Project Specific
Water Quality Management Plan (Preliminary)

For:
RANCHO PASEO de VALENCIA – TENTATIVE TRACT MAP 34760
RESIDENTIAL SUBDIVISION
CORONA, CA

DEVELOPMENT NO.
DESIGN REVIEW NO. DPR 06-010R

Prepared for:

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Prepared by:

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WQMP Preparation Date:
June 12, 2007
WQMP Revision Date:
August 7, 2008
October 24, 2008
November 11, 2008
May 27, 2009

OWNER'S CERTIFICATION

This project-specific Water Quality Management Plan (WQMP) has been prepared for:

The project known as Tentative Tract Map No. 34760 (Ranch Paseo de Valencia) located just north of the Cleveland National Forest and south of Tract Nos. 28153-6 and 28153. Entry to the site is from Malaga Street, south of Shepard Crest Drive. This WQMP is intended to comply with the requirements of the City of Corona for the preparation and implementation of a project-specific WQMP.

The undersigned, while owning the property/project described in the preceding paragraph, shall be responsible for the implementation of this WQMP and will ensure that this WQMP is amended as appropriate to reflect up-to-date conditions on the site. This WQMP will be reviewed with the facility operator, facility supervisors, employees, tenants, maintenance and service contractors, or any other party (or parties) having responsibility for implementing portions of this WQMP. At least one copy of this WQMP will be maintained at the project site or project office in perpetuity.

The undersigned is authorized to certify and to approve implementation of this WQMP. The undersigned is aware that implementation of this WQMP is enforceable under Corona Water Quality Ordinance (Municipal Code Section 13.27).

If the undersigned transfers its interest in the subject property/project, its successor in interest the undersigned shall notify the successor in interest of its responsibility to implement this WQMP.

"I certify under penalty of law that the provision of this WQMP have been reviewed and accepted and that the WQMP will be transferred to future successors in interest."

Owner's Signature	Date
Owner's Printed Name	Owner's Title/Position

Rancho Paso de Valencia
1253 Enterprise Court
Corona, CA. 92882
(951) 279-4877

Contents

I. Project Description

The project site is a 65.4 acre site located just north of the Cleveland National Forest and south of Tract Nos. 28153-6 and 28153. Approximately 36.9 acres of the site is within the City of Corona and the remaining 24.4 acres is within unincorporated County of Riverside and is being annexed as part of the project. Entry to the site is from Malaga Street, south of Shepard Crest Drive. The existing site has a natural channel near the westerly edge of the project site that flows into an existing offsite debris basin ("3D"). Another existing debris basin ("3") is located adjacent to the northeast portion of the site. The proposed development project will be an estate type residential subdivision (Tentative Tract Map 34760) consisting of thirty-four (34) new half acre single family residential lots accessed via four (4) proposed private streets; "A" , "B", "C" and "D" Circle. There is an existing 1.1 acre residential lot labeled N.A.P. which will remain. Lots "A" through Lot "D" are common open space areas and will be maintained by the proposed HOA. Lots "E" and "F" are water quality basins that will also be maintained by the HOA Lots "G" and "H" comprise 14.5 acres of proposed natural open space. The 9.0 acres of Lot "H" will be dedicated as a permanent natural conservation area.

The developed portion of the project will drain into two proposed water quality basins via vegetated swales, street curbs and gutters, and a series of proposed catch basins with connecting storm drain pipes. The size of each water quality basin will be depended upon the amount of run-off that can be treated by the vegetated swales. There will be three (3) vegetated swales constructed with an underlying gravel bed and perforated pipe. One will be placed along "D" Circle's eastern right of way. The other two swales will be placed along the southerly right of way of "A" Circle.

The swales will be designed to treat the runoff from their respective tributary areas, which will decrease the area to be treated by the proposed water quality basins ("E1" and "E2") located at the northeast and northwest portions of the site. The water quality basins will be designed to detain and treat the calculated Best Management Practices (BMP) volume. These proposed basins will each have side slope ratios of 3:1. The runoff captured by these two water quality basins will be released into the existing offsite debris basins ("3" and "3D") via proposed storm drain pipes.

Project Owner: **Rancho Paso de Valencia**
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Telephone: (951) 279-4877

WQMP Preparer: **Armstrong & Brooks Consultant Engineers**
1530 Consumer Circle, Unit "B"
Corona, CA 92880
Telephone: (951) 372-8400

Project Site Address: South of Shepard Crest Dr. & Malaga St.
Corona, CA 92881

APN Number(s): 114-040-019, 114-040-020, 275-100-003

Thomas Bros. Map: Page 773 Grid B4 – B5 - 2007 Edition

Project Watershed: Santa Ana River – Reach 3

Sub-watershed: Temescal Creek

Project Site Size: 65.4 Acres

Standard Industrial Classification (SIC) Code: N/A

Formation of Home Owners' Association (HOA) or Property Owners Association (POA): Yes there will be an HOA

Additional Permits/Approvals required for the Project

AGENCY	Permit required (yes or no)
State Department of Fish and Game, 1601 Streambed Alteration Agreement	no
State Water Resources Control Board, Clean Water Act (CWA) section 401 Water Quality Certification	no
US Army Corps of Engineers, CWA section 404 permit	no
US Fish and Wildlife, Endangered Species Act section 7 biological opinion	no
Other *(please list in the space below as required)*	

Appendix A of this project-specific WQMP includes a complete copy of the Final Conditions of Approval. Appendix B of this project-specific WQMP shall include:

1. A Vicinity Map identifying the project site and surrounding planning areas in sufficient detail to allow the project site to be plotted on Co-Permittee base mapping; and
2. A Site Plan for the project. The Site Plan included as part of Appendix B depicts the following project features:

- Location and identification of all structural BMPs, including Treatment Control BMPs;
- Landscaped areas;
- Paved areas and intended uses (i.e., parking, outdoor work area, outdoor material storage area, sidewalks, patios, tennis courts, etc.);
- Number and type of structures and intended uses (i.e., buildings, tenant spaces, dwelling units, community facilities such as pools, recreation facilities, tot lots, etc.);
- Infrastructure (i.e., streets, storm drains, etc.) that will revert to public agency ownership and operation;
- Location of existing and proposed public and private storm drainage facilities (i.e., storm drains, channels, basins, etc.), including catch basins and other inlets/outlet structures. Existing and proposed drainage facilities should be clearly differentiated;
- Location(s) of Receiving Waters to which the project directly or indirectly discharges;
- Location of points where onsite (or tributary offsite) flows exit the property/project site;
- Proposed drainage areas boundaries, including tributary offsite areas, for each location where flows exits the property/project site. Each tributary area should be clearly denoted;
- Pre- and post-project topography.

II. Site Characterization

Land Use Designation or Zoning:	Existing: Mountain Gate Specific Plan (SP-89-01); Estate Residential – Cluster (ER-Cluster) and Rural Residential (R-R) Proposed: Mountain Gate Specific Plan (SP-89-01); ER-Cluster
Current Property Use:	Avocado and Citrus Groves, Single Family Residence, Vacant
Proposed Property Use:	Single Family Residential and Open Space
Availability of Soils Report:	Yes
Phase 1 Site Assessment:	Yes

Receiving Waters for Urban Runoff from Site

Receiving Waters	303(d) List Impairments	Designated Beneficial Uses	Proximity to RARE Beneficial Use
Temescal Creek Reach 1	None	REC1, REC2, WARM, WILD	N/A
Santa Ana River Reach 3	Pathogens generated by dairies – "High" TMDL Priority	AGR, GWR, REC1, REC2, WARM, WILD, RARE	4.5 Miles

III. Pollutants of Concern

Potential Pollutants of Concern associated with urban runoff from the proposed project have been identified. There has been no presence of legacy pesticides, nutrients, or hazardous substances in the site's soil as a result of past uses. (Please see Phase I Environmental Site Assessment in Appendix H

Urban Runoff Potential or Expected Pollutants of Concern (Residential Development):

Sediment and Turbidity, Nutrients, Trash and Debris, Oxygen Demanding Substances, Bacteria and Viruses, Oil and Grease, and Pesticides.

Urban Runoff Pollutants of Concern which receiving waters are impaired with:

Santa Ana River Reach 3 is impaired with Pathogens from Dairy Farm activities per 2002 CWA Section 303(d) list of Water Quality Limited Segment by Santa Ana Regional Water Quality Control Board.

IV. Hydrologic Conditions of Concern

Impacts to the hydrologic regime resulting from the Project may include increased runoff volume and velocity; reduced infiltration; increased flow frequency, duration, and peaks; faster time to reach peak flow; and water quality degradation. Under certain circumstances, changes could also result in the reduction in the amount of available sediment for transport; storm flows could fill this sediment-carrying capacity by eroding the downstream channel. These changes have the potential to permanently impact downstream channels and habitat integrity. A change to the hydrologic regime of a Project's site would be considered a hydrologic condition of concern if the change would have a significant impact on downstream erosion compared to the pre-development condition or have significant impacts on stream habitat, alone or as part of a cumulative impact from development in the watershed.

This project-specific WQMP must address the issue of Hydrologic Conditions of Concern unless one of the following conditions are met:

- **Condition A:** Runoff from the Project is discharged directly to a publicly-owned, operated and maintained MS4; the discharge is in full compliance with Co-Permittee requirements for connections and discharges to the MS4 (including both quality and quantity requirements); the discharge would not significantly impact stream habitat in proximate Receiving Waters; and the discharge is authorized by the Co-Permittee.
- **Condition B:** The project disturbs less than 1 acre. The disturbed area calculation should include all disturbances associated with larger plans of development.
- **Condition C:** The project's runoff flow rate, volume, velocity and duration for the post-development condition do not exceed the pre-development condition for the 2-year, 24-hour and 10-year 24-hour rainfall events. This condition can be achieved by minimizing impervious area on a site and incorporating other site-design concepts that mimic pre-development conditions. This condition must be substantiated by hydrologic modeling methods acceptable to the Co-Permittee.

This Project meets the following condition: CONDITION “A” and CONDITION “C”

The project runoff discharges directly into two debris basins owned and maintained by the City of Corona. A small portion of the project runoff discharges to an existing storm drain pipe in Malaga Street that is also maintained by the City.

V. Best Management Practices

V.1 Site Design BMPs

Project proponents shall implement Site Design concepts that achieve each of the following:

1) Minimize Urban Runoff
2) Minimize Impervious Footprint
3) Conserve Natural Areas
4) Minimize Directly Connected Impervious Areas (DCIAs)

The proposed single-family residential development consists of 34 lots with a minimum area of one-half acre. The project circulation consists of direct access from existing Malaga St. into four proposed private streets, "A", "B", "C" and "D" Circle most of which are single loaded. The site will remain approximately 70 percent pervious, by maintaining large open space areas within the development to allow for increased natural infiltration and decreased urban runoff.

Urban runoff will be decreased by implementing vegetated swales along "A" and "D" Circles to capture the runoff from a portion of the adjacent manufactured slopes and allow infiltration into the soil. Water Quality basins "E1" and "E2" will be designed to capture the on-site runoff and detain the calculated water quality BMP volume. These water quality measures will decrease urban runoff.

The majority of the impervious surfaces proposed by this project, approximately 30 percent, will come for the street improvements and the residential buildings. The proposed streets have been designed to minimum widths per local development codes to decrease the impervious surface generated by the development.

The development plan proposes to dedicate approximately 9.0 acres (Lot "H") of the 14.5 acres of open space as permanent natural conservation area.

The developed site will reduce any directly connected impervious areas to the existing debris basins and storm drain system by conveying on-site flows through vegetated swales and water quality basins ("E1" and "E2") prior to entering the existing detention basins. See Section 4.5.1 of the WQMP for additional guidance on Site Design BMPs.

Table 1. Site Design BMPs

			Included	
Design Concept	**Technique**	**Specific BMP**	**yes**	**no**
Site Design Concept 1	*Minimize Urban Runoff*			
	The proposed streets have been designed to minimum widths per local development codes, open undeveloped areas will remain and contribute to the increase in permeable area.	Maximize the permeable area (See Section 4.5.1 of the WQMP).	**X**	
	On-site runoff drains to single loaded streets w/ vegetated swales which decrease urban runoff.	Incorporate landscaped buffer areas between sidewalks and streets.	**X**	
	The site will be landscaped with similar trees and shrubs or the same as the ones that currently exist.	Maximize canopy interception and water conservation by preserving existing native trees and shrubs, and planting additional native or drought tolerant trees and large shrubs.	**X**	
	Off-site flows will be passed through the development in the existing natural channel.	Use natural drainage systems.	**X**	
	The development incorporates water quality basins which decreases urban runoff.	Where soils conditions are suitable, use perforated pipe or gravel filtration pits for low flow infiltration.	**X**	
	The development incorporates water quality basins which decreases urban runoff.	Construct onsite ponding areas or retention facilities to increase opportunities for infiltration consistent with vector control objectives.	**X**	

	The site has been designed per local development code	Other comparable and equally effective site design concepts as approved by the Co-Permittee (Note: Additional narrative required to describe BMP and how it addresses Site Design concept).		**X**

Table 1. Site Design BMPs (Cont.)

