June 2013

Santa Margarita Region Hydromodification Management Plan

In Compliance with Order No. R9-2010-0016, this HMP has been developed by RBF Consulting in collaboration with the Riverside County Copermittees and will be implemented within 90 days of approval by the San Diego Regional Water Quality Control Board.

DRAFT

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS

ACCCMP	Alameda Countywide Clean Water Program	OCHM	Orange County Hydrology Manual
BAHM	Bay Area Hydrology Model	PDP	Priority Development Project
BEHI	Bank Erosion Hazard Index	PLS	Pervious Land Surface
BMI	Benthic Macroinvertebrates Index	PWA	Philip Williams & Associates
BMP	Best Management Practice	S	Slope in Lane's equation
CASQA	California Stormwater Quality Association	Q or Qw	Flow
CCCWP	Contra Costa Clean Water Program	Qcrit - Qc	Critical flow
CEM	Channel Evolution Model	Qcp	Geomorphically critical flow – 10% of the 2-year flow
CEQA	California Environmental Quality Act	Qs	Sediment discharge in Lane's equation
D_{50}	Median grain size diameter	RCFCWCD	Riverside County Flood Control and Water Conservation District
Ep	Erosion potential index	RWQCB	Regional Water Quality Control Board
ET	Evapotranspiration	SCCWRP	Southern California Coastal Water Research Project
FSURMP	Fairfield-Suisun Urban Runoff Management Program	SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
GIS	Geographical Information System	SMCWPPP	San Mateo Countywide Water Pollution Prevention Program
HEC-HMS	Hydrologic Modeling System; distributed by the US Army Corps of Engineers Hydrologic Engineering Center	SMR	Santa Margarita Region
HMP	Hydromodification Management Plan	SMRHM	Santa Margarita Region Hydrology Model
HR	Hydraulic Radius	STOPPP	San Mateo County Stormwater Pollution Prevention Program
HSPF	Hydrologic Simulation Program FORTRAN, distributed by USEPA	SSMP	Standard Stormwater Mitigation Plan, also known as WQMP (Water Quality Management Plan)
IMP	Integrated Management Practices	SUSMP	Standard Urban Stormwater Mitigation Plan
LEED	Leadership in Energy and Environmental Design	SWM SWMM	Stanford Watershed Model Stormwater Management Model; distributed by USEPA
LID	Low Impact Development	SWMP	Stormwater Management Plan
LSPC	Loading Simulation Program in C++	SWWM	Stormwater Management Model
MHHW	Mean Higher High Water	TMDL	Total Maximum Daily Load
NOAA	National Oceanic and Atmospheric Administration	USACE	United States Army Corps of Engineers
NPDES	National Pollutant Discharge Elimination System	USEPA	United States Environmental Protection Agency
NRCS	Natural Resource Conservation Service	USGS	United States Geological Survey

Simplified HMP Roadmap for Practitioner

The Riverside County Flood Control and Water Conservation District in cooperation with the Copermittees continue to reduce hydromodification by mitigating increased runoff and reduce flood risk through master planning and evaluating specific projects. Additionally, The Santa Margarita Region Hydromodification Management Plan (SMR HMP) was developed by the Copermittees of the Santa Margarita Region in response to Provision F.1.h of the 2010 SMR MS4 Permit (Order R9-2010-0016). The objective of the SMR HMP is to manage increases in runoff discharge rates and durations from all Priority Development Projects (PDPs). The Permit contains specific requirements that strongly influence the methodology chosen in the development of the HMP, including the development of hydrologic and sediment supply performance standards that will ensure the geomorphic stability within a channel.

The simplified HMP roadmap guides the project proponent through the steps and the sections of the SMR HMP to be followed to:

1. Identify if the project is subject to the requirements of the HMP; and
2. When required, meet the requirements of the HMP.

A practitioner, who must meet LID and hydromodification requirements simultaneously, may refer to the 2013 SMR WQMP.

How to identify if my project is subject to the requirements of this HMP?

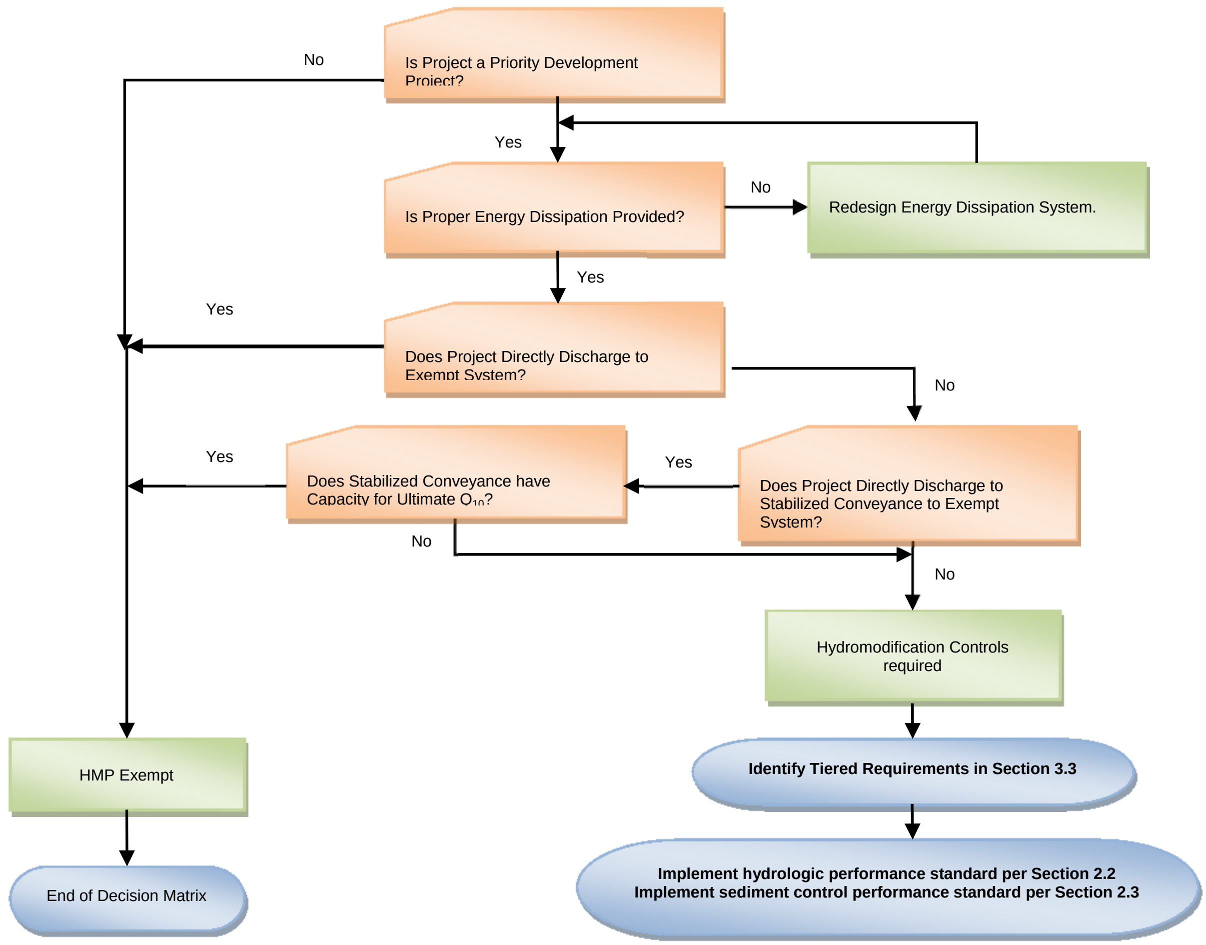
The practitioner may refer to the HMP Decision Matrix on the next page to identify if the development or redevelopment project is exempt from the requirements of the SMR HMP.

Conditions for exemption of HMP requirements must be documented by the practitioner and may only be considered by the governing Copermittee if:

- The project is not classified as Priority Development Project per Permit Provision F.1.d.;
- The proposed project discharges runoff directly to an exempt receiving water such as an exempt river reach, or an exempt reservoir. Or, if the proposed project discharges to an engineered conveyance system with the capacity to convey the 10-year ultimate condition that extends to an exempt river reach or reservoir (See **Section 3.2.i**);
- The project classifies as a watershed protection project and is not a PDP (See **Section 3.2.ii**);
- The project discharges to a large river per the definition provided in **Section 3.2.iii**; or
- The project discharges into stable receiving waters per a project-specific stream stability analysis performed by the project proponent (See **Section 3.2.iv**).
- Hydrologic and Sediment Control BMPs shall have a minimum orifice diameter of 1-inch to minimize clogging. Hydrologic and Sediment control matching that requires an orifice smaller than 1-inch will be exempted below the minimum orifice threshold (See **Section)**.
- Any BMP shall have 100% drawdown within 72 hours to accommodate vector control requirements. (See **Section i)**

If the project is non-exempt, the practitioner should identify the tier requirements that apply to the proposed project. For specific tier requirements, the practitioner may refer to **Section 3.3**. These direct the practitioner to implement, when required, hydrologic management controls and sediment supply management following the approach listed in **Section 2**.

HMP Decision Matrix



What are the HMP performance standards that PDPs must meet?

Priority project proponents shall demonstrate compliance with the overall HMP performance standard, thus demonstrate compliance with the ***hydrologic performance standard*** and the ***sediment supply performance standard***, respectively.

The hydrologic element of the performance standard consists of matching or reducing the flow duration curve of post-development conditions to that of pre-existing, naturally occurring conditions, for the range of geomorphically significant flows (10% of the 2-year runoff event up to the 10-year runoff event).[1]

The sediment source performance standard consists of maintaining the pre-project sediment bed material supply to the downstream channel reach.

PDPs are categorized per tier based on their size and type. Specific requirements are associated with each tier. The practitioner should refer to **Section 3.2** to identify the specific tier requirements.

How to meet the hydrologic element of the performance standard?

This HMP includes a tool to provide continuous simulation of peak flow rates, from 10% of the 2-year runoff event up to the 10-year runoff event for PDPs. The tool is the Santa Margarita Region Hydrology Model (SMRHM), which is an HSPF model based on the South Orange County Hydrology Model. This model allows applicants to demonstrate compliance with the HMP criteria through interactive graphic user interface. Details about how to use the model are provided in the 2013 SMRHM Guidance Document (see Appendix F).

In some situations, onsite hydrologic controls may not be feasible due to identified constraints. In this case the project proponent must investigate the feasibility of alternative options and must implement offsite hydrologic controls or instream restoration projects. The practitioner should refer to **Section 2.2** for additional information.

How to meet the sediment source performance standard?

The practitioner may follow a three-step process, as identified in **Section 2.3.,** to ensure maintenance of the pre-project sediment supply to the stream:

1. Determine whether the site is a significant source of bed material to the receiving stream.
2. Avoid significant bed material supply areas in the site design.
3. Replace significant bed material supply areas that are eliminated through urbanization.

If the three-step process is deemed infeasible, an alternative compliance option allows the project applicant to model the site conditions and the receiving stream and provide additional mitigation in site runoff to compensate for the reduction (or addition) of bed material. Specifics are detailed in **Section 2.3.ii**.

How to initiate compliance with the requirements of this HMP?

[1]Hydrologic and Sediment Control BMPs shall have a minimum orifice diameter of 1-inch. to minimize clogging. (See **Section 3.2.iv)**. Any BMP shall have 100% drawdown within 72 hours to accommodate vector control requirements. (See **Section 3.2.ivi)**

The practitioner shall integrate hydrologic management controls and sediment supply management into the project site design, and define the design specifics in the preliminary WQMP that should be submitted to the jurisdiction. The jurisdiction may approve the proposed design upon identification of compliance with the requirements of this HMP.

The practitioner may refer to the 2013 SMR WQMP at this regard.

1.0 Introduction

1.1 SMR HMP Context

Hydromodification refers to changes in the magnitude and frequency of stream flows and the associated sediment load due to urbanization or other changes in the watershed land use and hydrology. Other anthropogenic activities may include agriculture, forestry, mining, water withdrawal, climate change, and flow regulation by upstream reservoirs. Hydromodification can result in impacts on receiving channels, such as erosion, sedimentation, and potentially degradation of in-stream habitat. The degree to which a channel will erode or aggrade is a function of the increase or decrease in work (shear stress), the resistance of the channel bed and bank materials – including vegetation (critical shear stress), the change in sediment delivery, and the geomorphic condition (soil lithology) of the channel. Critical shear stress is the shear stress threshold above which motion of bed material load is initiated. Not all flows cause significant movement of bed material—only those which generate shear stress in excess of the critical shear stress of the bank and bed materials. Urbanization increases the discharge rate, amount and timing of runoff, and associated shear stress exerted on the channel by stream flows, may reduce sediment delivered to the stream, and can trigger erosion in the form of incision (channel downcutting), widening (bank erosion), or both. Flow depths that generate shear below critical shear stress levels have no effect on the channel stability.

The Riverside County Flood Control and Water Conservation District in cooperation with the Copermittees continue to reduce hydromodification by mitigating increased runoff and reduce flood risk through master planning and evaluating specific projects. Additionally, program Provision F.1.h of the Santa Margarita Region Municipal Separate Storm Sewer System (MS4) Permit (Order R9-2010-0016) issued by the San Diego California Regional Water Quality Control Board (SDRWQCB) requires that "Each Copermitee shall collaborate with the other Copermittees to develop and implement a Hydromodification Management Plan (HMP) to manage increases in runoff discharge rates and durations from all Priority Development Projects (PDPs)." Where receiving stream channels are already unstable, hydromodification management can be thought of as a method to avoid accelerating or exacerbating existing problems. Where receiving stream channels are in a state of dynamic equilibrium, hydromodification management may prevent the onset of accelerated erosion, sedimentation, lateral bank migration, or impacts to in-stream vegetation.

The Permit contains requirements that strongly influence the methodology chosen in development of the HMP. The Permit requires the Copermittees to develop an HMP for all Priority Development Projects (with certain exemptions) and develop a performance standard including a geomorphically-significant flow range that ensures the geomorphic stability within the channel. Supporting analyses must be based on continuous hydrologic simulation modeling. The loss of sediment supply due to the development must be considered.

The SMR HMP addresses the impacts of hydromodification from PDPs on the receiving waters. As identified in **Section 1.2**, other anthropogenic stressors to the receiving waters are located outside of the jurisdictional purview of the SMR Copermittees.

The SDRWQCB jurisdiction area covers the portion of Riverside County that is located within the Santa Margarita Watershed. The cities of Murrieta, Temecula, and Wildomar are wholly regulated by the SDRWQCB. Conversely, the city of Menifee is regulated by the Santa Ana RWQCB. MS4 Copermittees or dischargers directly or indirectly discharging runoff into waters of the United States within the San Diego Region include the Cities of Murrieta, Temecula, and Wildomar, as well as the County of Riverside and the Riverside County Flood Control and Water Conservation District.

The SMR HMP will serve as the technical documentation for hydromodification aspects to support the 2011 LID BMP Design Handbook and the 2013 Santa Margarita WQMP. The 2011 LID BMP Design Handbook will be updated with HMP BMPs. For BMP sizing and site planning purposes, developers and plan checkers may refer directly to the 2011 LID BMP Design Handbook and the 2013 Santa Margarita WQMP. The methodology for meeting LID and hydromodification requirements, or LID requirements alone, will be identified in these documents.

1.2 SMR History and Historical Hydromodification Impacts

The Southern California Coastal Water Research Project (SCCWRP) characterizes the Santa Margarita Hydrologic Unit as one of the largest unregulated rivers in southern California (SCCWRP, 2007). The mainstem of the Santa Margarita River begins at the confluence of Temecula Creek and Murrieta Creek, in Southern Riverside County, and flows southwest successively through Temecula Canyon, a large floodplain in Camp Pendleton Marine Corps Base, and ultimately discharges into the Pacific Ocean. The Santa Margarita Watershed drains a tributary area of 746-square miles and is physiologically split into a mountainous highland and broad, flat topped sea terrace. The boundary between the upper drainage basin and the coastal drainage basin transitions at the border between Riverside County and San Diego County. The portion of the Upper Santa Margarita River Watershed located in Riverside County is referred to as the Santa Margarita Region (SMR). Several structural and hydrologic elements of the SMR have historically impacted downstream waterbodies. The intent of this section is not to quantify these impacts, but rather to describe the existence of these historical stressors.

1.2.i State Water Project and Water Reservoirs

The Upper Santa Margarita Watershed includes two major basins, drained by Temecula and Murrieta Creeks. Over 50% of the Santa Margarita River Watershed has been controlled by the construction of Vail Dam and Skinner Reservoir in 1949 and in 1974, respectively. Vail Dam and Skinner Reservoir created significant storage capacity in the upper watershed.

In 1960, the Metropolitan Water District (MWD) contracted for additional water supplies from the State Water Project (SWP) operated by the State of California Department of Water Resources (DWR). In 1972, the SWP began bringing water from the wet climate of northern California to the dry climate of Southern California. In 1974, the 44,200 acre-feet Lake Skinner was formed by construction of a dam on Tucalota Creek. The reservoir is supplied by the Colorado River Aqueduct and the SWP, and feeds the Skinner Filtration Plant that distributes potable water to more than 2.5 million in Riverside County and San Diego County.

Vail Lake is a 49,370 acre-feet reservoir located at the confluence of Temecula Creek, Wilson Creek, and Kolb Creek. The reservoir was historically built in 1949 by the original owners of Vail Ranch to develop an irrigation system for expanding their agricultural activities. Since 1978, the reservoir has been operated by the Rancho California Water District to help replenish local groundwater.

Vail Lake and Skinner Lake are solely operated based on water supply and groundwater recharge considerations, and not for flood control purposes. The storage capacity of each reservoir induces a mitigation of peak flow rates and durations during storm events. The potential increases in flood flows resulting from development are offset by the storage effect of the reservoirs (PWA, 2004). The decrease in baseflow and increase in the severity and frequency of extremely low flow events has, however, impacted instream habitat and riparian ecosystems. Restoration of these habitats would result from the implementation of flow management strategies for the reservoirs, including the restoration of historical baseflow conditions. The SMR MS4 Copermittees do not, however, have jurisdiction over the management of the reservoirs. Secondly, the retention of surface flow and coarse sediment fluxes from Tucalota Creek and Temecula Creek may have altered the original dynamic equilibrium of downstream waterbodies.

