Development Design Manual

Domestic Water

Sanitation

Stormwater

Irrigation/Drainage

Non-Potable Water

Coachella Valley Water District

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Section 1

General Information and

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1.1 Coachella Valley Water District

The Coachella Valley Water District (CVWD) provides domestic water, wastewater (sanitation), non-potable water (reclaimed wastewater and Colorado River water), irrigation/drainage, stormwater and groundwater management services to a population of 265,000 throughout the Coachella Valley, California.

CVWD was formed in 1918 under the state water code provisions of the County Water District Act (Water Code § 30000 et seq.). A governing board of five members is elected from five general divisions for terms of four years each.

CVWD boundaries encompass an area of nearly 1,000 square miles in the Coachella Valley, California. Most of this land is in Riverside County, but CVWD also extends into Imperial and San Diego Counties. Communities served include Cathedral City, Indian Wells, La Quinta, Mecca, North Shore, Palm Desert, Rancho Mirage, Thermal and Thousand Palms in Riverside County as well as the communities of Bombay Beach, Desert Shores, Hot Mineral Spa, Salton Sea Beach and Salton City in Imperial County. The CVWD Service Area Map is located in Appendix A.

This manual and additional information regarding CVWD can be found on the CVWD website at www.cvwd.org.

1.2 Development Design Manual-General Information

This Development Design Manual (DDM) provides comprehensive procedural and technical requirements for the planning, design and construction of CVWD service infrastructure required for new development.

Section 1 provides general information and the requirements for processing a new development and Sections 2 through 9 present drawing format, right-of-way (ROW) procedures, inspection requirements and CVWD service function technical design standards. The Appendices provide more detailed information including checklists, construction notes, specifications, etc.

1.3 General Project Design Requirements

1.3.1 Design

The developer shall employ, at its sole expense, a qualified professional engineering firm (engineer) to plan, design and prepare detailed construction plans and specifications (plans) for the CVWD service infrastructure in full and complete accordance with the DDM. All such planning and design work and plans performed and prepared by the developer's engineer shall be subject to review and written approval by CVWD prior to providing to contractors for bidding purposes. The plans will conform to all applicable federal, state and local governmental rules, ordinances and regulations and all applicable environmental protection laws.

The project must also incorporate, if applicable, the elements of the Coachella Valley Water Management Plan (CVWMP) and the CVWD Urban Water Management Plan (UWMP). These documents are located on CVWD's website.

1.3.2 Water Supply Assessment & Water Supply Verification

Senate Bill 610 (SB610) was enacted in 2001 and became effective in January 1, 2002. It requires cities and counties to request the preparation of a Water Supply Assessment (WSA) that includes specific information on water supplies from the public water supply agency that would serve any project that is subject to California Environmental Quality Act (CEQA) and is defined as a "Project" in Water Code Section 10912. This information is to be included into environmental review documents prepared pursuant to CEQA.

Senate Bill 221 (SB221) was enacted in 2001 and became effective as of January 1, 2002. SB221 establishes the relationship between the WSA prepared for a project and the project approval under the Subdivision Map Act. Pursuant to California Government Code Section 66473.7, the public water supply agency must prepare a written Water Supply Verification (WSV) that indicates sufficient water supply is available prior to the approval of a new subdivision.

The WSA and WSV apply to developments with 500 or more residential units and larger commercial and industrial projects. If the proposed project requires a WSA/WSV, please contact the Engineering Department for more information on the development of these document(s).

1.3.3 CEQA

The developer shall, at developer's sole cost and expense, be responsible for compliance with the CEQA and all other applicable state and federal environmental laws and all requirements of the Federal Endangered Species Act and the California Endangered Species Act arising out of or in connection with the design and construction of the standard and/or special facilities and for compliance with all conditions and mitigation

measures which must be satisfied in connection with the same. The developer shall cause the appropriate public agency of the State of California to act as lead agency for the purposes of complying with CEQA, or District may elect, but shall have no obligation, to act as lead agency. As part of its obligation to fund the CEQA process, the developer shall prepare or cause to be prepared all instruments, documents, reports and other like or kind writings required to be prepared and/or filed by CEQA.

1.3.4 Right-of-Way

All new CVWD service infrastructure is required to be installed in appropriate right-of-way (ROW) which can include:

- Land which CVWD has fee title
- Easement-dedicated to CVWD on the final map or by separate instrument
- Public ROW

Section 3-Right-of-Way provides the detailed information related to the dedication of ROW and other related requirements.

1.4 Agreements, Fees and Annexations

1.4.1 Standard Installation Agreement

Standard infrastructure includes onsite pipelines. A Standard Installation Agreement will be required prior to the first plan check. See Appendix B for an example of a Standard Installation Agreement. All standard infrastructure plans must be reviewed and approved by the Engineering Department. See Section 2 for drawing format and requirements and Sections 5 through 9 for design details.

1.4.2 Special Installation Agreement

Special infrastructure include offsite pipelines, well sites, reservoirs, booster stations, lift stations, stormwater facilities, irrigation/drainage facilities, etc. A Special Installation Agreement will be required prior to the release of the plans. See Appendix B for an example of a Special Installation Agreement. All special infrastructure plans must be reviewed and approved by the Engineering Department. See Section 2 for drawing format and requirements and Sections 5 through 9 for design details.

1.4.3 Fees & Credits

CVWD's infrastructure funding is based on the premise that the capital expenditure for new infrastructure should be funded by new customers. Therefore, developers are responsible for all infrastructure capital costs required to serve the proposed development.

Development fees exist for domestic water and wastewater to fund the construction of regional facilities and obtain new sources of water supply. These fees include the Water

System Backup Facility Charge (WSBFC), Sanitation Capacity Charge (SCC) and the Supplemental Water Supply Charge (SWSC) (see Fees Section for current fees). Development fees for all units are due for each approved phase after progress for service and prior to release of the first water meter.

CVWD will credit the development fees for the construction of off-site infrastructure and facility upsizing required by CVWD by service function up to the amount of the development fees. The WSBFC and the Collection portion of the SCC are creditable. The SWSC is not creditable.

1.4.4 Annexations

CVWD requires new development to annex into Improvement Districts No. 54, 55 and 58 for sanitation service. The land so annexed shall be subject to all assessments, taxes and charges which may be levied within the Improvement District. An Annexation Petition is provided by the Development Services Division as part of the Plan Check Submittal Application (see Appendix A).

CVWD also requires new development to annex into the Stormwater Unit if the land is not already included in the Stormwater Unit. The land so annexed shall be subject to all assessments, taxes and charges which may be levied within the Stormwater Unit. The Annexation Petition is provided by the Stormwater Division as part of the City/County approval process (see Appendix K).

1.5 Development Review Letter and Notice of Water/Sewer Service Availability

At the very early stages of a development project, CVWD will prepare a Development Review Letter at the request of the County or City. This letter provides the County or City and the developer/engineer with a basic description of the services that CVWD will provide, notice of water/sewer service availability subject to CVWD regulations concerning water supply, conservation and efficiency of use in place at the time of said notice, along with any service concerns and potential conflicts with existing CVWD infrastructure, policies or guidelines. An example of the Development Review Letter is shown in Appendix A.

If a Development Review Letter has not been provided for the project, CVWD will provide a Notice of Water and/or Sewer Service Availability at the request of the developer/owner. An example of the Notice of Water/Service Availability is shown in Appendix A.

1.6 Development Project Review & Approval Process

After the Development Review Letter and/or Notice of Water and/or Sewer Service Availability has been issued, the developer/engineer begins the Development Project Review & Approval Process. Figure 1 presents the CVWD Development Project Review and Approval Process in flow chart form. The flow chart presents the sequence of events throughout the life of a development project. The primary CVWD department responsible for each process function is depicted in a small box in the lower-right hand corner. The referenced DDM section for key flow chart items are shown in brackets. The Standard Installation Agreement and Special

Installation Agreement include the detailed process requirements. The following sections describe the Development Project Review & Approval Process in general terms.

1.6.1 Initial Contact & CVWD Infrastructure Location

The primary contact throughout the life of the development project will be the Development Services Division of the Service Department. All plans or inquiries should be submitted to Development Services for routing to the appropriate CVWD departments for review.

