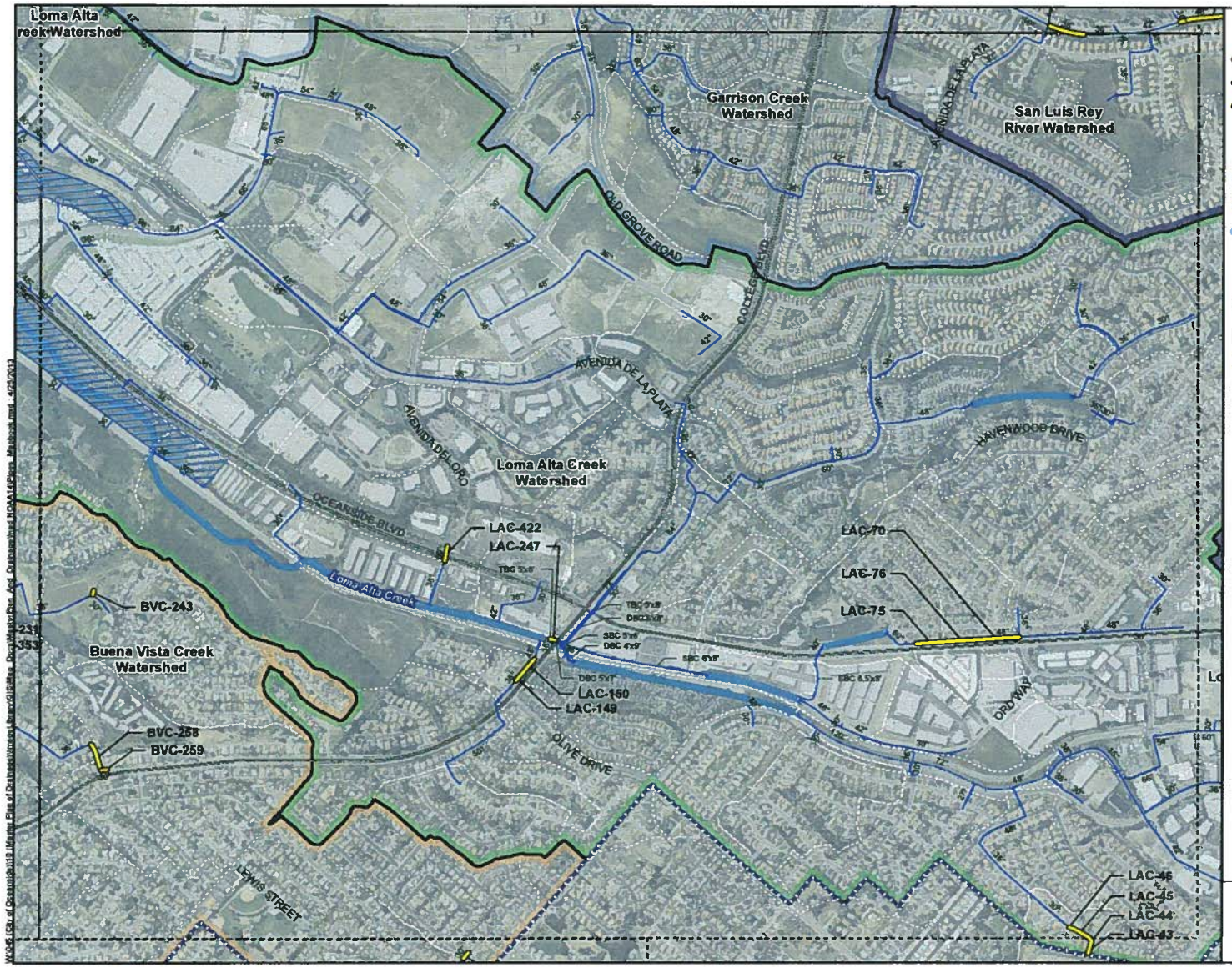
Oceanside MPD Update 2012
Existing Storm Drains
Atlas Page L



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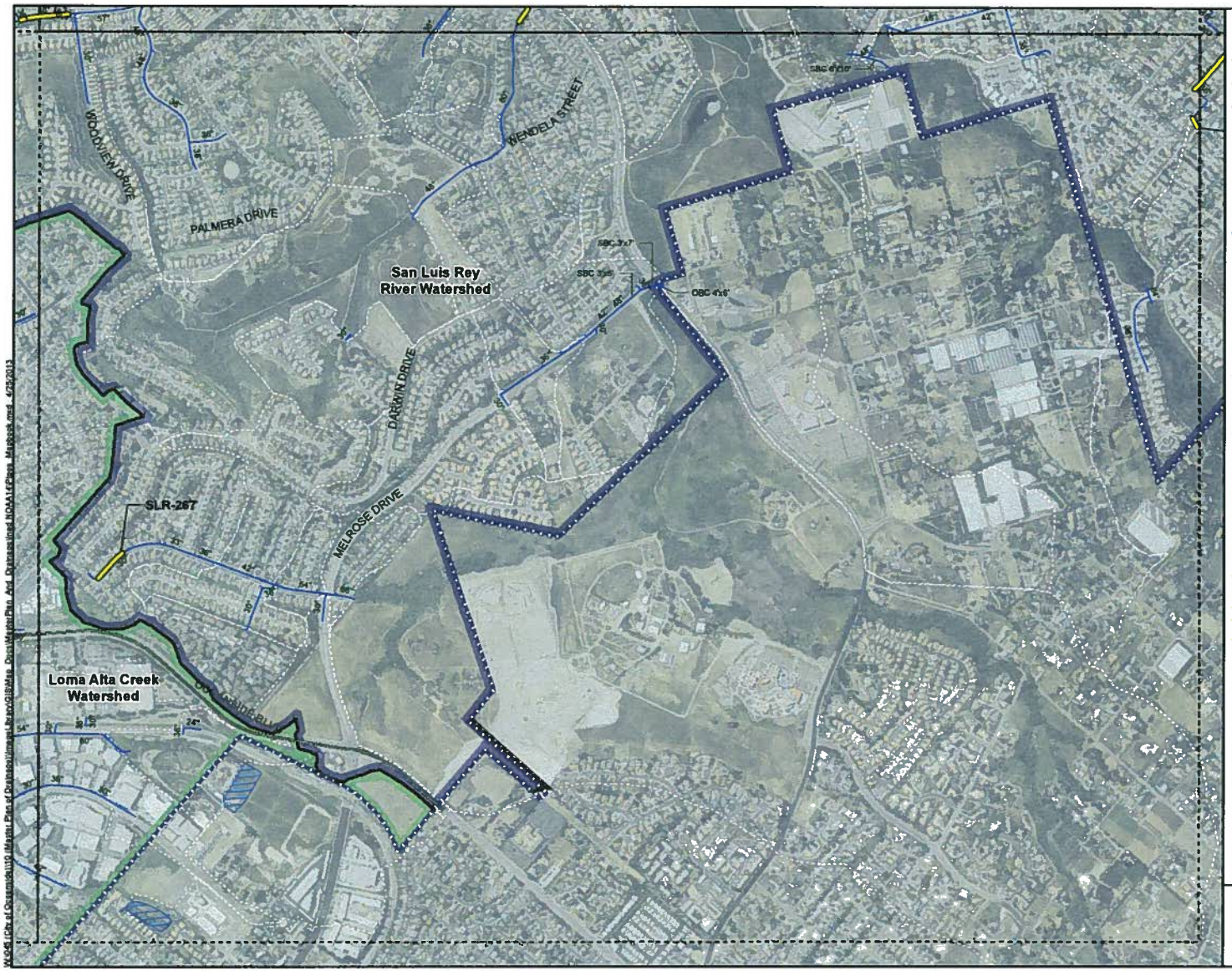