1.2.ii Existing Surface Water and Groundwater Conditions

Murrieta and Temecula Creeks are perennial interrupted streams. Perennial flows disappear by seeping into the sands and gravels and resurfacing upstream of the confluence of Murrieta and Temecula Creeks (2007 DAMP). The creeks in the urbanized areas of the watershed, located primarily in the valley, are ephemeral and flows are observed only during and immediately after significant storm events. During major storms, after initial wetting, periods of intense rainfall result in rapid increases in streamflow in steep foothill and mountain areas. Runoff in streams in the watershed is derived primarily from rainfall, and as a result, stream flow exhibits monthly and seasonal variations similar to those shown by the precipitation records. Absence of snow pack in the tributary watershed results in a rapid decrease in stream flow at the conclusion of the winter precipitation season. Following severe storms, discharge in the larger streams often increases in a few hours from practically no flow, to a rate of thousands of cubic feet per second. Stream flows vary greatly from month to month and from season to season.

1.2.iii Historical Urbanization in the SMR

In addition to Riverside County unincorporated land, Wildomar, Temecula, and Murrieta are the only three cities that are located within the SMR. The Riverside County Drainage Area Management Plan (2007 DAMP) assumes that 92% of the SMR remained undeveloped as of 2010. Much of the remaining SMR lands will ultimately be incorporated into the Western Riverside County Multi-Species Habitat Conservation Plan (MSHCP), which requires the ongoing conservation of 500,000 acres within the County. For the average annual event, it is estimated that approximately 89% of the volume of runoff in the SMR is due to non-urban land uses not regulated under the federal stormwater program (2007 DAMP).

1.3 SMR HMP Organization

The HMP is organized in two major sections, supported with technical appendices. The first major section identifies the SMR HMP performance standards and identifies the applicable tools and measures to meet these standards. The second major section establishes specific tiered requirements for a developer, based on a classification of the development or redevelopment project and the susceptibility to hydromodification of downstream channels. The technical appendices reference the HMP development process and reporting requirements per Permit Provision F.1.h.(5), provide a literature review of the state of the hydromodification science per Permit Provisions F.1.h.(1)(g) and F.1.h(1)(k), and incorporate the findings of HMP studies performed to classify stream segments per susceptibility category. The HMP also is required to identify opportunities for stream restoration or rehabilitation per Permit provisions F.1.h(1)(a) and F.1.h(1)(h), respectively.

It should be noted that this HMP has in large part been based on the San Diego HMP, which was developed by the County of San Diego and the Copermittees for San Diego County and the South Orange County HMP developed by the County of Orange and the Copermittees for South Orange County. The San Diego HMP was approved by the San Diego Regional Board and served as the starting point for development of the SMR HMP. The South Orange County HMP is awaiting approval from the SDRWQCB.

2.0 Santa Margarita HMP Criteria and Performance Standards

The objective of this section is to identify the specific HMP criteria and performance standards for hydromodification to be implemented in the SMR. PDPs are required to implement hydrologic control measures and onsite management controls so that post-project runoff flow rates and durations do not exceed pre-development, i.e. naturally occurring conditions, flow rates and durations where they would result in an increased potential for erosion or significant impacts to beneficial uses (Permit Section F.1.h.). The purpose of this chapter is to identify the HMP criteria, detail the HMP applicability requirements, and provide a framework for alternative compliance.

2.1 HMP Criteria and Performance Standards

The HMP criteria are designed to manage increases in runoff discharge rates and durations from PDPs. The HMP criteria include the following:

- All PDPs must use continuous simulation to ensure that post-project runoff flow rates and durations for the PDP shall not exceed pre-development, naturally occurring, runoff flow rates and durations by more than 10% over more than 10% the length of the flow duration curve, from 10% of the 2-year runoff event up to the 10-year runoff event.

This HMP includes a tool to provide continuous simulation of peak flow rates, from 10% of the 2-year runoff event up to the 10-year runoff event for PDPs. The tool is the Santa Margarita Region Hydrology Model (SMRHM), which is an HSPF model based on the South Orange County Hydrology Model. This model allows applicants to demonstrate compliance with the HMP criteria through interactive graphic user interface. Details about how to use the model are provided in the 2013 SMRHM Guidance Document.

Demonstration of flow duration matching for the range of geomorphically-significant flows constitutes conformance with the hydrologic element of the performance standard of this HMP. The second element of the HMP performance standard is the approximate maintenance of pre-project sediment bed material supply. The general approach that a project proponent shall follow to demonstrate compliance with the sediment source performance standard is described in **Section 2.3**.

Priority project proponents shall demonstrate compliance with the hydrologic performance standard and the sediment supply performance standard.[2] Compliance with these standards constitutes compliance with the overall performance standard for the HMP.

---

[2] Hydrologic and Sediment Control BMPs shall have a minimum orifice diameter of 1-inch. to minimize clogging. (See **Section 3.2.iv)**. Any BMP shall have 100% drawdown within 72 hours to accommodate vector control requirements. (See **Section 3.2.ivi)**

As demonstrated in **Appendix B**, the lower flow threshold ($0.1Q_2$) satisfies Section F.1.h.(1)(b) in that it corresponds with the critical channel flow that produces the critical shear stress that initiates channel bed movement or that erodes the toe of channel banks of a soft-bottomed channel.

The project proponent may put forth other low flow thresholds for individual projects, but other low flow thresholds will require site-specific justification, at the developer's expense, using modeling or field tests to support the unique threshold value. For those PDPs that chose to perform a site-specific analysis, the selected lower flow threshold must also ensure that it meets the requirements of Section F.1.h.(1)(b) of the Permit, i.e. the selected lower flow threshold shall correspond to the critical channel flow that produces the critical shear stress that initiates channel bed movement or that erodes the toe of channel banks. For a channel segment that is lined but not exempt by this HMP, the low flow threshold must be computed based on a comparable natural channel. Guidelines on how to develop a site-specific low flow threshold are provided in Appendix I.

The HMP performance standard is also applicable to those priority projects that are unable to implement flow duration controls onsite but seek compliance through offsite mitigation projects. The mitigation project must be capable of matching or reducing the equivalent flow duration curves from the project development.

This HMP offers an alternate hydrologic performance standard to those priority projects that are unable to implement flow duration matching onsite and offsite, only if the infeasibility is demonstrated and documented to the governing Copermittee. The alternative performance standard consists of implementing restoration projects that will ensure the channel stability and restore beneficial uses. The performance equivalency of a restoration project shall be demonstrated to the governing Copermittee.

Priority Development Projects that fail to meet the dual performance standard or do not qualify for the alternate performance standard are required to redesign the project.

2.2 Meeting the Hydrologic Performance Standard

PDPs are encouraged to use the full suite of hydrologic management measures available to meet the HMP criteria identified in **Section 2.2**. The intent of the HMP is not to specify the types of hydrologic control measures that can be used but rather identify the criteria that must be met, allowing flexibility for PDPs to use the full suite of management measures to meet the HMP criteria. The 2011 LID BMP Design Handbook provides information not only on hydromodification control design, but also on BMP[3] design to meet the combined LID and hydromodification requirements. The handbook will specify the type of BMPs that can be used

[3] Hydrologic and Sediment Control BMPs shall have a minimum orifice diameter of 1-inch to minimize clogging. (See **Section 3.2v**) Any BMP shall have 100% drawdown within 72 hours to accommodate vector control requirements. (See **Section 3.2.vi**)

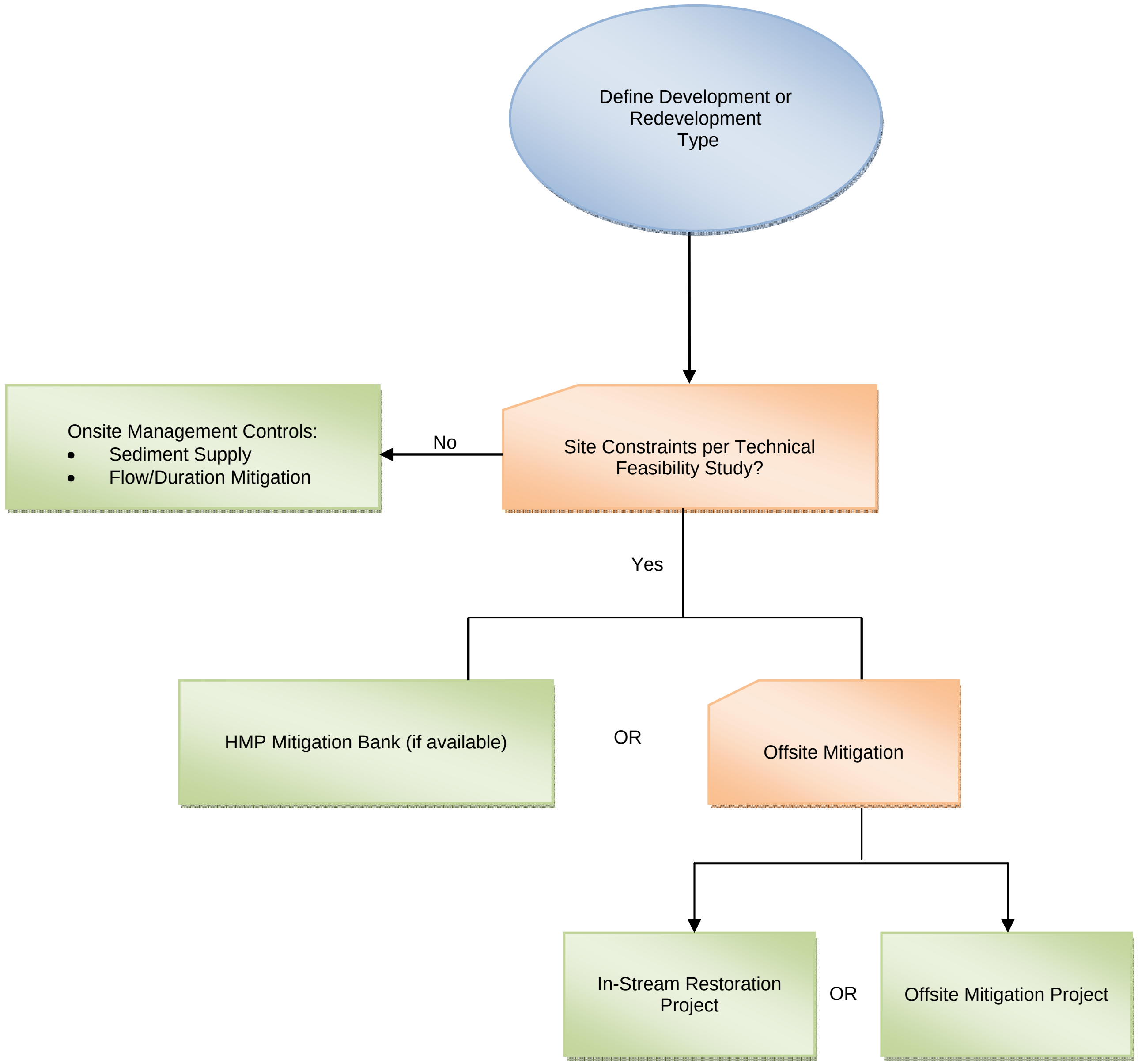
to meet hydromodification standards. The SMRHM includes BMPs that can be used to meet the HMP criteria and has been developed as the primary tool to select and size the appropriate hydrologic site design and BMP controls to meet not only the HMP criteria, but also LID requirements. The model also incorporates buffer zones as a management measure for those PDPs adjacent to stream channels.

For some PDPs, implementation of onsite hydromodification controls consistent with the HMP may not be feasible due to site constraints. There are two alternative compliance options for PDPs that cannot implement onsite hydromodification controls:

- Identify and construct offsite mitigation;
- Pay into an HMP mitigation bank, if an HMP mitigation bank is available to the PDP.

The decision matrix that applicants should follow to meet the hydrologic performance standard is summarized in **Figure 1**.

Figure 1 - Hydrologic Performance Standard – Decision Matrix



2.2.i Continuous Simulation Modeling

Introduction to the Santa Margarita Region Hydrology Model

Permit Provision F.1.h.(1)(b) identifies that the hydrologic element of the performance standard should be demonstrated based on continuous hydrologic simulation over the entire available rainfall record. As part of the HMP development, an integrated flow control sizing tool, SMRHM, has been prepared. The SMRHM has been developed to help applicants comply with hydromodification requirements. This modeling approach is different from Riverside County's calibrated rainfall-runoff procedures and criteria for drainage design, flood control design, and mitigation purposes. HMP requirements from the Regional Board are separate from Riverside County's requirement for mitigation within the drainage system for development effects on runoff per the Riverside County Flood Control and Water Conservation District Hydrology Manual. Specific evaluation criteria were developed for the design and analysis of hydromodification controls using continuous simulation hydrologic modeling.

Continuous simulation modeling uses an extended time series of recorded precipitation data as input and generates hydrologic output, such as surface runoff, infiltration, and evapotranspiration, for each model time step. Continuous hydrologic models are typically run using either 1-hour or 15-minute time steps. Based on a review of available rainfall records in the Santa Margarita Region of Riverside County, the SMRHM will use 15-minute time series of rainfall data. Continuous models generate model output for each time step. In this case, hydrologic output is generated at each time step (15 minutes) of the continuous model.

Use of the continuous modeling approach allows for the estimation of the frequency and duration by which flows exceed the lower flow threshold (adopted as 10% of the 2-year flow for this plan). The limitations to increases of the frequency and duration of flows within that geomorphically significant flow range represent the key component to the SMR approach to hydromodification management.

The SMRHM, along with a SMRHM Guidance Document explaining how to operate the model, is made available to all project proponents at no cost. The SMRHM is the only software that is approved by the District and the Copermittees. However, the project proponent may opt to develop its own model using publicly-available software, which performs continuous hydrologic simulations over the available period of rainfall record (over 30 years). The use of a different model than the SMRHM is subject to prior approval by the governing Copermittee. The following public domain software models may be used:

- Hydrologic Simulation Program – FORTRAN (HSPF), distributed by U.S. EPA
- Hydrologic Engineering Center – Hydrologic Modeling System (HEC-HMS), distributed by the U.S. Army Corps of Engineers Hydrologic Engineering Center
- Stormwater Management Model (SWMM); distributed by U.S. EPA

Peak Flow and Duration Statistics

To assess the effectiveness of stormwater flow control devices to meet the hydromodification criteria, peak flow frequency statistics are required. Peak flow frequency statistics estimate how often flow rates exceed a given threshold. In this case, the key peak flow frequency values are the lower and upper bounds of the geomorphically significant flow range. Peak flow frequency statistics can be developed using either a partial-duration or peak annual series. Partial-duration series frequency calculations consider multiple storm events in a given year while the peak annual series considers just the peak annual storm event.

Flow duration statistics are also summarized to determine how often a particular flow rate is exceeded. To determine if a stormwater facility meets the hydromodification criteria, peak flow frequency and flow duration curves are generated for the pre-development (naturally occurring) condition and the post-project condition. Both pre-development and post-project simulation runs are extended for the entire length of the rainfall record.

The need for partial-duration statistics is more pronounced for control standards based on more frequent return intervals (such as the 2-year runoff event), since the peak annual series does not perform as well in the estimation of such events due to limited data sets. This problem is especially pronounced in the SMRs semi-arid climate. After a review of supporting literature, the use of a partial-duration series is recommended for semi-arid climates similar to Riverside County, where prolonged dry periods can skew peak flow frequency results determined by a peak annual series for more frequent runoff events.

For the statistical analysis of the rainfall record, partial duration series events have been separated into discrete unrelated rainfall events assuming the following criteria.

1. A minimum interval of 24 hours between peaks is applied to capture those peaks generated from back-to-back storms.
2. The Weibull plotting method is used to rank the selected peaks as the method was specifically developed for California-based streams, where wet-weather and dry-weather years produce two populations of flood events.

Rainfall Data

The SMRHM integrates local rainfall data to design stormwater flow control devices. To provide for clear climatic designation between the Temecula valley, the western plateau, the northern valley, and the eastern slopes of the SMR, historical records for a series of three rainfall data stations located within or in close proximity to the SMR were compiled, formatted, modulated, and quality controlled for analysis.

Long-term rainfall records of 15-minute intervals have been prepared and made available by the District for these three rainfall stations. The District operates and maintains several rainfall stations, which feed into the Riverside County Automated Local Evaluation in Real Time (ALERT) telemetry system rain gauges, the California Climatic Data Archive, National Oceanic and Atmospheric Administration (NOAA), the National Climatic Data Center, and the Western

Regional Climate Center. For the selected three stations, the length of the overall rainfall station record is a minimum of 37 years.

Gauge selection was further governed by minimum continuous simulation modeling requirements, including the following:

- The selected precipitation gauge data set should exhibit similar meteorological and rainfall trends, especially in terms of intensity and total precipitation depth, to ensure that long-term rainfall records are similar to the anticipated rainfall patterns for the site. When available, gauges were selected near areas planned for future development and redevelopment.
- Reporting frequency for the gauge data set should be at least hourly, if not at a 15-minute interval. Most of the rainfall stations operated by the District report precipitation in real-time.
- The gauge rainfall data set should extend for the entire length of the record, with a minimum of 37 years.
- Use of the most applicable long-term rainfall gauge data, along with regional scaling of rainfall patterns from a reference station, is required to account for the diverse rainfall patterns across the SMR area.

Four meteorological zones were identified and delineated from the rainfall patterns observed from NOAA Atlas 14 precipitation-frequency maps, isohyetal maps from the Riverside County Hydrology Manual (1978), and the professional knowledge of the District's Hydrologic Data Collection Section. Only three precipitation stations were identified as viable for the purpose of continuous simulation because of the available length of precipitation records. Out of the three stations, only one station (Temecula, ID#217) is located within the SMR area; the two other stations, Elsinore (ID#067) and San Jacinto (ID#186), are located in close proximity to the watershed. The four meteorological zones are: the Western Plateau covering the Santa Rosa Plateau area, the Temecula Valley, the Wildomar/North Murrieta area, and the Eastern Slopes covering the eastern part of the watershed. For each meteorological zone, a correction factor, which accounts for the variations in depths and intensity observed on the isohyetal maps, is applied independently to the associated precipitation records. The location of the three selected raingage stations and the delineation of the four meteorological zones are shown in **Figure 2**.

Table 1 lists the meteorological zones and the associated rainfall stations. In addition, the period of available record is presented.