The developer/engineer should contact the Utility Coordinator in the Engineering Department to obtain existing utility infrastructure locations.

1.6.2 Initial Meeting with CVWD Departments

When preliminary development project plans are available, the developer/engineer should set up the Initial Development Project Meeting with the Development Services Division to discuss CVWD's requirements. Representatives of all applicable CVWD Departments will attend. The developer/engineer should be familiar with the contents of this manual prior to the Initial Development Project Meeting.

After the Initial Development Project Meeting, the developer/engineer will begin the formal Development Project Review & Approval Process as outlined in the following subsections.

1.6.3 Plan Check Submittal Requirements

Prior to acceptance of the first set of plans for plan check, the developer/engineer must submit to Development Services the Plan Check Submittal Application and associated hydraulic modeling deposit/information, fire flow requirements, plan check deposit, forms/agreements and completed plan check checklist (see Appendix A). Upon acceptance of the Plan Check Submittal Application, the plans will be forwarded to the Engineering Department for plan check.

Prior to accepting the plans for second plan check, the developer/engineer must submit to Development Services any recorded grant deeds, recorded easements, proposed tract map easements and landscape irrigation plans. CVWD's Water Management Department will review and approve the landscape plans and proposed irrigation water meter sizing.

Prior to the release of the approved plans (mylars), the developer/engineer must submit to Development Services the approved plans in electronic format, execute any Special Installation Agreements and pay the SCC for sewer-only projects.

1.6.4 Construction Requirements

After approval of the plans and prior to the pre-construction meeting, the developer/engineer must submit to the Inspection Division the Material Submittal Form (See Section 4-Inspection) and provide Development Services an electronic version of the recorded tract map and a Letter of Credit (LOC) or Certificate of Deposit (CD) in an amount equal to the greater of $5,000 or 5% of the estimated construction costs.

Next, the developer's contractor must schedule a preconstruction meeting with the Inspection Division prior to start of construction. The developer/contractor must provide certification that the contractor is properly licensed in California and that the developer has adequate insurance. The inspection deposit is paid to CVWD at the preconstruction meeting.

The work cannot begin until CVWD has installed all the connection points (primarily domestic water projects). All new CVWD service infrastructure will be constructed under direct CVWD inspection. See Section 4-Inspection for detail construction inspection requirements.

1.6.5 Progress for Fire Protection, Progress for Service and Project Completion & Acceptance

The water system can be progressed for fire protection prior to paving and after the water system has been chlorinated and pressure tested. This will allow the project to utilize the water system for fire protection during building construction.

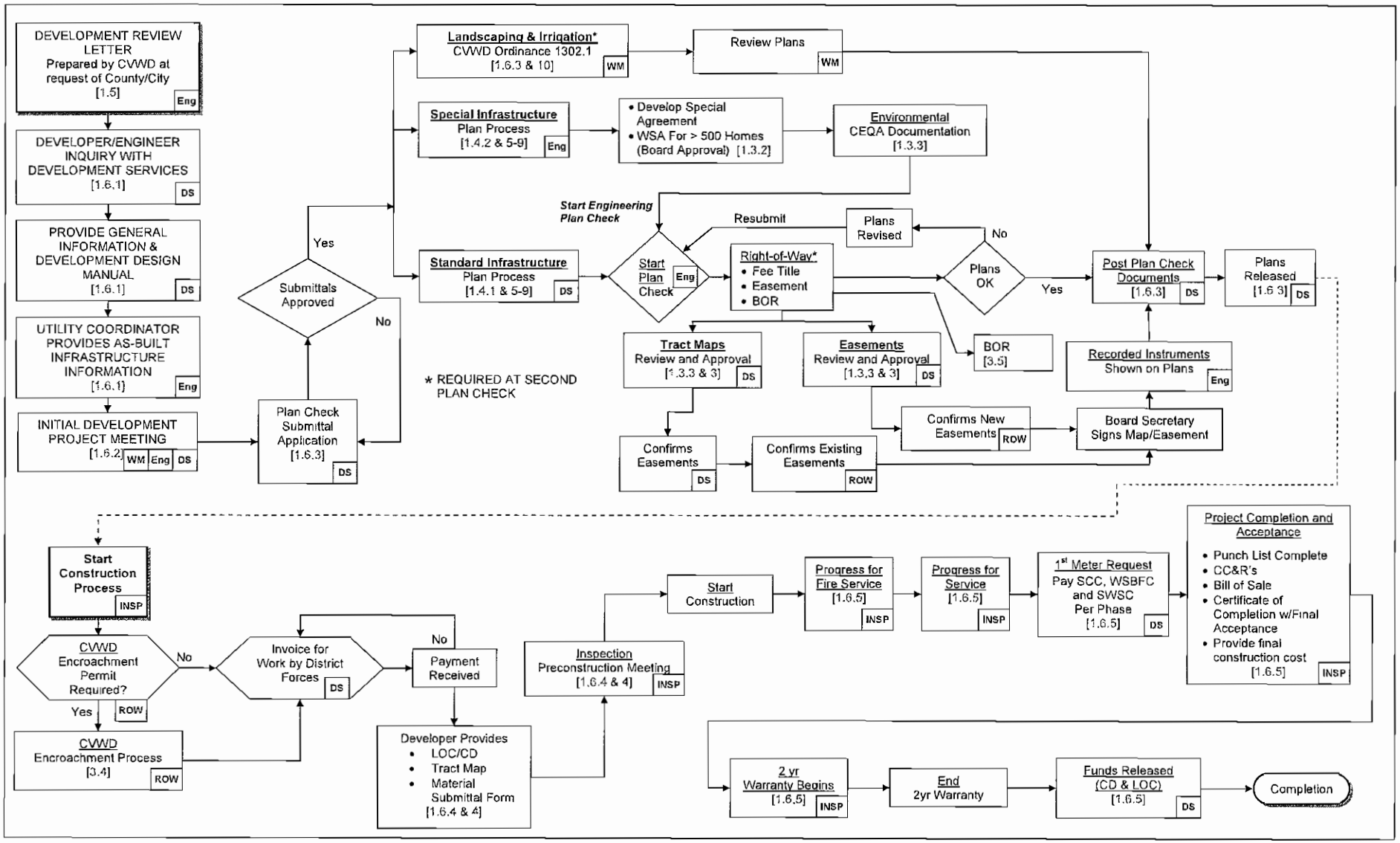
When the base paving is complete, the CVWD service infrastructure can be progressed for service. The SCC, WSBFC and SWSC for all units within the approved phase must be paid prior to the issuance of the first meter.

When final paving is complete, CVWD Inspection will develop a final punchlist. All punchlist items must be corrected and the developer must provide CVWD a copy of the the CC&Rs for the project prior to final acceptance. Upon final acceptance by CVWD, the developer will file a Certificate of Completion and Final Acceptance with the County and provide CVWD with the Bill of Sale conveying the facilities to CVWD along with the final construction costs. At this point, the two-year warranty period begins.

1.6.6 Construction Delay

Construction must begin within one year of approved CVWD service infrastructure plans. If more than one year has elapsed since approved plans, the developer/engineer shall re-submit the plans for review and approval.

FIGURE 1
CVWD DEVELOPMENT PROJECT REVIEW & APPROVAL PROCESS



Section 8

Design Criteria
Stormwater Facilities

8.1 Introduction

8.1.1 The Coachella Valley Water District (CVWD)

CVWD provides regional flood protection within its Stormwater Service Area (see Appendix K) by intercepting and conveying regional flood flows through the Coachella Valley to the Salton Sea. This regional stormwater conveyance system consists of the 50-mile Whitewater River/Coachella Valley Stormwater Channel (WWRSC/CVSC) and related tributary stormwater facilities.

CVWD is the National Flood Insurance Program (NFIP) Administrator for unincorporated areas in Riverside County that are subject to flooding and lie within CVWD's Stormwater Service Area. CVWD also provides floodplain management services to most of the cities in the Stormwater Service Area. On-site drainage for new development within the Stormwater Service Area is reviewed by Riverside County (unincorporated areas) or the Cities (incorporated areas).