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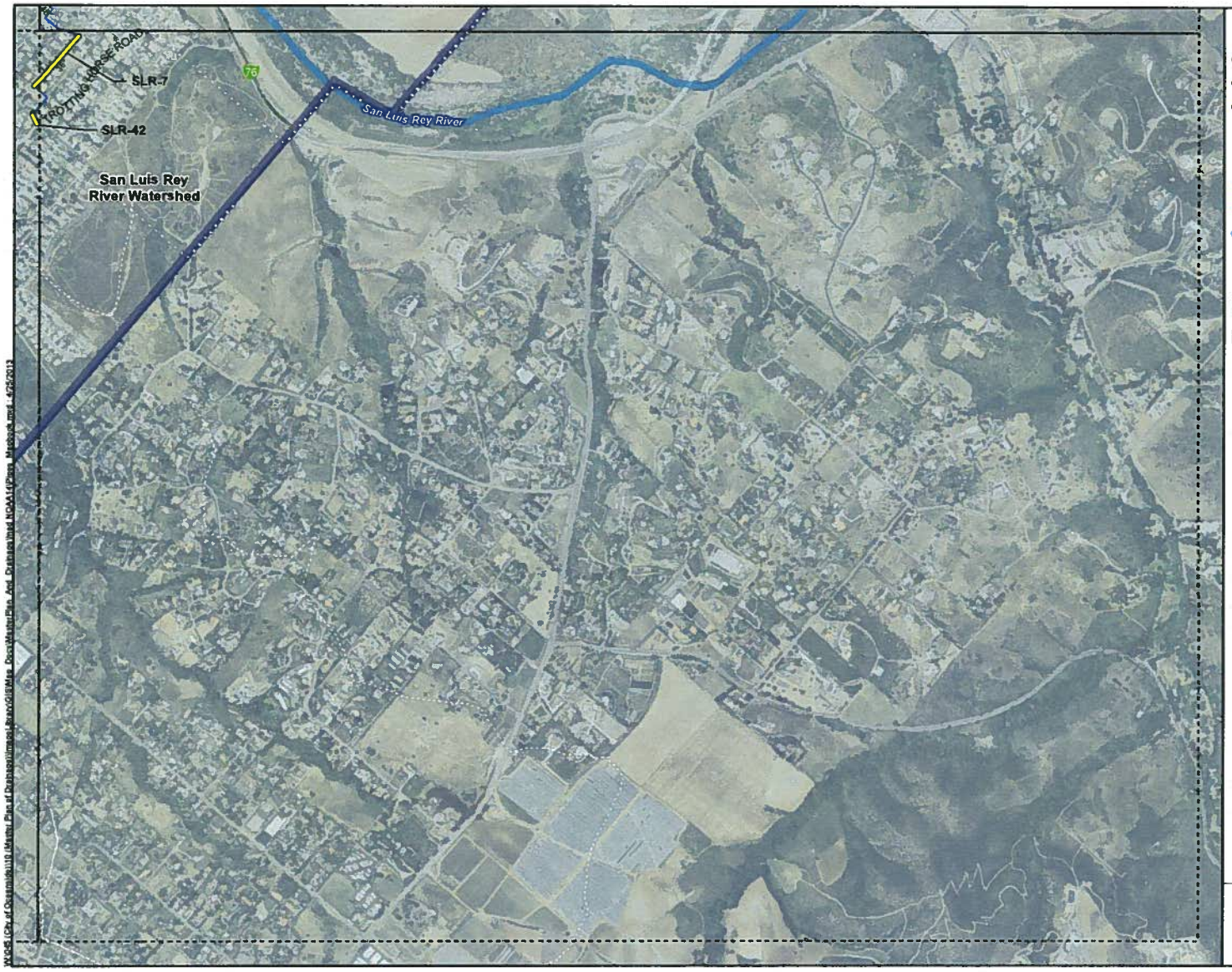

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Existing Storm Drains