Table 1 - SMR Meteorological Zones & Associated Rainfall Stations

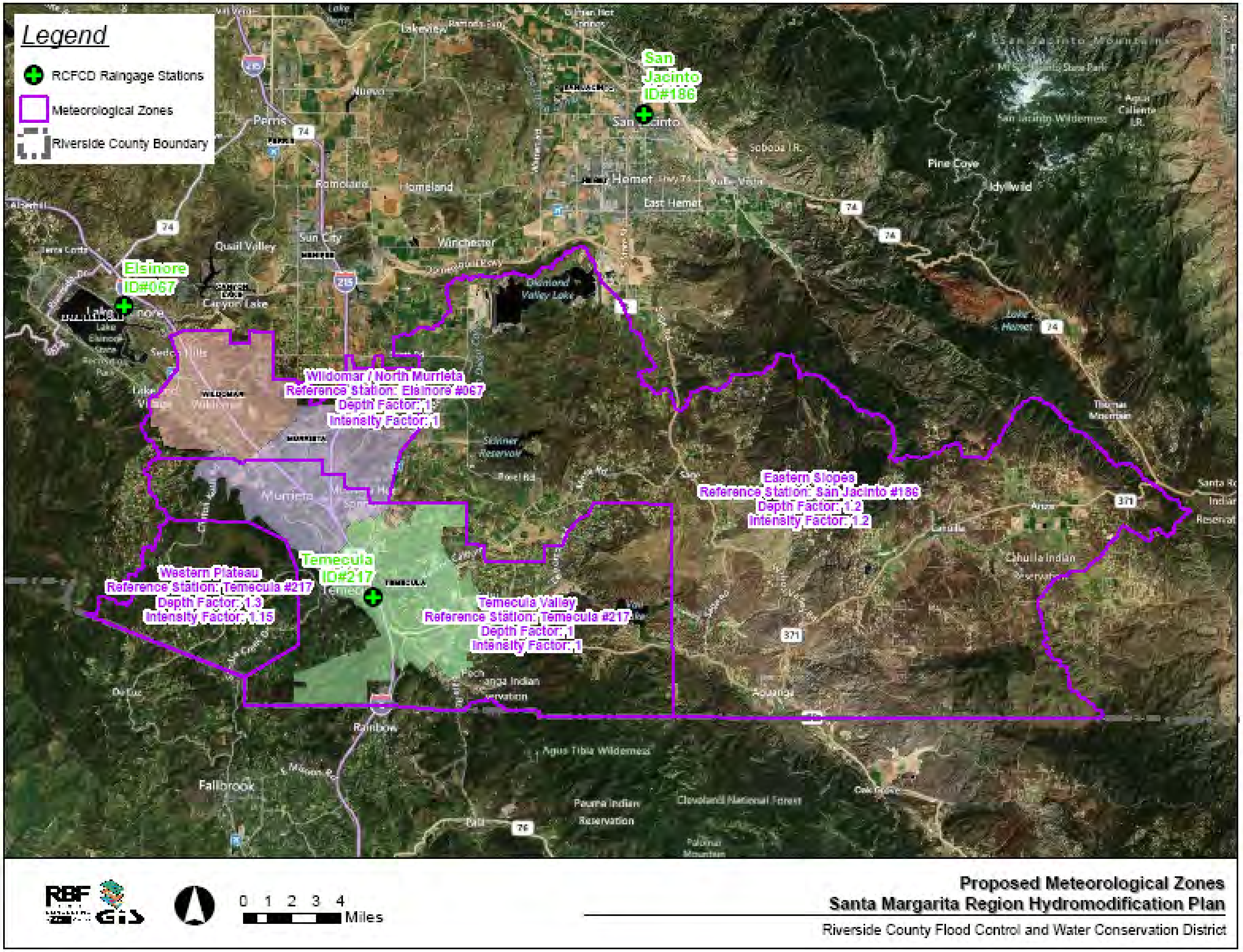
Meteorological Zone	Station	15-minute data span
Western Plateau	Temecula (ID#217)	January 1974 – July 2012
Wildomar/North Murrieta	Elsinore (ID#067)	January 1940 – July 2012
Temecula Valley	Temecula (ID#217)	January 1974 – July 2012
Eastern Slopes	San Jacinto (ID#186)	January 1940 – July 2012

All the presented factors have been considered in the selection of the appropriate rainfall data set before inclusion into the SMRHM. For a given project location, an applicant should refer to the rainfall station map shown in **Figure 2** and identify the meteorological zone where the proposed project is located. The meteorological zones are integrated in the SMRHM and the appropriate raingage station will be automatically selected by the model upon pinpointing the location on the model's map.

If desirable, the applicant is allowed to design a project-specific continuous simulation model and shall comply with the factors and precipitation zones presented in this section when selecting the associated raingage station.

A rainfall station map associated with this HMP is presented in **Figure 2** for public use. Where possible, rainfall data sets located in the same meteorological zone as the project should be selected.

Figure 2 - Precipitation Zones and Rainfall Stations for the Santa Margarita Region



Evapotranspiration Parameters

Standards developed as part of this HMP to control runoff peak flows and durations are based on a continuous simulation of rainfall runoff using locally derived parameters for evaporation and evapotranspiration. Known data sources for potential evapotranspiration data in proximity to the SMR area are listed below.

Historical potential evapotranspiration at Elsinore station (CA042805) is considered to best represent the evapotranspiration conditions within the SMR area of Riverside County.

Other gauging stations that record potential evapotranspiration were not selected because the period of record did not match with that of the precipitation station, or the local meteorological patterns are not representative of those observed in the SMR area. The potential evapotranspiration will be coupled with historical records of temperature to determine the actual daily evapotranspiration. **Table 2** summarizes available sources for potential evapotranspiration in the SMR area.

Table 2 - Available Evapotranspiration Sources

Station Name ID	Data Type	Data Source	Recording Frequency	Hourly data span
Elsinore (CA042805)	Potential Evapotranspiration	BASIN	Hourly	August 1948 – November 2005

Long-term evaporation / evapotranspiration data sets are being generated to correspond with long-term rainfall records. The final selection of rainfall loss parameters and evaporation data is part of the SMRHM development process.

In summary, the published literature reviewed as part of this study support the methods and approach taken in developing the SMR HMP.

2.2.ii Identification of naturally-occurring conditions

Permit language of Section F.1.h.(d) requires that estimated post-project runoff discharge rates and durations shall not exceed pre-development (naturally occurring) discharge rates and durations. Compliance with the Permit requirement should be based on the results of continuous simulation and the use of the SMRHM or an approved equivalent model. As part of developing the supporting hydrology model for a development or redevelopment project, a project proponent shall identify and document, using professional knowledge, pre-development (naturally occurring) conditions in terms of geology, topography, soils, and vegetation.

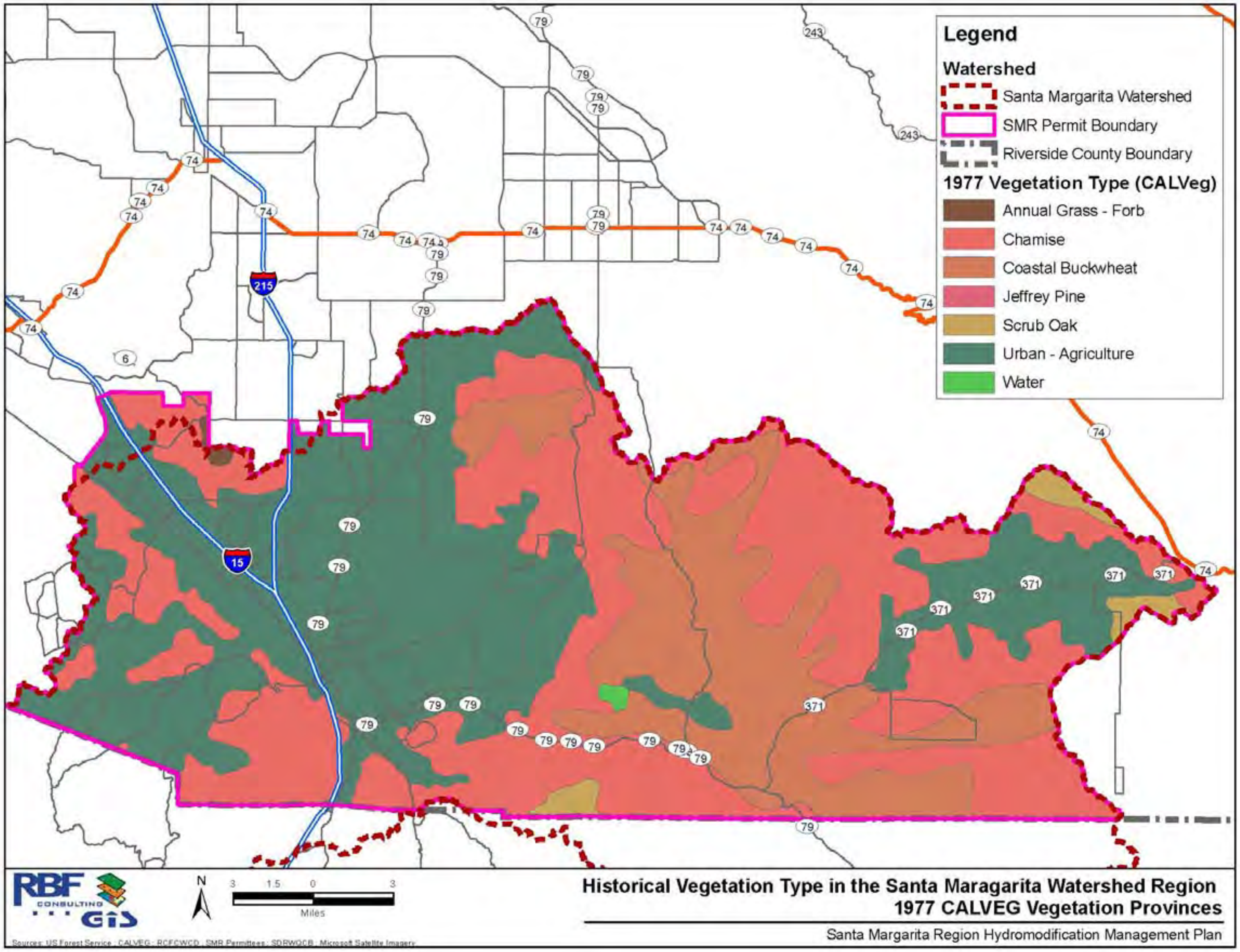
Several publicly-available information sources may help the developer characterize pre-development conditions, including:

- Soil database (#678, #679, and #680) from the Natural Resources Conservation Service (NRCS). Among the parameters of interest, the database identifies the type, the original range of observed topographic slopes, the soil erosion factor K, and, if available, plant community information for the native or pre-development soil. The database is accessible through the Web Soil Survey page (http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm).

- Vegetation and ecoregional GIS information listed by the U.S. Forest Services. The EPA Ecoregion database information locates the SMR in the Southern California Mountains and Valleys Ecoregion and references the climate of humid and temperate Mediterranean type. The EPA Ecoregion database identifies also the vegetation province of the SMR within the California Coastal Range Open Woodland-Shrub-Coniferous Forest-Meadow province. A historical CALVEG GIS vegetation layer is available for the year 1977 (USFS, 2000). The historical vegetation layer reveals a majority of evergreen chaparral shrub and scrub oak within the watershed. For those areas located within the Urban Land and Agriculture vegetation area, the developer may select the shrub vegetation for pre-development, naturally occurring, conditions. **Figure 3** delineates the distribution of historical vegetation types in the Santa Margarita Region. GIS-based layers are available on the USFS website (http://www.fs.usda.gov/detail/r5/landmanagement/gis/).

- Other historical USGS topographic maps and aerials of Riverside County, specifically of the SMR area, are publicly available from the USGS website.

Figure 3 - Historical Vegetation and Ecoregions in the Santa Margarita Region



2.2.iii Hydrologic Management Measures

As identified in Section 2.2.i. PDPs are encouraged to use the full suite of hydrologic management measures available to meet the hydrologic mitigation criteria. The intent of the HMP is not to specify the types of hydrologic control measures that can be used but rather identify the criteria that must be met.

Selection and design of hydrologic management measures is an iterative process that can be facilitated using the SMRHM. The SMRHM has a comprehensive menu of hydrologic site design measures and hydrologic management measures that can be selected for implementation for PDPs. The design parameters for these hydrologic measures have been incorporated into the model and can be modified to an extent based on site constraints. The applicant is invited to refer to the SMRHM Guidance Document that is referenced in **Appendix G** for SMRHM specific questions.

Maintenance for hydrologic control measures is critical to ensure their optimal operation. PDPs are conditioned to provide verification of inspections and maintenance operations as defined in Section H of the SMR WQMP Project-Specific Template that must be completed in its entirety prior to the issuance of a grading permit. The list of such inspections and maintenance operations shall be included in the WQMP submitted by the applicant. Maintenance activities shall ensure that the systems are functioning as designed.

2.2.iv Alternative Compliance Approach

Riverside County Flood Control and Water Conservation District in cooperation with the Copermittees reduce hydromodification by mitigating increased runoff and reduce flood risk through master planning and evaluating specific projects. The following compliance approach will require coordination with the appropriate Copermittees. For some PDPs, implementation of onsite hydromodification controls consistent with the HMP may not be feasible due to site constraints. These projects require alternatives to onsite hydromodification controls. There are two alternative compliance options for PDPs that cannot implement onsite hydromodification controls. One option is for a PDP proponent to identify and construct offsite mitigation. The other option is for the PDP proponent to pay into an HMP mitigation bank, if an HMP mitigation bank option is available to the PDP.

HMP Alternative Compliance Option 1: Offsite Mitigation

A progression through a defined process is required to document eligibility then implementation of alternative compliance for the HMP. Offsite mitigation is based on completing a series of steps to meet compliance that is consistent with Section F.1.h.(3) of the MS4 Permit. These steps include the following:

1. Technical feasibility study of onsite hydromodification controls; and
2. Offsite mitigation project within the same hydrologic unit as the PDP or in-stream restoration of the receiving water of the PDP.

Step 1: Conduct a technical feasibility study for onsite hydromodification controls

A technical feasibility study is required to identify why onsite hydromodification controls cannot be incorporated into the project. The technical feasibility study must include the project constraints and provide detailed technical justification as to why the project constraints prevent implementation of onsite controls. The technical feasibility study will be submitted to the jurisdiction of the location of the PDP for review as part of the Preliminary Project-Specific WQMP. The jurisdiction must approve the technical feasibility before the PDP moves on to Step 2.

Guidance on the hydromodification technical feasibility study will be incorporated into the 2013 SMR WQMP Template and the associated RCFCWCD 2011 LID BMP Design Handbook. The hydromodification technical feasibility study will be integrated with the LID feasibility analysis; however, it should be noted that the criteria for hydromodification and LID requirements are different. The feasibility analysis for both hydromodification and LID will be integrated into one feasibility study for the project and submitted with the Preliminary Project-Specific WQMP.

Step 2: Implement offsite mitigation within the same stream channel system as the PDP (2a) or implement in-stream restoration of the PDP receiving water (2b)

For those PDPs where the technical feasibility study for onsite controls has been approved by the jurisdiction, step 2 for the PDP is to either (a) implement an offsite mitigation project within the same stream channel system as the PDP, or (b) implement an in-stream restoration project for the receiving water of the PDP. The process for these options under Step 2 is detailed below:

HMP Alternative Compliance Option 1 – Step 2a: Implement Offsite Mitigation within the same Stream Channel System as the PDP

In choosing this option, the PDP must investigate potential locations for implementation of an offsite mitigation project within the same stream channel system as the PDP. If the project proponent demonstrates that an offsite mitigation project is not feasible in the same stream channel system as the PDP then an offsite mitigation project in the same hydrologic unit as the PDP may be approved. The offsite mitigation project must mitigate the incremental impact from not achieving the pre-development (naturally occurring) runoff flow rates and durations for the project site. Sizing of offsite mitigation controls may be accomplished using the SMRHM. The PDP will evaluate and identify potential sites in the same stream channel system, and if not feasible, then evaluate projects in the same hydrologic unit for implementation of an offsite hydromodification project that has the capacity to mitigate the PDPs hydromodification requirements. If an adequate site is identified by the PDP in the same stream channel system, the PDP will submit a report detailing:

- That the offsite mitigation project mitigates the incremental impact from not achieving the pre-development (naturally occurring) runoff flow rates and durations for the project site;
- Conceptual plans for the offsite mitigation project as part of an amended WQMP for review and approval;
- If the project is a redevelopment project, that the post-project runoff flow rates and durations do not exceed pre-project runoff flow rates and durations; and
- If no potential offsite mitigation project sites are identified in the same stream channel system the PDP, that there is an offsite mitigation project in the same hydrologic unit.

If no potential offsite mitigation project sites are identified in the same hydrologic unit as the PDP, the PDP must implement Option 2(b), an in-stream restoration project of the PDP receiving water.

HMP Alternative Compliance Option 1 – Step 2b: Implement In-stream Restoration of the PDP Receiving Water

In choosing this option, the PDP investigates the potential for implementation of an in-stream restoration project for the receiving water of the project. It must be determined that the receiving water for the project has hydromodification impacts. The in-stream restoration project must be located in the receiving water of the PDP. The PDP must submit a report detailing the condition of the receiving water due to hydromodification, as well as conceptual plans for the in-stream restoration project to the PDPs jurisdiction for review. The Copermittee is responsible for ensuring that the level of restoration is adequate given the impacts of the PDP. Copermittees will establish individual processes consistent with their ministerial approval procedures to ensure that the applicant's obligations under the HMP alternative compliance process are completed prior to project approval.

Pursuant to Permit Provision F.1.h(1)(h) and as part of this HMP effort, opportunities for restoration or rehabilitation were identified in the SMR based on a desktop survey. Prior to considering an in-stream project, the developer shall investigate the list of available opportunities for restoration that is found in **Appendix D**.

Once the project conceptual plans have been approved by the PDPs jurisdiction, the PDP must submit the appropriate permit applications to the appropriate regulatory agencies (e.g., Regional Board, California Department of Fish and Wildlife, U.S. Army Corps of Engineers) for review and approval. If the PDP identifies no opportunities for in-stream restoration in the receiving water that the PDP discharges to, then the PDP must implement Option 2(a), an offsite mitigation project within the same hydrologic unit as the PDP.

HMP Alternative Compliance Option 2: HMP Mitigation Bank Alternative Compliance Option

(Note: Option 2(c) is available only if an HMP mitigation bank has been developed and is available to the PDP.)

The County and the Copermittees have the option to develop an HMP mitigation bank or multiple HMP mitigation banks. A mitigation bank will develop regional HMP mitigation projects where PDPs can buy HMP mitigation credits if it is determined that implementing onsite hydromodification controls is infeasible. The development and operation of an HMP mitigation bank will include the identification of potential regional HMP mitigation projects; the planning, design, permitting, construction, and maintenance of regional HMP mitigation projects; the development of a fee structure for PDPs participating in the mitigation bank; and managing the HMP mitigation bank fund. Regional HMP mitigation projects can also serve as projects for an LID waiver program if site conditions allow for implementation of LID-type projects.