8.1.2 Background

This Section summarizes the standards that CVWD has adopted to ensure safe conveyance of floodwaters through its stormwater system while providing – to the maximum extent practicable – protection to properties located adjacent to these facilities. Guidance is provided to developers and their engineers on submissions required for approval of the design and construction of projects that encroach on or are adjacent to CVWD stormwater facilities. Section 8.4 summarizes standards and submissions for projects that encroach on or are adjacent to the stormwater facilities.

This Section also summarizes the standards that CVWD has adopted for developments that are in flood-prone areas but not mapped or designated as flood hazard areas. Guidance is provided to developers and their engineers on the studies and analyses that are required for conceptual and final approval of their reports and tract maps. Section 8.5 describes standards for submissions for developments in flood-prone areas.

This Section is organized so that standards are described in the main text while technical details, methods or criteria to meet the standards, report outlines and checklists are provided in Appendix K. Where practical, reference is provided for published standards or guidelines of other agencies, such as the US Army Corps of Engineers (USACE) or the Federal Emergency Management Agency (FEMA).

8.1.3 Application

This document applies to projects within the jurisdiction of CVWD. They also apply to projects funded entirely by CVWD and projects funded in cooperation with Counties or other agencies.

8.1.4 Proviso

CVWD will review and approve studies and reports related to its stormwater system or for development within flood-prone areas for conformance with its regulations and with County, State and Federal regulations, where appropriate. This notwithstanding, CVWD assumes no liability for inadequate design or improper construction. Review and approval does not absolve the owner, developer, design engineer, or contractor of liability. Compliance with this document or with regulatory standards does not guarantee that properties will be free from flooding or flood damage.

The project engineer retains the responsibility for design of storm water or drainage facilities that meet industry standards of practice and provide public safety. CVWD, its officials, and its employees assume no liability for information, data or conclusions reached by developers or engineers and make no warranty, express or implied, when they review or approve projects or studies.

8.2 CVWD Guiding Regulations

CVWD relies on three regulations to ensure flood protection for the Coachella Valley; (1) California Drainage Law, (2) Riverside County Ordinance 458 and (3) CVWD Ordinance 1234. The following sub-sections describe the basic principles behind these regulations.

8.2.1 California Drainage Law

California Drainage Law states that property owners have the right to protect themselves from flooding as long as they do not unreasonably increase flood risk for adjacent property owners. Flows must be reasonably received and released in the historical flow paths at the historical flow depths and velocities.

8.2.2 Riverside County Ordinance 458

This ordinance was adopted by Riverside County for the unincorporated areas as a requirement of its participation in the National Flood Insurance Program (NFIP) of FEMA as stipulated in Title 44, Section 65 of the Code of Federal Regulations (44CFR65). Ordinance 458 specifically regulates development in Special Flood Hazard Areas identified on maps prepared by FEMA, the State of California or the County that are based on the 1% chance flood, also referred to as the "100-year flood".

8.2.3 CVWD Ordinance 1234

Ordinance 1234 provides conditions of approval for development in flood hazard areas within CVWD Stormwater Service Area. In order to minimize flood damage and to provide a greater level of protection, the standard project storm (SPS) and standard project flood (SPF) rather than the 100-year storm and 100-year flood should be used for the design of flood control facilities. Please refer to Guideline K-5 for exceptions. Ordinance 1234 then indicates that any flood protection facilities not designed and constructed for

the SPS and SPF will not normally be owned, operated, or maintained by CVWD and it also identifies several requirements for developer who construct such flood protection facilities, related to notification, transfer of ownership and indemnification (Guideline K-6).

8.3 CVWD's Regional Stormwater System

The Whitewater River, which originates on the southern slopes of the San Bernardino Mountains, flows southeast through the Coachella Valley to the Salton Sea. The drainage area is approximately 1,500 square miles at the Salton Sea. Downstream from the vicinity of Washington Street (Point Happy) the Whitewater River Stormwater Channel (WWRSC) has been channelized to the Salton Sea, this channelized extension is named the Coachella Valley Stormwater Channel (CVSC). The WWRSC/CVSC conveys flood flows for a distance of approximately 50 miles. Portions of the CVSC with adjacent development have been improved by levees and bank protection to pass the standard project flood.

The other major elements of CVWD's stormwater system are described in Table 8.1 and are also shown on the maps in Appendix K. Tributary stormwater facilities convey floodwaters to the WWRSC/CVSC which originate in the Santa Rosa Mountains on the southwest or in the Little San Bernardino Mountains to the northeast. These projects include the West Magnesia Channel, Thousand Palms Channel, Detention Channels 2 and 3, La Quinta Evacuation Channel and Deep Canyon Channel. CVWD also operates stormwater systems that intercept regional floods and convey them to the tributary stormwater facilities. Examples of these types of projects include East Dike, Dike No. 4, and the Bear Creek Detention System. CVWD also operates stormwater facilities or systems that discharge directly to the Salton Sea, such as Detention Channel No. 1.

CVWD also has a number of planned stormwater flood control systems that are in various stages of development and accreditation by FEMA. These include:

- The Whitewater River Basin Thousand Palms Flood Control Project. This project is being developed by the US Army Corps of Engineers (Los Angeles District).
- North Indio Master Planning Project
- Eastern Coachella Valley Stormwater Master Planning Project

Table 8.1: CVWD Stormwater Facilities

Facility	Type	Material	Length (mi)
Whitewater River/CVSC	Channel/Levee	Earth/Concrete Slope Lining	49.0
Bear Creek System & La Quinta Evacuation Channel	Levee/Basin/Channel	Earth/Concrete/Soil Cement	5.8
Dead Indian System & Deep Canyon System	Levees/Channel	Earthen/Concrete	7.8
Palm Valley Channel & Cat Creek	Basins/Channels	Earthen/Concrete	7.0
East Magnesia Canyon Channel	Channel	Earthen/Concrete	1.8
West Magnesia Canyon Channel	Basin/Channel	Earthen/Concrete	1.3
Thunderbird Channel	Channel	Concrete/Earthen	1.0
Thunderbird Villas Stormwater Channel	Channel/Storm Drain	Concrete/Earthen	0.8
Peterson Stormwater Channel	Channel/Storm Drain	Concrete/Earthen	0.5
Sky Mountain Channel	Channel/Storm Drain	Concrete/Earthen	1.8
Eastside Dike	Levee	Earthen	25.5
Detention Channel 1	Channel	Concrete	3.3
Detention Channel 2	Channel	Concrete	2.3
Detention Channel 3	Channel	Concrete	1.3
Dike #2	Levee	Earthen	1.0
Dike #4	Levee	Earthen Dike	3.5
Avenue 64 Evacuation Channel	Channel	Concrete Channel & Pipes	6.8
Guadalupe Dike System	Levee	Earthen Dike	1.0

8.4 Standards for Projects near the Regional Stormwater System

CVWD requires that hydrologic, hydraulic and engineering analyses/design reports be prepared for all projects that may be impacted by CVWD's stormwater system. Such projects include developments immediately adjacent to CVWD facilities, utility crossings, bridges or other crossings, storm drains entering its facilities, modification or repair of levees, and other projects that may affect performance. CVWD and its stormwater consultants will review and approve reports and plans prior to construction.

The following sections provide minimum standards for design review submission. Appendix K provides guidance on technical methods that meet these standards and also provides general guidance on the organization of reports.

8.4.1 Hydrologic Standards

The design of the WWRSC/CVSC and most of the regional stormwater facilities is based on the SPF. The SPF was developed by the United States Army Corp of Engineers in 1980 using rainfall from the standard project storm-local type and the standard project storm-general type. The standard project storm-local type is the September 24, 1939 storm at Indio. The standard project storm-general type is a composite of the Hurley Flat 1927 storm and the Raywood Flat 1938 storm. The storm that resulted in the most critical flooding in each sub-watershed was ultimately utilized to develop the SPF. The SPF has been calculated for much of the regional stormwater system and CVWD will provide copies of CVWD reports and confirm preferred methods for interpolating or routing the SPF or calculating the SPF if this has not been previously done.

Subsequent rainfall-runoff studies have indicated that the flood calculated from the 100-year storm may exceed the SPF in some areas, particularly from small watersheds. Based on these studies, CVWD now requires that both the SPF and the 100-year flood be calculated and included in design studies (Guideline K-5). CVWD will provide the preferred methods for calculating 100-year peak flows upon inquiry.

