HYDROMODIFICATION MANAGEMENT PLAN

EVALUATION PROGRAM

-

SANTA ANA REGION of RIVERSIDE COUNTY

April 18, 2017

Contents

P8/158365

Introduction

This HMP Evaluation Program defines a protocol as required by Provision XII.B.5.b. of the 2010 SAR MS4 Permit that will be implemented by the Permittees to evaluate potential impacts to those channel segments deemed most susceptible to hydromodification.

> *"The HMP will identify sites to be monitored, include an assessment methodology, and required follow-up actions based on monitoring results. Where applicable, monitoring sites may be used to evaluate the effectiveness of BMPs in preventing or reducing impacts from Hydromodification."*

One key consideration of the HMP Evaluation Program is to attempt to distinguish hydromodification impacts, if any, that are caused by new development or significant redevelopment. A series of upstream dams, flood mitigation basins, agricultural developments, significant storm events or other stressors within the SAR are major elements that need to be considered when determining an impact.

The HMP Evaluation Program will operate on the basis of adaptive management principles. Adaptive management is a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs.

The term of the Evaluation Program will extend through fiscal year 2021. Data will be gathered from the two monitored sites (described in Section 4.5 below) which will be submitted to the SARWQCB, tentatively in Fall 2022. However, as data is collected and new programs developed, this plan may be modified by the Permittees and the SARWQCB. The final report will contain:

- An explanation of field monitoring and GIS methods utilized;
- A summary of the monitored sites;
- A characterization of the physical conditions of monitored surface waters due to Hydromodification;
- An assessment. using the pebble count results, of whether any of the monitored sites exhibited impacts from sediment due to Hydromodification,
- An assessment of the suspected causes of Hydromodification;
- A description of how the data gathered under this Evaluation Program will be used in future monitoring and/or implementation efforts.

1 Watershed History and Historical Hydromodification Impacts

The intent of this section is to describe qualitatively the existence of historical stressors to the natural geomorphologic processes occurring within the SAR. In addition, a technical memorandum, entitled “Causes of Degradation and Aggradation in the SAR of Riverside County", was developed as part of the SAR HMP (Appendix B). The technical memorandum identifies evidences of degradation based on geologic, land cover, and topographic considerations, as well as historical aerial photographs of channel segments. The findings of the technical memorandum are summarized per subwatershed in Section 2.2 of the SAR HMP.

Santa Ana River Watershed

The Santa Ana River Watershed is located in southern California, south and east of the city of Los Angeles. The Santa Ana River Watershed includes much of Orange County, the northwestern corner of Riverside County, the southwestern corner of San Bernardino County, and a small portion of Los Angeles County. The Santa Ana River Watershed is bound on the south by the Santa Margarita Watershed, on the east by the Whitewater Watershed and on the northwest by the San Gabriel River Watershed. The area of the Santa Ana River Watershed is approximately 2,650 square miles. The headwaters of the Santa Ana River are in the San Bernardino Mountains with its major tributary being the San Jacinto River, originating in the San Jacinto Mountains. The Santa Ana River traverses through Prado Dam before cutting through the Santa Ana Mountains and flowing to the Orange Coastal Plain. Eventually, the river discharges to the ocean in the City of Huntington Beach.

Santa Ana Region

The SAR is that portion of the Santa Ana River Watershed within Riverside County and is the area addressed by this HMP Evaluation Program. The SAR extends over more than 63 miles from east to west, and over more than 29 miles from north to south. The SAR lies between the Santa Ana Mountains and the San Bernardino Mountains; the topography of the SAR varies highly with altitudes ranging from 415 feet to 8,200 feet. The San Jacinto River is a tributary of the Santa Ana River within Riverside County. Runoff from the 768-square mile San Jacinto River Watershed is regulated by Railroad Canyon Dam and natural storage in Lake Elsinore. This Watershed contributes flow into the Santa Ana River only as a result of unusual high intensity storm events that result in overflow from Lake Elsinore. The San Jacinto River flows through Canyon Lake, Lake Elsinore, and Temescal Creek to confluence with the Santa Ana River in the city of Corona.

Surface drainage from the remainder of the SAR, including the cities of Jurupa Valley, Eastvale, and Riverside, drain through local systems to Reach 3 of the Santa Ana River.

1.1 Lakes, Water Reservoirs, and Basins

The SAR includes basins, two natural lakes and several man-made reservoirs, some of which may have modified the hydrologic and sediment supply regimes of the natural channels within the SAR. The natural lakes are Lake Elsinore and Mystic Lake; the man-made reservoirs are Prado Dam, Lake Mathews, Canyon Lake, Diamond Valley Lake, Lake Hemet, and Lake Perris. These man-made reservoirs do not include the smaller regional watershed protection facilities that may warrant evaluation of their inherent contributions in mitigating potential HCOCs during project planning.

Basins

There are many retention, detention, debris, and infiltration basins located within the SAR that may affect geomorphologic processes. Although they are structurally similar facilities, they serve different purposes. Basins may include an excavated area and an outlet structure to provide an impoundment. Retention basins are typically used to manage stormwater runoff to prevent flooding, downstream erosion, and improve water quality in an adjacent river, stream or lake. Detention basins are typically installed to protect against flooding and downstream erosion by storing or "detaining" runoff for a limited period. Debris basins are designed to prevent debris flows (rocks, boulders, trees, sediment, etc.) from reaching channels where the material may compromise flow conveyance and result in flooding of agricultural or urban development. An infiltration basin is typically an impoundment designed to infiltrate runoff to recharge groundwater basins. Infiltration basins have been demonstrated to have high pollutant removal efficiency.