If PDPs are unable to meet the HMP criteria by incorporating onsite hydromodification controls, and a HMP mitigation bank is available, the PDP can apply to participate in the bank. The application must include a technical feasibility study to identify why onsite hydromodification controls cannot be incorporated into the project. The technical feasibility study must include the project constraints and detailed technical justification as to why the project constraints prevent implementation of onsite controls. The technical feasibility study will be submitted to the jurisdiction where the PDP is located for review as part of the Preliminary Project-Specific WQMP. The jurisdiction must approve the technical feasibility study for the PDP to participate in a HMP mitigation bank.

If in-stream restoration projects are considered, the governing Copermittee(s) shall primarily consider the list of available opportunities for restoration that is found in Appendix D. The list of opportunities for restoration or rehabilitation was developed as a response to Permit Provision F.1.h(1)(h).

2.3 Meeting the Sediment Control Performance Standard

Sediment supply plays a role in the stability of alluvial stream channels. As identified in **Appendix B**, a change in coarse (bed material) sediment supply will cause instability in the channel manifested through general scour or aggradation. Lateral bank migration may also result from changes in sediment supply as the channel slope increases or decreases.

The delivery of bed material during construction may increase as land surface is cleared and the potential for erosion is increased. Once the land surface is urbanized, the potential for bed material transport may be reduced as compared to the pre-development condition. The purpose of this portion of the HMP[4] is to maintain the pre-development delivery of bed material to receiving streams following urbanization. Bed material is defined as the portion of sediment that comprises the bed and banks of the receiving stream. Bed material load consists of the bed

[4] Hydrologic and Sediment Control BMPs shall have a minimum orifice diameter of 1-inch to minimize clogging. (See **Section 3.2v**) Any BMP shall have 100% drawdown within 72 hours to accommodate vector control requirements. (See Section **3.2.ivi**)

load (material that moves along the bed by sliding or saltating) and part of the suspended load, including particle size fractions in the channel bed sediments. Bed material load is a primary variable controlling stream channel morphology. Wash load is the portion of the total sediment load carried continuously in suspension by the flow, and generally consists of the finest particles. Changes in wash load are not likely to significantly affect the channel stability, and reductions in wash load are generally assumed to improve habitat function.

The resiliency of receiving channels to forestall changes due to urbanization varies with the magnitude of the change and characteristics of the channel (bed and bank material, vegetation, channel cross-section and slope). It is difficult to quantitatively predict the response in a receiving channel to changes in the fundamental variables described by Lane (1955) of discharge, bed material grain size, channel slope and sediment supply. Accordingly, the most effective approach to ensuring channel stability may be to avoid changes in the fundamental variables (Lane's interrelationship) during urbanization through the implementation of stream channel management guidelines. In the case of bed material sediment supply, this will be accomplished by avoiding development in areas that are a significant contributor of bed material load to the receiving channel.

The general approach to ensure maintenance of the pre-project sediment supply is a three-step process:

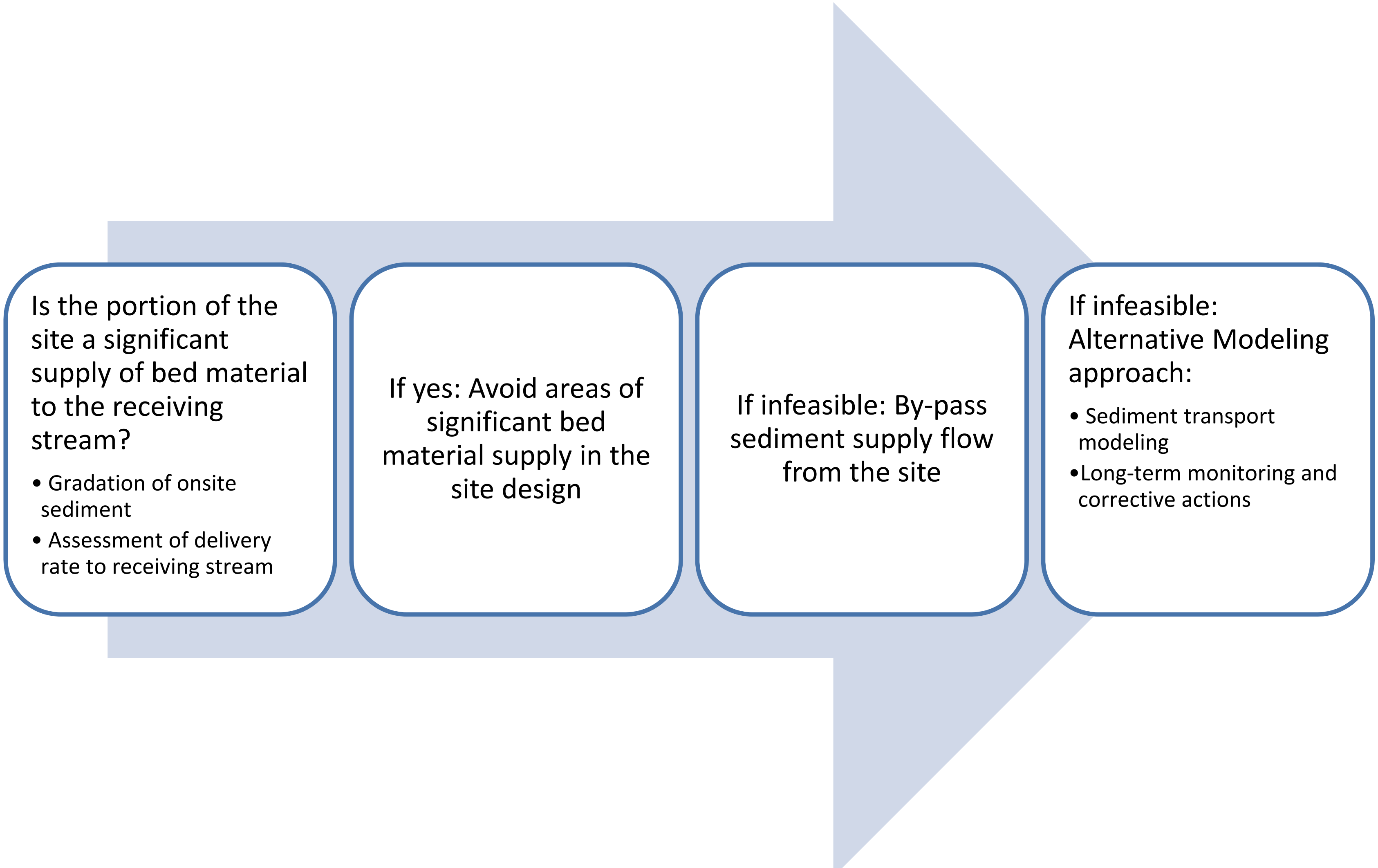
1. Determine whether the portion of the site is a significant source of bed material to the receiving stream.
2. Avoid significant bed material supply areas in the site design.
3. Site-specific alternative compliance measures.

In the event of a projected reduction in sediment supply, the project proponent shall investigate the feasibility of sediment management measures, including bypassing coarse bed sediments from source areas onsite, otherwise maintaining pre-project bed material discharge from the site, or providing additional mitigation in site runoff to accommodate the reduced bed material load. Specific guidance on sediment management measures will be provided in the 2013 SMR Project-Specific WQMP Template.

An alternative compliance option allows the project applicant to model the site conditions and the receiving stream and provide additional mitigation in site runoff to compensate for the reduction (or addition) of bed material. This option may only be used if the general approach outlined above is deemed infeasible by the permitting authority, or if the project site design requires significant alteration of onsite streams.

The stepwise approach that developers should follow to meet the sediment control performance standard is summarized in **Figure 4**.

Figure 4 - Sediment Control Performance Standard – Stepwise Approach



2.3.i Three-Step Process

The project applicant must determine the location of the downstream alluvial receiving water that may be impacted by the project. The first downstream conveyance that is unlined (invert, side slopes or both) will serve as the "assessment" or "receiving" stream for the project. The following methodology will be used to ensure that the project does not adversely impact bed material load to the assessment stream.

Step 1: Determine whether the Portion of the Site is a Significant Source of Bed Material to the Receiving Stream

A triad approach will be completed to determine whether the site is a significant source of bed material to the receiving stream and includes the following components:

A. Site soil assessment, including an analysis and comparison of the bed material in the receiving stream and the onsite streams;
B. Determination of the capability of the onsite streams to deliver the site bed material (if present) to the receiving stream; and
C. Present and potential future condition of the receiving stream.

Prior to performing a site-specific triad assessment, the designer should refer to the macro-scale findings of the HRU/GLU Analysis performed as part of the SMR Hydromodification Susceptibility Study (**Appendix D**). The HRU/GLU Analysis will provide the designer with critical geomorphic information for the watershed where the project is located, including the impacts of existing imperviousness on the hydrologic cycle and the potential for sediment production.

A. Site soil assessment, including an analysis and comparison of the bed material in the receiving stream and the onsite streams

A geotechnical and sieve analysis is the first piece of information to be used in a triad approach to determine if the site is a significant source of bed material load to the assessment stream. An investigation shall be completed of the assessment stream to complete a sieve analysis of the bed material. Two samples shall be taken of the assessment stream using the "reach" approach (TS13A, 2007). Samples in each of the two locations should be taken using the surface and subsurface bulk sample technique (TS13A, 2007) for a total of four samples. Pebble counts may be required for some streams.

A similar sampling assessment should be conducted on the project site. First-order and greater streams that will be impacted by the project (drainage area changed, stabilized, lined or replaced with underground conduits) will be analyzed in each subwatershed. First-order streams are identified as the unbranched channels that drain from headwater areas and develop in the uppermost topographic depressions, where two or more contour crenulations (notches or indentations) align and point upslope (NEH, 2007). First-order streams may, in fact, be field ditches, gullies, or ephemeral gullies (NEH, 2007). One stream per subwatershed that will be impacted on the site must be assessed. A subwatershed is defined as tributary to a single discharge point at the project property boundary.

The sieve analysis should report the coarsest 90% (by weight) of the material for comparison between the site and the assessment stream. The Professional Engineer shall render an opinion if the material found on the site is of similar gradation to the material found in the receiving stream. The opinion will be based on the following information:

- Sieve analysis results
- Soil erodibility (K) factor
- Topographic relief of the project area
- Lithology of the soils on the project site

The Professional Engineer shall rate the site as having either a high, medium, or low probability of supplying bed material load to the receiving stream consistent with Figures 4 through 6 of the Hydromodification Susceptibility Report and Mapping: SMR (See **Appendix D**). This site soil assessment serves as the first piece of information for the triad approach.

B. Determination of the capability of the onsite streams to deliver the site bed material (if present) to the receiving stream.

The second piece of information is to qualitatively assess the sediment delivery potential of the site streams to deliver the bed material load to the receiving stream, or the bed material sediment delivery potential or ratio. There are few documented procedures to estimate the sediment delivery ratio (see: Williams, J. R., 1977: Sediment delivery ratios determined with sediment and runoff models. IAHS Publication (122): 168-179, as an example); it is affected by a number of factors, including the sediment source, proximity to the receiving stream, onsite channel density, project watershed area, slope, length, land use and land cover, and rainfall intensity. The Professional Engineer will qualitatively assess the bed material sediment delivery potential and rate the potential as high, medium, or low.

C. Present and potential future condition of the receiving stream.

The final piece of information is the present and potential future condition of the receiving stream. The Professional Engineer shall assess the receiving stream for the following:

- Bank stability - Receiving streams with unstable banks may be more sensitive to changes in bed material load.
- Degree of incision - Receiving streams with moderate to high incision may be more sensitive to changes in bed material load.
- Bed material gradation - Receiving streams with more coarse bed material (such as gravel) are better able to buffer change in bed material load as compared to beds with finer gradation of bed material (sand).

- Transport vs. supply limited streams. Receiving streams that are transport limited may be better able to buffer changes in bed material load as compared to streams that are supply limited.

The Professional Engineer will qualitatively assess the receiving stream using the gathered observations and rate the potential for adverse response based on a change in bed material load as high, medium, or low.

In addition to the findings of the macro-scale HRU/GLU Analysis, the Professional Engineer shall use the triad assessment approach, weighting each of the components based on professional judgment to determine if the project site provides a significant source of bed material load to the receiving stream, and the impact the project would have on the receiving stream. The final assessment and recommendation shall be documented in the HMP portion of the WQMP.

The recommendation may be any of the following:

- Site is a significant source of sediment bed material – all onsite streams must be preserved or by-passed within the site plan.
- Site is a source of sediment bed material – some of the onsite streams must be preserved (with identified streams noted).
- Site is not a significant source of sediment bed material.

The final recommendation will be guided by the triad assessment. Projects with predominantly "high" values for each of the three assessment areas would indicate preservation of onsite streams. Sites with predominantly "medium" values may warrant preservation of some of the onsite streams, and sites with generally "low" values would not require site design considerations for bed material.

The Professional Engineer shall also assess if the receiving stream has been altered either for alignment, cross section, or longitudinal grade, or has degraded to the extent that an in-stream restoration project would be required to restore the functions and values of the stream bed. In such cases, the Professional Engineer should discuss options for participating in an in-stream project in lieu of onsite design features to preserve bed material load.

Provision for waiver of sediment assessment.

If any of the following are present, the site shall not be required to consider sediment component as a part of the HMP mitigation.

1. The site was previously developed and is being redeveloped.
2. There was no stormwater discharge from the site to a receiving water for the range of flows associated with the HMP.
3. The site discharges directly to a bay, estuary, reservoir, lake or the ocean, or through engineered channels to any of these receiving waters.
4. The total project area is smaller than one acre.

5. The site is being used to develop a Single-family project that is not part of a larger development project.
6. The receiving waters of the project site are identified as stable. The condition of stability may be demonstrated based on a stream stability analysis for the receiving waters to the PDP. The exemption is detailed in Section 3.2.iv.

Step 2: Avoid Significant Bed Material Supply Areas in the Site Design

If the analysis in Step 1 indicates that some or all of the site stream courses must be preserved as a contributor of bed material load to the receiving stream, the site plan shall be developed to avoid impacting the identified streams. The Engineer will designate streams onsite that should be avoided to preserve the discharge of bed material load from the site. The Engineer may consider the factors discussed above when determining whether a specific onsite stream course is a significant contributor of bed material load and should be preserved.

Step 3: Site-Specific Alternative Compliance Measures

If it is infeasible to avoid onsite streams that contribute significant bed material load in the design of the site plan, the drainage(s) may be by-passed to maintain bed material flow. The Professional Engineer will need to prepare specific designs to achieve this objective.

2.3.ii Alternative Compliance Approach

The alternative compliance program may only be pursued if the significant replacement of bed material supply is deemed infeasible by the permitting authority, or if the project site design requires significant alteration of onsite streams. The infeasibility of the different sediment management measures stated in the general approach may only be demonstrated and documented by a Professional Engineer. The Professional Engineer may also demonstrate the expected feasibility of the alternative compliance methodology.

In such an eventuality, applicants may propose an alternative compliance methodology for bed material load mitigation from a project based on numerical modeling. This approach would generally include a long-term monitoring program, with potential corrective measures to be identified and implemented as needed in response to findings from the monitoring program.
For example, the engineer may recommend an annual replenishment of bed material downstream of the development based on an estimation of the amount of reduction as a result of development.

The general steps to estimate the average annual bed material replacement needed are:

1. Identify sediment supply sources based on a geotechnical review of the site. Areas that are not a significant supply of bed material may be omitted from the analysis.
2. Estimate the base erosion rate of sources. This estimate should be completed using the Modified Universal Soil Loss Equation (MUSLE) and a 2-year return period.

3. Approximate the sediment delivery ratio of sources. This can be done using published values for the area or estimated values based on best professional judgment.
4. Evaluate the bedload proportion of sources and calculate the yield rate. The bedload proportion of the sources should be done by comparing the sieve analysis in the channel with that in the identified supply areas on the site. The yield is computed by multiplying the total yield, by the bedload proportion and the sediment delivery ratio.
5. Identity sources to be eliminated after development. This is done based on a review of the site plan.
6. Calculate and compare the total pre- and post-development bedload yield to estimate the average annual amount of material that should be replenished to the stream.

Alternatively, the Professional Engineer may propose adjusting the flow duration curve to maintain pre-project conditions in the receiving channel with the expected change in bed material load discharge from the site. The erosion potential (total sediment transported in the proposed condition vs. the baseline) should be modeled and used to adjust the flow duration curve to ensure a condition that does not vary more than 10 %t from the natural condition. Changes in sediment supply after development are accounted for by changing the target Ep from 1.0 (proposed is the same as pre-project) in proportion to the change in bed sediment supply (post-development/pre-development), calculated using the six steps above. This option may not be practical when changes in bed sediment supply are relatively large (greater than 50 %). The Professional Engineer shall determine, using best professional judgment, if the alternative modeling approach is applicable.

The alternative modeling approach shall include the following:

1. Continuous hydrologic simulation for the project baseline condition and proposed condition over the range of flow values up to the pre-project 10-year event;
2. Sediment transport model of the receiving stream for the project baseline condition and proposed condition;
3. Analysis of the change in sediment bed material from the project baseline condition to the proposed condition;
4. Explanation of method used to control the discharge from the project to account for changes in the delivered sediment bed material; and
5. Summary report.

Stream systems and fluvial processes react to changes in the watershed as to maintain the dynamic equilibrium of the stream channel. The alternative performance standard for this option consists of evaluating the changes in both sediment supply and hydrologic changes caused by a development project. The applicant must demonstrate through a stream stability impact assessment that the changes to both the amount of sediment transported and the amount of sediment supplied to the stream will maintain the general trends of aggradation and degradation in the different impacted channel reaches, which are representative of the dynamic equilibrium of a stream channel. Typical stream sediment continuity analysis procedures may be performed using moveable bed fluvial models such as HEC-6t or equivalent.

Receiving channel monitoring may be required for the site to ensure that the development does not result in long-term changes to the receiving channel. The Professional Engineer shall make a recommendation if long-term monitoring is required, for concurrence by the lead agency. Some of the considerations in assessing the need for a long-term monitoring program are:

1. Total area of the watershed at the project discharge point vs. the project area;
2. Condition and type of receiving channel;
3. Magnitude of change in bed material supply to the receiving channel;
4. Relief of the land on the project site;
5. Number of streams (density) potentially delivering bed material to the receiving stream, and the delivery ratio; and
6. Soil characteristics on the project site.