			Included	
Design Concept	**Technique**	**Specific BMP**	**yes**	**no**
Site Design Concept 2	Minimize Impervious Footprint			
	The proposed streets have been designed to minimum widths per local development codes, open undeveloped areas will remain and contribute to the increase in permeable area.	Maximize the permeable area (See Section 4.5.1 of the WQMP).	X	
		Construct walkways, trails, patios, overflow parking lots, alleys, driveways, low-traffic streets and other low -traffic areas with open-jointed paving materials or permeable surfaces, such as pervious concrete, porous asphalt, unit pavers, and granular materials.		X
	The streets have been designed to minimum widths per local development codes.	Construct streets, sidewalks and parking lot aisles to the minimum widths necessary, provided that public safety and a walk able environment for pedestrians are not compromised.	X	
	The streets have been designed to minimum widths per local development codes.	Reduce widths of street where off-street parking is available.	X	
	70-percent of the site is pervious and roof and a large portion of pervious surfaces will drain toward landscaped areas or vegetated swales.	Minimize the use of impervious surfaces, such as decorative concrete, in the landscape design.	X	
		Other comparable and equally effective site design concepts as approved by the Co-Permittee (Note: Additional narrative required describing BMP and how it addresses Site Design concept).		X
Site Design Concept 3	Conserve Natural Areas			

	The development conserves 9.0 acres of natural areas.	Conserve natural areas (See WQMP Section 4.5.1).	X	
	The development implements the conservation of natural areas, which in turn preserves existing native trees and shrubs.	Maximize canopy interception and water conservation by preserving existing native trees and shrubs, and planting additional native or drought tolerant trees and large shrubs.	X	
	The development conserves the primary existing natural Channel, which will be used to convey off-site flows.	Use natural drainage systems.	X	
	The developed site has been designed to its best efficiency due to property constraints and limitations	Other comparable and equally effective site design concepts as approved by the Co-Permittee (Note: Additional narrative required describing BMP and how it addresses Site Design concept).	X	

Table 1. Site Design BMPs (Cont.)

			Included	
Design Concept	**Technique**	**Specific BMP**	**Yes**	**no**
Site Design Concept 4	Minimize Directly Connected Impervious Areas (DCIAs)	X		
	All flows from the developed site will ultimately drain into water quality basins	Residential and commercial sites must be designed to contain and infiltrate roof runoff, or direct roof runoff to vegetative swales or buffer areas, where feasible.	X	
	All flows from the developed site will ultimately drain into water quality basins	Where landscaping is proposed, drain impervious sidewalks, walkways, trails, and patios into adjacent landscaping.	X	
	Vegetated swales have been implemented within the site where feasible.	Increase the use of vegetated drainage swales in lieu of underground piping or imperviously lined swales.	X	
		Rural swale system: street sheet flows to vegetated swale or gravel shoulder, curbs at street corners, culverts under driveways and street crossings.		X
	There are swales implemented on “A” and “D” Circle to pick up partial street flows.	Urban curb/swale system: street slopes to curb; periodic swale inlets drain to vegetated swale/biofilter.	X	
	The flows generated from the streets are ultimately conveyed to the water quality basins before entering the existing debris basins.	Dual drainage system: First flush captured in street catch basins and discharged to adjacent vegetated swale or gravel shoulder, high flows connect directly to MS4s.	X	
		Design driveways with shared access, flared (single lane at street) or wheel strips (paving only under tires); or, drain into landscaping prior to discharging to the MS4.		X
	All flows from the developed site will ultimately drain into water quality basins	Uncovered temporary or guest parking on private residential lots may be paved with a permeable surface, or designed to drain into landscaping prior to discharging to the MS4.	X	

	Vegetated swales have been implemented along some streets to convey flows from manufactured slopes.	Where landscaping is proposed in parking areas, incorporate landscape areas into the drainage design.	X	
		Overflow parking (parking stalls provided in excess of the Co-Permittee's minimum parking requirements) may be constructed with permeable paving.		X
	The developed site has been designed to its best efficiency due to property constraints and limitations	Other comparable and equally effective design concepts as approved by the Co-Permittee (Note: Additional narrative required describing BMP and how it addresses Site Design concept).	X	

V.2 Source Control BMPs

Complete Table 2.

Table 2. Source Control BMPs

BMP Name	Check One: Included	Check One: Not Applicable	If not applicable, state brief reason
Non-Structural Source Control BMPs			
Education for Property Owners, Operators, Tenants, Occupants, or Employees	X		
Activity Restrictions	X		
Irrigation System and Landscape Maintenance	X		
Common Area Litter Control		X	No common area gatherings requiring litter receptacles
Street Sweeping Private Streets and Parking Lots	X		
Drainage Facility Inspection and Maintenance	X		
Structural Source Control BMPs			
MS4 Stenciling and Signage	X		
Landscape and Irrigation System Design	X		
Protect Slopes and Channels	X		
Provide Community Car Wash Racks		X	No Community Car Wash Racks
Properly Design:			
Fueling Areas		X	No fueling areas
Air/Water Supply Area Drainage		X	No Air/Water Supply Area
Trash Storage Areas		X	Single Family Residential Development
Loading Docks		X	No Loading Docks
Maintenance Bays		X	No Maintenance Bays
Vehicle and Equipment Wash Areas		X	None On-Site
Outdoor Material Storage Areas		X	
Outdoor Work Areas or Processing Areas		X	None
Provide Wash Water Controls for Food Preparation Areas		X	None

Education for Property Owners, Operators, Tenants, Occupants, or Employees – Informational materials to promote the prevention of Urban Runoff pollution will be provided by the project proponent to the first residents/occupants/tenants.

Activity Restrictions – The blowing, sweeping, or hosing of debris (leaf litter, grass clippings, litter, etc.) into streets, storm drain inlets and other conveyances is prohibited. Dumpster lids are to remain closed at all times. All activity restriction will be outlined within the CCR's for the project.

Irrigation System and Landscape Maintenance - Maintenance of irrigation systems and landscaping shall be consistent with the City of Corona's water conservation ordinance, which can be accessed through the City of Corona's website or obtained through the city's planning/permitting counter. Fertilizer and pesticide usage shall be consistent with the instructions contained on product labels and with regulations administered by California's Department of Pesticide Regulation. Additionally, landscape maintenance must address replacement of dead vegetation, repair of erosion rills, proper disposal of green waste, etc. Irrigation system maintenance must address periodic testing and observation of the irrigation system to detect overspray, broken sprinkler heads, and other system failures. The Property owner shall be responsible for the maintenance of the irrigation system and landscaping on private property. HOA will be responsible for the maintenance of the irrigation system on and landscaping in common areas.

Drainage Facility Inspection and Maintenance - The frequency shall be no less than the frequency of drainage facility cleaning conducted by the City of Corona. At a minimum, routine maintenance of drainage facilities should take place in the late summer or early fall prior to the start of the rainy season (October 1). The drainage facilities must be cleaned if accumulated sediment/debris fills 25% or more of the sediment/debris storage capacity. Drainage facilities shall be inspected annually and the cleaning frequency shall be assessed. An HOA will be the responsible party for the implementation of inspection and maintenance for the drainage facility.

MS4 Stenciling and Signage – An HOA will maintain labeling of all storm drain inlets and catch basins within project area with language "ONLY RAIN DOWN THE STORM DRAIN" per city of Corona standard shown in Appendix C.

Landscape and Irrigation System Design – Rain shutoff devices and flow reducers or shutoff valves triggered by a pressure drop shall be installed. Irrigation systems shall be designed according to each landscaped area's water requirements. The timing and application methods of the irrigation water shall be designed to minimize the runoff of excess irrigation water. The landscape plan shall utilize drought tolerant plants, group plants with similar water requirements together, use mulches in planter areas without ground cover, and utilize plants that minimize or eliminate the use of fertilizers or pesticides. The Property owner shall be the responsible party for the implementation of the landscape and irrigation system design for private property and an HOA will be responsible for common areas.

Protect Slopes and Channels – Runoff will be safely conveyed away from the tops of slopes. Slopes will be landscaped with deep-rooted, drought tolerant plant species selected for erosion control. The HOA will be responsible for the maintenance of all on-site slopes and channels

Appendix C includes copies of the educational materials that will be used in implementing this project-specific WQMP.

Street Sweeping Private/Public Streets and Parking Lots –The frequency shall be determined by the City of Corona. The project-specific WQMP should identify the anticipated sweeping frequency, source of funding and the party responsible for conducting the periodic sweeping. Street sweeping frequency shall take place a minimum of twice a month.

The party responsible for monitoring the frequency of private streets is the Home Owner's Association. The party responsible for monitoring the frequency of the street sweeping is the City of Corona.

Design and Maintenance of Trash Storage Areas – All trash container areas shall meet the following requirements:

1. Paved with an impervious surface, designed not to allow run-on from adjoining areas, designed to divert drainage from adjoining roofs and pavements diverted around the area, screened or walled to prevent off-site transport of trash.

2. Trash dumpsters (containers) shall be leak proof and have attached covers or lids.

3. Connection of trash area drains to MS4 is prohibited.

The property owner will be responsible for their respective trash storage area while the HOA will be responsible for the maintenance of any public trash storage areas.

V.3 Treatment Control BMPs

The developed site will drain into two proposed water quality basins via street curb and gutter, a series of proposed catch basins with connecting storm drain pipes and perforated pipes from proposed vegetated swales. The catch basins will have drain inserts to filter out trash that settles in.

The three (3) vegetated swales are constructed with an underlying gravel bed and perforated pipe. One will be placed along "D" Circle's eastern right of way. The other two swales will be placed along the southern right of way of "A" Circle. The swales will collect and treat runoff from portions of Open Space Lots "B" and "C". The swales pipe system will convey flows to a series of proposed catch basins. The swales are designed to treat sediment, nutrients, trash, metals, oil and grease, organics and oxygen demanding substances.

The water quality basins (TC-22) are designed to treat sediment, nutrients, trash, metals, oil and grease and oxygen demanding substances, as well as to detain the calculated Best Management Practices (BMP) volume. The size of each water quality basin will be dependent upon the amount of run-off that can be treated by the vegetated swales. A water quality basin will be located at both the northeast and northwest end of the site. The proposed water quality basins each have a maximum side slope ratio of 3:1. The runoff treated by the water quality basins will be released into the two existing debris basins ("3" and "3D") via the proposed storm drain pipes.

Table 3: Treatment Control BMP Selection Matrix

Pollutant of Concern	Treatment Control BMP Categories(9)							
	Veg. Swale /Veg. Filter Strips	Detention Basins(2)	Infiltration Basins & Trenches/Porous Pavement(3)(10)	Wet Ponds or Wetlands	Sand Filter or Filtration	Water Quality Inlets	Hydrodynamic Separator Systems (4)	Manufactured/ Proprietary Devices
Sediment/Turbidity Y ☐ N ☒	H/M ☒	M ☒	H/M ☐	H/M ☐	H/M ☐	L ☒	H/M (L for turbidity) ☐	U ☐
Nutrients Y ☐ N ☒	L ☒	M ☒	H/M ☐	H/M ☐	L/M ☐	L ☒	L ☐	U ☐
Organic Compounds Y ☐ N ☒	U ☐	U ☐	U ☐	U ☐	H/M ☐	L ☒	L ☐	U ☐
Trash & Debris Y ☐ N ☒	L ☒	M ☒	U ☐	U ☐	H/M ☐	M ☒	H/M ☐	U ☐
Oxygen Demanding Substances Y ☐ N ☒	L ☒	M ☒	H/M ☐	H/M ☐	H/M ☐	L ☒	L ☐	U ☐
Bacteria & Viruses Y ☒ N ☐	U ☒	U ☒	H/M ☐	U ☐	H/M ☐	L ☒	L ☐	U ☐
Oils & Grease Y ☐ N ☒	H/M ☒	M ☒	U ☐	U ☐	H/M ☐	M ☒	L/M ☐	U ☐
Pesticides (non-soil bound) Y ☐ N ☒	U ☒	U ☒	U ☐	U ☐	U ☐	L ☒	L ☐	U ☐
Metals Y ☐ N ☒	H/M ☐	M ☐	H ☐	H ☐	H ☐	L ☒	L ☐	U ☐

Santa Ana River Reach 3 is impaired with Pathogens per 2002 CWA Section 303(d) list of Water Quality Limited Segment by Santa Ana Regional Water Quality Control Board.

Abbreviations:

L: Low removal efficiency H/M: High or medium removal efficiency U: Unknown removal efficiency

Notes:

(1) Periodic performance assessment and updating of the guidance provided by this table may be necessary.

(2) Includes grass swales, grass strips, wetland vegetation swales, and bioretention.

(3) Includes extended/dry detention basins with grass lining and extended/dry detention basins with impervious lining. Effectiveness based upon minimum 36-48-hour drawdown time.

(4) Includes infiltration basins, infiltration trenches, and porous pavements.