Natural Lakes

The natural lakes located within the SAR are Mystic Lake and Lake Elsinore. Mystic Lake is a 200-acre ephemeral lake in the San Jacinto Valley that lies within the outlet area of the San Jacinto River. Lake Elsinore is the largest natural freshwater lake in southern California. When high intensity storm events occur, overflow from Lake Elsinore drains into Temescal Wash.

Man-Made Reservoirs and Flood Control Improvements

Prado Lake is a flood control dam that was built in 1941 by the U.S. Army Corps of Engineers (USACE) downstream of the SAR to provide flood protection to the communities in Orange County. The 25,800 acre-feet dam is also operated to provide water conservation capacity. The USACE also constructed levees along the Santa Ana River to protect adjacent and downstream communities.

Bautista Basin is located at the headwaters of Bautista Creek southwest of the city of Hemet in the San Jacinto River Watershed. Bautista Basin was constructed by the USACE to regulate flow and control sedimentation. Accumulated sediment is removed by sand and gravel operations located in the basin. Outflow from the basin is conveyed to Bautista Channel and on to the San Jacinto River. Downstream communities are protected by levees constructed along Bautista Creek (earthen levee faced with ungrouted stone revetment) and the San Jacinto River (Segments 1a and 1b of earthen levee faced with grouted stone revetment) by the USACE and local entities.

Lake Hemet was formed in 1895 following the completion of the 135-foot high arched masonry structure. Lake Hemet is located at 4,340 feet above sea level in the San Jacinto Mountains and has a storage capacity of 14,000 acre-feet. Lake Hemet captures runoff from the upper reaches of the San Jacinto River and is operated based on water supply and recreational activities purposes, not flood control.

Lake Mathews is an 182,000 acre-feet reservoir that commenced to supply water in 1941. Lake Mathews receives water supply from the State Water Project and the Colorado Aqueduct, and captures the natural stormwater flows from Cajalco Creek. A series of water quality wetlands and basins, as well as sediment basins are located on Cajalco Creek. Lake Mathews and the water quality wetlands and basins are operated by the Metropolitan Water District solely on the considerations of water supply, not for flood control purposes. Releases from Lake Mathews would only occur if the water elevation was to reach the spillway crest.

Canyon Lake, also referenced as Railroad Canyon Reservoir, was constructed in 1928 and has a total capacity of 11,600 acre-feet. Canyon Lake receives runoff from the 749-square mile San Jacinto River Watershed. Canyon Lake creates a sump for bed material that has been transported along the San Jacinto

River. The Elsinore Valley Municipal Water District operates the lake based on water supply considerations and maintains a minimum lake elevation of 1,372 feet for the benefits of residents of the Lake Elsinore/Canyon Lake area. In addition, the Canyon Lake Property Owners Association leases surface rights for water recreation and regulates residential development around the edge of the lake.

Diamond Valley Lake is a man-made water supply reservoir located near Hemet and is one of the largest reservoirs in southern California. The Metropolitan Water District began construction of the project in 1995 and first started filling the lake by way of the Colorado River Aqueduct in 1999. Diamond Valley Lake was created by construction of three earth fill dams, two located on either side of the valley and one on the north rim. Diamond Valley Lake provides storage for 800,000 acre-feet of water and is not a flood control facility.

Lake Perris is another man-made water supply reservoir that was completed in 1973 in the mountain-rimmed valley between Moreno Valley and the city of Perris. Lake Perris is supplied from imported State Water Project water and the storage capacity of the reservoir is of 131,400 acre-feet and is not a flood control facility.

The storage capacity of Prado Dam, Lake Elsinore, Mystic Lake, Bautista Basin, Lake Hemet, Lake Mathews, Canyon Lake, Diamond Valley Lake, and Lake Perris provide a reduction of peak flow rates and durations during storm events. The potential increases in flood flows resulting from upstream development are offset, if not fully absorbed, by the storage effect of the reservoirs (Phillip Williams & Associates, 2004). However, the presence of these lakes and reservoirs in the SAR affects the geomorphologic equilibrium and the health of riparian communities by:

- Decreasing the amount of runoff released after frequent storm events.
- Altering the supply of coarse-grained sediment from high yield areas to the downstream channels. The presence of coarse-grained sediments is essential in maintaining the natural highly dynamic geomorphic processes in the SAR.

1.2 Urbanization in the SAR

The land uses in the SAR are primarily undeveloped with only approximately 30% in residential, commercial, and industrial. In 2008, agriculture accounted for 10% of the land uses within the SAR. Historically, the SAR has seen significant agricultural development and remains a strong component of the County's economy[1] (2020 General Plan, Riverside County). As of September 2013, the SAR is home to approximately 1.6 million individuals[1], and current projections indicate a 70% increase by 2035[2]. Projections for housing demand are proportional to the projected increase in population, and urbanization has, over the past few decades, been rising rapidly to meet the demand. Over the last approximately 18 years, Permittees have mitigated increases in runoff from new development during the planning process and have minimized downstream impacts.