Site-specific modeling is discussed further in **Appendix H**.

3.0 Santa Margarita HMP Requirements for Projects

Per Permit Provision F.1.h(1)(d), this chapter identifies where in the watershed and under what circumstances do the hydrologic performance standard and the sediment control performance standard of this HMP apply to Priority Development Projects. The HMP identifies the coverage areas that are exempted from hydromodification requirements based on Permit Provisions, the state of the hydromodification science, the practicality of implementation of hydromodification controls, environmental benefits of the implementation of controls, and approved hydromodification exemptions for other jurisdictions in California.

Project proponents may refer to the HMP Decision Matrix presented in **Section 3.1** to determine if hydromodification management controls are required per the ramifications of this HMP. When required, the HMP Decision Matrix will direct the project proponent to the adequate sections of this HMP describing the specificities of hydromodification management controls to be implemented based on the project type and size.

3.1 HMP Applicability Requirements

3.1.i HMP Decision Matrix

To determine if a proposed project must implement hydromodification controls, refer to the HMP Decision Matrix in **Figure 5**.

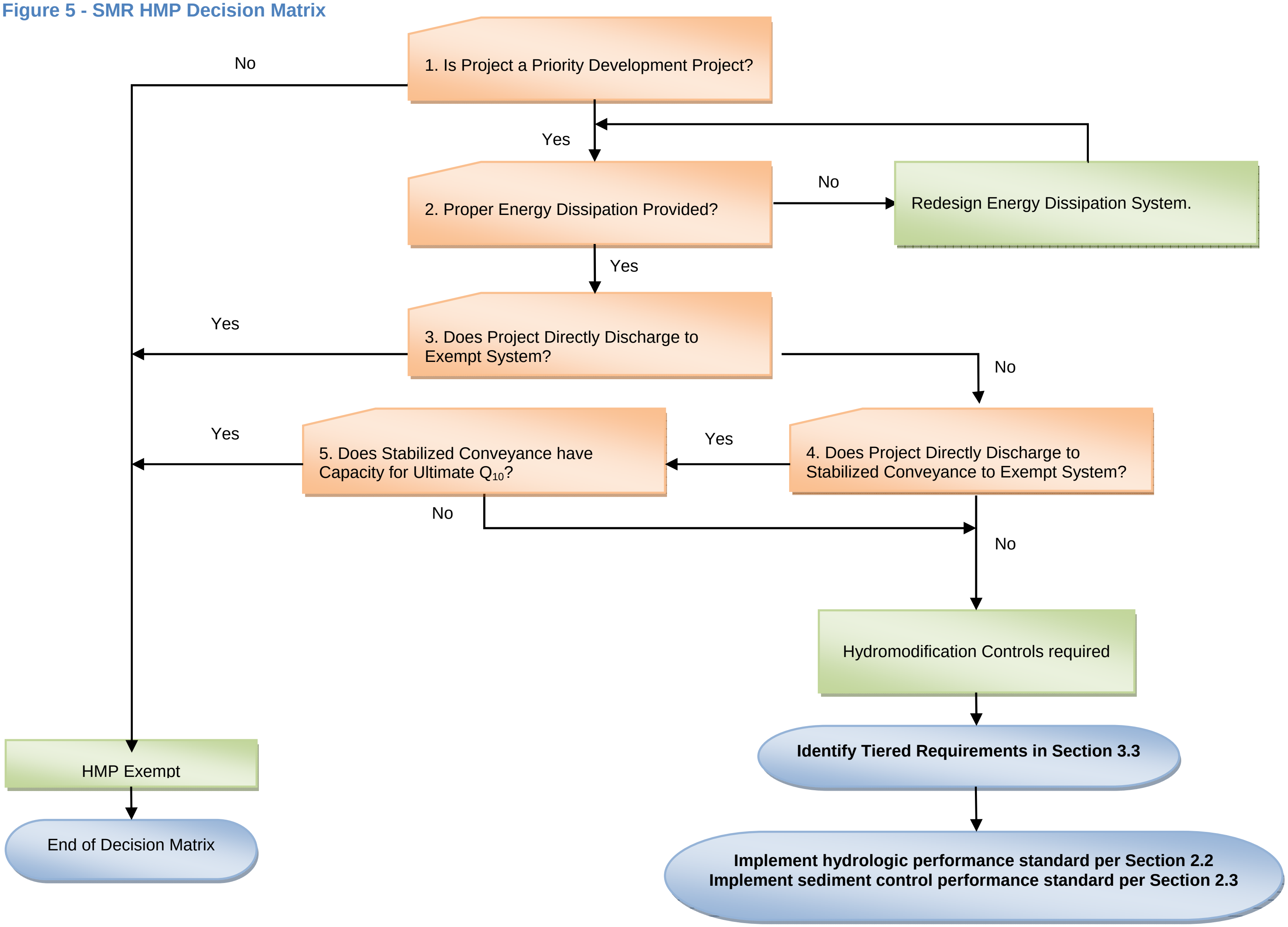
The HMP Decision Matrix can be used for all projects. Project tiers are based on the size and type of development or redevelopment, and are identified in **Figure 12**, and their associated requirements are defined in **Section 3.3**.

It should be noted that all PDPs are subject to the Permit's LID and water quality treatment requirements even if hydromodification flow controls are not required.

As noted in **Figure 5**, projects may be exempt from HMP criteria under the following conditions.

- If the project is not a PDP;
- If the proposed project discharges stormwater runoff directly into underground storm drains discharging directly to bays or the ocean;
- If the proposed project discharges runoff directly to an exempt receiving water as defined in **Section 3.2.i**;
- If the project is considered a watershed protection project in the context of stormwater management (See **Section 3.2.ii**); or,
- If the project discharges to a large river per the definition provided in **Section 3.2.iii**
- If the project discharges into stable receiving waters per the conditions defined in **Section 3.2.iv**.

Figure 5 - SMR HMP Decision Matrix



- **Figure 5**, Node 1 – Hydromodification mitigation measures are only required if the proposed project is a PDP, as defined per Permit Section F.1.d.
- **Figure 5**, Node 2 – Properly designed energy dissipation systems are required for all project outfalls to unlined channels. Such systems should be designed in accordance with the District Standard Drawings and the 1982 Los Angeles County Flood Control District Hydraulic Design Manual or approved alternative to ensure downstream channel protection from concentrated outfalls (identified in **Section 3.1.ii)**.
- **Figure 5**, Node 3 – Exemptions may be granted for projects discharging runoff directly to an exempt receiving water, such as Vail Lake or Skinner Lake, or to an exempt channel system discharging directly into a large river stream (identified in Table 3), but also for watershed protection projects in the context of stormwater management (identified in **Section 3.2.ii**).
- **Figure 5**, Nodes 4 and 5 – For projects discharging runoff directly to an engineered conveyance system that extends to exempt receiving waters detailed in Node 3, exemptions from hydromodification criteria may be granted. Such engineered systems include storm drain and channel reaches that have been identified as non-susceptible to hydromodification (see SMR Hydromodification Susceptibility Study in **Appendix C**). PDPs may also project-specific stream stability analysis to determine if the receiving waters are stable based on hydraulic and geomorphic considerations (identified in **Section 3.2.iv**). To qualify for these exemptions, the existing engineered conveyance system must continue uninterrupted to the exempt system. The engineered conveyance system cannot discharge to an unlined, non-engineered channel segment prior to discharge to the exempt system. Additionally, the project proponent must demonstrate that the engineered conveyance system has the capacity to convey the 10-year ultimate condition flow through the conveyance system. The 10-year flow should be calculated based upon the 10-year high confidence synthetic rainfall hydrograph, as detailed in the 1978 RCFCD Hydrology Manual. As an alternative, the 10-year ultimate peak discharge may also be determined based on continuous simulation and the results of the SMRHM.
- **Figure 6** provides an overview of the stream susceptibility in the SMR, and identifies potentially exempt areas per the requirements of the Permit and non-exempt areas.
- **Figure 7** and **Figure 8** zoom geographically into the Temecula area and the Temecula Creek area downstream of Vail Lake, respectively. These two areas encompass the essential of potentially exempted areas.

3.1.ii Requirement for Proper Energy Dissipation System(s)

As identified in the HMP Decision Matrix in **Figure 5**, properly designed energy dissipation systems are required for all project outfalls to unlined channels. The provision is consistent with the RCFCWCD Standard Design Manual and the 1982 Los Angeles County Flood Control District Hydraulic Design Manual or approved alternative to ensure downstream channel protection from concentrated outfalls.

For reference purposes, the 1982 Los Angeles County Flood Control District Hydraulic Design Manual identifies that (page B-12):

"When a storm drain outlets into a natural channel, an outlet structure shall be provided, which prevents erosion and property damage. Velocity of the flow at the outlet should agree as closely as possible with the existing channel velocity. Fencing and a protection barrier shall be provided…

(1) … When the discharge velocity is high, or supercritical, the designer shall, in addition, consider bank protection in the vicinity of the outlet and an energy dissipator structure."

In order to encroach a District facility and construct an energy dissipation system, an Encroachment Permit to the District Facility system must be obtained during the design phase. The project proponent may contact the Districts Operations and Maintenance Division for up-to-date criteria as to location and type of location to be used prior to initiating any design of outlet structure. For a majority of projects seeking encroachment to a District facility, the initial location and type of outlet structures and energy dissipation systems will typically be assessed during the planning phase, specifically during the Environmental Review and Document phase.

Figure 6 - SMR Stream Susceptibility and Exemption Coverage

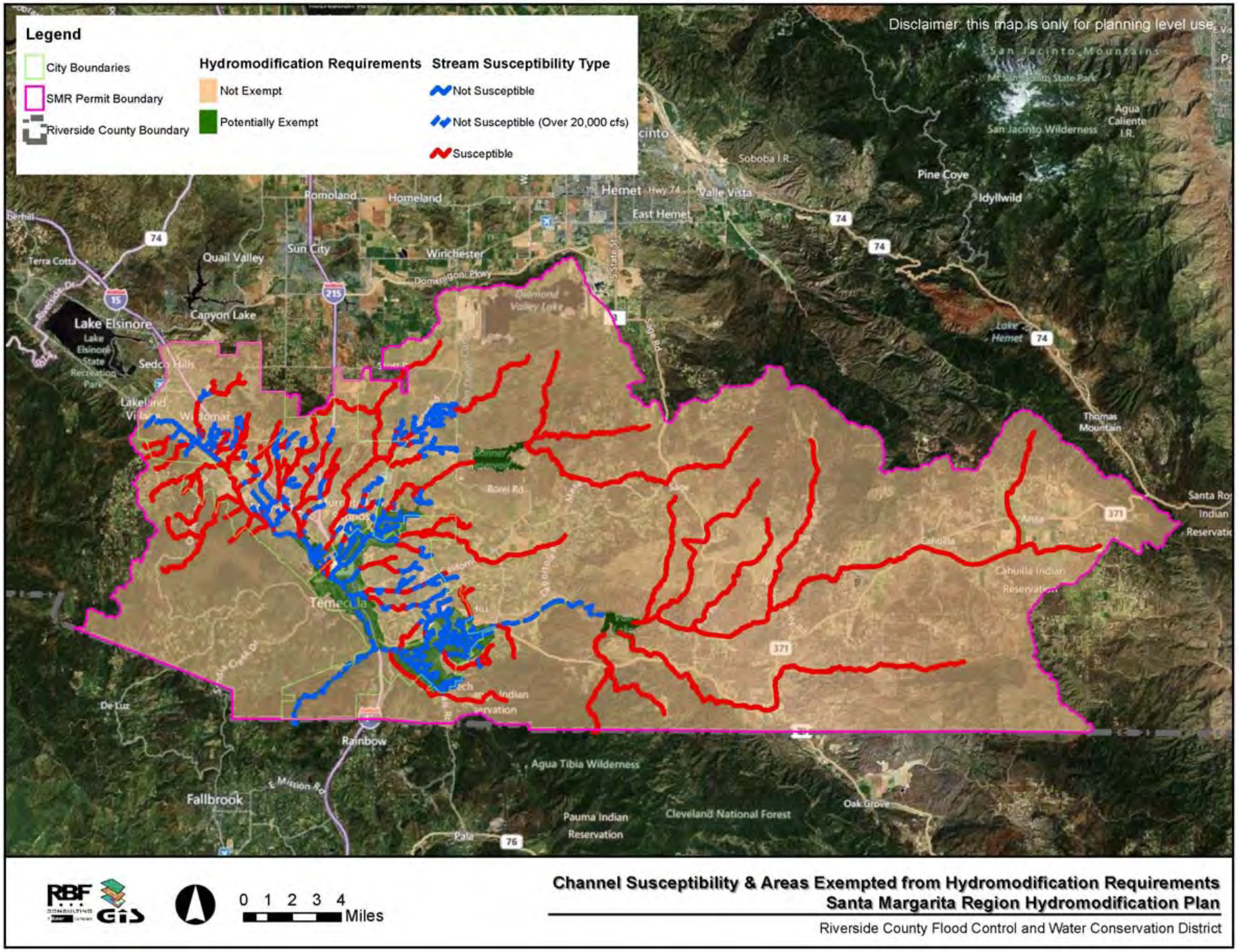


Figure 7 - SMR Stream Susceptibility and Exemption Coverage – Temecula Area

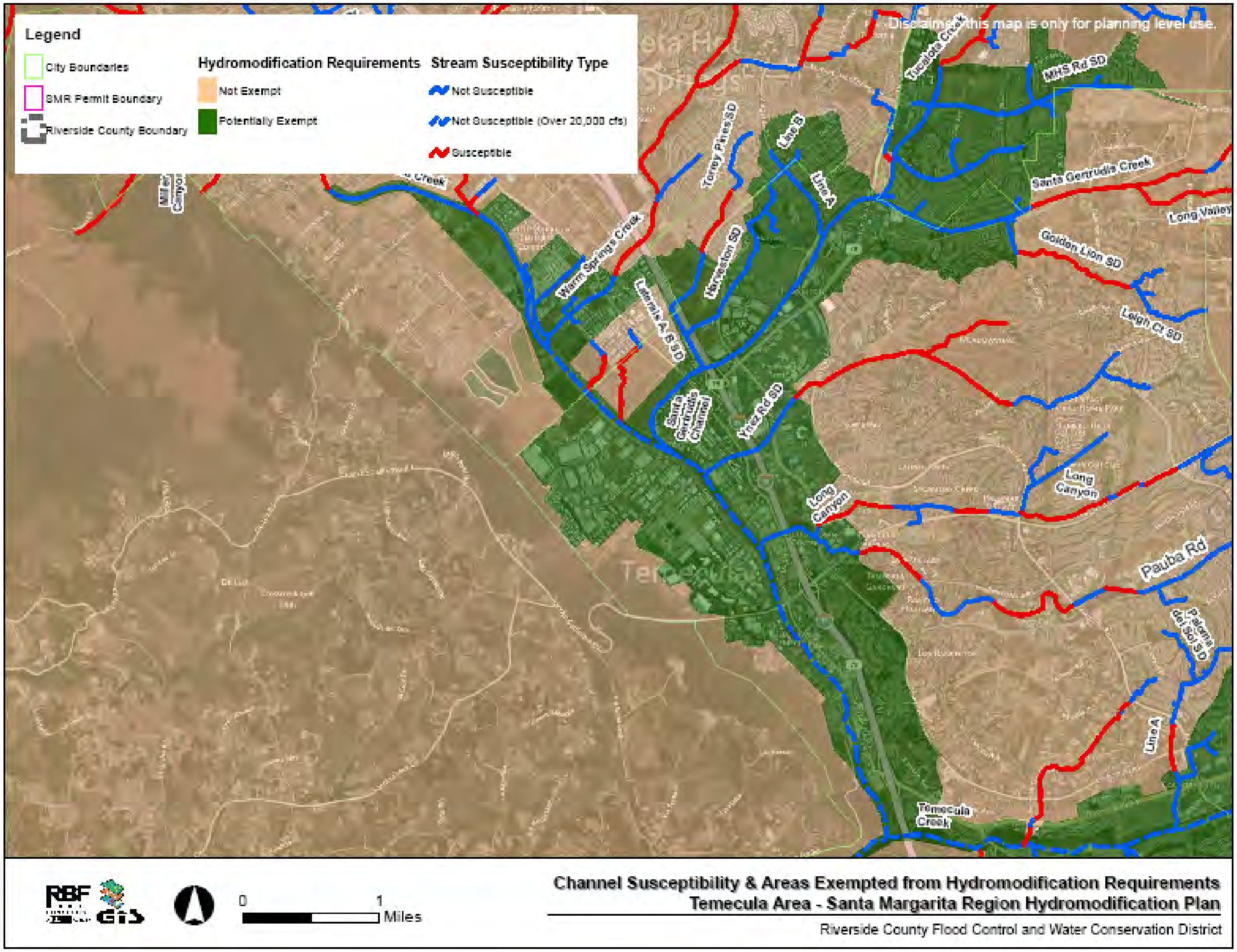
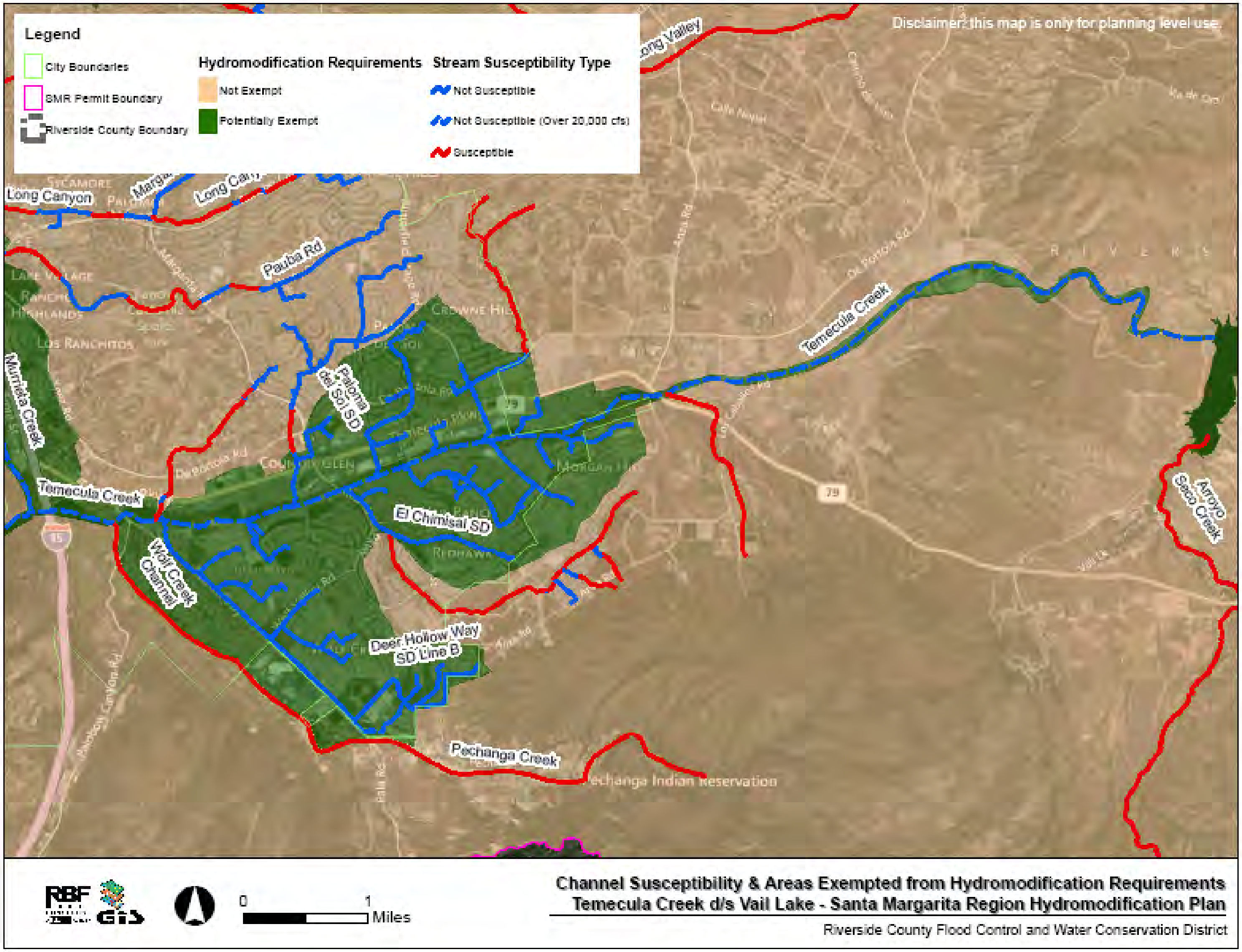


Figure 8 - SMR Stream Susceptibility and Exemption Coverage – Temecula Creek Area



3.2 HMP Exemptions

PDPs may be exempt from HMP criteria based on specific channel or watershed conditions. These exemptions are detailed in this section.