General standards for calculating the 100-year flood include the following:

- For sites near existing regional stormwater facilities, contact CVWD to determine if rainfall from NOAA Atlas 14 is to be used instead of NOAA Atlas 2.
- For sites with no previous studies, with no flood protection, or if directed by the CVWD use rainfall from NOAA Atlas 14.

8.4.2 Hydraulic Standards

The design of projects near the WWRSC/CVSC and other parts of CVWD stormwater facilities may require analysis of existing and proposed water surface profiles as well as other hydraulic characteristics, such as depths, velocities, and shear stresses. CVWD recommends the following hierarchy of methods for the hydraulic analysis:

- If available, obtain CWVD's HEC-RAS hydraulic model of the stormwater facilities and update the geometry and channel characteristics to reflect existing conditions. Updating the model may require new surveys, field inspection, and model development and calibration. Once existing conditions are established the model can be modified as required to calculate post-project hydraulic conditions.
- Prepare a suitable hydraulic model for the site, developed from recent topography. Suitable models include one-dimensional hydraulic models such as HEC-RAS or two-dimensional models in areas of complex topography and channel shifting, such as on fans, or in areas of complex flow patterns, such as the junctions of major tributaries or junctions of major tributaries with the WWRSC/CVSC.
- Uniform flow calculations or other simple calculations where the assumptions underlying these procedures are met by the site conditions and are appropriate for the design of the proposed project.

The design water surface profiles discussed above are calculated as the maximum of the elevation of the SPF water surface plus one foot of freeboard or the 100-year water surface elevation plus three feet of freeboard. Other flow characteristics are calculated for the greater of the two discharges.

It is recommended that the developer or their engineer contact CVWD prior to undertaking any hydraulic studies, especially for projects near or adjacent to stormwater facilities that do not have existing hydraulic models.

8.4.3 Engineering Design Standards

The following paragraphs briefly summarize the standards for design of projects adjacent to CVWD regional stormwater facilities that contribute stormwater to these facilities or encroach on the facilities or right-of-way. The technical details and methods are described in Appendix K.

Slope (Bank) Protection for development within 300 feet of CVWD stormwater facilities

Concrete slope protection is required on the bank and levee of stormwater channels where any development is proposed within 300 feet of the stormwater channel, is at risk from inundation or erosion from failure of the facilities, or as directed by CVWD. The slope protection consists of a concrete revetment extending from the top of the channel bank or levee to the elevation of the lowest point of the channel bed (based on the original channel design); with a cutoff wall extending from that point to the maximum scour depth or minimum scour elevation. In some cases, where hydraulic conditions are appropriate, the concrete revetment can be combined with, or replaced by reinforced turf or other grass and soil combinations. Guideline K-2 provides details for design of the slope protection and discusses scour and the other elevations required for design of the protective works.

Utility crossings of CVWD stormwater facilities

Crossings are only allowed in special circumstances after review and approval of engineering plans and specifications. The general standards below are applicable for

crossing both "soft-bottom" or earthen channels and concrete-bottom channels (see Table 8-1):

- Utility crossings should be perpendicular to the channel.
- The maximum elevation of the utility within CVWD's stormwater facility shall be:
    - 2 feet below the concrete bottom or toe of the concrete slope lining cut-off wall in the reach or below the anticipated minimum scour elevation for the design flood
    - 10 feet below the channel design invert (if no concrete slope protection) or below the anticipated minimum scour elevation for the design flood
- Utility crossings shall be installed using horizontal and/or directional boring unless otherwise approved by CVWD.

Guideline K-2 provides further details on scour calculations, planning and design of slope protection and submissions.

Bridge and/or Low Flow Crossings of CVWD stormwater facilities
Bridges or other crossings shall be designed to pass the design flood with adequate freeboard and protect stream banks and the channel bed from erosion or scour resulting from flows around piers or abutments or through the bridge opening. Any post project alteration of upstream and downstream conditions must be fully mitigated. Section 8.4.2 discusses hydraulic standards and information sources. Also, proposed bridges should integrate utility corridors in their design.

Guidance for calculating local and general scour and other hydraulic parameters at bridges is provided in US Federal Highways and Waterways Administration, Hydraulic Engineering Circular 18 (Richardson and Davis 1995). Bank protection designs are described in more detail in Guideline K-2.

Storm Drains discharging into CVWD stormwater facilities
Storm drain outlets discharging into CVWD stormwater facilities shall provide adequate protection within the outlet system to prevent scour and erosion in "soft-bottom" channels (e.g. WWRSC/CVSC, Thousand Palms Stormwater Channel, La Quinta Evacuation Channel, etc.) and meet design standards for concrete-bottomed channels (e.g. Palm Valley Channel, West Magnesia Channel, etc). Where storm drain outlets are proposed to discharge into concrete-bottomed channels the developer/engineer should consult with CVWD to determine if the discharge is feasible, given capacity constraints and the highly-engineered hydraulic design of these channels. The outlet protection works will be designed in accordance with guidelines appropriate for the particular site. Guideline K-3 provides details.

Modification, Repair or Construction of a Levee
All levee design and construction shall at a minimum meet FEMA requirements as stipulated in Title 44, Code of Federal Regulations, Chapter 1, Section 65.10

(44CFR65.10) and all current engineering manuals and engineering technical letters of the US Army Corps of Engineers related to levee design and construction that are referred to in the Federal Code. In general, ownership and maintenance of levees is a CVWD responsibility. Private ownership and maintenance of levee facilities is not allowed. Development projects that include modification and/or construction of levees, berms, floodwalls, training dikes, etc., as part of a flood control scheme should consult with CVWD prior to designing such a project, as the studies and requirements are typically very onerous.

Construction plans that involve modification or encroachment of a United States Bureau of Reclamation (USBR) dike (levee) will require review and approval of the USBR following review and approval of design plans and flood management reviews by CVWD.

8.5 Development Projects under CVWD Jurisdiction

Within the Stormwater Service Area, CVWD is responsible for ensuring that developers adequately describe regional flood hazards at project sites and mitigate these hazards to meet CVWD, Riverside & City Floodplain Ordinances, State and Federal requirements.

Land development may alter runoff or modify local drainage systems, resulting in greater peak flows, runoff volumes, water surface elevations, velocities, or sediment transport load that may impact adjacent properties. If it does, mitigation or stormwater management plans are required. Hydrologic, hydraulic, flood hazard assessment and stormwater management reports shall be submitted for all development projects subject to regional flooding. The greater of SPF or 100-year storm event should be used in this case (Guideline K-5).

The following sections provide standards for identifying flood hazards, quantifying, mapping and mitigating on-site hazards and managing stormwater. Guideline K-4 provides a standard outline for reports submitted to CVWD.

8.5.1 Existing Hazard Studies and Maps

CVWD recognizes that there are flood hazards areas not shown on FEMA County-wide Flood Insurance Rate Maps (FIRM), therefore the current FIRMs may not fully reflect the flood hazard risk. Project sites in such areas are subject to regulation and developers will be required to carry out studies to define the specific hazards on their property.

8.5.2 Flood Hazards

The following specific flood hazards occur within CVWD's the Stormwater Service Area:

- Riverine hazards, including high in-channel velocities, overtopping or eroding of banks and spreading of floodwaters across the floodplain.
- Alluvial fan hazards, including unpredictable flow paths, a broad extent of flooding and erosion that may undermine structures. "Alluvial Fan Flooding", prepared by the Committee on Alluvial Fan Flooding (1996) and Appendix G of the FEMA Guideline and Specifications for Flood Hazard Mapping Partners further describe these processes (FEMA 2003).

- Sheet flow and channelized flow near the toe of alluvial fans and on the floor of the Coachella Valley from floodwaters crossing alluvial fans, runoff on the valley floor, or runoff arriving from upstream existing developments.
- Coastal or lakeshore hazards relating to inundation from the Salton Sea, including wave erosion and other coastal hazards as described in various FEMA publications.