(5) Includes permanent pool wet ponds and constructed wetlands.

(6) Includes sand filters and media filters.

(7) Also known as hydrodynamic devices, baffle boxes, swirl concentrators, or cyclone separators.

(8) Includes proprietary stormwater treatment devices as listed in the CASQA Stormwater Best Management Practices Handbooks, other stormwater treatment BMPs not specifically listed in this WQMP, or newly developed/emerging stormwater treatment technologies.

(9) Project proponents should base BMP designs on the Riverside County Stormwater Quality Best Management Practice Design Handbook. However, project proponents may also wish to reference the California Stormwater BMP Handbook – New Development and Redevelopment (www.cabmphandbooks.com). The Handbook contains additional information on BMP operation and maintenance.

(10) Note: Projects that will utilize infiltration-based Treatment Control BMPs (e.g., Infiltration Basins, Infiltration Trenches, Porous Pavement) must include a copy of the property/project soils report as Appendix E to the project-specific WQMP. The selection of a Treatment Control BMP (or BMPs) for the project must specifically consider the effectiveness of the Treatment Control BMP for pollutants identified as causing an impairment of Receiving Waters to which the project will discharge Urban Runoff.

V.4 EQUIVALENT TREATMENT CONTROL ALTERNATIVES

"NOT APPLICABLE"

V.5 REGIONALLY-BASED TREATMENT CONTROL BMPS

"NOT APPLICABLE"

VI. Operation and Maintenance Responsibility for Treatment Control BMPs

Operation and maintenance (O&M) requirements for all structural Source Control and Treatment Control BMPs shall be identified in the project-specific WQMP. The project-specific WQMP shall address the following:

- Identification of each BMP that requires O&M.
  - Three (3) Vegetated Swales
  - Two (2) Water Quality Basins

Bio Swales:

The useful life of a bio/infiltration swale system is directly proportional to its maintenance frequency. If properly designed and regularly maintained, vegetated swales can last indefinitely. The maintenance objectives for vegetated swale systems include keeping up the hydraulic and removal efficiency of the channel and maintaining a dense, healthy grass cover.

Maintenance activities should include periodic mowing (with grass never cut shorter than the design flow depth), weed control, watering during drought conditions, reseeding of bare area, and clearing of debris and blockages. Cuttings should be removed from the channel and disposed in a local composting facility. Accumulated sediment will be removed manually to avoid concentrated flows in the swale. The application of fertilizers and pesticides should be minimal.

Another aspect of a good maintenance plan is repairing damaged areas within a channel. For example, if the channel develops ruts or holes, it should be repaired using suitable soil that is properly tamped and seeded. The grass covers should be thick; if it is not, reseed as necessary. Any standing water removed during maintenance operations must be disposed to a sanitary sewer at an approved discharge location. Residuals (e.g., silt, grass cuttings) must be disposed in accordance with local or state requirements. Maintenance of grassed swales mostly involves maintenance of grass or wetland plant cover.

Thorough description of O&M activities of the bio swale:

- Inspect swales at least twice annually for erosion, damage to vegetation, and sediment and debris accumulation preferably at the end of the wet season to schedule summer maintenance and before major fall runoff to be sure the swale is ready for winter. However, additional inspection after periods of heavy runoff is desirable. The swale should be checked for debris and litter, and areas of sediment accumulation.
- Grass height and mowing frequency may not have a large impact on pollutant removal. Consequently, mowing may only be necessary once or twice a year for safety or aesthetics or to suppress weeds and woody vegetation.

- Trash tends to accumulate in swale areas, particularly along highways. The need for litter removals determined through periodic inspection, but litter should always be removed prior to mowing.
- Sediment accumulating near culverts and in channels should be removed when it builds up to 75 mm (3 in.) at any spot, or covers vegetation.
- Regularly inspect swales for pools of standing water. Swales can become a nuisance due to mosquito breeding in standing water if obstructions develop (e.g. debris accumulation, invasive vegetation) and/or proper drainage slopes are not implemented and maintained.
- Clean out sediment traps, forebays, inlet/outlet structures, overflow spillway and trenches if necessary.
- Replace first layer of aggregate and filter fabric if clogging appears only to be at the surface.
- Clean trench when loss of infiltrative capacity is observed. If drawdown time is observed to have increased significantly over the design drawdown time, removal of sediment may be necessary.

Detention Basin:

Inspection Activities:

- Inspect after several storm events for bank stability, vegetation growth, and to determine if the desired residence time has been achieved. This activity will take place post construction.
- Inspect outlet structure for evidence of clogging or outflow release velocities that are greater than design flow. This activity will take place post construction.
- Inspect for the following issues: differential settlement, cracking; erosion of pond banks or bottom, leakage, or tree growth on the embankment; the condition of the riprap in the inlet, clogging of outlet and pilot channels; standing water, slope stability, presence of burrows; sediment accumulation in the basin, forebay, and outlet structures; trash and debris, and the vigor and density of the grass turf on the basin side slopes and floor. This activity will take place semi-annually.
- Inspect for the following issues: subsidence, damage to emergency spillway; inadequacy of the inlet/outlet channel erosion control measures; changes in the condition of the pilot channel, accumulated sediment volume, and semi-annual inspection items. This will take place annually.
- During inspections, changes to the extended storage pond or the contributing watershed should be noted, as these may affect basin performance. This will take place annually.

Maintenance activities:

- If necessary, modify the outlet orifice to achieve design values if inspection indicates modifications are necessary. This will take place as needed.
- Repair undercut and eroded areas. This will take place as needed.
- Mow side slopes. This will take place as needed.

- Manage pesticides and nutrients. This will take place s needed.
- Remove liter and debris. This will take place as needed.
- Control mosquitoes as necessary.
- Remove accumulated trash and debris from the basin, around the riser pipe, side slopes, embankment, emergency spillway, and outflow trash racks. The frequency of this activity may be altered to meet specific site conditions. This will take place semi-annually.
- Trim vegetation at the beginning and end of the wet season to prevent establishment of woody vegetation and for aesthetic and vector reasons. This will take place semi-annually.
- Seed or sod to restore dead or damaged ground cover. This will take place annually.
- Repair erosion to banks and bottom as required.
- Supplement wetland plants if a significant portion have not established (at least 50% of the surface area.). This will take place annually.
- Remove nuisance plant species. This will take place annually.
- Remove sediment from the forebay to reduce frequency of main basin cleaning. This will take place annually.
- Remove sediment from the forebay to reduce frequency of main basin cleaning. This will take place every 3 to 5 years.
- Monitor sediment accumulation and remove accumulated sediment and re-grade about every 10 years or when accumulated sediment volume exceeds 10-20% of basin volume, or when accumulation reaches 6 inches or if re-suspension is observed. Clean in early spring so vegetation damaged during cleaning has time to re-establish. This will take place between 20 to 25 years.

An HOA will be established and will be the responsible party for the Operation and Maintenance of all Treatment BMPs.

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VII. Funding

The funding source for the O&M of each Treatment Control BMP identified in the project-specific WQMP will be the provided by Property Owner. By certifying the project-specific WQMP, the Project applicant is certifying that the funding responsibilities have been addressed and will be transferred to the property. One example of how to adhere to the requirement to transfer O&M responsibilities is to record the project-specific WQMP against the title to the property.

"I certify under penalty of law that the provision of this WQMP have been reviewed and accepted and that the Operation and Maintenance (O&M) will be funded by the Property Owner."

______________________________ ______________________________

Owner's Signature Date

______________________________ ______________________________

Owner's Printed Name Owner's Title/Position

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Appendix A

Conditions of Approval

(Pending)

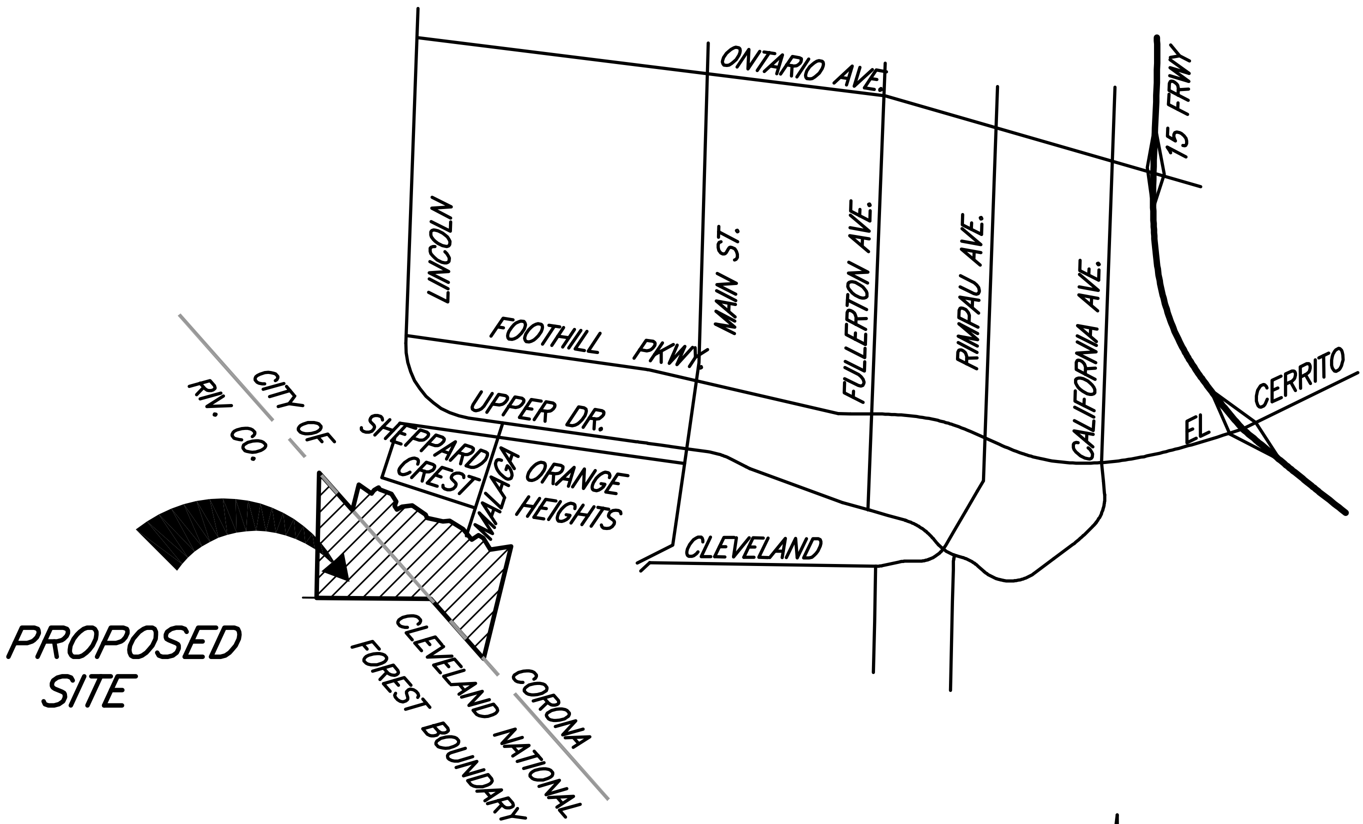
Planning Commission Resolution: _______________

Dated: _______________

Appendix B

Vicinity Map and Site Plan

VICINITY MAP
TRACT 34760



VICINITY MAP

N.T.S.

THOMAS BROS. – 2004
PAGE 773 GRID B4 – B5

OWNER/DEVELOPER

RANCHO PASO DE VALENCIA
1253 S. ENTERPRISE CT.
CORONA, CA 92882

ENGINEER

ARMSTRONG & BROOKS CONSULTING ENGINEERS
1530 CONSUMER CIRCLE, UNIT B
CORONA, CA 92880
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(951) 372-8430

TRACT 34760 - WQMP EXHIBIT "B"

Appendix C

Supporting Detail Related to Hydraulic Conditions of Concern
(To be included with Final WQMP)

Appendix D

Educational Materials

Site Design & Landscape Planning SD-10

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- ☑ Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from stormwater.

Approach

Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for site design and landscapes planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.

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Designing New Installations

Begin the development of a plan for the landscape unit with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.

- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open unwooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (e.g., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Conserve Natural Areas during Landscape Planning

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.

- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.

- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.

- Promote natural vegetation by using parking lot islands and other landscaped areas.

- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.

- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

- Evaluating infiltration opportunities by referring to the stormwater management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydrogeological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

Protection of Slopes and Channels during Landscape Design

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Vegetate slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of “ redevelopment” must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under “designing new installations” above should be followed.

Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, disconnect directly connected impervious areas.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Storm Drain Signage SD-13

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- ☑ Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Waste materials dumped into storm drain inlets can have severe impacts on receiving and ground waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets.

Approach

The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Storm drain messages have become a popular method of alerting the public about the effects of and the prohibitions against waste disposal.

Suitable Applications

Stencils and signs alert the public to the destination of pollutants discharged to the storm drain. Signs are appropriate in residential, commercial, and industrial areas, as well as any other area where contributions or dumping to storm drains is likely.