[1] County of Riverside General Plan, Vision Statement for Year 2020. Website: http://planning.rctlma.org/ZoningInformation/GeneralPlan.aspx

[1] State of California, Dept. of Finance, E-1 Population Estimates, and RCIT's Riverside County Progress Report

[2] 2010 Projections of Population. Riverside County Center for Demographic Research.

1.3 Floodplain Management

Runoff from urbanization is managed by the Riverside County Flood Control and Water Conservation District (District), the principal Permittee, in collaboration with the Co-Permittees. The District reviewed technical literature including the "Effects of Increased Urbanization from the 1970's to the 1990's on storm-runoff characteristics in Perris Valley, CA" and the "Engineering Workshop on Peak reduction for Drainage and Flood Control Projects" when developing the criteria for managing increased runoff. A number of technical issues were explored in some detail, including a review of the models used to evaluate development-related increases in runoff, and a review of the effectiveness of the various detention/retention schemes commonly proposed as management measures. During the planning and design phase of all new development and significant redevelopment projects, Permittees require users to demonstrate that the projects associated runoff volume and peak discharge will not significantly increase for selected storm return frequencies.

The Permittees participate in the National Flood Insurance Program, which provides flood insurance to participating communities. The Permittees successively implement and enforce a floodplain management ordinance to regulate development in mapped flood hazard areas. Consistent with the requirements of the National Flood Insurance Program, the District has adopted the 100-year return frequency storm event as the minimum standard for the protection of all habitable structures. Flood protection facilities, including storm drains and detention and retention facilities within the SAR, are designed to provide this level of protection. In addition, onsite drainage facilities are required to convey the 10-year storm while habitable structures are protected from the 100-year flood by the inclusion of factors of safety and freeboard. Projects that do not meet or exceed these requirements do not receive a grading permit until the requirements are met.

The Permittees collectively maintain MS4 facilities to ensure that adequate level of protection is provided for their communities. Projects are be considered by the District to reduce historical flooding hazards in specific communities in order to minimize threats to life, property, and the environment. Improvement projects may also include the rehabilitation or restoration of channel segments that have been impacted by hydromodification.

1.4 Future Infrastructure and Project Prioritization

The Permittees are responsible for the maintenance of MS4s and other drainage facilities within the SAR. The District was established by the Legislature to ensure that the major drainage infrastructure is properly functioning to convey the design discharge and protect the communities of Riverside County. The District, as part of its annual budget process, holds public budget hearings for the purpose of receiving flood control project requests. At this time the public can also request projects for beneficial use preservation and restoration and mitigation of environment impacts of Hydromodification. The process is described, as follows:

- Public hearings are held in a centrally located public place in each of the District's seven tax zones. Each zone has three Flood Control Commissioners who are zone residents. These Commissioners are appointed by the Board of Supervisors.
- Any individual, or representative of any business, organization, or government entity, may make a request for a flood control project by appearing at the budget hearing for the appropriate zone, or by submitting a written request to the District. Support for currently budgeted projects may also

be offered. Written project requests should include the location and nature of the problem and the degree of damage (i.e., are residences or businesses actually flooded, etc.).

- After the public hearing, District staff prepares cost estimates of all newly requested projects, as well as ongoing projects, and then prioritizes them on the basis of public need, necessity, and available funds. A draft budget is then prepared by District staff and is presented to the Commissioners at a second public meeting (Work Session). At the Work Session, the Commissioners review the draft budget with District staff and make adjustments as they deem appropriate before making a recommendation for approval. The Work Session is a public meeting and there is opportunity for public comment.
- In June of each year, a final draft proposed budget, approved by the District Commissioners, is forwarded to the District's Board of Supervisors for final approval.

2 Technical Concepts

Hydromodification monitoring measures aim at identifying a potential response of channel segments to an altered flow regime, if any, or other physical and watershed constraints. Response from a channel segment may be assessed through the monitoring of two types of field indicators: a morphologic assessment of channel geometry and an evaluation of the channel physical indicators in an identified segment as a deviation from natural geomorphological processes. This section provides a technical justification to using both field indicators.

2.1 HMP Monitoring Measures

Temporal Evolution of Channel Morphology

Evaluation of instream conditions may provide insight on the effects caused by urbanization, and in turn may be used to predict possible future degradation resulting from expanded development. The most direct method to assess changes instream, due to scour or deposition, is to physically measure the pre-project and post-project cross sections, and determine if the channel is aggrading or degrading (incising and/or widening) over time. This may be accomplished by conducting geomorphic assessments and measurements of channel geometry of segments upstream and downstream of a planned development before and after construction. However, channel aggradation and degradation must be considered in the context of natural geomorphologic processes in the SAR. As an alternative to physical measurements, comparison of current and historical photos, aerial photogrammetry and site inspection for signs of channel degradation and vegetation changes can provide important supporting evidence.

2.2 Temporal and Spatial Variability of Hydromodification Monitoring Locations

An investigation of the potential causes of channel degradation in all major subwatersheds of the SAR was performed as part of the SAR HMP. The investigation included both the examination of historical and current aerial photographs and the development of a GIS-based study using three factors to create geomorphic landscape units including geology types, land cover, and hill slope gradient[3]. A brief summary of the findings of the investigations is provided per subwatershed, as follows:

- The upper San Jacinto River subwatershed outlets at its confluence with Bautista Creek and has observed limited development (5.9%) since 1972. The majority of the upper, steeper reaches have remained in a natural condition, which would be beneficial to replenish the downstream channels with coarse grained sediments. However, the presence of Lake Hemet has partially reduced this supply to downstream reaches.
- The middle and lower San Jacinto River subwatersheds are located downstream of the confluence with Bautista Creek and drain successively to Canyon Lake and Lake Elsinore. Debris and detention basins have been constructed downstream of the upper reaches that are concentrated near the San Jacinto Mountains, the Lakeview Mountains, and the Santa Ana Mountains surrounding Lake Elsinore. The debris and detention basins have reduced the supply of coarse grained sediment from making it to the downstream channel reaches. In addition, the significant change in impervious area due to watershed development has increased the frequency and rate of flow in the channel.