3.2.i Engineered Channel Exempt Areas

The channel exempt areas include those areas that discharge to engineered channels sections that have the capacity to convey the 10-year ultimate condition discharge. This includes, as identified in Section F.1.h.(4) of the Permit:

- PDPs that discharge runoff into underground storm drains discharging directly to water storage reservoirs and lakes; or
- PDPs that discharge runoff into conveyance channels whose bed and bank are concrete lined all the way from the point of discharge to water reservoirs and lakes; or
- PDPs that discharge runoff into other areas identified in the HMP as acceptable to not need to meet the requirements of Section F.1.h by the San Diego Water Board Executive Officer.

Engineered sections, as identified per the SMR Hydromodification Susceptibility Study (see **Appendix D**), are exempt from the hydromodification requirements. To confirm the exemption, the succession of existing engineered conveyance sections must be continuous from the discharge point to an exempt receiving water, such as a reservoir or a large river. PDPs may evaluate local drainage systems that were not included in the SMR Hydromodification Susceptibility Report for exemption applicability.

The 10-year flow should be calculated based upon the 10-year high confidence synthetic rainfall hydrograph, as detailed in the 1978 RCFCD Hydrology Manual. As an alternative, the 10-year ultimate peak discharge may also be determined based on continuous simulation and the results of the SMRHM.

Pursuant to Permit Provision F.1.h(1)(a), the SMR Permit Area was screened to identify and classify susceptible and non-susceptible channels. The screening analysis consisted of verifying the type of material and susceptibility of the delineated District GIS drainage facilities using as-built plans and aerial photography. For questionable segments, the analysis was complemented by a field visit. Findings are summarized in the Hydromodification Susceptibility Documentation Report and Mapping (see **Appendix D**).

Major storm drains that are exempt from hydromodification requirements are presented in **Table 3** for reference only. The PDP may use the exemption maps, including Figures 6 through 11 of this HMP and Map 2: HCOC Applicability Map from the Hydromodification Susceptibility Documentation Report and Mapping: SMR (See **Appendix D**), for planning purposes and must determine if the development or redevelopment project discharges runoff into a continuous succession of existing engineered conveyance sections all the way to an exempt reservoir or other exempt waterbody. The table contains the name of the channel, as well as the associated downstream and upstream limits. The upstream limit being reported corresponds to the nearest cross street. The resulting map from this effort is presented in **Figure 9**. The map shows drainage areas that are potentially exempt from HM criteria.

Table 3 - Channels Exempt from Hydromodification Requirements in the SMR

Channel	Downstream Limit	Upstream Limit
Temecula Creek	Confluence with Santa Margarita River	–Outflow of Vail Lake
Wolf Valley Creek	Temecula Creek	None – all tributaries are exempt
Via Del Coronado Storm Drain	Temecula Creek	None – all tributaries are exempt
Line V / VV of Temecula Creek	Temecula Creek	Earthen Channel upstream of Dartolo Rd
Storm Drain RCFC 3482	Temecula Creek	None Except for tributaries to Storm Drain RCFC 3484
Apis Road Storm Drain	Temecula Creek	None – all tributaries are exempt
Wolf Valley Loop / Margarita Road Storm Drain	Temecula Creek	None – all tributaries are exempt
Mahlon Vail Circle Storm Drain	Temecula Creek	None – all tributaries are exempt
DePortola Road Storm Drain	Temecula Creek	Butterfield Stage Park
Butterfield Stage Road / Macho Road Storm Drain	Temecula Creek	None – all tributaries are exempt
Temecula Creek Road Storm Drain	Temecula Creek	Highway 79
Chaote Street Storm Drain	Temecula Creek	None – all tributaries are exempt
Nighthawk Pass Storm Drain	Temecula Creek	None – all tributaries are exempt
Empire Creek	Murrieta Creek	Ynez Road
Storm Drain RCFC 4989	Empire Creek	Rancho California
Storm Drain RCFC 3463	Murrieta Creek	Overland Drive
Santa Gertrudis Creek	Murrieta Creek	Joseph Road
Tucalota Creek	Santa Gertrudis Creek	400 feet north of Winchester Road
Willows Avenue Storm Drain	Santa Gertrudis Creek	Checker Center
Murrieta Hot Springs Storm Drain	Tucalota Creek	Pourroy Road
Santa Gertrudis Lateral A	Santa Gertrudis Creek	Ynez Road
Santa Gertrudis Lateral B	Santa Gertrudis Creek	Grove Way
Warm Springs Creek	Murrieta Creek	Madison Avenue
Storm Drains RCFC 4761 through 4766	Murrieta Creek	Jefferson Avenue
Murrieta Creek	Confluence with Santa Margarita River	850 feet upstream of Hawthorn Street

Table 4 provides a summary of the two exempt reservoirs in the SMR area, as identified in the Hydromodification Susceptibility Study. Large reservoirs or lakes can be exempt systems from a hydromodification standpoint since reservoir and lake stormwater inflow velocities are naturally mitigated by the significant tailwater condition in the reservoir. HMP exemptions would only be granted for projects discharging runoff directly to the exempt reservoirs or into engineered conveyance systems designed convey the 10-year ultimate condition discharging into a lake or reservoir. To qualify for the exemption, the outlet elevation of the conveyance system must be within (or below) the normal operating water surface elevations of the reservoir and properly designed energy dissipation must be provided.

Table 4 - Reservoirs in the Santa Margarita Region

Reservoir	Watershed
Vail Lake	Temecula Creek
Skinner Lake	Tucalota Creek

Figure 9 below displays areas that are potentially exempt for the entire Santa Margarita Watershed Permit area based on the criteria outlined above, where the areas in green are potentially exempt as they discharge to engineered conveyances all the way to exempt receiving waters (large river, water storage reservoirs). **Figure 10** provides the project proponent with an exemption map of higher definition in the Temecula area. **Figure 11** provides the project proponent with an exemption map of higher definition for Temecula Creek downstream of Vail Lake.

Figure 9 - SMR Exemption Area

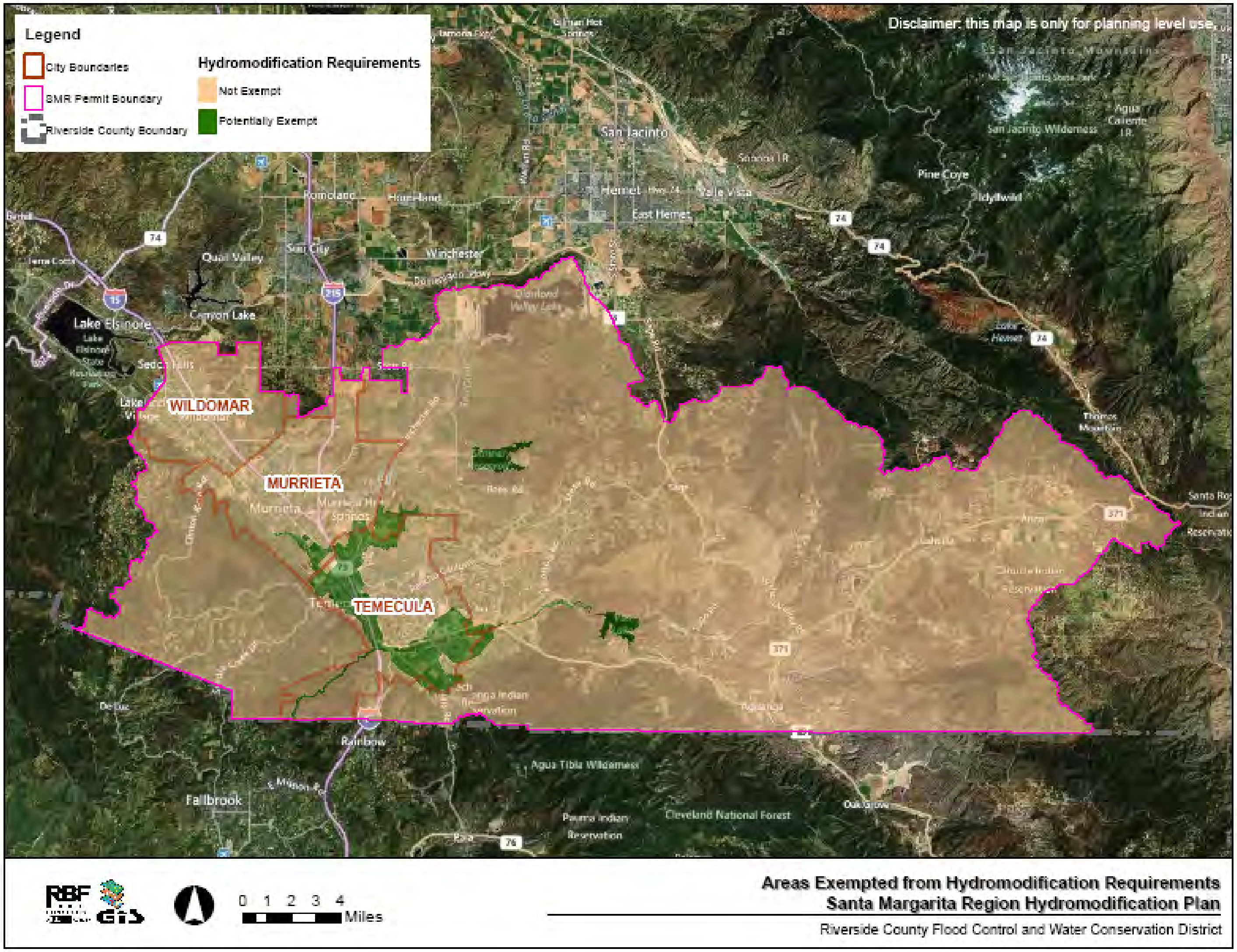


Figure 10 - SMR Exemption Area – Temecula Area

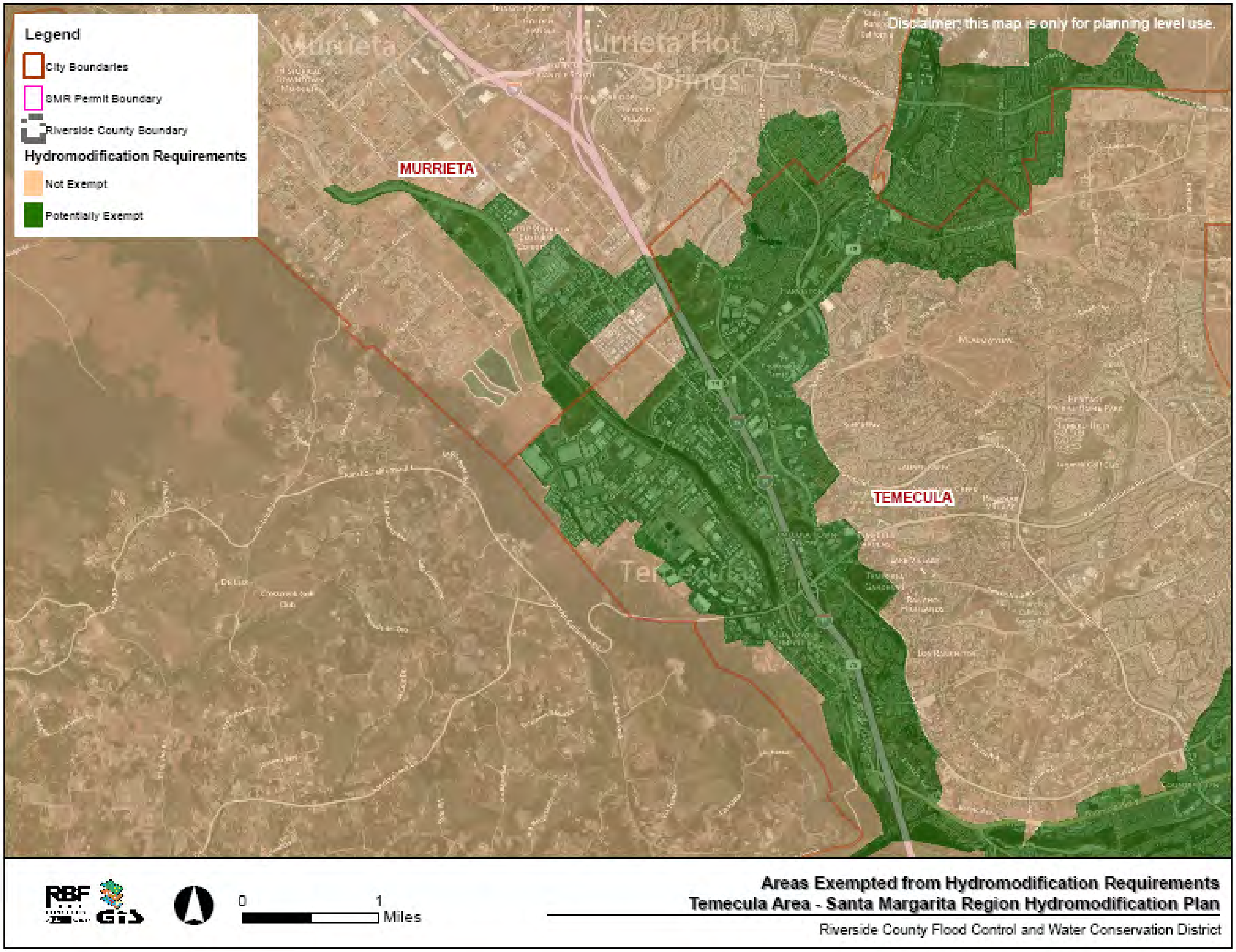
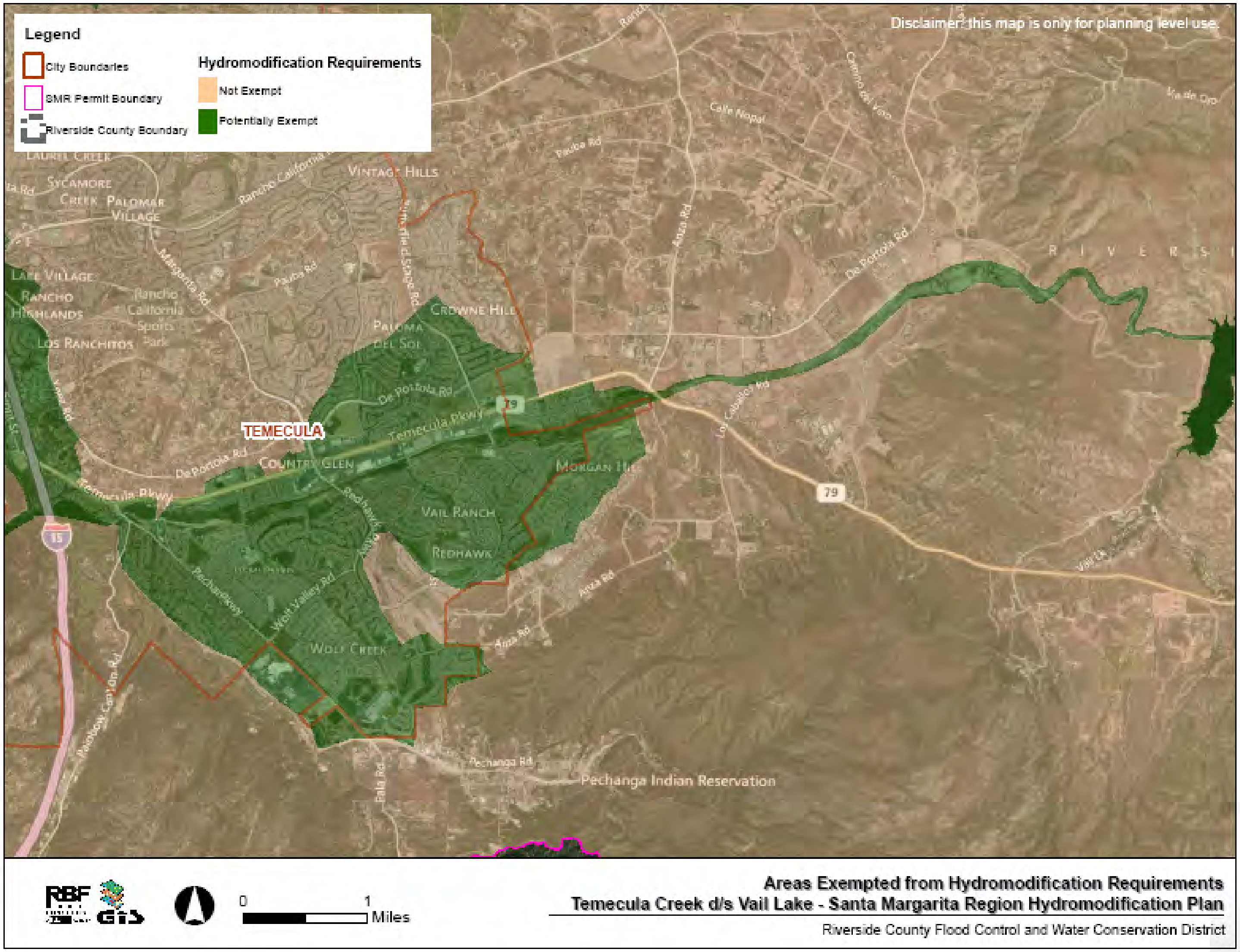


Figure 11 - SMR Exemption Area – Temecula Creek downstream of Vail Lake



3.2.ii Exemption for Watershed Protection Projects

Watershed Protection Projects, in the context of stormwater management, are constructed to prevent economic, social, and environmental damage to the watershed, including receiving waters, by providing the following:

- Water quality protection by the proper management of stormwater and floodplains
- Flood risk reduction for adjacent land uses, stored matter, and stockpiled material
- Elimination of the comingling of stormwater and hazardous materials
- Erosion mitigation
- Restoration of rivers and ecosystems
- Groundwater recharge
- Creation of new open space and wetlands
- Programs for water conservation, stormwater capture and management
- Retrofit projects constructed to improve water quality

Watershed Protection Projects provide an important environmental benefit toward protecting beneficial uses by preventing stormwater from mobilizing pollutant loads and/or managing pollutant sources into receiving waters from adjacent land uses. Watershed Protection Projects are not a PDP.