Design Considerations

Storm drain message markers or placards are recommended at all storm drain inlets within the boundary of a development project. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side. All storm drain inlet locations should be identified on the development site map.

Designing New Installations

The following methods should be considered for inclusion in the project design and show on project plans:

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include "NO DUMPING

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– DRAINS TO OCEAN" and/or other graphical icons to discourage illegal dumping.

- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Note - Some local agencies have approved specific signage and/or storm drain message placards for use. Consult local agency stormwater staff to determine specific requirements for placard types and methods of application.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. If the project meets the definition of "redevelopment", then the requirements stated under " designing new installations" above should be included in all project design plans.

Additional Information

Maintenance Considerations

- Legibility of markers and signs should be maintained. If required by the agency with jurisdiction over the project, the owner/operator or homeowner's association should enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards or signs.

Placement

- Signage on top of curbs tends to weather and fade.

- Signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.

Supplemental Information

Examples

- Most MS4 programs have storm drain signage programs. Some MS4 programs will provide stencils, or arrange for volunteers to stencil storm drains as part of their outreach program.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Extended Detention Basin **TC-22**

Design Considerations

- Tributary Area
- Area Required
- Hydraulic Head

Description

Dry extended detention ponds (a.k.a. dry ponds, extended detention basins, detention ponds, extended detention ponds) are basins whose outlets have been designed to detain the stormwater runoff from a water quality design storm for some minimum time (e.g., 48 hours) to allow particles and associated pollutants to settle. Unlike wet ponds, these facilities do not have a large permanent pool. They can also be used to provide flood control by including additional flood detention storage.

Targeted Constituents

☑	Sediment	▲
☑	Nutrients	●
☑	Trash	■
☑	Metals	▲
☑	Bacteria	▲
☑	Oil and Grease	▲
☑	Organics	▲

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

California Experience

Caltrans constructed and monitored 5 extended detention basins in southern California with design drain times of 72 hours. Four of the basins were earthen, less costly and had substantially better load reduction because of infiltration that occurred, than the concrete basin. The Caltrans study reaffirmed the flexibility and performance of this conventional technology. The small headloss and few siting constraints suggest that these devices are one of the most applicable technologies for stormwater treatment.

Advantages

- Due to the simplicity of design, extended detention basins are relatively easy and inexpensive to construct and operate.
- Extended detention basins can provide substantial capture of sediment and the toxics fraction associated with particulates.
- Widespread application with sufficient capture volume can provide significant control of channel erosion and enlargement caused by changes to flow frequency

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relationships resulting from the increase of impervious cover in a watershed.

Limitations

- Limitation of the diameter of the orifice may not allow use of extended detention in watersheds of less than 5 acres (would require an orifice with a diameter of less than 0.5 inches that would be prone to clogging).
- Dry extended detention ponds have only moderate pollutant removal when compared to some other structural stormwater practices, and they are relatively ineffective at removing soluble pollutants.
- Although wet ponds can increase property values, dry ponds can actually detract from the value of a home due to the adverse aesthetics of dry, bare areas and inlet and outlet structures.

Design and Sizing Guidelines

- Capture volume determined by local requirements or sized to treat 85% of the annual runoff volume.
- Outlet designed to discharge the capture volume over a period of hours.
- Length to width ratio of at least 1.5:1 where feasible.
- Basin depths optimally range from 2 to 5 feet.
- Include energy dissipation in the inlet design to reduce resuspension of accumulated sediment.
- A maintenance ramp and perimeter access should be included in the design to facilitate access to the basin for maintenance activities and for vector surveillance and control.
- Use a draw down time of 48 hours in most areas of California. Draw down times in excess of 48 hours may result in vector breeding, and should be used only after coordination with local vector control authorities. Draw down times of less than 48 hours should be limited to BMP drainage areas with coarse soils that readily settle and to watersheds where warming may be determined to downstream fisheries.

Construction/Inspection Considerations

- Inspect facility after first large to storm to determine whether the desired residence time has been achieved.
- When constructed with small tributary area, orifice sizing is critical and inspection should verify that flow through additional openings such as bolt holes does not occur.

Performance

One objective of stormwater management practices can be to reduce the flood hazard associated with large storm events by reducing the peak flow associated with these storms. Dry extended detention basins can easily be designed for flood control, and this is actually the primary purpose of most detention ponds.

Dry extended detention basins provide moderate pollutant removal, provided that the recommended design features are incorporated. Although they can be effective at removing some pollutants through settling, they are less effective at removing soluble pollutants because of the absence of a permanent pool. Several studies are available on the effectiveness of dry extended detention ponds including one recently concluded by Caltrans (2002).

The load reduction is greater than the concentration reduction because of the substantial infiltration that occurs. Although the infiltration of stormwater is clearly beneficial to surface receiving waters, there is the potential for groundwater contamination. Previous research on the effects of incidental infiltration on groundwater quality indicated that the risk of contamination is minimal.

There were substantial differences in the amount of infiltration that were observed in the earthen basins during the Caltrans study. On average, approximately 40 percent of the runoff entering the unlined basins infiltrated and was not discharged. The percentage ranged from a high of about 60 percent to a low of only about 8 percent for the different facilities. Climatic conditions and local water table elevation are likely the principal causes of this difference. The least infiltration occurred at a site located on the coast where humidity is higher and the basin invert is within a few meters of sea level. Conversely, the most infiltration occurred at a facility located well inland in Los Angeles County where the climate is much warmer and the humidity is less, resulting in lower soil moisture content in the basin floor at the beginning of storms.

Vegetated detention basins appear to have greater pollutant removal than concrete basins. In the Caltrans study, the concrete basin exported sediment and associated pollutants during a number of storms. Export was not as common in the earthen basins, where the vegetation appeared to help stabilize the retained sediment.

Siting Criteria

Dry extended detention ponds are among the most widely applicable stormwater management practices and are especially useful in retrofit situations where their low hydraulic head requirements allow them to be sited within the constraints of the existing storm drain system. In addition, many communities have detention basins designed for flood control. It is possible to modify these facilities to incorporate features that provide water quality treatment and/or channel protection. Although dry extended detention ponds can be applied rather broadly, designers need to ensure that they are feasible at the site in question. This section provides basic guidelines for siting dry extended detention ponds.

In general, dry extended detention ponds should be used on sites with a minimum area of 5 acres. With this size catchment area, the orifice size can be on the order of 0.5 inches. On smaller sites, it can be challenging to provide channel or water quality control because the orifice diameter at the outlet needed to control relatively small storms becomes very small and thus prone to clogging. In addition, it is generally more cost-effective to control larger drainage areas due to the economies of scale.

Extended detention basins can be used with almost all soils and geology, with minor design adjustments for regions of rapidly percolating soils such as sand. In these areas, extended detention ponds may need an impermeable liner to prevent ground water contamination.

The base of the extended detention facility should not intersect the water table. A permanently wet bottom may become a mosquito breeding ground. Research in Southwest Florida (Santana et al., 1994) demonstrated that intermittently flooded systems, such as dry extended detention ponds, produce more mosquitoes than other pond systems, particularly when the facilities remained wet for more than 3 days following heavy rainfall.

A study in Prince George's County, Maryland, found that stormwater management practices can increase stream temperatures (Galli, 1990). Overall, dry extended detention ponds increased temperature by about 5°F. In cold water streams, dry ponds should be designed to detain stormwater for a relatively short time (i.e., 24 hours) to minimize the amount of warming that occurs in the basin.

Additional Design Guidelines

In order to enhance the effectiveness of extended detention basins, the dimensions of the basin must be sized appropriately. Merely providing the required storage volume will not ensure maximum constituent removal. By effectively configuring the basin, the designer will create a long flow path, promote the establishment of low velocities, and avoid having stagnant areas of the basin. To promote settling and to attain an appealing environment, the design of the basin should consider the length to width ratio, cross-sectional areas, basin slopes and pond configuration, and aesthetics (Young et al., 1996).

Energy dissipation structures should be included for the basin inlet to prevent resuspension of accumulated sediment. The use of stilling basins for this purpose should be avoided because the standing water provides a breeding area for mosquitoes.

Extended detention facilities should be sized to completely capture the water quality volume. A micropool is often recommended for inclusion in the design and one is shown in the schematic diagram. These small permanent pools greatly increase the potential for mosquito breeding and complicate maintenance activities; consequently, they are not recommended for use in California.

A large aspect ratio may improve the performance of detention basins; consequently, the outlets should be placed to maximize the flowpath through the facility. The ratio of flowpath length to width from the inlet to the outlet should be at least 1.5:1 (L:W) where feasible. Basin depths optimally range from 2 to 5 feet.

The facility's drawdown time should be regulated by an orifice or weir. In general, the outflow structure should have a trash rack or other acceptable means of preventing clogging at the entrance to the outflow pipes. The outlet design implemented by Caltrans in the facilities constructed in San Diego County used an outlet riser with orifices

Figure 1
Example of Extended Detention Outlet Structure

sized to discharge the water quality volume, and the riser overflow height was set to the design storm elevation. A stainless steel screen was placed around the outlet riser to ensure that the orifices would not become clogged with debris. Sites either used a separate riser or broad crested weir for overflow of runoff for the 25 and greater year storms. A picture of a typical outlet is presented in Figure 1.

The outflow structure should be sized to allow for complete drawdown of the water quality volume in 72 hours. No more than 50% of the water quality volume should drain from the facility within the first 24 hours. The outflow structure can be fitted with a valve so that discharge from the basin can be halted in case of an accidental spill in the watershed.

Summary of Design Recommendations

(1) Facility Sizing - The required water quality volume is determined by local regulations or the basin should be sized to capture and treat 85% of the annual runoff volume. See Section 5.5.1 of the handbook for a discussion of volume-based design.

Basin Configuration – A high aspect ratio may improve the performance of detention basins; consequently, the outlets should be placed to maximize the flowpath through the facility. The ratio of flowpath length to width from the inlet to the outlet should be at least 1.5:1 (L:W). The flowpath length is defined as the distance from the inlet to the outlet as measured at the surface. The width is defined as the mean width of the basin. Basin depths optimally range from 2 to 5 feet. The basin may include a sediment forebay to provide the opportunity for larger particles to settle out.

A micropool should not be incorporated in the design because of vector concerns. For online facilities, the principal and emergency spillways must be sized to provide 1.0 foot of freeboard during the 25-year event and to safely pass the flow from 100-year storm.

(2) Pond Side Slopes - Side slopes of the pond should be 3:1 (H:V) or flatter for grass stabilized slopes. Slopes steeper than 3:1 (H:V) must be stabilized with an appropriate slope stabilization practice.

(3) Basin Lining – Basins must be constructed to prevent possible contamination of groundwater below the facility.

(4) Basin Inlet – Energy dissipation is required at the basin inlet to reduce resuspension of accumulated sediment and to reduce the tendency for short-circuiting.

(5) Outflow Structure - The facility's drawdown time should be regulated by a gate valve or orifice plate. In general, the outflow structure should have a trash rack or other acceptable means of preventing clogging at the entrance to the outflow pipes.

The outflow structure should be sized to allow for complete drawdown of the water quality volume in 72 hours. No more than 50% of the water quality volume should drain from the facility within the first 24 hours. The outflow structure should be fitted with a valve so that discharge from the basin can be halted in case of an accidental spill in the watershed. This same valve also can be used to regulate the rate of discharge from the basin.

The discharge through a control orifice is calculated from:

$$Q = CA(2gH-H_o)^{0.5}$$

where: Q = discharge (ft^3/s)
C = orifice coefficient
A = area of the orifice (ft^2)
g = gravitational constant (32.2)
H = water surface elevation (ft)
H_o = orifice elevation (ft)

Recommended values for C are 0.66 for thin materials and 0.80 when the material is thicker than the orifice diameter. This equation can be implemented in spreadsheet form with the pond stage/volume relationship to calculate drain time. To do this, use the initial height of the water above the orifice for the water quality volume. Calculate the discharge and assume that it remains constant for approximately 10 minutes. Based on that discharge, estimate the total discharge during that interval and the new elevation based on the stage volume relationship. Continue to iterate until H is approximately equal to H_o. When using multiple orifices the discharge from each is summed.

(6) Splitter Box - When the pond is designed as an offline facility, a splitter structure is used to isolate the water quality volume. The splitter box, or other flow diverting approach, should be designed to convey the 25-year storm event while providing at least 1.0 foot of freeboard along pond side slopes.

(7) Erosion Protection at the Outfall - For online facilities, special consideration should be given to the facility's outfall location. Flared pipe end sections that discharge at or near the stream invert are preferred. The channel immediately below the pond outfall should be modified to conform to natural dimensions, and lined with large stone riprap placed over filter cloth. Energy dissipation may be required to reduce flow velocities from the primary spillway to non-erosive velocities.