[3] Draft Technical Memorandum - Causes of Degradation and Aggradation in the Santa Ana Region of Riverside County. SAR HMP Appendix B. November 2013.

- Agriculture and grasslands have historically been dominant land uses within the Temescal Wash subwatershed. Historical aerial photographs depict a significant urbanization within the floodplain over the 1952-2013 period. The aerial photographs notably show the impacts of increasing imperviousness on the natural hydrologic response of the subwatershed and on the geomorphology of Temescal Wash.
- The SAR portion of the San Timoteo Creek subwatershed originates in the San Bernardino Mountains and drains to Cherry Valley. Agricultural runoff and effluent from publicly-owned treatment works activities occur year-round to San Timoteo Creek and create a perennial flow condition. Historical aerials show that dense vegetation has stabilized the geomorphology of the creek under altered hydrologic and sediment regimes.

Temporal Variability

The single most important factor affecting the temporal variability inherent to measuring channel aggradation and degradation is variable inter-annual rainfall frequency and intensity. Droughts in the SAR can last years. Historical precipitation records since year 1895 at Prado Dam have recorded a minimum of 4.6 inches for the 2006-2007 water year[4]. In addition to droughts, the SAR also experiences anomalously high storm frequencies and intensities. During El Niño years, frequencies and intensities resulted in sudden naturally occurring geomorphic changes. Rainfall intensity also varies intra-annually. Accordingly, findings from the HMP Evaluation Program will be derived only over time. Trends may require many years to identify. Physical indicator metrics may be a correlating variable to geomorphic changes in channels. As identified in Section 2.1, physical indicator metrics should be evaluated on an individual basis that reflects the flow conditions (perennial, intermittent, or ephemeral) of the evaluated channel segment.

Spatial Variability

A change in elevation in the SAR translates into significant geographic variation of the average annual rainfall, which equals approximately 10 inches and 28 inches in Riverside and in Idyllwild, respectively. The selection of a monitoring location should encompass, to the maximum extent practicable, these geographic variations of natural (stated above) and anthropogenic stressors such as urbanization. Specifically, the measurement of physical indicator metrics and the evaluation of measurements of channel geometry is important to document the range of natural watershed conditions and stream stability of channel segments and to identify if hydromodification associated with new development or significant redevelopment has occurred. Other important factors that reflect channel responses to hydromodification include channel grade, watershed area, and channel sinuosity. In addition to channel and watershed features, location within the watershed is an important consideration. Monitoring locations should ideally:

- Be located in the headwaters or upper portion of representative subwatersheds within the SAR;
- Be located just downstream (or within the domain of influence as defined in Appendix A of the SAR HMP) of a new development or significant redevelopment project of sufficient size, so that hydromodification effects of the project can be isolated to the maximum extent practicable; and
- Not be influenced by other confounding variables including dam operation, non-MS4 runoff, runoff retention basins, Caltrans runoff, or agricultural development and operation.

Specifically, channel segments that are located downstream of controlled release points are not ideal locations for the investigations.

[4] Preliminary Studies of Flow of Santa Ana River at Prado Dam – Indices of Precipitation and Runoff and Base Periods. Bookman and Edmonston. March 1966

Upper reaches in representative SAR subwatersheds may provide more definitive measures of HMP effectiveness if they can more directly correlate effects to specific new development or significant redevelopment projects. Upper reaches within the SAR may include the San Jacinto Mountains, the Lakeview Mountains, and the Santa Ana Mountains surrounding Lake Elsinore.

Middle subwatershed and lower subwatershed sites would be influenced by confounding variables (such as mass wasting or other existing development projects) in the subwatershed. Mass wasting or slope failure occurs on channel banks subject to weathering, increased water content, changes in vegetation cover, and overloading. Therefore, middle and lower subwatershed monitoring sites would require much more time to assess overall program effectiveness, if achievable.

The concept of providing hydromodification effectiveness measurements in the watershed headwaters is supported by Southern California Coastal Water Research Project (SCCWRP). Research has shown that hydromodification effects of a development project may become muted with increasing distance from the project site (defined by SCCWRP as the Domain of Effect).

3 Approaches Selected to Assess HMP Effectiveness

The selection of adequate monitoring locations considered the siting criteria defined in Section 2.2. The Permittees may also consider the effect any channel changes are having on the ecologic system, public health and safety, site access, and the possibility of a future development project. However, finding an uninfluenced evaluation site in the upper reaches of the watershed specific to new development or significant redevelopment projects was challenging. New development projects tend to be constructed in the middle or lower watersheds and may be delayed where the monitoring timeline would be uncertain. We have elected to choose two monitoring sites on streams that were classified as potentially susceptible. This is consistent with the MS4 permit requirements which require an evaluation of potential impacts to those channel segments deemed most susceptible to hydromodification. Assessment survey data will be gathered from each site, it will be utilized to track site geomorphic evolution, and assess what type of impacts may have occurred; if necessary, those impacts can then be addressed within the context of the project prioritization outlined in Section 1.4

3.1 Assessment Principles

The HMP Evaluation Program will extend for a period of five years. Implementation of the HMP Evaluation Program will be discussed in the SAR annual monitoring reports. HMP monitoring data will be submitted to the Santa Ana Regional Board at the end of the evaluation period, tentatively in Fall 2021. However, as data is collected and new programs developed, this plan may be modified by the Permittees and the SARWQCB.