Any potential impacts upon the environment from Watershed Protection Projects are mitigated through required compliance with CEQA, the United States Army Corps of Engineers 404 Permits, RWQCB Section 401 Water Quality Certification and California Department of Fish and Game Section 1602 Streambed Alteration Agreements. Furthermore, Watershed Protection Projects are not considered development projects as they do not involve any post-construction human use or activity, and have no associated pollutants of concern. Consequently, these projects would not require the preparation of a Project-Specific WQMP. To comply with the requirements of this HMP, Watershed Protection Projects are required to incorporate LID principles in terms of site design, source control, and other BMPs which may or may not include treatment control BMPs.

3.2.iii Exemption for Large River Reaches

Effects of cumulative watershed impacts are minimal in stream reaches of large depositional rivers. These large rivers typically have very wide floodplain areas when in the natural condition or are stabilized when in the engineered condition, and are of low gradient. The results of a flow duration curve analysis that was performed for the San Diego River are presented in the San Diego County HMP.

This analysis demonstrated that the effects of cumulative watershed impacts are minimal in those reaches for which the contributing drainage area exceeds 100 square miles and with a 100-year design flow in excess of 20,000 cfs. Development and redevelopment projects that discharge either directly or via an engineered conveyance system designed to convey the 10-

year ultimate condition into such large river streams are hence exempt from the SMR HMP requirements, provided that properly sized energy dissipation is implemented at the outfall location. As identified in the SMR Hydromodification Susceptibility Study (See **Appendix D**), all exempt river reaches, which are presented in **Table 5** have a drainage area larger than 100 square miles and a 100-year design flow higher than 20,000 cfs. **Table 5** also provides the corresponding upstream and downstream limits to define the exempted reach.

Table 5 - Exempt River Reaches in the Santa Margarita Region

River	Downstream Limit	Upstream Limit
Murrieta Creek	Confluence with Santa Margarita River	Above Warm Springs Creek
Temecula Creek	Confluence with Santa Margarita River	Outlet of Vail Lake
Santa Margarita River	Pacific Ocean	At Origin

3.2.iv Exemption for Stable Receiving Waters

Project proponents have the option to perform a stream stability analysis for the receiving waters to the PDP. The stream stability analysis should analyze the susceptibility of receiving waters to hydromodification based on hydraulic and geomorphic considerations. The project proponent may identify, if applicable, that the receiving waters are currently stable. PDPs discharging into stable receiving waters are exempt from the requirements of this HMP. The results of the stream stability analysis should be documented and attached to the project preliminary WQMP for approval by the governing Copermittee.

3.2.v Exemption for Hydrologic and Sediment Control Matching Below a Minimum Orifice Size

Hydrologic and Sediment Control BMPs shall have a minimum orifice diameter of 1-inch to minimize clogging. Hydrologic and Sediment control matching that requires an orifice smaller than 1-inch will be exempted below the minimum orifice threshold

3.2.vi Exemption for 72 Hour Drawdown Requirement

Any BMP shall have 100% drawdown within 72 hours to accommodate vector control requirements. Hydrologic and Sediment control matching requiring an orifice that will not meet the 72-hour drawdown requirement will be exempted below the minimum drawdown threshold.

3.3 Tiered Requirements

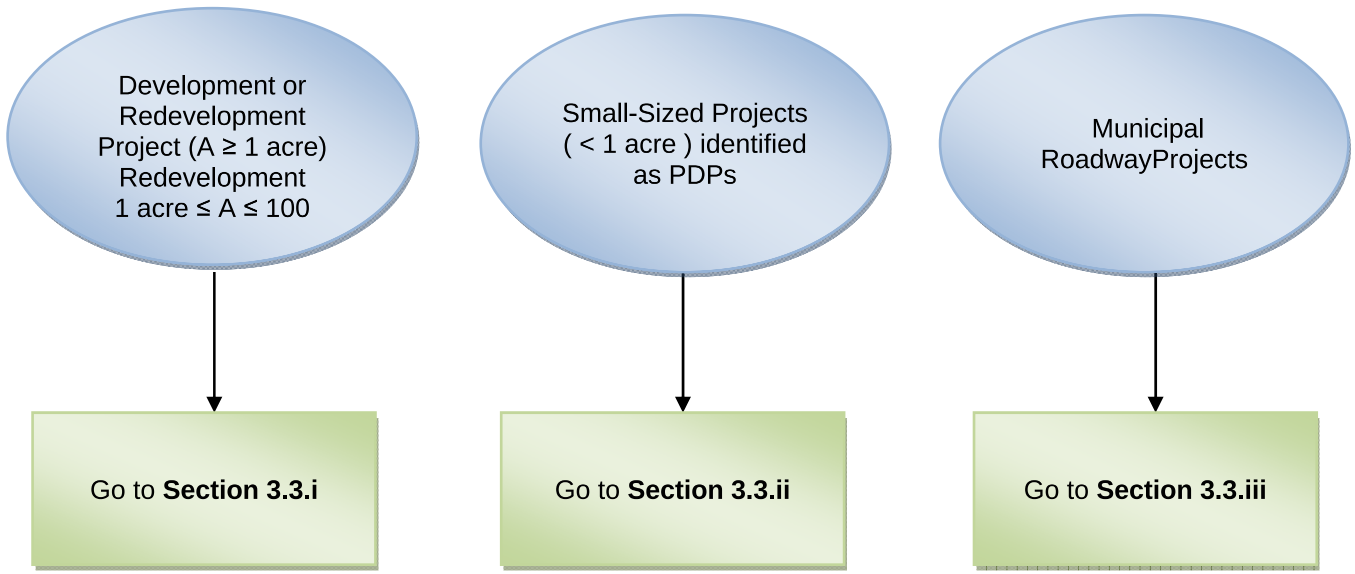
A proposed PDP that is not located in an exemption zone (see **Figure 9**, **Figure 10**, or **Figure 11**) must meet the HMP criteria and performance standards requirements defined in Section 2.1, following the guidelines described in this section. **Figure 9**, **Figure 10**, and **Figure 11** are provided for planning purposes; however, the project proponent shall verify the eligibility to exemption criteria as defined in **Section 3.2**. The PDP must be classified by an applicable tier and meet all the requirements outlined for that tier. The project proponent may associate the size and type of the PDP to one of the following three tiers:

- Tier 1 – Development projects exceeding one acre or redevelopment projects over one acre
- Tier 2 – Small-sized projects less than one acre yet defined as a PDP
- Tier 3 – Municipal roadway projects

Proposed development or redevelopment projects face different levels of spatial, environmental, financial, technical, and permitting constraints based on their size and type. As such, the permit language was translated into HMP requirements that are specific and adapted to each tier configuration. The definition of the three tiers was principally derived from the elements of the permit, as well as from a review of the other HMPs (Santa Clara, Alameda, Sacramento, San Diego, and South Orange County). Most individual single-family residential projects will be exempt from the HMP requirements.

Figure 10 illustrates the three tiers. The following subsections detail the HMP criteria specific to each tier.

Figure 12 - PDP Tiers – Hydromodification Requirements



3.3.i Tier 1 – Development or Redevelopment Project over One Acre

Tier 1 includes development projects over one acre, as well as redevelopment projects of one acre or more. Tier 1 development or redevelopment projects will be subject to a large panel of spatial, environmental, financial, technical, and permitting constraints.

Hydrologic control measures and onsite management controls for sediment supply to ensure compliance with the HMP criteria and performance standards are described in **Section 2.1**. Using this approach, mitigation of both flow and duration is achieved through onsite hydrologic control measures, and sediment loss is addressed through onsite management controls.[5]

Alternatively, if onsite hydrologic control measures and management controls are not technically feasible due to site constraints, a technical feasibility study will be developed to demonstrate the infeasibility. The technical infeasibility study is to be performed in two folds:

- For the hydrologic performance standard, the PDP may follow Step 1 in **Section 2.2.iv**. Step 2 involves implementation of either an offsite mitigation project in the same hydrologic unit as the PDP or implementation of an in-stream restoration project in the receiving water that the PDP discharges to. Details of Step 2 are provided in **Section 2.2.iv**. PDPs can pursue the HMP mitigation bank option, if available.
- For the sediment control performance standard, the PDP may perform the three-step approach as described in **Section 2.3.i**. The alternative compliance will consist of modifying the hydrologic regime of onsite runoff to compensate for sediment loss, while meeting the established hydrologic performance standard.

The alternative compliance approaches to meet both the hydrologic performance standard and the sediment control performance standard are intrinsically related.

If allowed by the governing Copermittee, a project proponent of a development project that is greater than 100 acres or a development project in a common development plan that exceeds 100 acres may implement comprehensive regional control systems. Comprehensive regional control systems must be implemented to fulfill water quality, hydrologic, and fluvial geomorphologic requirements consistent with a study framework. A technical feasibility study must demonstrate compliance with the HMP standards:

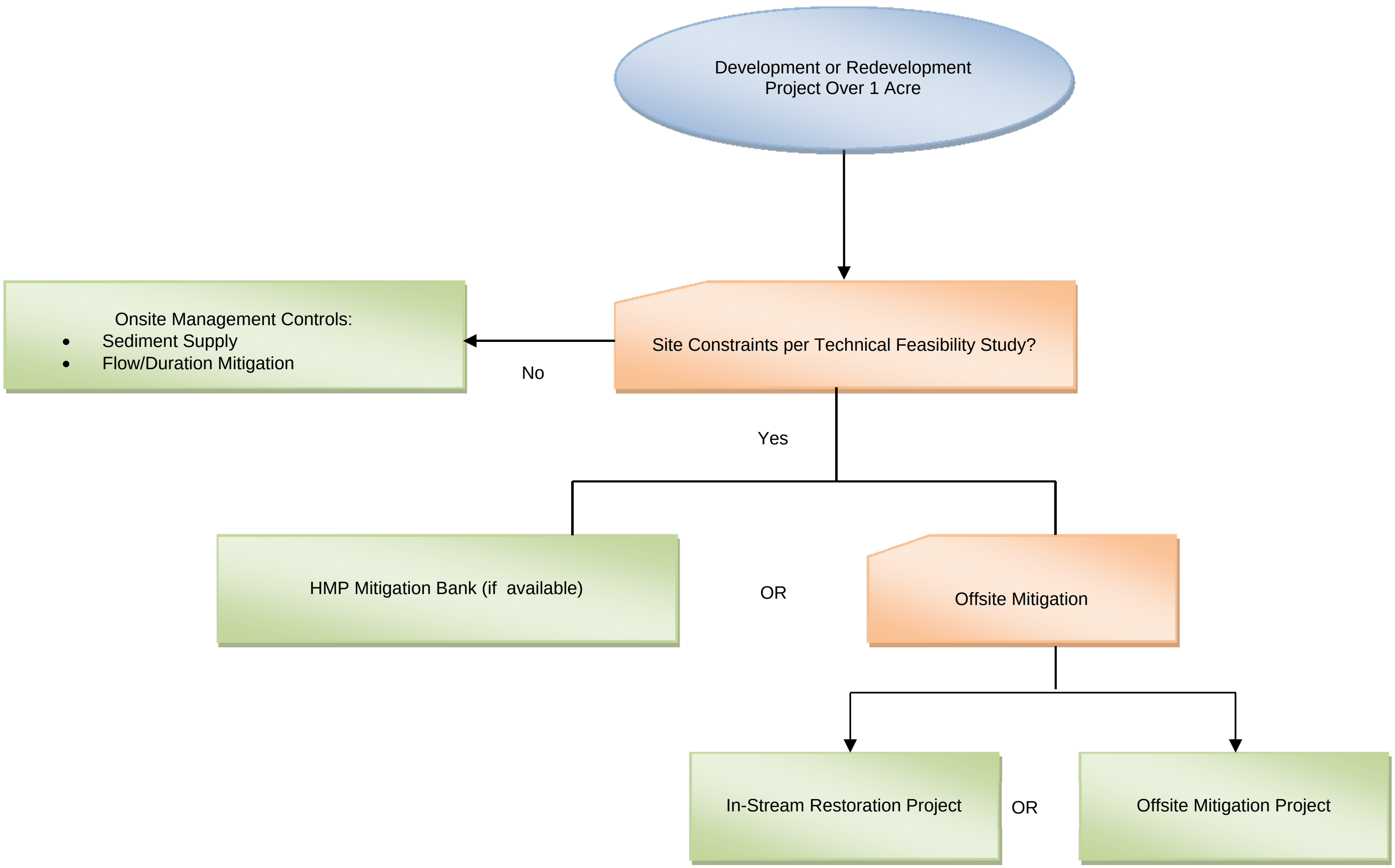
- For the hydrologic performance standard, the PDP may follow Step 1 in **Section 2.2.iv**. If a HMP mitigation bank is available, the PDP can pursue this option. The PDP can also pursue the in-stream restoration option (Option 1 – Step 2b) identified in **Section 2.2.iv**.
- For the sediment control performance standard, the PDP may perform the three-step approach as described in **Section 2.3.i**. The alternative compliance will consist of

[5] Hydrologic and Sediment Control BMPs shall have a minimum orifice diameter of 1-inch. to minimize clogging. (See **Section 3.2.iv)**. Any BMP shall have 100% drawdown within 72 hours to accommodate vector control requirements. (See **Section 3.2.ivi)**

modifying the hydrologic regime of onsite runoff to compensate for sediment loss, while meeting the established hydrologic performance standard.

A flow chart indicating which HMP criteria should be pursued and implemented for a Tier 1 project is shown in **Figure 13**.

Figure 13 - Hydromodification Requirements for Developments or Redevelopments Projects Over 1 Acre



3.3.ii Tier 2 – Small Size Priority Development Projects (less than one acre)

Tier 2 encompasses small-sized projects less than one acre but defined as a PDP. The tier may include the following projects, as characterized by Permit Provision F.1.d.(1) and Permit Provision F.1.d.(2):

- New development projects that are smaller than one acre that create 10,000 square feet or more of impervious surfaces (collectively over the entire project site) including commercial, industrial, residential, mixed-use, and public projects. This category includes development projects on public or private land which fall under the planning and building authority of the Copermittees.
- Projects on automotive repair shops that are smaller than one acre. This category is defined as a facility that is categorized in any one of the following Standard Industrial Classification (SIC) codes: 5013, 5014, 5541, 7532-7534, or 7536-7539.
- Restaurants - This category is defined as a facility that sells prepared foods and drinks for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption (SIC code 5812), where the land area for development is greater than 5,000 square feet. Restaurant where land development is less than 5,000 square feet must meet all Standard Stormwater Mitigation Plan (SSMP) requirements except for structural treatment BMP and numeric sizing criteria requirement F.1.d.(6) and hydromodification requirement F.1.h.
- All hillside development greater than 5,000 square feet but lesser than one acre. This category is defined as any development which creates 5,000 square feet of impervious surface which is located in an area with known erosive soil conditions, where the development will grade on any natural slope that is 25% or greater.
- All development lesser than one acre that are located within or directly adjacent to or discharging directly to an ESA (where discharges from the development or redevelopment will enter receiving waters within the ESA), which either creates 2,500 square feet of impervious surface on a proposed project site or increases the area of imperviousness of a proposed project site to 10% or more of its naturally occurring condition. "Directly adjacent" means situated within 200 feet of the ESA. "Discharging directly to" means outflow from a drainage conveyance system that is composed entirely of flows from the subject development or redevelopment site, and not commingled with flows from adjacent lands.
- Impervious parking lots 5,000 square feet or more and potentially exposed to runoff. Only parking lots that are less than one acre are included into Tier 3. Parking lot is defined as a land area or facility for the temporary parking or storage of motor vehicles used personally, for business, or for commerce.
- Retail Gasoline Outlets (RGOs) - This category includes RGOs that meet the following criteria: (a) 5,000 square feet or more or (b) a projected Average Daily Traffic (ADT) of 100 or more vehicles per day. RGO projects that are lesser than one acre are included into Tier 3.
- Those redevelopment projects lesser than one acre that create, add, or replace at least 5,000 square feet of impervious surfaces on an already developed site and the existing

development and/or the redevelopment project falls under the project categories or locations listed in Permit Provision F.1.d.(2). Where redevelopment results in an increase of less than 50% of the impervious surfaces of a previously existing development, and the existing development was not subject to WQMP requirements, the numeric sizing criteria discussed in Permit Provision F.1.d.(6) applies only to the addition or replacement, and not to the entire development. Where redevelopment results in an increase of more than 50% of the impervious surfaces of a previously existing development, the numeric sizing criteria applies to the entire development.