(8) Safety Considerations - Safety is provided either by fencing of the facility or by managing the contours of the pond to eliminate dropoffs and other hazards. Earthen side slopes should not exceed 3:1 (H:V) and should terminate on a flat safety bench area. Landscaping can be used to impede access to the facility. The primary spillway opening must not permit access by small children. Outfall pipes above 48 inches in diameter should be fenced.

Maintenance

Routine maintenance activity is often thought to consist mostly of sediment and trash and debris removal; however, these activities often constitute only a small fraction of the maintenance hours. During a recent study by Caltrans, 72 hours of maintenance was performed annually, but only a little over 7 hours was spent on sediment and trash removal. The largest recurring activity was vegetation management, routine mowing. The largest absolute number of hours was associated with vector control because of mosquito breeding that occurred in the stilling basins (example of standing water to be avoided) installed as energy dissipaters. In most cases, basic housekeeping practices such as removal of debris accumulations and vegetation management to ensure that the basin dewaters completely in 48-72 hours is sufficient to prevent creating mosquito and other vector habitats.

Consequently, maintenance costs should be estimated based primarily on the mowing frequency and the time required. Mowing should be done at least annually to avoid establishment of woody vegetation, but may need to be performed much more frequently if aesthetics are an important consideration.

Typical activities and frequencies include:

- Schedule semiannual inspection for the beginning and end of the wet season for standing water, slope stability, sediment accumulation, trash and debris, and presence of burrows.
- Remove accumulated trash and debris in the basin and around the riser pipe during the semiannual inspections. The frequency of this activity may be altered to meet specific site conditions.
- Trim vegetation at the beginning and end of the wet season and inspect monthly to prevent establishment of woody vegetation and for aesthetic and vector reasons.
- Remove accumulated sediment and regrade about every 10 years or when the accumulated sediment volume exceeds 10 percent of the basin volume. Inspect the basin each year for accumulated sediment volume.

Cost

Construction Cost

The construction costs associated with extended detention basins vary considerably. One recent study evaluated the cost of all pond systems (Brown and Schueler, 1997). Adjusting for inflation, the cost of dry extended detention ponds can be estimated with the equation:

$$C = 12.4V^{0.760}$$

where: C = Construction, design, and permitting cost, and
V = Volume (ft^3).

Using this equation, typical construction costs are:

$ 41,600 for a 1 acre-foot pond

$ 239,000 for a 10 acre-foot pond

$ 1,380,000 for a 100 acre-foot pond

Interestingly, these costs are generally slightly higher than the predicted cost of wet ponds (according to Brown and Schueler, 1997) on a cost per total volume basis, which highlights the difficulty of developing reasonably accurate construction estimates. In addition, a typical facility constructed by Caltrans cost about $160,000 with a capture volume of only 0.3 ac-ft.

An economic concern associated with dry ponds is that they might detract slightly from the value of adjacent properties. One study found that dry ponds can actually detract from the perceived value of homes adjacent to a dry pond by between 3 and 10 percent (Emmerling-Dinovo, 1995).

Maintenance Cost

For ponds, the annual cost of routine maintenance is typically estimated at about 3 to 5 percent of the construction cost (EPA website). Alternatively, a community can estimate the cost of the maintenance activities outlined in the maintenance section. Table 1 presents the maintenance costs estimated by Caltrans based on their experience with five basins located in southern California. Again, it should be emphasized that the vast majority of hours are related to vegetation management (mowing).

Table 1 Estimated Average Annual Maintenance Effort

Activity	Labor Hours	Equipment & Material ($)	Cost
Inspections	4	7	183
Maintenance	49	126	2282
Vector Control	0	0	0
Administration	3	0	132
Materials	-	535	535
Total	**56**	**$668**	**$3,132**

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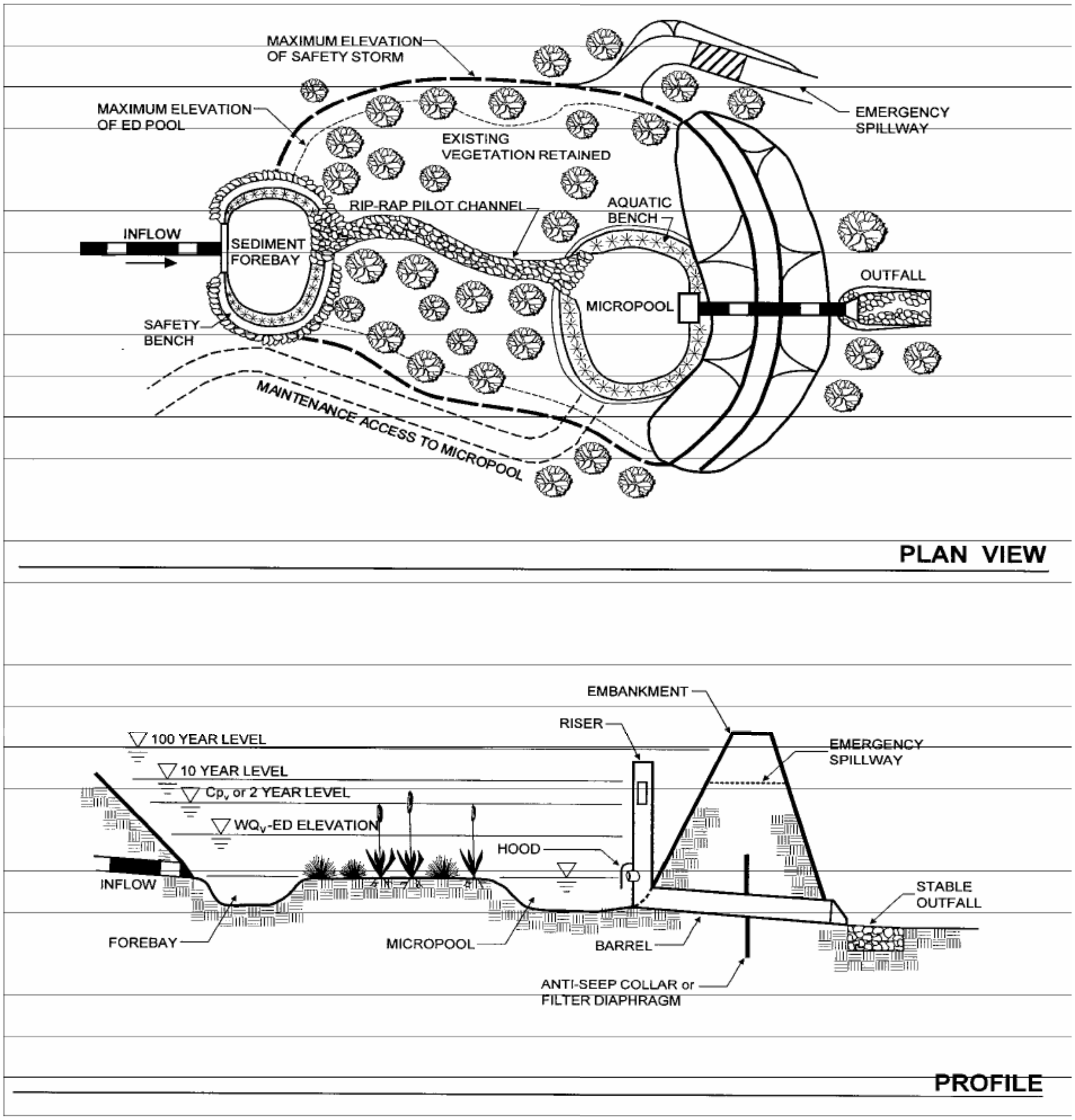

Schematic of an Extended Detention Basin (MDE, 2000)

Drain Inserts MP-52

Description

Drain inserts are manufactured filters or fabric placed in a drop inlet to remove sediment and debris. There are a multitude of inserts of various shapes and configurations, typically falling into one of three different groups: socks, boxes, and trays. The sock consists of a fabric, usually constructed of polypropylene. The fabric may be attached to a frame or the grate of the inlet holds the sock. Socks are meant for vertical (drop) inlets. Boxes are constructed of plastic or wire mesh. Typically a polypropylene "bag" is placed in the wire mesh box. The bag takes the form of the box. Most box products are one box; that is, the setting area and filtration through media occur in the same box. Some products consist of one or more trays or mesh grates. The trays may hold different types of media. Filtration media vary by manufacturer. Types include polypropylene, porous polymer, treated cellulose, and activated carbon.

California Experience

The number of installations is unknown but likely exceeds a thousand. Some users have reported that these systems require considerable maintenance to prevent plugging and bypass.

Advantages

- Does not require additional space as inserts as the drain inlets are already a component of the standard drainage systems.
- Easy access for inspection and maintenance.
- As there is no standing water, there is little concern for mosquito breeding.
- A relatively inexpensive retrofit option.

Limitations

Performance is likely significantly less than treatment systems that are located at the end of the drainage system such as ponds and vaults. Usually not suitable for large areas or areas with trash or leaves than can plug the insert.

Design and Sizing Guidelines

Refer to manufacturer's guidelines. Drain inserts come any many configurations but can be placed into three general groups: socks, boxes, and trays. The sock consists of a fabric, usually constructed of polypropylene. The fabric may be attached to a frame or the grate of the inlet holds the sock. Socks are meant for vertical (drop) inlets. Boxes are constructed of plastic or wire mesh. Typically a polypropylene "bag" is placed in the wire mesh box. The bag takes the form of the box. Most box products are

Design Considerations

- Use with other BMPs
- Fit and Seal Capacity within Inlet

Targeted Constituents

- ☑ Sediment
- ☑ Nutrients
- ☑ Trash
- ☑ Metals
- Bacteria
- ☑ Oil and Grease
- ☑ Organics

Removal Effectiveness

See New Development and Redevelopment Handbook-Section 5.

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one box; that is, the setting area and filtration through media occurs in the same box. One manufacturer has a double-box. Stormwater enters the first box where setting occurs. The stormwater flows into the second box where the filter media is located. Some products consist of one or more trays or mesh grates. The trays can hold different types of media. Filtration media vary with the manufacturer: types include polypropylene, porous polymer, treated cellulose, and activated carbon.

Construction/Inspection Considerations

Be certain that installation is done in a manner that makes certain that the stormwater enters the unit and does not leak around the perimeter. Leakage between the frame of the insert and the frame of the drain inlet can easily occur with vertical (drop) inlets.

Performance

Few products have performance data collected under field conditions.

Siting Criteria

It is recommended that inserts be used only for retrofit situations or as pretreatment where other treatment BMPs presented in this section area used.

Additional Design Guidelines

Follow guidelines provided by individual manufacturers.

Maintenance

Likely require frequent maintenance, on the order of several times per year.

Cost

- The initial cost of individual inserts ranges from less than $100 to about $2,000. The cost of using multiple units in curb inlet drains varies with the size of the inlet.

- The low cost of inserts may tend to favor the use of these systems over other, more effective treatment BMPs. However, the low cost of each unit may be offset by the number of units that are required, more frequent maintenance, and the shorter structural life (and therefore replacement).

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Woodward Clyde, June 11, 1996, Parking Lot Monitoring Report, Santa Clara Valley Nonpoint Source Pollution Control Program.

Photo Credit: Geoff Brosseau

Objectives

- Contain
- Educate
- Reduce/Minimize

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	☑
Oil and Grease	☑
Organics	☑
Oxygen Demanding	☑

Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff that may contain certain pollutants. Maintaining catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis will remove pollutants, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

Approach

Suggested Protocols

Catch Basins/Inlet Structures

- Municipal staff should regularly inspect facilities to ensure the following:
  - Immediate repair of any deterioration threatening structural integrity.
  - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
  - Stenciling of catch basins and inlets (see SC-75 Waste Handling and Disposal).
- Clean catch basins, storm drain inlets, and other conveyance structures in high pollutant load areas just before the wet season to remove sediments and debris accumulated during the summer.

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- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Record the amount of waste collected.
- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
- Dewater the wastes with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed of. Do not dewater near a storm drain or stream.
- Except for small communities with relatively few catch basins that may be cleaned manually, most municipalities will require mechanical cleaners such as eductors, vacuums, or bucket loaders.

Storm Drain Conveyance System

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.
- Collect flushed effluent and pump to the sanitary sewer for treatment.

Pump Stations

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge from cleaning a storm drain pump station or other facility to reach the storm drain system.
- Conduct quarterly routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.
- Sample collected sediments to determine if landfill disposal is possible, or illegal discharges in the watershed are occurring.

Open Channel

- Consider modification of storm channel characteristics to improve channel hydraulics, to increase pollutant removals, and to enhance channel/creek aesthetic and habitat value.
- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a steam or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies

(SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS

Illicit Connections and Discharges

- During routine maintenance of conveyance system and drainage structures field staff should look for evidence of illegal discharges or illicit connections:
  - Is there evidence of spills such as paints, discoloring, etc.
  - Are there any odors associated with the drainage system
  - Record locations of apparent illegal discharges/illicit connections
  - Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of up gradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
  - Once the origin of flow is established, require illicit discharger to eliminate the discharge.
- Stencil storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as “Dump No Waste Drains to Stream” stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Illegal Dumping

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots
  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)
  - Mode of dumping (abandoned containers, “midnight dumping” from moving vehicles, direct dumping of materials, accidents/spills)
  - Responsible parties
- Post “No Dumping” signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

- The State Department of Fish and Game has a hotline for reporting violations called Cal TIP (1-800-952-5400). The phone number may be used to report any violation of a Fish and Game code (illegal dumping, poaching, etc.).