8.5.3 Flood Hazard Identification

Coastal hazards or hazards related to the Salton Sea have not been studied nor have the extent of these hazards been mapped. CVWD may require properties adjacent to the Salton Sea to complete specific studies of these hazards that follow applicable FEMA Guidelines.

8.5.4 Alluvial Fan and Other Hazard Studies

Hazard identification for a particular property or site follows the Appendix G "Guidance for Alluvial Fan Flooding Analyses and Mapping" of FEMA (2003). This document recommends a three stage process: Stage 1-identify alluvial fan landform boundaries, Stage 2-identify active and inactive areas on the fan and Stage 3-flood hazard analyses.

Stage 1 analysis determines whether the property lies on or off the alluvial fan. Note that those properties that lie off the toe of alluvial fans and on the floor of the Coachella Valley shall also require detailed analyses, as described below. .

Stage 2 identifies active and inactive areas on the fan surfaces. This includes analyses of topographic, soils and surficial geology maps, review and analysis of historic air photos, review of historic records or observations of flooding followed by field studies/inspection to confirm active and inactive boundaries on the fan. On many fans, geomorphic studies that evaluate the relative ages of different fan surfaces are invaluable in defining inactive and active fan areas. Similar analyses are required to identify the potential for channelized flow or to document the general nature and extent of sheet flow inundation at project sites that lie off the toe of a fan. Due to the limited rainfall records, CVWD requires extensive and thorough analysis to identify potentially inactive fan surfaces.

Once the nature and extent of the hazards are determined, they are quantified and classified by detailed geomorphic, hydrologic and hydraulic studies. Given the complexity of flows and channels on active alluvial fans and the impact of human development on flow paths on some fans, hydraulic studies often require extensive and detailed LiDAR or other topographic surveys of the fan and valley floor.

8.5.5 Hydrologic Analysis

In general, the following hierarchy of hydrologic analysis methods or approaches is recommended to estimate these flows for a particular fan:

- SPF and 100-year floods calculated in previous studies that have been adopted by CVWD, such as USACE (1980) & (1997) Reports or the Bechtel Corporation (2003) draft FIS for the Oasis Area of the Coachella Valley. CVWD may require

the developer to update these estimates to reflect NOAA Atlas 14 rainfall storms, as discussed in Section 8.4.

- Where there are no previous studies or where CVWD deems that these studies are out-of-date, SPF can be calculated from the standard project storm and the 100-year flood calculated from NOAA Atlas 14 rainfall, Guideline K-5.

Peak flow design calculations for hazard assessment of developments on the Coachella Valley floor requires consideration of the timing of peak flows from the various contributing areas such as fan apex, tributary inactive fan and valley floor areas to the development.

8.5.6 Hydraulic Analysis Standards

The purposes of the hydraulic analyses are to define existing conditions (pre-project) & developed conditions (post project) flow characteristics such as depths, velocities, etc. to evaluate potential impacts of the development on adjacent properties, for "on-site" stormwater management and required mitigation.

In general, CVWD recommends the following hierarchy of hydraulic methods or models to calculate existing conditions and post-project conditions when the project lies on an alluvial fan:

- If the development is on the active portion of a fan, a two-dimensional model will be used to route the hydrograph to the development site and, if necessary, downstream to a CVWD regional stormwater facility. Generally, multiple scenarios are recommended to define the hydraulic conditions at the development site. Two-dimensional modeling requires detailed topography on the active portion of the fan.
- If the development is on the inactive portion of the fan, a one-dimensional model may be utilized to define the design hydraulics if confined and stable channels cross the inactive surface. Here, uncertainty with regard to flow paths may be disregarded. The one-dimensional models may require a more detailed hydraulic analysis at the fan head to determine the distribution of the design flood over the various channels and surfaces on the fan. Hydraulic analysis will also be required for sheet flow potentially generated by rainfall on the inactive fan surface.
- If the development is in an area of low topographic relief or on a low gradient surface where there is no evidence of channelized flow, sheet flow may be the dominant flood hazard. Such conditions are not common in the Stormwater Service Area; however, where they occur, hydraulic conditions may be calculated by the methods described in Appendix G (FEMA 2003) or in other similar documents.

Where the development is off the toe of an alluvial fan or on the floor of the Coachella Valley and is potentially exposed to flooding, the following hierarchy of hydraulic models or methods is recommended. As above, these are used to calculate both existing and post-project conditions at the site and upstream and downstream of the project:

- Where the site is exposed to flows crossing an active alluvial fan, a 2-dimensional hydraulic model is extended from the apex of the active fan, or other suitable points, to include the development area. Such a model will route the appropriate flood from the upper watershed across the fan, onto the valley bottom, and to a downstream stormwater facility, if appropriate. The model will include inflows from the valley bottom tributary area and inactive fan surface. At the approval of CVWD, such models may account for infiltration of surface flows into the lower fan and valley floor surface. CVWD does not presently have standards or guidance for incorporating infiltration but will provide a detailed review of proposals from developers and their engineers.
- Where the development site is distant from a fan and is only exposed to flows from the valley floor and it includes channels or other evidence of channelized flows, hydraulic conditions may be calculated from one-dimensional hydraulic models or uniform flow calculations, where these are appropriate.
- If the valley floor at the development site shows no evidence of channels and if sheet flow is the dominant flood hazard, then existing hydraulic conditions can be determined by the methods described in FEMA (2003).

CVWD will consider other hydraulic models or approaches where they are appropriate for the site conditions and provide results that are consistent with the above approaches.

8.5.7 Flood Hazard Zoning

Developers/engineers shall prepare flood hazard or flood insurance zone maps and other information suitable for a Letter of Map Revision (LOMR) at the development site. The zones are defined from the depths and velocities calculated at the development site for the design flood.

There are often considerable uncertainties in the calculated hydraulic conditions at a particular site because of uncertainties in the design flood, in the distribution of flows on the fan and the valley floor as a result of channel erosion or sedimentation, and the routing of flows because of development, roads and other features on fans. For sites on the active fan and those distant from the fan apex, a range of flow input distributions into the model should be utilized to predict the design hydraulic conditions at the site. Each scenario then represents a potential hydraulic design condition that might occur at the development site.

Flood insurance zones shall be determined at the development site by overlaying the results of the model scenarios and selecting the worst case depths and velocities at the project site.

8.5.8 Flood Hazard Mitigation

The basic standard for stormwater management on the development site is to protect it from flooding while conveying water through the site in such a manner that flood hazards are not modified for adjacent properties. To help meet this goal, the

disturbance of natural watercourses on the site shall be minimized and the points where channels or runoff historically have entered or exited a property shall be maintained (California Drainage Law).

The recommended approach for evaluating potential impacts of development on adjacent properties is to repeat the hydraulic analysis or modeling for existing conditions with the development and the proposed flood hazard mitigation in place. The existing and post-development hydraulic conditions are then compared for upstream, downstream and adjacent to the development site. Where the post-project changes to water levels, velocities, or other hydraulic parameters may be detrimental to adjacent properties or channels, either the flood hazard mitigation works are modified to eliminate these changes or suitable protective works are developed for the adjacent channels and properties.

Where the flood mitigation plan proposes to collect sheet flow, combine multiple channels in a braided wash into one channel, construct flood channels, or otherwise divert or re-route floods, more stringent standards apply. In these circumstances, the safety of the developments and of upstream and downstream properties depends on the continued functioning of the flood control channels. Design and construction of the flood control works generally will meet the standards of the US Army Corps of Engineers, as expressed in their Engineering Manual 1110-2-1601 (Hydraulic Design of Flood Control Channels), EM 1110-2-1418 (Channel Stability Assessment for Flood Control Projects) or other manuals appropriate for the particular flood channel concept. Such design studies require sediment transport assessment and detailed consideration of upstream and downstream channel response. This is described further in the next section.

8.5.9 Sediment Hazard Mitigation

CVWD requires an assessment of existing conditions (pre-project) sediment hazards as well as developed conditions (post-project). This analysis will compare conditions and evaluate changes in sediment transport, the potential for channel filling or erosion, and the potential impacts on neighboring properties or on the regional stormwater facilities. Where channel adjustments seem likely to occur as a result of the project design, appropriate mitigation measures are to be included in the flood hazard design. These measures will be appropriate for the site and the likely channel response and may include channel lining or stabilization, bank protection, sediment trapping, or other suitable measures.