Monitoring measures aim at identifying potential susceptibility of monitored stream reaches to Hydromodification, and then tracking their geomorphology over time. The Co-Permittees will collect the following Hydromodification monitoring observations and measurements at the two monitoring locations described in Section 4.3, below:

1) Channel conditions, including:
   a) Channel dimensions,
   b) Hydrologic and geomorphic conditions,
   c) Presence and condition of vegetation and habitat;
2) Location of discharge points;
3) Photo documentation of existing erosion, with location (i.e. latitude and longitude coordinates) where photos were taken;
4) Measurement or estimate of dimensions of any existing channel bed or bank eroded areas, including length, width, and depth of any incisions;
5) Known or suspected cause(s) of existing downstream erosion impact, including flow, soil, slope, and vegetation conditions, as well as upstream land uses and contributing new and existing development.

3.2 Field Methods

Stream Susceptibility

To begin the evaluation and during the first monitoring year, the “Hydromodification Screening Tools: Field Manual for Assessing Channel Susceptibility” developed by SCCWRP (Technical Report 606, 2010) will be utilized as appropriate to make the observations and measurements described above. In support of the Hydromodification monitoring observations and measurements noted above, two data types will be calculated through GIS analysis and collected during field efforts:

1) Landscape GIS Metrics
   a) Contributing drainage area above the point of interest

   b) Mean annual area-weighted precipitation
   c) Geomorphic confinement: valley bottom width at site
   d) Valley slope at site
   e) Upstream land use coverage
2) Site Specific Field Metrics
   a) Bank angle
   b) Bank height
   c) Stream gradient
   d) Substrate particle size (if necessary)
   e) Vertical susceptibility
   f) Lateral susceptibility

A stream reach at each location will be delineated. Once the stream reach to be assessed has been determined, the risk potential for mass wasting (erosion) will be measured. At representative transects, the left and right bank angles and bank heights will be measured using a stadia rod and gravity-driven protractor. If necessary, the stream substrate particle size (pebble count) will be measured and a median particle size will be determined. Vertical and lateral susceptibility to bank wasting will then be assessed. Vertical susceptibility will first be assessed by recording the status of three streambed parameters: composition of the stream substrate, armoring potential (i.e. bed consolidation), and grade control presence and effectiveness. Lateral susceptibility will then be assessed through a decision tree using a combination of vertical susceptibility rating, bank stability threshold, and valley width index to determine the lateral susceptibility.

Stream Geomorphology

In addition to assessing susceptibility, geomorphology of each monitored site will be tracked over time; a channel survey at each sites' selected cross-sectional transects will be conducted annually. The channel survey will consist of collecting topographic and bathymetric measurements along each cross-section to characterize morphology and longitudinal slope of the channel segment. Four parameters will be surveyed: 1) the floodprone width; 2) the bankfull width; 3) the bankfull depth; and 4) the longitudinal slope. Initially, each surveyed channel segment will be classified per the simplified Rosgen system of channel classification (Rosgen, 1996), as detailed in Figure 1. During each subsequent year, surveyed channel segments will be compared to the six-stage Channel Evolution Model defined by Simon, as well as the previous year's cross-section data, to correlate any potential impacts of urbanization to a change of channel geomorphology (Simon et al., 1992). The six-stage Channel Evolution Model and steps for assessing geomorphology of each monitored site are described in more detail in Section IV.A below.

Figure 1: Simplified Rosgen Channel Classification

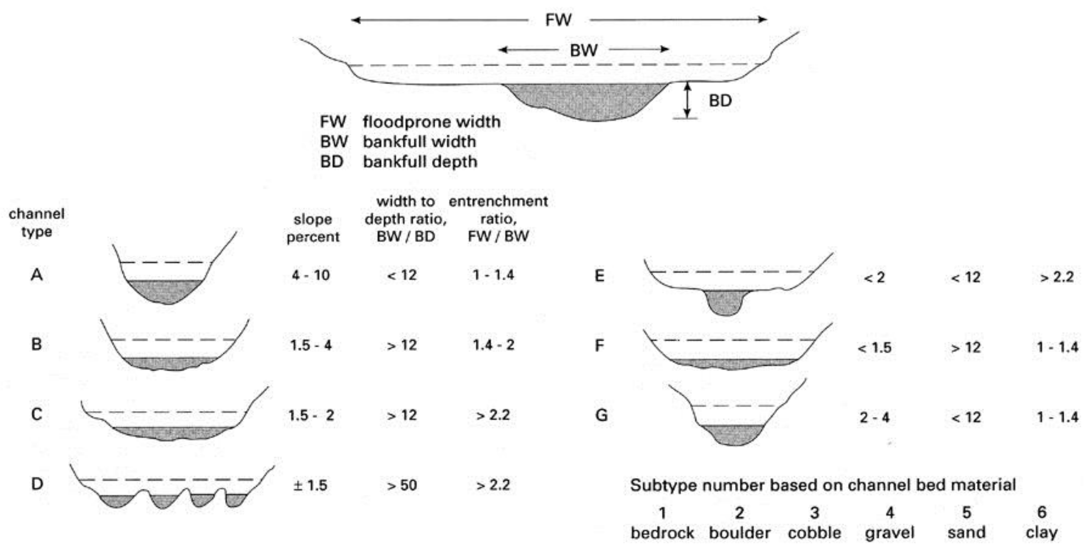


Figure 1.12 The Rosgen system of channel classification.