- The California Department of Toxic Substances Control's Waste Alert Hotline, 1-800-69TOXIC, can be used to report hazardous waste violations.

Training

- Train crews in proper maintenance activities, including record keeping and disposal.

- Only properly trained individuals are allowed to handle hazardous materials/wastes.

- Train municipal employees from all departments (public works, utilities, street cleaning, parks and recreation, industrial waste inspection, hazardous waste inspection, sewer maintenance) to recognize and report illegal dumping.

- Train municipal employees and educate businesses, contractors, and the general public in proper and consistent methods for disposal.

- Train municipal staff regarding non-stormwater discharges (See SC-10 Non-Stormwater Discharges).

Spill Response and Prevention

- Refer to SC-11, Prevention, Control & Cleanup

- Have spill cleanup materials readily available and in a known location.

- Cleanup spills immediately and use dry methods if possible.

- Properly dispose of spill cleanup material.

Other Considerations

- Cleanup activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.

- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and disposal of flushed effluent to sanitary sewer may be prohibited in some areas.

- Regulations may include adoption of substantial penalties for illegal dumping and disposal.

- Municipal codes should include sections prohibiting the discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.

- Private property access rights may be needed to track illegal discharges up gradient.

- Requirements of municipal ordinance authority for suspected source verification testing for illicit connections necessary for guaranteed rights of entry.

Requirements

Costs

- An aggressive catch basin cleaning program could require a significant capital and O&M budget. A careful study of cleaning effectiveness should be undertaken before increased cleaning is implemented. Catch basin cleaning costs are less expensive if vacuum street sweepers are available; cleaning catch basins manually can cost approximately twice as much as cleaning the basins with a vacuum attached to a sweeper.

- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary. Encouraging reporting of illicit discharges by employees can offset costs by saving expense on inspectors and directing resources more efficiently. Some programs have used funds available from "environmental fees" or special assessment districts to fund their illicit connection elimination programs.

Maintenance

- Two-person teams may be required to clean catch basins with vactor trucks.

- Identifying illicit discharges requires teams of at least two people (volunteers can be used), plus administrative personnel, depending on the complexity of the storm sewer system.

- Arrangements must be made for proper disposal of collected wastes.

- Requires technical staff to detect and investigate illegal dumping violations, and to coordinate public education.

Supplemental Information

Further Detail of the BMP

Storm Drain flushing

Sanitary sewer flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in sanitary sewer systems. The same principles that make sanitary sewer flushing effective can be used to flush storm drains. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as to an open channel, to another point where flushing will be initiated, or over to the sanitary sewer and on to the treatment facilities, thus preventing re-suspension and overflow of a portion of the solids during storm events. Flushing prevents "plug flow" discharges of concentrated pollutant loadings and sediments. The deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce the impacts of stormwater pollution, a second inflatable device, placed well downstream, may be used to re-collect the water after the force of the flushing wave has dissipated. A pump may then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure may be more practical or required to re-collect the flushed waters.

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75 percent for organics and 55-65 percent for dry weather grit/inorganic material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used or that fire hydrant line flushing coincide with storm drain flushing.

Flow Management

Flow management has been one of the principal motivations for designing urban stream corridors in the past. Such needs may or may not be compatible with the stormwater quality goals in the stream corridor.

Downstream flood peaks can be suppressed by reducing through flow velocity. This can be accomplished by reducing gradient with grade control structures or increasing roughness with boulders, dense vegetation, or complex banks forms. Reducing velocity correspondingly increases flood height, so all such measures have a natural association with floodplain open space. Flood elevations laterally adjacent to the stream can be lowered by increasing through flow velocity.

However, increasing velocity increases flooding downstream and inherently conflicts with channel stability and human safety. Where topography permits, another way to lower flood elevation is to lower the level of the floodway with drop structures into a large but subtly excavated bowl where flood flows we allowed to spread out.

Stream Corridor Planning

Urban streams receive and convey stormwater flows from developed or developing watersheds. Planning of stream corridors thus interacts with urban stormwater management programs. If local programs are intended to control or protect downstream environments by managing flows delivered to the channels, then it is logical that such programs should be supplemented by management of the materials, forms, and uses of the downstream riparian corridor. Any proposal for steam alteration or management should be investigated for its potential flow and stability effects on upstream, downstream, and laterally adjacent areas. The timing and rate of flow from various tributaries can combine in complex ways to alter flood hazards. Each section of channel is unique, influenced by its own distribution of roughness elements, management activities, and stream responses.

Flexibility to adapt to stream features and behaviors as they evolve must be included in stream reclamation planning. The amenity and ecology of streams may be enhanced through the landscape design options of 1) corridor reservation, 2) bank treatment, 3) geomorphic restoration, and 4) grade control.

Corridor reservation - Reserving stream corridors and valleys to accommodate natural stream meandering, aggradation, degradation, and over bank flows allows streams to find their own form and generate less ongoing erosion. In California, open stream corridors in recent urban developments have produced recreational open space, irrigation of streamside plantings, and the aesthetic amenity of flowing water.

Bank treatment - The use of armoring, vegetative cover, and flow deflection may be used to influence a channel's form, stability, and biotic habitat. To prevent bank erosion, armoring can be done with rigid construction materials, such as concrete, masonry, wood planks and logs, riprap, and gabions. Concrete linings have been criticized because of their lack of provision of biotic habitat. In contrast, riprap and gabions make relatively porous and flexible linings. Boulders, placed in the bed reduce velocity and erosive power.

Riparian vegetation can stabilize the banks of streams that are at or near a condition of equilibrium. Binding networks of roots increase bank shear strength. During flood flows, resilient vegetation is forced into erosion-inhibiting mats. The roughness of vegetation leads to lower velocity, further reducing erosive effects. Structural flow deflection can protect banks from erosion or alter fish habitat. By concentrating flow, a deflector causes a pool to be scoured in the bed.

Geomorphic restoration – Restoration refers to alteration of disturbed streams so their form and behavior emulate those of undisturbed streams. Natural meanders are retained, with grading to gentle slopes on the inside of curves to allow point bars and riffle-pool sequences to develop. Trees are retained to provide scenic quality, biotic productivity, and roots for bank stabilization, supplemented by plantings where necessary.

A restorative approach can be successful where the stream is already approaching equilibrium. However, if upstream urbanization continues new flow regimes will be generated that could disrupt the equilibrium of the treated system.

Grade Control - A grade control structure is a level shelf of a permanent material, such as stone, masonry, or concrete, over which stream water flows. A grade control structure is called a sill, weir, or drop structure, depending on the relation of its invert elevation to upstream and downstream channels.

A sill is installed at the preexisting channel bed elevation to prevent upstream migration of nick points. It establishes a firm base level below which the upstream channel can not erode.

A weir or check dam is installed with invert above the preexisting bed elevation. A weir raises the local base level of the stream and causes aggradation upstream. The gradient, velocity, and erosive potential of the stream channel are reduced. A drop structure lowers the downstream invert below its preexisting elevation, reducing downstream gradient and velocity. Weirs and drop structure control erosion by dissipating energy and reducing slope velocity.

When carefully applied, grade control structures can be highly versatile in establishing human and environmental benefits in stabilized channels. To be successful, application of grade control structures should be guided by analysis of the stream system both upstream and downstream from the area to he reclaimed.

Examples

The California Department of Water Resources began the Urban Stream Restoration Program in 1985. The program provides grant funds to municipalities and community groups to implement stream restoration projects. The projects reduce damages from streambank aid watershed instability arid floods while restoring streams' aesthetic, recreational, and fish and wildlife values.

In Buena Vista Park, upper floodway slopes are gentle and grassed to achieve continuity of usable park land across the channel of small boulders at the base of the slopes.

The San Diego River is a large, vegetative lined channel, which was planted in a variety of species to support riparian wildlife while stabilizing the steep banks of the floodway.

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Appendix E

Soils Report
(Separate Attachment)

Appendix F

Treatment Control BMP Sizing Calculations and Design Details

BASIN E-1

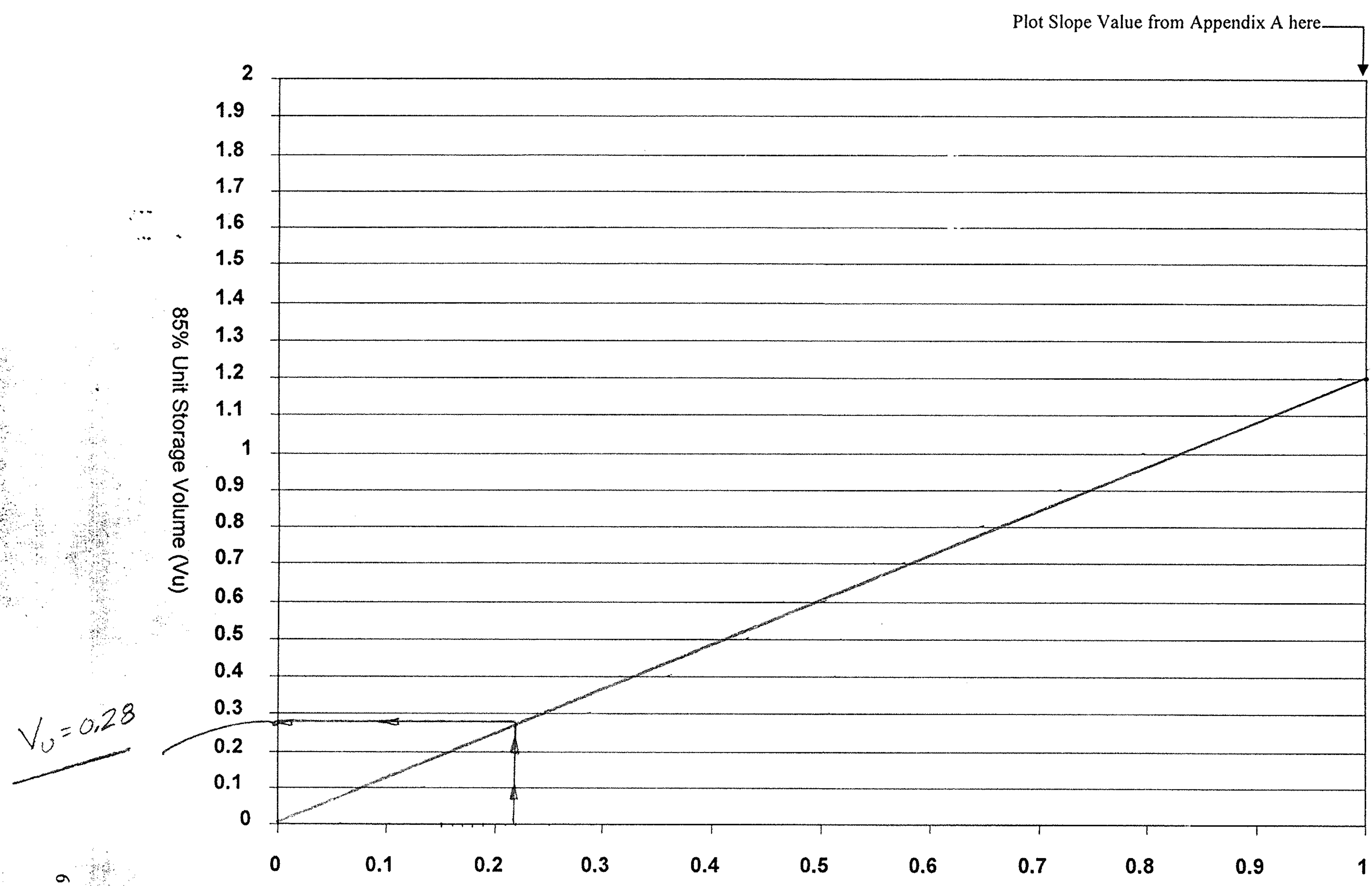


Figure 2 Unit Storage Volume Graph

BASIN "E-2"