Also, where the flood mitigation plan re-routes or channelizes flood flows within the development, an assessment of potential erosion and sedimentation within the flood control channel is required. Where erosion might potentially occur, suitable channel linings or protection will be provided in the mitigation plan. Where sedimentation might potentially occur, a suitable mitigation plan is also required, consisting of sediment trapping or sediment removal as part of maintenance.

Given the complexity of the sediment analysis, it is recommended the proposed analytic and mitigation methods be discussed with CVWD during the early stages of the design.

8.5.10 Long Term and Post Storm Operation & Maintenance Plans

Operations and Maintenance (O&M) plans are required for proposed flood control facilities, whether the facilities are to be deeded to CVWD or owned by the development. O&M plans will include maintenance access easements through the development, equipment access routes in and out of facilities, disposal sites, vegetation management plans, and provide local, state and federal permits which allow long-term and post-storm repair and restoration activities. The O&M plans will provide detailed instructions and requirements for the long-term maintenance required to ensure performance and for post-storm maintenance and repairs to restore functioning.

Developers are required to submit long term and post storm O & M plans concurrently with each phase of design plans (conceptual to final). This will help ensure that an adequate O&M plan is provided as part of design and development plans.

8.6 Technical Appendix

Further technical guidance and recommended report formats and contents are included in Appendix K to the Design Manual. This Appendix includes CVWD's Stormwater Service Area Map and the following specific guidelines:

- Guideline K-1: Report Format and Contents for Projects Adjacent to CVWD Stormwater Facilities
- Guideline K-2: Slope Protection Design Guidance
- Guideline K-3: Storm Outlet Design Guidance
- Guideline K-4: Report Format and Contents for Development Projects
- Guideline K-5: Framework for Hydrologic Modeling
- Guideline K-6: CVWD Ordinance No. 1234
- Guideline K-7: Stormwater Annexation Form

8.7 References

Bechtel Infrastructure Corporation. 2003. Flood Insurance Study for Oasis Area of Coachella Valley. Prepared for Coachella Valley Water District, Coachella, CA.

Committee on Alluvial Fan Flooding. 1996. Alluvial Fan Flooding. National Academy Press. Washington, D.C. 172 pp.

FEMA. 2003. Guidelines and Specifications for Flood Hazard Mapping Partners. Appendix G: Guidance for Alluvial Fan Flooding Analysis and Mapping. 33 pp. April.

Richardson, E.V. and S.R. Davis. 1995. Evaluating Scour at Bridges, third edition. US Federal Highway Administration. Hydraulic Engineering Circular No. 18.

USACE. 1980. Whitewater River Basin Feasibility Report for Flood Control and allied Purposes. San Bernardino and Riverside Counties, California. Los Angeles District. May.

USACE. 1991 (with 1994 revisions). Hydraulic Design of Flood Control Channels. US Army Corps of Engineers Engineering Manual EM 1110-2-1601.

USACE. 1994. Channel Stability Assessment for Flood Control Projects. US Army Corps of Engineers Engineering Manual EM 1110-2-1418.

Guideline K-4
Format and Contents for Reports for Development Projects in CVWD Stormwater Service Area

K-4.1 General Requirements

Within the Stormwater Service Area, CVWD is responsible for ensuring that developers adequately describe regional flood hazards at project sites and mitigate these hazards to meet CVWD, Riverside & City Floodplain Ordinances, State and Federal requirements. CVWD requires developers to submit a report that adequately describes flood hazards at their project sites and describes mitigation for these hazards. CVWD also requires that this report considers whether flood hazards are altered on adjacent properties as a result of the development and provides the necessary mitigation, if applicable. These two objectives are generally addressed by comparing existing and post-project hydraulic characteristics at, adjacent to, and upstream and downstream of the development site. Consequently, a detailed description of the hydraulic models and their development, calibration, verification, sensitivity testing, and output will be an important part of the reporting. Also, given the focus on flood hazards at the site, CVWD requires that the study meets the minimum standards of a Flood Insurance Study and provide corresponding Flood Insurance Rate Map revisions.

CVWD requests that the report be concise, clear and complete, including all the data, tables, exhibits, plans, interpretation and references required for a detailed review of the proposed project. Methodologies, technical approaches, assumptions, summaries of calculations, and the basis of design must be presented in the main body of the report.

Detailed technical information, which is too large to include in the main body of the report, will be included as Appendices. Input and output files from computer programs will be copied to a CD or other storage media and included with the report. Other relevant and pertinent technical material and data should also be included in Appendices.

K-4.2 Report Format and Contents

Reports submitted under Guideline K-4 will generally include the sections or chapters described below and the figures or illustrations described under the headings. Content and emphasis are expected to vary from project to project.

Executive Summary

Provide a brief description of the setting of the development, describe the hydrologic and hydraulic analyses and results, and based on existing (pre-project) and proposed (post-project) conditions describe flood hazards and the proposed mitigation, if any, that is required to treat post-project conditions at the site, adjacent to the site, and upstream and downstream.

Introduction

Describe the project, its location, study objectives and design criteria and guidelines adopted for the study. The Introduction will also summarize background information provided by the CVWD or others, and the general technical approach. Illustrations will include project boundaries on vicinity and local maps, watershed boundaries (if prepared) and existing floodplain or flood hazard maps.

Watershed Characteristics

Define the boundaries and characteristics of the watershed(s) that potentially contribute flow to the project site, as described in Section 8.5, and determine whether the development site appears to be on a fan, on the valley floor, or on some other geologic feature. The description of the watershed(s) will include geology, soils, slopes and other watershed features required for rainfall-runoff modeling or that are relevant to evaluating hazards or estimating sediment supply. Illustrations will include those required for the hydrologic modeling, such as watershed subdivisions, soils and geology maps or other relevant information.

The watershed characteristics section will also provide a preliminary assessment of flood and geological hazards at the development site, based on review of existing reports, air photographs, maps, anecdotal information, discussions with agencies and field reconnaissance. Illustrations for this section will include air photos or maps showing historic channels, areas of flooding, evidence of debris flow deposits, or other hazards. Additional illustrations helpful to evaluate site conditions include long profiles along stream channels, stream channel cross sections or comparisons of historic channel positions.

Alluvial Fan Analysis (if required)

Hazard identification for a particular property or site follows the Appendix G "Guidance for Alluvial Fan Flooding Analyses and Mapping" of FEMA (2003). This document recommends a three stage process: Stage 1-identify alluvial fan landform boundaries, Stage 2-identify active and inactive areas on the fan and Stage 3-flood hazard analyses.

Stage 1 analysis identifies the boundaries of the alluvial fan and determines whether the property lies on or off the alluvial fan. Properties that lie off the toe of alluvial fans and on the floor of the Coachella Valley are exposed to many of the same hazards as those on alluvial fans and shall be analyzed similarly.

Stage 2 identifies active and inactive areas on the fan surfaces. This includes analyses of topographic, soils and surficial geology maps, review and analysis of historic air photos, and review of historic records or observations of flooding followed by field studies/inspection to confirm active and inactive boundaries on the fan. On many fans, geomorphic studies that evaluate the relative ages of different fan surfaces are invaluable in defining inactive and active fan areas. These same analyses are required to identify the potential for channelized flow or to document the general nature and extent of sheet flow inundation at project sites that lie off the toe of a fan. Due to the limited rainfall records, CVWD requires extensive and thorough analysis to identify potentially inactive fan surfaces.

Once the nature and extent of the hazards are determined, they are quantified and classified by detailed geomorphic, hydrologic and hydraulic studies. Given the complexity of flows and channels on active alluvial fans and the impact of human development on flow paths on some fans, hydraulic studies often require extensive and detailed LiDAR or other topographic surveys of the fan and valley floor.

Hydrology

Summarize and review all previous estimates of the SPF and the 100-year flood for the watersheds that drain to the development site. If new design flows are calculated, this section will describe the input data and methods adopted for the calculations. Methods are to meet CVWD standards described in Section 8.5 and new design flows will be compared to previous estimates. The end result of this section is to present the design flows at the points required for the hydraulic analysis, such as the hydrologic apex of a fan or the development site boundaries.