(Rosgen, 1996)

4 Data Analysis and Reporting

The SAR HMP Evaluation Program extends through fiscal year 2021; this period of time is necessary to implement monitoring, analyze data from selected sites and the SMC survey, and to account for spatial and temporal variability of the conditions in the SAR. Implementation of the SAR HMP Evaluation Program will be discussed in the SAR Annual Reports. Analytical data and a final report will be submitted to the SARWQCB at the end of the monitoring program period, tentatively in Fall 2022.

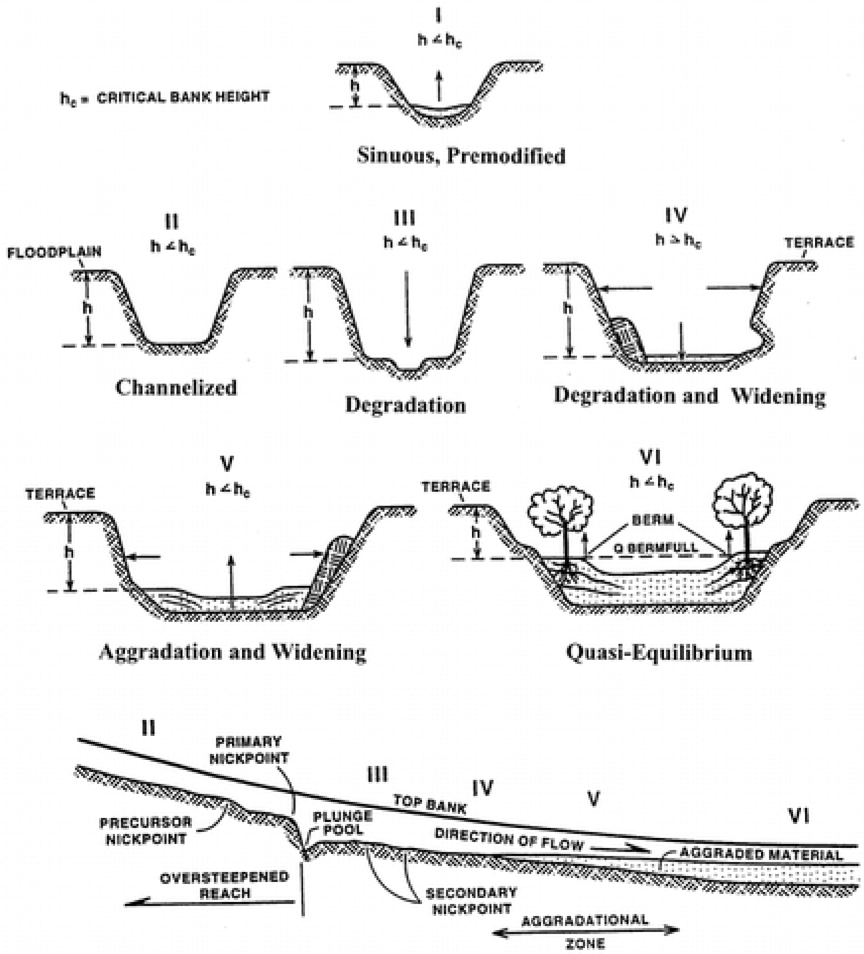
4.1 Data Analysis

Desktop GIS analysis for calculating drainage area, valley width, and valley slope for each site will be performed using the USGS National Elevation Dataset Digital Elevation Models.

The risk of bank failure will be calculated using a combination of bank height and bank angle field measures relative to the probability of mass wasting equation and table published in the Hydromodification Screening Tool document. Lateral and vertical susceptibility, as well as sediment observations that may affect infiltration, will be assessed through pebble counts, field measures, and decision trees available in the screening tool document.

Geomorphology of each site will be tracked by annually surveying each site's selected cross-sectional transects. The temporal evolution in geomorphology, if any, of the surveyed channel segment will be compared to the six-stage Channel Evolution Model defined by Simon et al, as well as the previous year's cross-section data, to correlate any potential impacts of urbanization to a change of channel geomorphology (Simon et al., 1992). Figure 2 illustrates the six-stage sequence of incised channel evolution (Simon et al., 1992). A channel segment will be considered stable over time if features of the channel segment (such as dimension, pattern, and profile) are maintained, and the channel system neither aggrades nor degrades.