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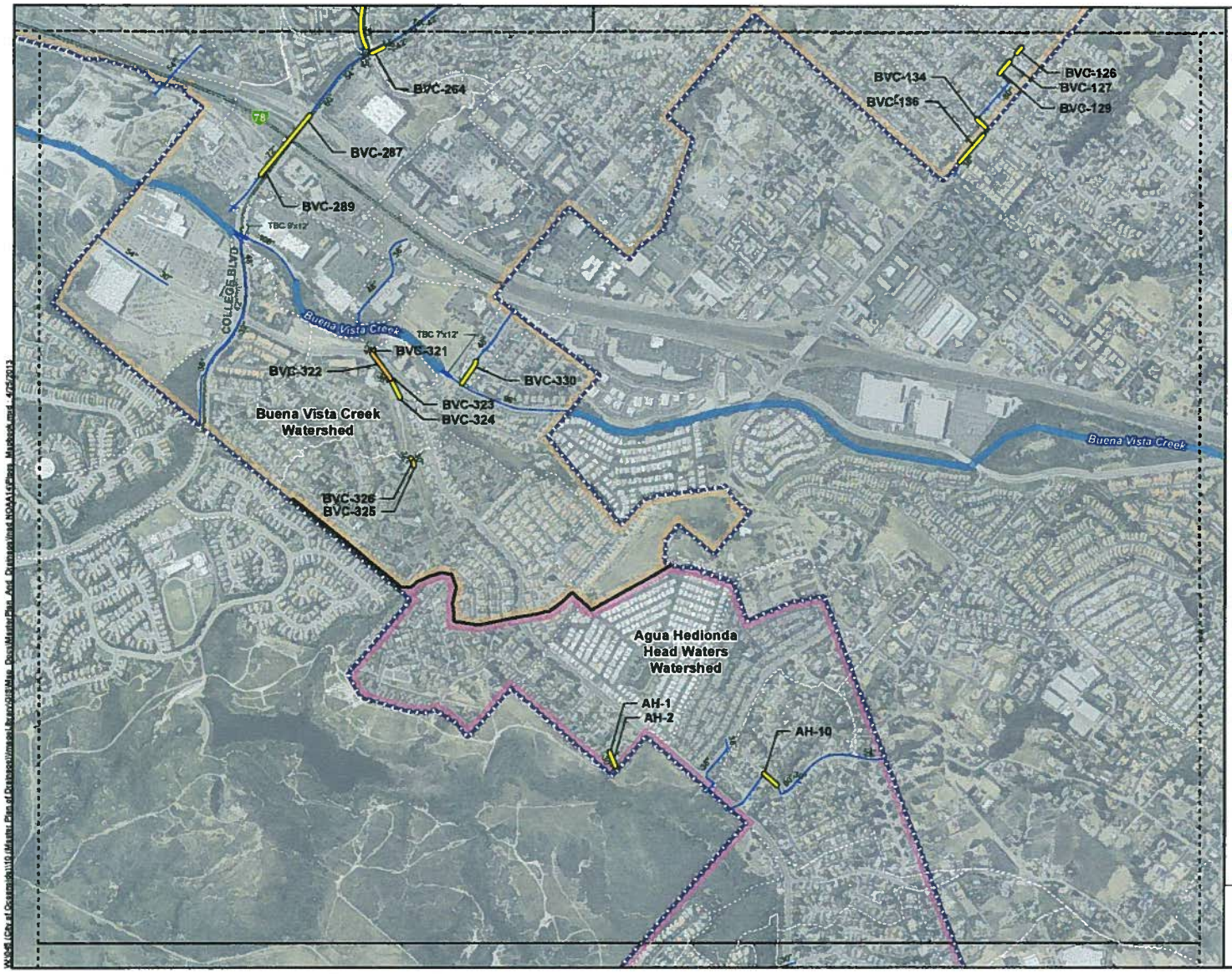

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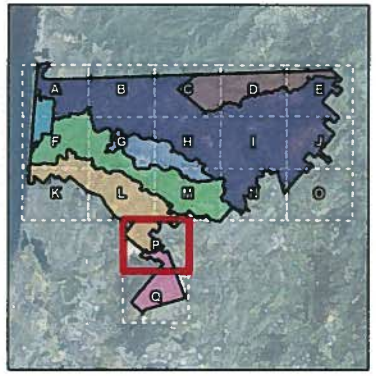

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Oceanside MPD Update 2012
Existing Storm Drains
Atlas Page P

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Atlas Page Q