Hydraulic Analysis

Describe the selection and development of an appropriate hydraulic model for the project site conditions, the proposed development, and the hydraulic parameters that will be needed to assess flood hazards, primarily depths (or elevations) and velocities. Different models are appropriate for different hazards and different sites. Where flood hazards are channelized or riverine, a steady one-dimensional hydraulic model (such as HEC-RAS) will often be suitable. For studies on the active portion of alluvial fans, two-dimensional models are often required to adequately model hydraulic conditions. Where the site is distant from fans or other flooding sources and hazards seem to be primarily from sheet flows, the relatively simple analyses described in FEMA (2003) or other publications might be appropriate. However, if upstream conditions are likely to change and alter the distribution of flows, more detailed analyses will be required.

CVWD expects the project engineer to justify the model selection, the model domain, describe model development and provide model input and output files so that a thorough review of the hydraulic analysis can be completed.

The hydraulic analysis will generally compare existing (pre-project) and proposed (post-project) hydraulic conditions within the reach of the channel potentially affected by the project. The particular hydraulic parameters that will be compared depend on the nature of the project but will include water surface elevations, depths, velocities and derived parameters such as shear stresses. As discussed earlier, for developments that are on active alluvial fans or off the toe of an alluvial fan but subject to flooding from the alluvial fan, multiple models are generally required to adequately define conditions at the development site, as described in Section 8.5.

Illustration will include air photos and ground photos of the site to indicate roughness and other conditions that affect the model, pre-project and post-project water surface elevations, pre-project and post-project areas of inundation, and pre-project and post-project maps of depths and velocities. Often, the most useful maps are ones that show differences between the pre-project and post-project conditions. Flood hazard maps will be developed from the hydraulic results for the development site, for pre-project and post-project conditions.

Sediment Transport Studies

Where the proposed development alters the distribution or character of design flows upstream and downstream of the site or where flows are channelized or otherwise re-routed

through the development site, sediment transport, erosion and deposition studies are required to evaluate potential changes to the channel network, as described in Section 8.5. Given that such studies are complex, it is recommended to consult with the CVWD prior to undertaking these analyses.

Flood Hazard Mitigation Design

Describe the flood hazard mitigation (stormwater management plan) proposed for the development and describe any mitigation works required for upstream and downstream properties. General guidance for mitigation design concepts is provided in the following sources:

- On-Site Hazard Mitigation: Riverside County Ordinance 458.12 and other publications by FEMA or other agencies that provide standards and methods for floodproofing of individual lots or structures.
- Flood Channel Design: General guidance in USACE (1991) and other publications related to design of supercritical conveyance channels.
- Levees and other Flood Protection Works: General guidance is provided by FEMA and their associated documents, as described in Section 8.4.

Illustrations will include plan, profile and typical sections of the mitigation works with suitable stationing, design water levels, top of slope elevations, channel bottom elevations, typical sections, and design details for hydraulic structures. If required by CVWD, a conversion will be provided between the vertical datum used for the drawings and the CVWD vertical datum.

Results and Conclusions

Provide a narrative of the results of studies and recommend specific flood hazard mitigation works, where they are required.

References

CVWD requires a complete bibliography of all reports, publications, or books that are referred to in the report. The bibliography should be adequate to identify and locate specific publications. In general, CVWD does not recommend referencing draft reports; however, in some circumstances these may provide the most up-to-date technical approaches and methods.

Appendices

The appendices should include photographs, technical information that is too voluminous to be included in the main body of the report, specific studies (such as bed material measurements), raw data, and computer model input and output files. These data should be presented in electronic forms on DVD or CD or other storage media.

K.4.3. References

USACE. 1991. (with revisions 1994). Hydraulic design of flood control channels. U.S. Army Corps of Engineers, EM 1110-2-1601.

USACE. 1997. Draft "Without Project" Hydrology Report Thousand Palms Area, Whitewater River Basin, Riverside and San Bernardino Counties, California. March 20, 1997.

K-5.1 General Design Criteria

Coachella Valley Water District's (CVWD's) Ordinance No. 1234 describes the hydrologic criteria for flood control design within the stormwater service area. It identifies the Standard Project Storm (SPS) and the Standard Project Flood (SPF) as the design standard for CVWD flood control facilities---not the 100-year storm and 100-year flood. In general, the tributary stormwater facilities that intercept flows from the hills and mountains and discharge into the WWRSC/CVSC have been designed to the SPF calculated from the Indio Storm of September 24, 1939. This storm was defined as the local SPS by the United States Army Corp of Engineers (USACE) (1980). This same storm has also been used as a basis to calculate the SPF in hydrologic analyses prepared by CVWD.

For smaller watersheds, the peak flows for the 100-year rainfall event from the recently updated NOAA Atlas 14 may exceed the SPS peak flows (see Section K-5.2). In this case, a design based on NOAA Atlas 14 might minimize flood damage and provide a greater level of protection. Therefore, comparison of the SPF and the 100-year flood for all development projects is a requirement.

K-5.2 Comparison of Standard Project Storm and 100-Year Rainfall

Table K-5.1 compares 100-year rainfall amounts from NOAA 14 for Indio and the Santa Rosa Mountains against estimated rainfall amounts from the Indio SPS for a range of durations. For durations less than one hour, the Indio SPS is less severe than the rainfall depths from NOAA 14.

Table K-5.1 NOAA 14 and Standard Project Storm Rainfall Depths

Duration	100-year Rainfall Depth from NOAA 14 Atlas for Indio[1] (inches)	100-yr Depth from NOAA Atlas 14 for Santa Rosa Mountains [2] (inches)	Maximum Amount in 1939 Indio Storm [3] (inches)
5 minutes	0.60	0.77	0.36
15 minutes	1.13	1.46	0.94
1 hour	1.88	2.43	2.55
6 hours	2.96	4.13	6.45

[1] NOAA 14 depths extracted from the NOAA Hydrometeorological Design Studies Center website for Lat 33.70866 N, Long 116.2153 W and elevation of 13 feet below sea level

[2] NOAA 14 depths extracted from the NOAA Hydrometeorological Design Studies Center website for Lat 33.397 N, Long 116.19 W and elevation of about 3100 ft above sea level

[3] Estimated from Plate E-5.9 of the Riverside County Flood Control & Water Conservation District Hydrology Manual

The rainfall depths quoted in Table K-5.1 certainly suggest that for small watersheds characterized by short durations to peak flow, the 100-year rainfall event might result in higher peak flows than those from the Indio SPS. Conversely, for moderate and large watersheds, the Indio SPS will likely predict much larger peak flows than those calculated from the 100-year rainfall depths and durations.

K-5.3 CVWD Design Standards

For sites with no previous studies, or where the CVWD deems the previous studies inadequate, CVWD requires that the SPF peak flow be calculated from the Indio SPS and the 100-year peak flow be calculated from the 100-year NOAA 14 rainfall. The greater of these two values will be adopted for steady-state hydraulic design. Hydrograph volumes required for design will be the greater of the volume generated by the Indio SPS or that from an appropriately constructed 6-hour 100-year NOAA 14 storm. The development of design storms is described below.

K-5.4 Hydrologic Modeling Guidelines

Objectives

The overall objectives of the hydrologic modeling guidelines are to:

- Provide logical and technically defensible standards that provide an appropriate level of protection for the public and CVWD facilities to the maximum extent practicable
- Provide consistent estimates of design flows which are as reliable as possible recognizing the limitations and uncertainty imposed by the scarcity of hydrometric data in the area
- Establish an approach to hydrologic modeling which is reasonably consistent with the current state-of-the-art, again recognizing the limitations imposed by the scarcity of hydrometric data
- Provide a consistent framework for analysis and product delivery to facilitate CVWD review and approval

Modeling Approach

Except for the very few locations in this arid region where long-term streamflow records are available, CVWD recommends rainfall-runoff modeling for hydrologic analysis. CVWD currently recommends that hydrologic modeling use HEC-HMS,

General Comments on Model Application

The following bullets provide general requirements for defining hyetographs, hydrologic losses and convert hyetographs to hydrographs:

- When identifying the area or areas contributing flow to the points of interest, sub-basins for hydrologic modeling should be delineated to take into account the gross variations in meteorological inputs and hydrologic response over the contributing areas.
- The 100-year design hyetograph or storm will be developed for point rainfall amounts for durations ranging from 5 minutes to 6 hours from NOAA Atlas 14. 100-year design storm hyetographs will then be constructed by nesting the 100-year amounts for the different durations. Appropriate depth-area adjustments are applied to the point rainfall amounts to determine rainfall amounts over the contributing areas. CVWD will provide advice on developing design storms, if required.
- The SPS should be based on the 1939 Indio Storm with a 6-hour point rainfall depth of 6.45 inches. The depth-area reduction for the 6-hour SPS and the temporal distribution

of rainfall within the storm may be taken from Plates E-5.8 and E-5.9 respectively of Riverside County Flood Control and Water Conservation District (1978).