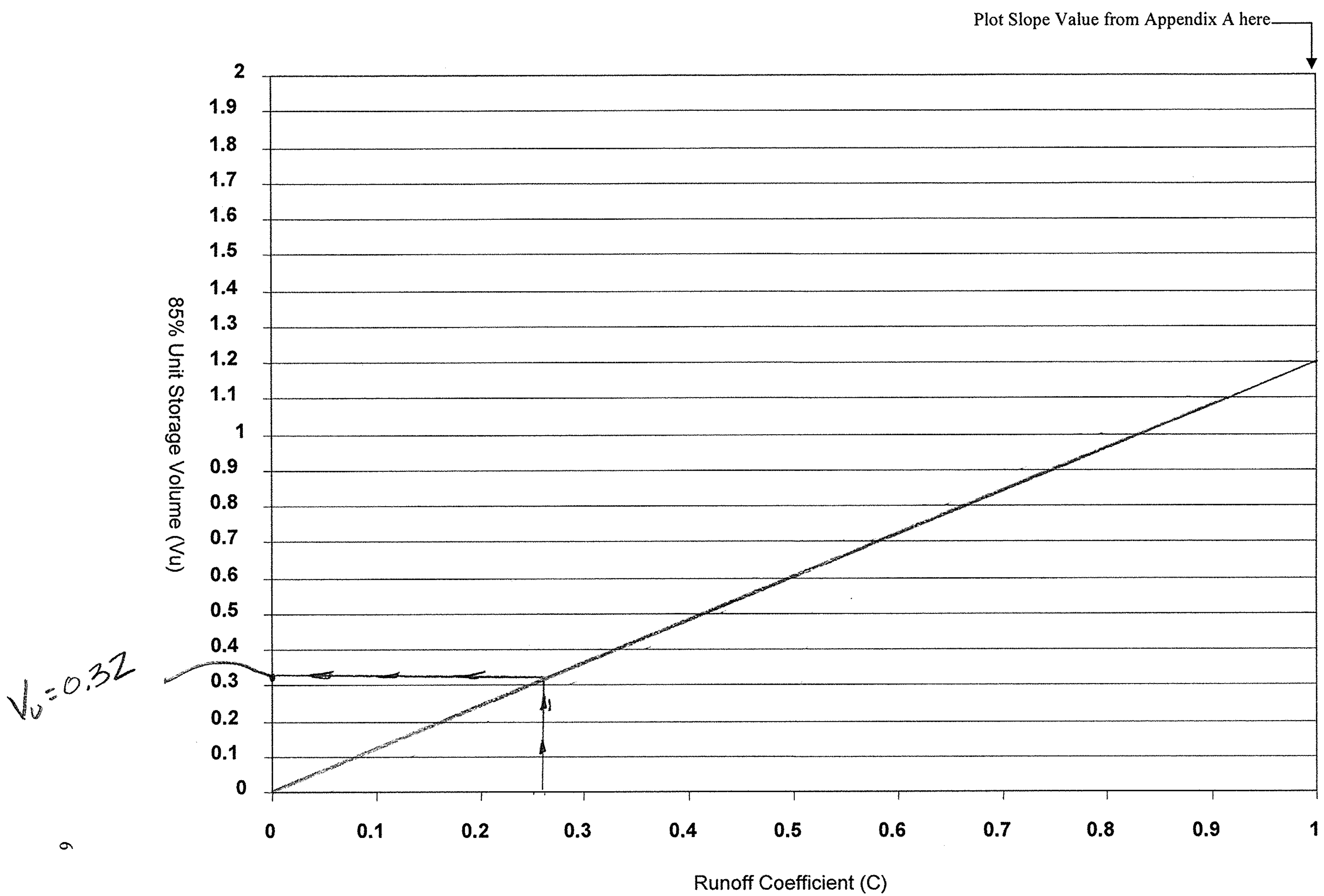
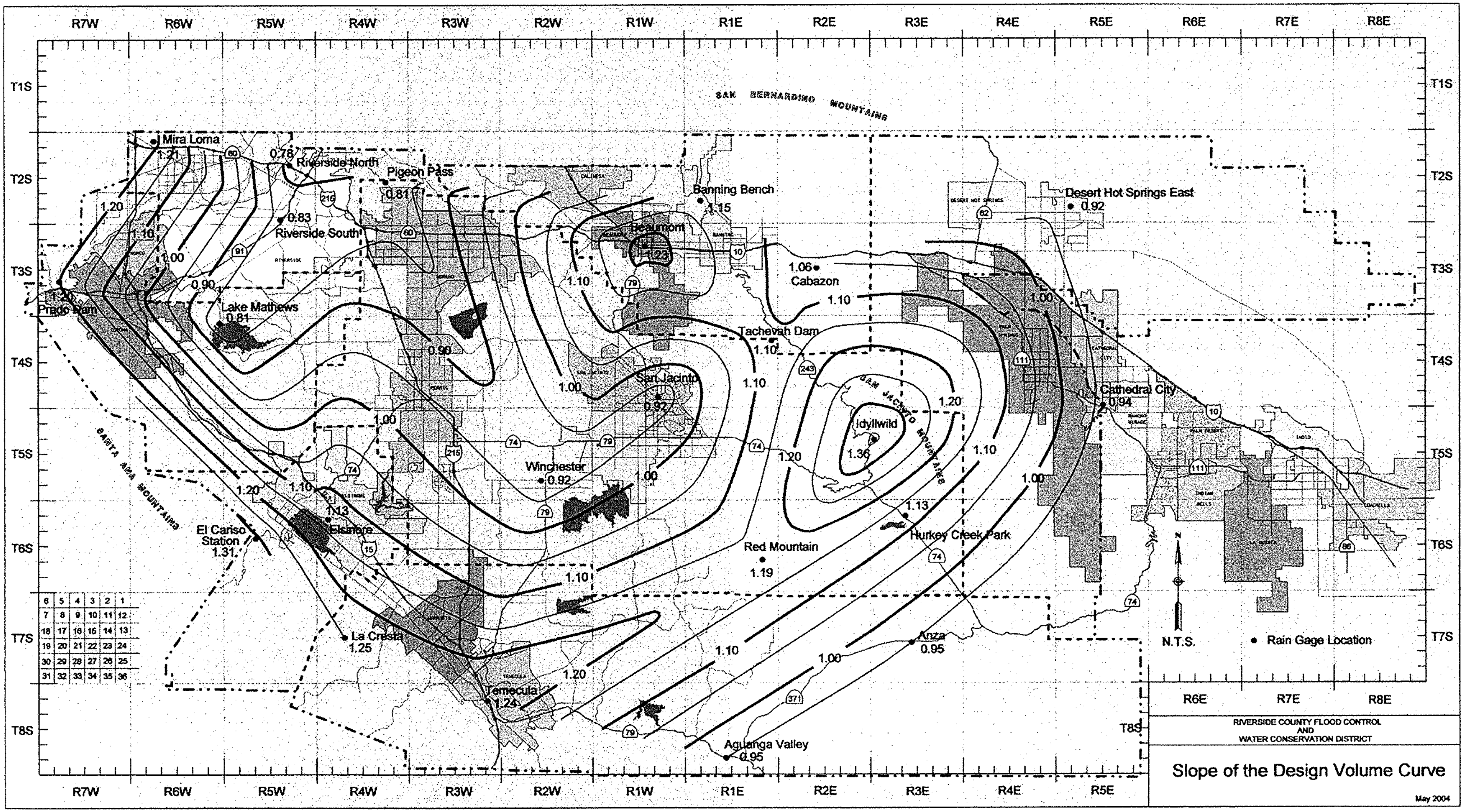


Figure 2 Unit Storage Volume Graph

Table 4. Runoff Coefficients for an Intensity = 0.2 $^{in}/_{hr}$ for Urban Soil Types*

Impervious %	A Soil RI =32	B Soil RI =56	C Soil RI =69	D Soil RI =75
0 (Natural)	0.06	0.14	0.23	0.28
5	0.10	0.18	0.26	0.31
10	0.14	0.22	0.29	0.34
15	0.19	0.26	0.33	0.37
20 (1-Acre)	0.23	0.30	0.36	0.40
25	0.27	0.33	0.39	0.43
30	0.31	0.37	0.43	0.47
35	0.35	0.41	0.46	0.50
40 (1/2-Acre)	0.40	0.45	0.50	0.53
45	0.44	0.48	0.53	0.56
50 (1/4-Acre)	0.48	0.52	0.56	0.59
55	0.52	0.56	0.60	0.62
60	0.56	0.60	0.63	0.65
65 (Condominiums)	0.61	0.64	0.66	0.68
70	0.65	0.67	0.70	0.71
75 (Mobilehomes)	0.69	0.71	0.73	0.74
80 (Apartments)	0.73	0.75	0.77	0.78
85	0.77	0.79	0.80	0.81
90 (Commercial)	0.82	0.82	0.83	0.84
95	0.86	0.86	0.87	0.87
100	0.90	0.90	0.90	0.90

*Complete District's standards can be found in the Riverside County Flood Control Hydrology Manual



Slope of the Design Volume Curve

Worksheet 2

Design Procedure for BMP Design Flow

Uniform Intensity Design Flow

Designer: Sam Nelson
Company: Armstrong & Brooks Consulting Engineers
Date: 20-May-09
Project: TTM 34760
Location: "A" Circle -East / Vegetated Swale

1 Determine Impervious Percentage a. Determine total tributary area b. Determine Impervious %	A_{total} = 1.5 acres **(1)** I = 0 % **(2)**
2 Determine Runoff Coefficient Values Use Table 2 and impervious % found in step 1 a. A Soil Runoff Coefficient b. B Soil Runoff Coefficient c. C Soil Runoff Coefficient d. D Soil Runoff Coefficient	C_a = 0 **(3)** C_b = 0 **(4)** Cc = 0 **(5)** Cd = 0.28 **(6)**
3 Determine the Area decimal fraction of each soil type in tributary area a. Area of A soil / **(1)** b. Area of B soil / **(1)** c. Area of C soil / **(1)** d. Area of D soil / **(1)**	A_a = 0 **(7)** A_b = 0 **(8)** Ac = 0 **(9)** Ad = 1 **(10)**
4 Determine Runoff Coefficient a. C = **(3)(7)** + **(4)(8)** + **(5)(9)** + **(6)(10)** =	C= 0.28 **(11)**
4 Determine BMP Design Flow a. Q_{bmp} = C x I x A = **(11)** x (0.2 x **(1)**	Q_{bmp}= 0.08 **(12)**

Worksheet 9

Design Procedure Form for Vegetated Swale

85th Percentile runoff event

Designer: Sam Nelson
Company: Armstrong & Brooks Consulting Engineers
Date: 20-May-09
Project: TTM 34760
Location: "A" Circle -East / Vegetated Swale

1	Determine Design Flow (Use Worksheet 2)	Q_{bmp}= 0.08 cfs
2	Swale Geometry a. Swale bottom width (b) b. Side slope (z) c. Flow direction slope (s)	 b= 2 ft z= 3:1 s= 0.7 %
3	Design flow velocity (Manning n = 0.2)	v= 0.17 ft/s
4	Depth of flow (D)	D= 0.18 ft
5	Design Length (L) L =(7 min) x (flow velocity, ft/sec) x 60	L= 71.4 ft
6	Vegetation (describe)	Grassy Turf
8	Outflow Colletcion (Check type used or describe other)	___ Grated inlet ___ Infiltration Trench X Underdrain ___ Other ________

Notes:

A 835' swale is proposed, see WQMP exhbit

Worksheet 2

Design Procedure for BMP Design Flow

Uniform Intensity Design Flow

Designer: Sam Nelson
Company: Armstrong & Brooks Consulting Engineers
Date: 20-May-09
Project: TTM 34760
Location: "A" Circle -West / Vegetated Swale

1 Determine Impervious Percentage				
a. Determine total tributary area	A_{total} =	0.4	acres	**(1)**
b. Determine Impervious %	I =	0	%	**(2)**
2 Determine Runoff Coefficient Values Use Table 2 and impervious % found in step 1				
a. A Soil Runoff Coefficient	C_a =	0		**(3)**
b. B Soil Runoff Coefficient	C_b =	0		**(4)**
c. C Soil Runoff Coefficient	Cc =	0		**(5)**
d. D Soil Runoff Coefficient	Cd =	0.28		**(6)**
3 Determine the Area decimal fraction of each soil type in tributary area				
a. Area of A soil / **(1)**	A_a =	0		**(7)**
b. Area of B soil / **(1)**	A_b =	0		**(8)**
c. Area of C soil / **(1)**	Ac =	0		**(9)**
d. Area of D soil / **(1)**	Ad =	1		**(10)**
4 Determine Runoff Coefficient				
a. C = **(3)(7)** + **(4)(8)** + **(5)(9)** + **(6)(10)** =	C=	0.28		**(11)**
4 Determine BMP Design Flow				
a. Q_{bmp} = C x I x A = **(11)** x (0.2 x **(1)**	Q_{bmp}=	0.02	ft^3/s	**(12)**

Worksheet 9

Design Procedure Form for Vegetated Swale

85th Percentile runoff event

Designer: Sam Nelson

Company: Armstrong & Brooks Consulting Engineers

Date: 20-May-09

Project: TTM 34760

Location: "A" Circle -West / Vegetated Swale

1	Determine Design Flow (Use Worksheet 2)	Q_{bmp}= 0.02 cfs
2	Swale Geometry a. Swale bottom width (b) b. Side slope (z) c. Flow direction slope (s)	 b= 2 ft z= 3:1 s= 1 %
3	Design flow velocity (Manning n = 0.2)	v= 0.12 ft/s
4	Depth of flow (D)	D= 0.7 ft
5	Design Length (L) L =(7 min) x (flow velocity, ft/sec) x 60	L= 50 ft
6	Vegetation (describe)	grassy turf
8	Outflow Colletcion (Check type used or describe other)	___ Grated inlet ___ Infiltration Trench X Underdrain ___ Other ________