Figure 2: Six-Stage Channel Evolution Model



(Simon et al, 1992)

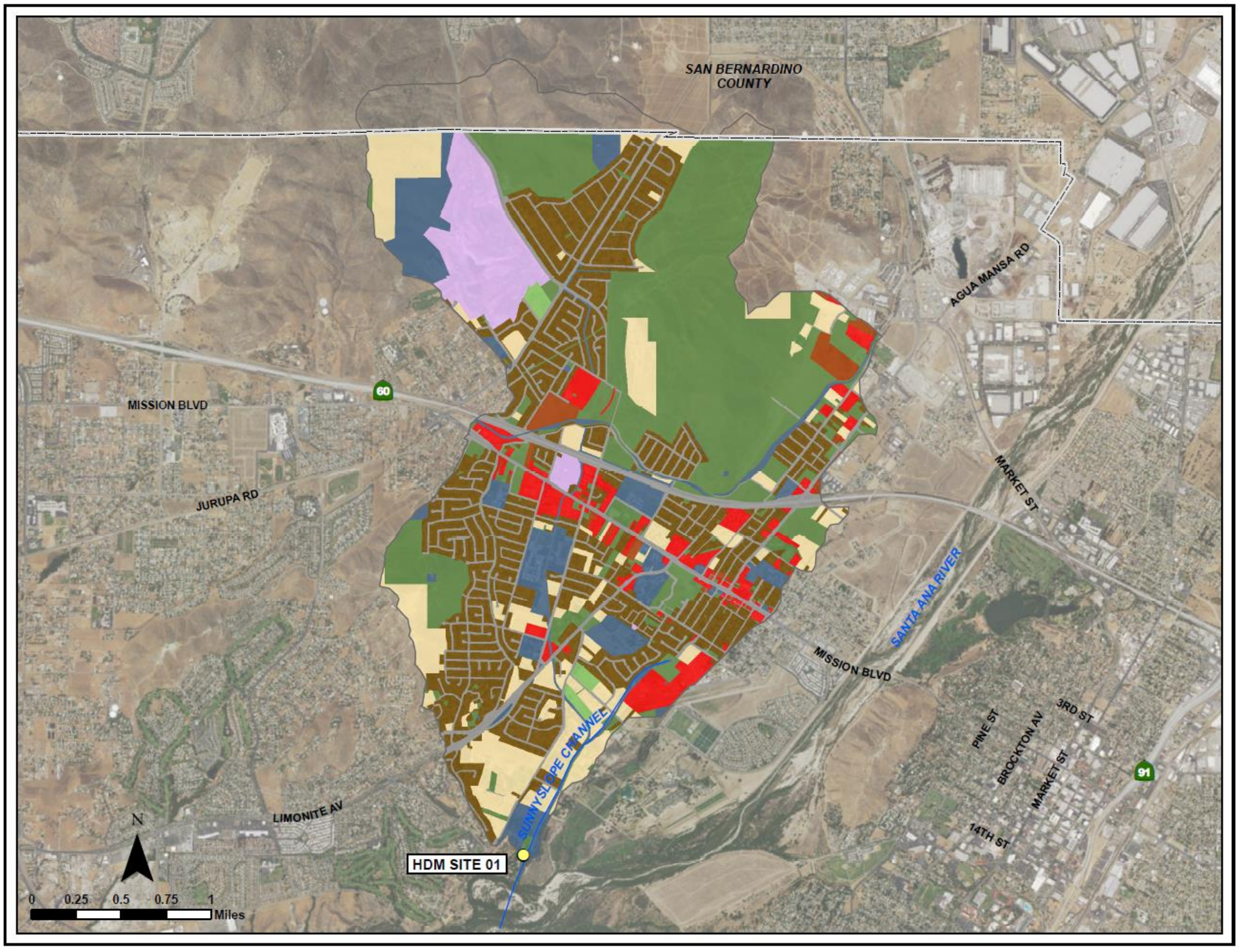
4.2 Reporting

The term of the Evaluation Program will extend through fiscal year 2021. Data will be gathered from the two monitored sites (described in Section 4.5 below) which will be submitted to the SARWQCB, tentatively in Fall 2022. However, as data is collected and new programs developed, this plan may be modified by the Permittees and the SARWQCB. The final report will contain:

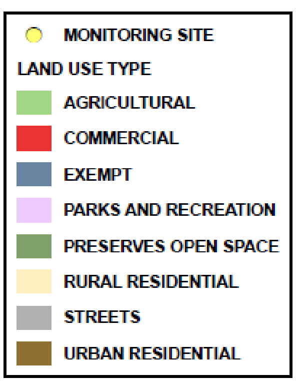
- An explanation of field monitoring and GIS methods utilized;
- A summary of the monitored sites;
- A characterization of the physical conditions of monitored surface waters due to Hydromodification;
- An assessment, using the pebble count results, of whether any of the monitored sites exhibited impacts from sediment due to Hydromodification,
- An assessment of the suspected causes of hydromodification;
- A description of how the data gathered under this Evaluation Program will be used in future monitoring and/or implementation efforts.

4.3 Monitoring Sites

Two sites have been selected in the region. The first site is within District Property downstream of Sunnyslope Channel. The District partners with the Riverside County Parks District to advance habitat conservation efforts and encourages environmental education in this area. The natural stream is currently used as a nature trail as part of the Louis Rubidoux Nature Center.



*Drainage area boundary and acreage may be subject to revision as additional data is received.