- A synthetic unit hydrograph procedure is recommended for converting the design rainfall hyetograph to a runoff hydrograph. This requires specifying both hydrologic loss rates (hydrologic infiltration rates) and unit hydrographs for the contributing areas.
- Initial and constant losses should be estimated from existing maps of soils and surficial geology. For areas which have not been mapped (there are no published soils maps for most of the mountainous portions of the drainage system), loss rates can be estimated by extrapolation from mapped areas. In general, CVWD recommends a hydrologic loss rate of 0.1 inches/hour for mountainous areas with a thin soil cover over bedrock.
- In the absence of more recent information, the USACE dimensionless S-graph adopted for the Whitewater River basin studies can be used to determine a basin or sub-basin specific unit hydrograph. The S-graph used by the USACE for the Whitewater basin studies was developed more than 30 years ago. It may be advisable to review the basis for the S-graph and to determine whether an update using more recent information is warranted.

K.5.5. References

Riverside County Flood Control and Water Conservation District. 1978. Hydrology Manual. Prepared by F.J. Peairs under the supervision of J.W. Bryant and R.A. Nelson. 219 pp.

USACE. 1980. Whitewater River Basin Feasibility Report for Flood Control and allied Purposes. San Bernardino and Riverside Counties, California. Appendix 1 Hydrology. Los Angeles District.

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ORDINANCE NO. 1234

File: 0106.51
0141.

AN ORDINANCE OF THE
COACHELLA VALLEY WATER DISTRICT
ESTABLISHING REQUIREMENTS RELATING TO
STORMWATER POLICIES ON PUBLIC NOTIFICATION
AS CONDITIONS TO APPROVAL OF DEVELOPMENTS
IN AREAS SUBJECT TO SPECIAL FLOOD HAZARDS
AND REPEALING ALL ORDINANCES IN CONFLICT THEREWITH

The Board of Directors of the COACHELLA VALLEY WATER DISTRICT (hereafter "District") finds and determines as follows:

1. There are areas within the Coachella Valley which are subject to flash flooding, primarily from the hills and mountains surrounding the valley; flood control facilities in those areas should be designed using the "standard project storm" and "standard project flood" as design criteria rather than the "100-year storm" and "100-year flood" in order to minimize flood damage, the "standard project storm" and "standard project flood" require a greater level of protection.

2. There are areas within the jurisdiction of the District which have been identified as flood hazard areas by the Federal Insurance Administration on maps prepared by the Federal Insurance Administration entitled "The Flood Insurance Study for the County of Riverside" dated January 18, 1979, as amended, including the Federal Insurance Rate Map Panel 1625, revised September 30, 1988. Such areas are subject to Riverside County Ordinance No. 458 (Ordinance No. 458) regulating development in flood hazard areas and implementing the National Flood Insurance Program. The Ordinance provides that no land shall be developed within a flood hazard area until the applicable requirements of the Ordinance have been met.

3. Said Ordinance No. 458 is based on the use of the 100-year storm and 100-year flood as the design criteria for the level of flood protection required as a condition to approval by the County of the proposed development. In areas within its jurisdiction, the District serves as the County's agent in determining whether the requirements of Ordinance No. 458 have been met.

4. The flood protection facilities constructed by a developer in compliance with the requirements of Ordinance No. 458 will normally not be

owned, operated or maintained by the District. The District, by approving a plan for such facilities, does not accept ownership of said facilities, responsibility for construction of same in conformance with the plan, or responsibility for the operation and/or maintenance of the facilities once completed. Nevertheless, by reason of its flood control functions in other areas, it is possible that the District will be misperceived as responsible for any damage that may result from improper construction, operation or maintenance of such private flood control facilities.

5. In order to reduce the risk of unfounded lawsuits against the District by reason of the foregoing and in order to reduce the cost of defending any such suits as may be filed, the District should:

A. Require notification in writing to property owners downstream a distance of six hundred (600) feet from the development's lower boundary (subject to the General Manager's discretion to extend said distance as reasonably required by geographic circumstances) that flood protection work is being done as part of the upstream development in accordance with Ordinance No. 458 and may affect downstream properties; and

B. Require the developer to agree that upon transfer of the ownership of the flood control facilities to a homeowners association or other entity (which transfer shall not require the District's approval or consent), the obligation of the developer shall be assumed by the transferee insofar as it relates to operation and/or maintenance of said facilities; and

C. Require the developer to seek neither damages nor indemnity from the District based on the District's approval of the developer's design for flood protection facilities.

6. In the event that an area within the County of Riverside which is presently subject to Ordinance No. 458 becomes part of a city by annexation or otherwise, if that city requests the District to approve proposed plans for flood control facilities related to new development within that area, which plans are based upon a design criteria using a design storm and design flood of lower magnitude than a standard project

storm and standard project flood, the policy set forth herein should continue to apply.

NOW, THEREFORE, BE IT ORDAINED by the Board of Directors of the COACHELLA VALLEY WATER DISTRICT that conditions to approval by the District of a plan for flood control facilities for proposed development as meeting the requirements of Ordinance No. 458 shall include the following:

1. The developer shall give written notice of the proposed flood control plan proposed in connection with the development to property owners downstream a distance of six hundred (600) feet from the development's lower boundary (subject to the General Manager's discretion to extend the distance as reasonably required by geographic circumstances); said notice shall include a statement that said flood protection work is being proposed in accordance with Ordinance No. 458 and may affect downstream properties; and

2. The developer shall execute an agreement with the District which shall include the following provisions:

A. A provision that upon the transfer of the ownership of the flood control facilities to a homeowners association or other entity (which transfer shall not require the approval or consent of District), the obligation of the developer shall be assumed by the transferee in ownership of said facilities insofar as said obligation relates to the operation and/or maintenance of said facilities.

B. A provision that the developer agrees that it will seek neither damages nor indemnity from District based on or related to the design of the flood control facilities within the project.

C. A provision that the developer will cause to be recorded in the chain of title to the flood control facilities within the project a document which will cause these obligations regarding the operation and maintenance of the flood control facilities to run with the land and to be binding upon successors and assigns of the developer in connection with the ownership of said facilities and shall further cause these obligations to be included in any contract between the developer and a homeowners association for the conveyance of the flood control facilities.

3. The foregoing conditions to approval by the District shall also apply in cases where a flood hazard area within the County which is presently subject to Ordinance No. 458 becomes part of a city by annexation or otherwise and the city requests the District to approve proposed plans for flood control facilities related to new development in that area based upon design criteria using a design storm and design flood having a magnitude which is less than a standard project storm and standard project flood.

REPEALS:

All other ordinances or parts of ordinances in conflict with the provisions of this Ordinance are hereby expressly repealed.

BE IT FURTHER ORDAINED that this Ordinance shall become effective upon adoption.

ADOPTED this 8th day of December, 1992.

President

I, the undersigned Acting Assistant Secretary of the Coachella Valley Water District, do hereby certify that the foregoing is a true and correct copy of Ordinance No. 1234 of said District introduced and passed at meeting of said Board held December 8, 1992, and that said Ordinance was passed by the following vote:

Ayes:	Five
Directors:	McFadden, Rummonds, DeLay, Fish, Codekas
Noes:	None
Absent:	None

I further certify that said Ordinance was thereupon signed by the President of the Board of Directors of said District.

Julia Fernández
Acting Assistant Secretary

(SEAL)