Notes:

A 210' swale is proposed, see WQMP exhbit

Worksheet 2

Design Procedure for BMP Design Flow

Uniform Intensity Design Flow

Designer: Sam Nelson
Company: Armstrong & Brooks Consulting Engineers
Date: 20-May-09
Project: TTM 34760
Location: "D" Circle - Vegetated Swale

1 Determine Impervious Percentage a. Determine total tributary area b. Determine Impervious %	A_{total} = 1.9 acres **(1)** I = 13 % **(2)**
2 Determine Runoff Coefficient Values Use Table 2 and impervious % found in step 1 a. A Soil Runoff Coefficient b. B Soil Runoff Coefficient c. C Soil Runoff Coefficient d. D Soil Runoff Coefficient	C_a = 0 **(3)** C_b = 0 **(4)** Cc = 0 **(5)** Cd = 0.37 **(6)**
3 Determine the Area decimal fraction of each soil type in tributary area a. Area of A soil / **(1)** b. Area of B soil / **(1)** c. Area of C soil / **(1)** d. Area of D soil / **(1)**	A_a = 0 **(7)** A_b = 0 **(8)** Ac = 0 **(9)** Ad = 1 **(10)**
4 Determine Runoff Coefficient a. C = **(3)(7)** + **(4)(8)** + **(5)(9)** + **(6)(10)** =	C= 0.37 **(11)**
4 Determine BMP Design Flow a. Q_{bmp} = C x I x A = **(11)** x (0.2 x **(1)**	Q_{bmp}= 0.14 ft^3/s **(12)**

Worksheet 9

Design Procedure Form for Vegetated Swale

85th Percentile runoff event

Designer: Sam Nelson

Company: Armstrong & Brooks Consulting Engineers

Date: 20-May-09

Project: TTM 34760

Location: "D" Circle - Vegetated Swale

1	Determine Design Flow (Use Worksheet 2)	Q_{bmp}= 0.14 cfs
2	Swale Geometry a. Swale bottom width (b) b. Side slope (z) c. Flow direction slope (s)	 b= 2 ft z= 3:1 s= 1.5 %
3	Design flow velocity (Manning n = 0.2)	v= 0.27 ft/s
4	Depth of flow (D)	D= 0.2 ft
5	Design Length (L) L =(7 min) x (flow velocity, ft/sec) x 60	L= 113 ft
6	Vegetation (describe)	grassy turf
8	Outflow Colletcion (Check type used or describe other)	___ Grated inlet ___ Infiltration Trench X Underdrain ___ Other ________

Notes:

A 750' swale is proposed, see WQMP exhbit

Worksheet 1

Design Procedure for BMP Design Volume

85^{th} Percentile runoff event

Designer: Sam Nelson
Company: Armstrong & Brooks Consulting Engineers
Date: 20-May-09
Project: TTM 34760
Location: Northwest Basin - "E-1"

1. Create Unit Storage Volume Graph				
a. Site Location (Township, Range, and Section).		Sec. 11, T 4S, R 7W		**(1)**
b. Slope value from the Design Volume Curve in **Apendix A**.	**Slope =**	1.20		**(2)**
c. Plot this value on the Unit Storage Volume Graph shown on **Figure 2**.				
d. Draw a straight line from this point to the origin, to create the graph	Is this graph attached?	Yes□	No□	
2. Determine Runoff Coefficient				
a. Determine total impervious area	$A_{impervious}$=	8	acres	**(5)**
b. Determine total tributary area	A_{total}=	28.7	acres	**(6)**
c. Determine Impervious Fraction, **i=(5)**/**(6)**	i=	0.28		**(7)**
d. Use **(7)** in Figure 1 to find to find Runoff OR $C=0.858i^3-0.78i^2+0.774i+0.04$	C=	0.21		**(8)**
3. Determine 85% Unit Storage Volume				
a. Use (8) in Figure 2 Draw a Vertical line from (8) to the graph, then a Horizontal line to the desired V_u value	V_u=	0.28	in-acre/acre	**(9)**
4. Determine Design Storage Volume				
a. V_{BMP}=**(9) x (6)** [in-acre]	V_{BMP}=	8.04	in-acre	**(10)**
b. V_{BMP}=**(10)**/12 [ft-acres]	V_{BMP}=	0.67	ft-acre	**(11)**
c. V_{BMP}=**(11) x** 43560 [ft^3] graph, then a Horizontal line to the desired V_u value	V_{BMP}=	29,171	ft^3	**(12)**
Notes:				

Worksheet 3

Design Procedure for BMP Design Flow

Designer: Sam Nelson
Company: Armstrong & Brooks Consulting Engineers
Date: 20-May-09
Project: TTM 34760
Location: Northwest Basin - "E-1"

1. Determine Design Volume (Use Worksheet 1) a. Total Tributary Area (minimum 5 ac.) b. Design Volume, V_{bmp}	 A_{total} = 28.7 acres V_{bmp}= 29,171 ft^3
2. Basin Length to Width Ratio (2:1 min.)	Ratio = Varies L:W
3. Two-Stage Design a. Overall Design 1) Depth (3.5' min.) 2) Width (30' min.) 3) Length (60' min.) 4) Volume (must be > V_{bmp}) b. Upper Stage 1) Depth (2' min.) 2) Bottom Slope (2% to low flow channel recommended) c. Bottom Stage 1) Depth (1.5' tp 3') 2) Length 3) Volume (10% to 25% of V_{bmp})	 Depth = 5 ft Width = 70 ft Length = 170 ft Volume = 54,000 ft^3 Depth = - ft Slope = - % Depth = - ft Length = - ft Volume = - ft^3
4. Forebay Design a. Forebay Volume (5 to 10% of V_{bmp}) b. Outlet pipe drainage time = (45 min)	 Volume= 2,900 ft^3 Drain time= 45 minutes
5. Low-Flow Channel a. Depth (9" minimum) b. Flow Capacity (2 * Forebay Q_{out})	 Depth = 0.75 ft $Q_{Low Flow}$ = 28 cfs
6. Trash Rack or Gravel Pack (check one)	Trash Rack ____ Gravel Rack X

7. Basin Outlet a. Outlet type (check one)	Single Oriface ___X___ Multi Oriface plate ______ Perforated Pipe ______ Other ______
b. Oriface Area c. Oriface Type d. Maximum Depth of water above bottom orifice e. Length of time for 50% V_{bmp} drainage (24 hour minimum) f. Length of time for 100% Vbmp drainage (between 48 and 72 hours) g. Attached Documents (all required) 1) Stage vs. Discharge 2) Stange vs. Volume 3) Inflow Hydrograph 4) Basin Routing	Area = 3.14 ft^2 Type = CMP Dpeth = 3 ft Time 50% = 24 hrs Time 100% = 72 hrs Attached Documents Check 1) Final Engineering 2) Final Engineering 3) Final Engineering 4) Final Engineering
8. Increased Runoff (optional) Is this basin also mitigating increased runoff? Attached Docments (all required) for 2, 5, 10-year storms: 1) Stage vs. Discharge 2) Stange vs. Volume 3) Inflow Hydrograph 4) Basin Routing	Yes X No (if no skip to #9) Attached Documents Check 1) Final Engineering 2) Final Engineering 3) Final Engineering 4) Final Engineering
9. Vegetation (check type)	X Native Grasses ___ Irrigated turf ___ Other
10. Embankment a. Interior slope (3:1 max.) b. Exterior slope (3:1 max.)	Interior slope = 3:1 Exterior slope = 3:1
11. Access a. Slope (10% max.) b. Width (15 feet min.)	Slope = 10 % Width = 15 ft

Worksheet 1

Design Procedure for BMP Design Volume

85^{th} Percentile runoff event

Designer:	Sam Nelson
Company:	Armstrong & Brooks Consulting Engineers
Date:	20-May-09
Project:	TTM 34760
Location:	Northeast Basin - "E-2"

1. Create Unit Storage Volume Graph		
a. Site Location (Township, Range, and Section).	Sec. 11, T 4S, R 7W	**(1)**
b. Slope value from the Design Volume Curve in **Apendix A**.	**Slope =** 1.20	**(2)**
c. Plot this value on the Unit Storage Volume Graph shown on **Figure 2**.		
d. Draw a straight line from this point to the origin, to create the graph	Is this graph attached? Yes□ No□	
2. Determine Runoff Coefficient		
a. Determine total impervious area	$A_{impervious}$= 7 acres	**(5)**
b. Determine total tributary area	A_{total}= 18.8 acres	**(6)**
c. Determine Impervious Fraction, **i=(5)/(6)**	i= 0.37	**(7)**
d. Use **(7)** in Figure 1 to find to find Runoff OR $C=0.858i^3-0.78i^2+0.774i+0.04$	C= 0.26	**(8)**
3. Determine 85% Unit Storage Volume		
a. Use (8) in Figure 2 Draw a Vertical line from (8) to the graph, then a Horizontal line to the desired V_u value	V_u= 0.32 in-acre/acre	**(9)**
4. Determine Design Storage Volume		
a. V_{BMP}=**(9) x (6)** [in-acre]	V_{BMP}= 6.02 in-acre	**(10)**
b. V_{BMP}=**(10)**/12 [ft-acres]	V_{BMP}= 0.50 ft-acre	**(11)**
c. V_{BMP}=**(11) x** 43560 [ft^3] graph, then a Horizontal line to the desired V_u value	V_{BMP}= 21,838 ft^3	**(12)**
Notes:		

Worksheet 3

Design Procedure for BMP Design Flow

Designer: Sam Nelson
Company: Armstrong & Brooks Consulting Engineers
Date: 20-May-09
Project: TTM 34760
Location: Northeast Basin - "E-2"

1. Determine Design Volume (Use Worksheet 1) a. Total Tributary Area (minimum 5 ac.) b. Design Volume, V_{bmp}	A_{total} = 18.8 acres V_{bmp}= 21,838 ft^3
2. Basin Length to Width Ratio (2:1 min.)	Ratio = Varies L:W
3. Two-Stage Design a. Overall Design 1) Depth (3.5' min.) 2) Width (30' min.) 3) Length (60' min.) 4) Volume (must be > V_{bmp}) b. Upper Stage 1) Depth (2' min.) 2) Bottom Slope (2% to low flow channel recommended) c. Bottom Stage 1) Depth (1.5' tp 3') 2) Length 3) Volume (10% to 25% of V_{bmp})	Depth = 5 ft Width = 80 ft Length = 150 ft Volume = 38,000 ft^3 Depth = - ft Slope = - % Depth = - ft Length = - ft Volume = - ft^3
4. Forebay Design a. Forebay Volume (5 to 10% of V_{bmp}) b. Outlet pipe drainage time = (45 min)	Volume= 2,180 ft^3 Drain time= 45 minutes
5. Low-Flow Channel a. Depth (9" minimum) b. Flow Capacity (2 * Forebay Q_{out})	Depth = 0.75 ft $Q_{Low Flow}$ = 28 cfs
6. Trash Rack or Gravel Pack (check one)	Trash Rack_____ Gravel Rack___**X**__

7. Basin Outlet a. Outlet type (check one)	Single Oriface X Multi Oriface plate ____ Perforated Pipe ____ Other ____
b. Oriface Area c. Oriface Type d. Maximum Depth of water above bottom orifice e. Length of time for 50% V_{bmp} drainage (24 hour minimum) f. Length of time for 100% Vbmp drainage (between 48 and 72 hours) g. Attached Documents (all required) 1) Stage vs. Discharge 2) Stange vs. Volume 3) Inflow Hydrograph 4) Basin Routing	Area = 3.14 ft^2 Type = CMP Dpeth = 3 ft Time 50% = 24 hrs Time 100% = 72 hrs Attached Documents Check 1) Final Engineering 2) Final Engineering 3) Final Engineering 4) Final Engineering
8. Increased Runoff (optional) Is this basin also mitigating increased runoff? Attached Docments (all required) for 2, 5, 10-year storms: 1) Stage vs. Discharge 2) Stange vs. Volume 3) Inflow Hydrograph 4) Basin Routing	Yes X No (if no skip to #9) Attached Documents Check 1) Final Engineering 2) Final Engineering 3) Final Engineering 4) Final Engineering
9. Vegetation (check type)	X Native Grasses ____ Irrigated turf ____ Other
10. Embankment a. Interior slope (3:1 max.) b. Exterior slope (3:1 max.)	Interior slope = 3:1 Exterior slope = 3:1
11. Access a. Slope (10% max.) b. Width (15 feet min.)	Slope = 10 % Width = 15 ft

Appendix G

Agreements – CC&Rs, Covenant and Agreements and/or Other Mechanisms For Ensuring Ongoing Operation, Maintenance, Funding and Transfer of Requirements For This Project-Specific WQMP
(To be included in Final WQMP)

Appendix H

Phase I Environmental Assessment
(Separate Attachment)