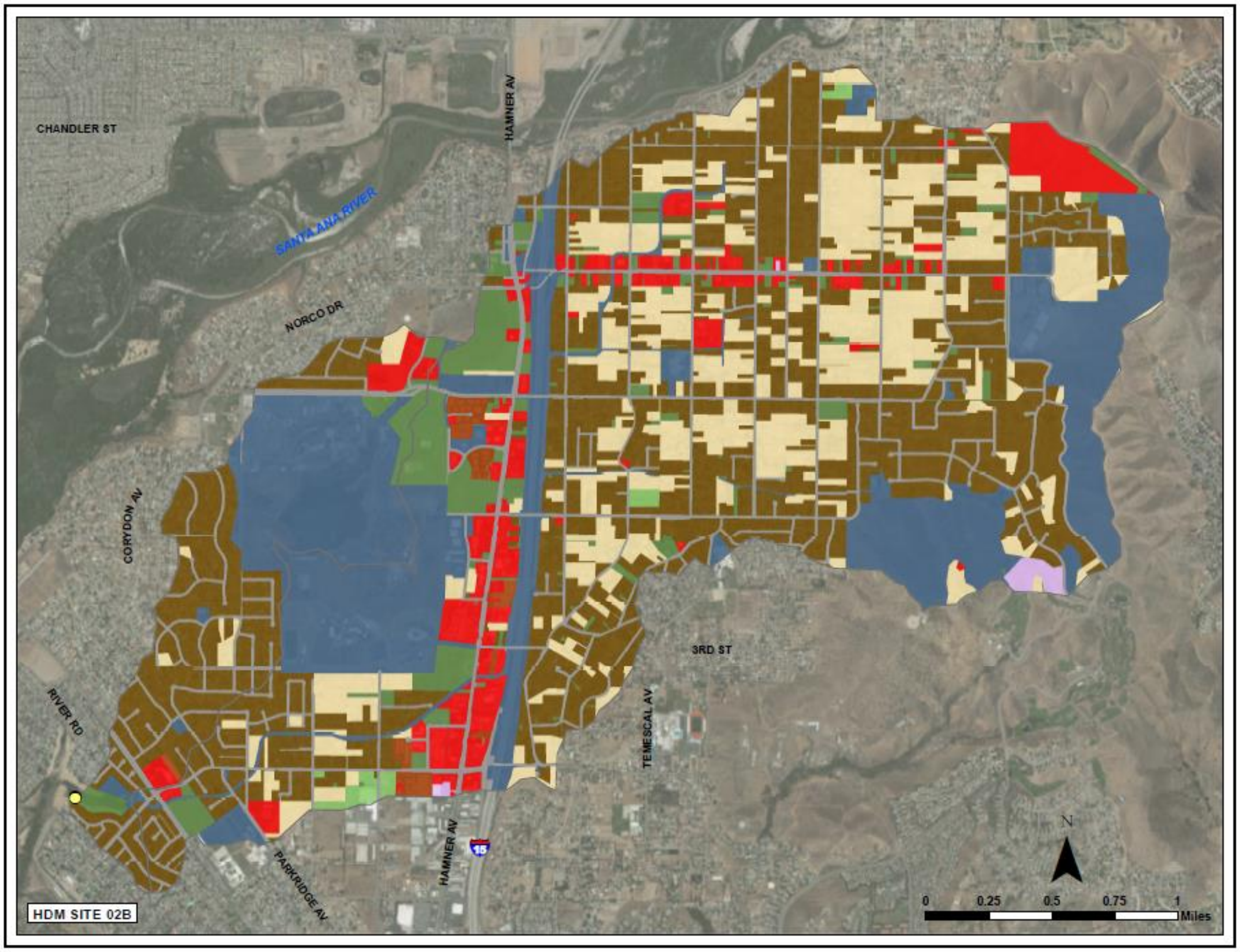
LAND USE	ACRES	LAND USE %
URBAN RESIDENTIAL	1114	24
INDUSTRIAL	67	1
COMMERCIAL	227	5
STREETS	546	12
TOTAL URBAN	**1954**	**42**
RURAL RESIDENTIAL	581	13
AGRICULTURE	27	0
PRESERVES & OPEN SPACE	1355	30
PARKS & RECREATION	256	6
EXEMPT PUBLIC PROPERTIES	397	9
TOTAL NON-URBAN	**2616**	**58**

Site Name – Sunnyslope Channel (HDM SITE 01)

Latitude 33° 58' 32.52" N

Longitude 117° 25' 34.68" W

The second site is not within District Property and is located downstream of District owned facility, North Norco Channel. This site is owned by Orange County Public Works and will require their approval.



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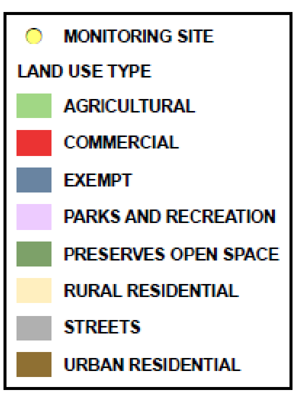

LAND USE	ACRES	LAND USE %
URBAN RESIDENTIAL	1694	36
INDUSTRIAL	45	1
COMMERCIAL	311	7
STREETS	450	10
TOTAL URBAN	**2500**	**54**
RURAL RESIDENTIAL	806	17
AGRICULTURE	25	0
PRESERVES & OPEN SPACE	272	6
PARKS & RECREATION	18	0
EXEMPT PUBLIC PROPERTIES	1109	23
TOTAL NON-URBAN	**2230**	**46**

Site Name – North Norco Channel (HDM SITE 02B)

Latitude 33° 54' 27.52" N

Longitude	117° 35' 15.85" W