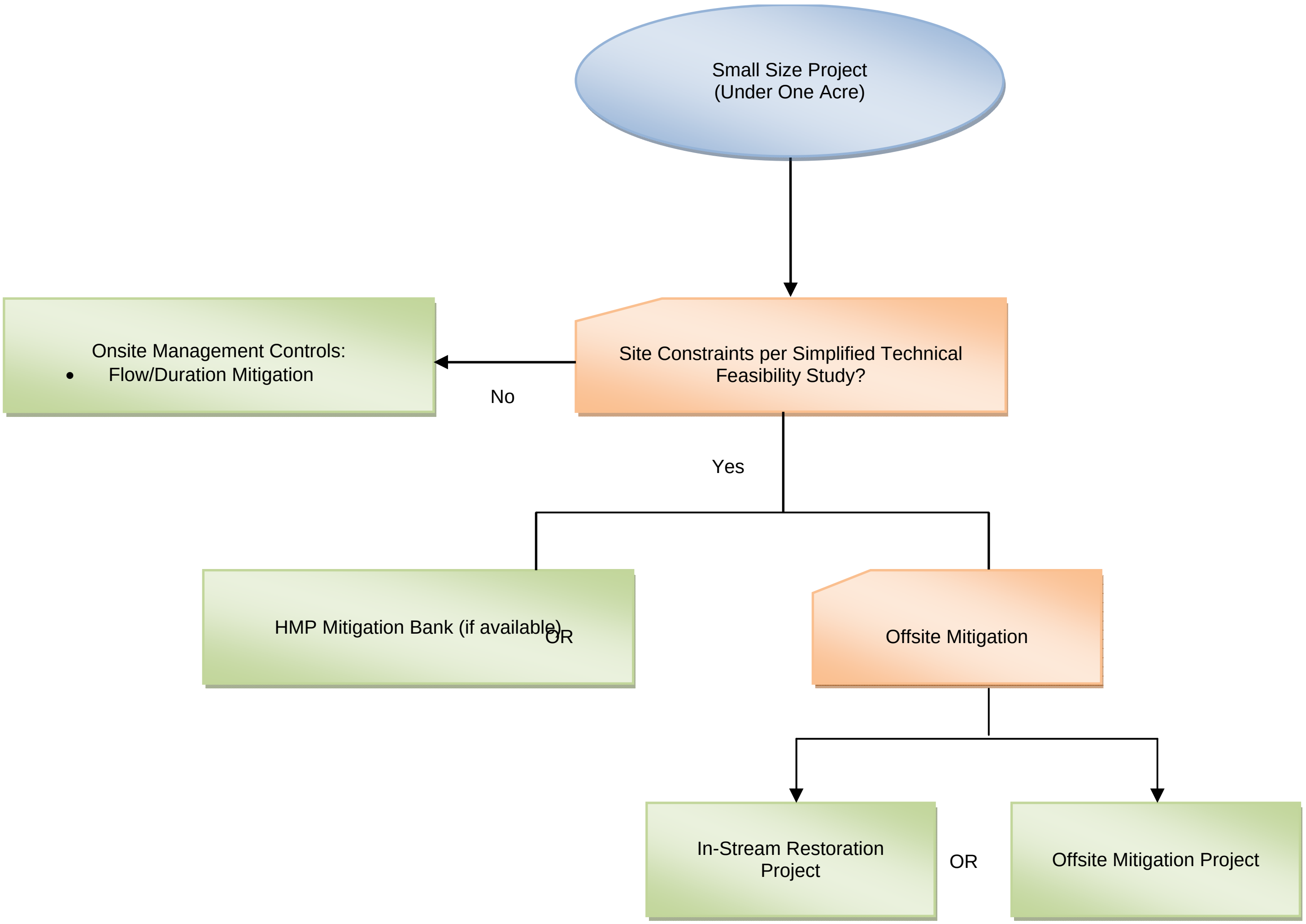
The majority of Tier 2 projects are completed within a very limited amount of space, making it unlikely the applicant will be able to implement onsite management controls. Two approaches are available:

- Implementing hydrologic control measures and onsite management controls within the project boundaries to ensure compliance with the HMP criteria and performance standards identified in **Section 2.1**. Using this approach, mitigation of both flow and duration is achieved through onsite hydrologic control measures.[6]
- If onsite hydrologic control measures and management controls are not technically feasible due to site constraints, a simplified technical feasibility study shall be developed to explain why the HMP criteria cannot be met onsite. The simplified technical feasibility study must include:
  - the soil conditions of the PDP site;
  - a demonstration of the lack of available space for onsite controls;
  - an explanation of prohibitive costs to implement onsite controls; and
  - a written opinion from a California Registered Geotechnical Engineer, who will identify the infeasibility due to geotechnical concerns.
- Once the simplified technical feasibility study is accepted by the jurisdiction of the PDP, the PDP can pursue payment into the HMP mitigation bank, if one exists and is available to the PDP. If not, the PDP must pursue either an offsite mitigation project or an in-stream restoration project detailed in Option 1 – Step 2b in **Section 2.2.iv**. The offsite mitigation project or in-stream restoration will meet the hydrologic performance standard.

A flow chart indicating which HMP criteria should be considered for a Tier 2 project is shown in **Figure 14**.

[6] Hydrologic and Sediment Control BMPs shall have a minimum orifice diameter of 1-inch. to minimize clogging. (See **Section 3.2.iv)**. Any BMP shall have 100% drawdown within 72 hours to accommodate vector control requirements. (See **Section 3.2.ivi)**

Figure 14 - Hydromodification Requirements for Small Size Developments or Redevelopments



3.3.iii Tier 3 – Municipal Roadway Projects

Municipal Roadway Projects constitute a standalone tier based on their unique characteristics. Municipal Roadway Projects are linear development or redevelopment projects to be completed within a limited right-of-way. Tier 3 includes the following roadway projects, as defined per Permit Provisions F.1.d.(1) and F.1.d.(2):

- Streets, roads, highways, and freeways. This category includes any paved surface that is 5,000 square feet or greater used for the transportation of automobiles, trucks, motorcycles, and other vehicles. To the extent that the Copermittees develop revised standard roadway design and post-construction BMP guidance that comply with the provisions of Section F.1 of the Order, then public works projects that implement the revised standard roadway sections do not have to develop a project-specific WQMP. The standard roadway design and post-construction BMP guidance must be submitted with the Copermittees' updated WQMP.
- Roadway redevelopment projects that create, add, or replace at least 5,000 square feet of impervious surfaces. Where a roadway redevelopment project results in an increase of less than 50% of the impervious surface within the limits of the project, and the existing development was not subject to WQMP requirements, the numeric sizing criteria discussed in Permit Provision F.1.d.(6) applies only to the addition or replacement, and not to the entire development. Where the roadway redevelopment project results in an increase of more than 50% of the impervious surface within the limits of the project, the numeric sizing criteria applies to the entire project.

Routine roadway maintenance projects that maintain the original line and grade, hydraulic capacity, original purpose of the facility, or emergency roadway maintenance activities that are required to protect public health and safety are exempt from HMP requirements.

Municipal roadway or Copermittee transportation projects that implement the *Low Impact Development Guidance and Standards for Transportation Projects for Santa Margarita Region* (SMR TPG) are not required to develop a Project-Specific WQMP, thus are exempt from HMP requirements. Applicants must, however, complete and submit a TPG, which will include all the water quality treatment and LID source controls that are implemented at the project site.

The TPG advocates for the implementation of a green street approach, to the maximum extent practicable, that is consistent with the 2008 U.S. EPA Green Streets Manual. If it is determined that due to site constraints implementation of a "green streets" approach for the municipal roadway project is infeasible, the PDP will complete a LID BMP Feasibility Analysis identifying the constraints of why a "green streets" approach cannot be implemented. The LID BMP Feasibility Analysis is listed in Section 5 of the SMR TPG BMP Template. The opportunity to develop a green street project will depend upon several factors, including but not limited to the ownership of the land adjacent to the right-of-way, the location of existing utilities, the course of the existing storm drain, and potential access opportunities.

4.0 HMP and Model WQMP Integration

Within 90 days after a finding of adequacy from the SDRWQCB, the final SMR HMP requirements will be incorporated into the 2013 Santa Margarita Region Water Quality Management Plan Template, the 2013 SMR WQMP, and the District's 2011 LID BMP Design Handbook.

Within the SMR WQMP, HMP requirements including the HMP criteria and performance standards will be incorporated into Section 3.6 – Meet Hydromodification Requirements. The section will also identify tiered requirements, as well as the methodology and steps that project proponents must follow to achieve compliance with the SMR HMP. HMP alternative compliance for the hydrologic and sediment source elements of the SMR HMP will also be integrated into Sections 3.6.3.a) – Off-Site Mitigation and 3.6.3.b) – HMP Mitigation Bank, and Section 3.6.4 – Meet the Sediment Supply Performance Standard, respectively.

Guidance regarding the hydromodification technical feasibility study will be integrated with the LID feasibility analysis as part of Section D of the SMR WQMP Template. Section D of the SMR WQMP Template will evaluate onsite conditions that may require implementation of offsite mitigation systems. The feasibility study will be submitted with the preliminary WQMP.

The Copermittees will use the SMR WQMP, WQMP Template, and LID BMP Design Handbook with the HMP requirements to incorporate requirements into the local approval processes via their local WQMPs and municipal ordinances. This will also be completed within 90 days after receiving a finding of adequacy from the SDRWQCB.

5.0 References

Alameda Countywide Clean Water Program (ACCWP). 2005. Hydrograph Modification Management Plan. May 2005.

Amos, C.B., Burbank, D.W. 2007. Channel width response to differential uplift. Journal of Geophysical Research. Vol. 112.

Beighley, R.E., J.M. Melack, and T. Dunne. 2003. Impacts of California's Climatic Regimes and Coastal Land Use Change on Streamflow Characteristics; Journal of the American Water Resources Association.

Bendaa, L., Miller, D., Bigelowa, P., Andrasa, K. 2003. Effects of post-wildfire erosion on channel environments, Boise River. Forest Ecology and Management 178 (2003)105–119

Bicknell, B.R., Imhoff, J.C., et al. 1997. Hydrological Simulation Program – FORTRAN, User's Manual for Version 11: U.S. Environmental Protection Agency, National Exposure Research Laboratory, Athens, Ga., EPA/600/R-97/080, 755 p.

Bledsoe, B.P. 2001. Relationships of Stream Responses to Hydrologic Changes, Linking Stormwater BMP Designs and Performance to Receiving Water Impact Mitigation. Proceedings of an Engineering Foundation Conference, August 19-24, 2001, Snowmass Village, CO.

______. 2002. Stream Erosion Potential and Stormwater Management Strategies. Journal of Water Resources Planning and Management 128: 451.

______. 2007. Assessment of Stream response to Urbanization. Cities of the Future: Towards Integrated Sustainable Water and Landscape Management.

Bledsoe, B.P., Hawley, R., and Stein E. 2008. Channel Classification and Mapping Systems with Implications for Assessing Susceptibility to Hydromodification in Southern California. Southern California Coastal Water Research Project.

Booth, D.B. 1990. Stream Channel Incision Following Drainage Basin Urbanization. Journal of the American Water Resources Association 26(3): 407-417.

______. 1991. Urbanization and the Natural Drainage System—Impacts, Solutions, and Prognoses. The Institute for Environmental Studies 7(1).

Booth, D.B. and C.R. Jackson 1997. Urbanization of Aquatic Systems: Degradation Thresholds, Stormwater Detection, and the Limits of Mitigation. Journal of the American Water Resources Association 33(5): 1077-1090.

Brown and Caldwell. 2007. Development of San Diego County Interim Hydromodification Criteria. October 30.

______. 2008. HMP Submittal Requirements. September 25.

______. 2008. Using Continuous Simulation to Size Stormwater Control Facilities. May.

______. 2009. Flow Threshold Analysis for the San Diego HMP. April 30.

______. 2009. Lower Flow Threshold Alternatives. April 30.

______. 2009. Minimum Criteria for Evaluation of Stormwater Controls to Meet Interim Hydromodification Criteria. April 30.

______. 2009. Summary of Evaporation and Evapotranspiration Data for the San Diego Region. April 30.

______. 2009. Summary of HSPF Modeling Efforts in Southern California. April 30.

Butcher, J. 2007. Comparison of BAHM and Contra Costa Approaches to Hydromodification Management Plan Requirements. Tetra Tech, Inc. Memorandum to Janet O'Hara (CA RWQCB Region 2). December 7, 2007.

California Department of Conservation, 2002. California Geomorphic Provinces. Note 36. California Geological Survey.

California Regional Water Quality Control Board – San Diego Region. 2010. Order No. R9-2010-0016. November 10.

California Stormwater Quality Association (CASQA). 2003. Stormwater Best Management Practice Handbook. New Development and Redevelopment. January 2003.

Chin, A. and K.J. Gregory (2005). Managing urban river channel adjustments. Geomorphology 69:28-45.

Clear Creek Solutions, Inc., 2007. Bay Area Hydrology Model User Manual, Prepared for Alameda Countywide Clean Water Program, San Mateo Countywide Water Pollution Prevention Program, Santa Clara Valley Urban Runoff Pollution Prevention Program. July 2007.

Clear Creek Solutions, Inc., 2012. South Orange County Hydrology Model, South Orange County Copermittees. April.

Clear Creek Solutions, Inc., 2012. South Orange County Hydrology Model Guidance Manual, South Orange County Copermittees. April.

Coleman, D., C. MacRae, and E.D. Stein. 2005. Effect of increases in peak flows and imperviousness on the morphology of southern California streams. Research Project Technical Report #450. Report from the Stormwater Monitoring Coalition, Southern California Coastal Water, Westminster, CA.

Contra Costa Clean Water Program (CCCWP). 2004. Work Plan and Literature Review for the Hydrograph Modification Management Plan.

______. 2005. Hydrograph Modification Management Plan. Prepared by Philip Williams & Associates. May 15, 2005.

Donigan, A.S., and H.H. Davis. 1978. User's Manual for Agricultural Runoff Management (ARM) Model. EPA-600/3-78-080. U.S. Environmental Protection Agency.

Dunne, T. and L.B. Leopold. 1978. Water in Environmental Planning. New York, W.H. Freeman and Company. 818 pp.

Federal Interagency Stream Restoration Work Group (FISRWG). 1998. Stream Corridor Restoration: Principles, Processes, and Practices. United States Department of Agriculture.

Fischenich, C. 2001. Stability of Stream Restoration Materials. ERDC TN-EMRRP-SR-29

Geosyntec Consultants. 2004. Evaluation of the Range of Storms for HMP Performance Criteria. Memorandum to Onsite Management Measures Subgroup, Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP). April 1, 2004. Revised Final Draft.

Henshaw, P.C. and D.B. Booth 2000. Natural Restabilization of Stream Channels in Urban Watersheds. Journal of the American Water Resources Association 36(6): 1219-1236.

Hey, R. D., and Thorne, C. R. 1986. "Stable Channels with Mobile Gravel Beds," Journal of Hydraulic Engineering, American Society of Civil Engineers, Vol. 112, No. 8, pp. 671-689.

Hollis, G.E. 1975. The Effect of Urbanization on Floods of Different Recurrence Intervals. Water Resources Research.

Kirkby, M.J. 1995. Modeling the links between vegetation and landforms. Geomorphology 13, 319-35.

Lane, E. W. 1955. The importance of fluvial morphology in hydraulic engineering. Proceedings, American Society of Civil Engineers, No. 745, July.

Leeder, M.R., T. Harris, et al. 1998. Sediment supply and climate change: implications for basin stratigraphy. Basin Research 10(1): 7-18.

Leopold, L.B., M.G. Wolman, J.P. Miller. 1964. Fluvial Processes in Geomorphology. San Francisco, W.H. Freeman and Company. 522 pp.

Los Angeles Regional Water Quality Control Board. 2002. TMDL to Reduce Bacterial Indicator Densities at Santa Monica Bay Beaches During Wet Weather. June 21.

MacRae C.R., 1997. Experience from Morphological Research on Canadian Streams: Is Control of the Two-Year Frequency Runoff Event the Best Basins for Stream Channel Protection? Effects of Watershed Development And Management Of Aquatic Ecosystems, L.A. Roesner, ed., ASCE Reston, VA., 144-162.

MacRae, C.R. 1993. An Alternate Design Approach for the Control of Instream Erosion Potential in Urbanizing Watersheds. Sixth International Conference on Urban Storm Drainage, Niagara Falls, Ontario.

Mangarella, P. and Palhegyi, G. Geosyntec Consultants. 2002. Santa Clara Valley Urban Runoff Pollution Prevention Program Hydromodification Management Plan Literature Review.

National Climatic Data Center. 2012. Climatic Data. November.

Palhegyi, G.,P. Mangarella, et al. 2004. Developing Management Plans to Address Impacts from Urbanization on Stream Channel Integrity, ASCE.

Paul, M.J. and J.L Meyer. 2001. Streams in the Urban Landscape. Annual Review of Ecologic Systems. 32:333–65

Phillip Williams and Associates. 2003. Sources of nonlinearity and complexity in geomorphic systems. Progress in Physical Geography 27(1):

______. 2009b. Literature Review for the San Diego Hydromodification Management Plan. October 19.

Richman, T., P. E. Jill Bicknell, et al. 2004. Start at the Source: Site Planning and Design Guidance Manual for Stormwater Quality Protection, ASCE.

Riley, A.L. 1998. Restoring Streams in Cities: A Guide for Planners, Policymakers, and Citizens. March.

Ripple, W.J., E.J. Larsen, et al. 2001. Trophic cascades among wolves, elk and aspen on Yellowstone National Park's northern range. Biological Conservation 102(3): 227-234.

Riverside County Flood Control and Water Conservation District. 1978. Riverside County Hydrology Manual. April.

Riverside County Flood Control and Water Conservation District. 2006. Riverside County Stormwater Quality Best Management Practice Design Handbook. July

Riverside County Flood Control and Water Conservation District. 2009. Riverside County WQMP Template. January.

Riverside County Flood Control and Water Conservation District. 2013. Draft 2013 Santa Margarita WQMP. June.

Riverside County Flood Control and Water Conservation District. 2013. 2013 Draft LID BMP Design Handbook. June.

Riverside County Flood Control and Water Conservation District. 2012. Hydrologic Data Collection. November.

Riverside County Flood Control and Water Conservation District. 2012. Riverside County Santa Margarita Storm Drain Inventory.

Rosgen D.L. 1994. A classification of natural rivers. Catena 22, pp 169-199

Rosgen D.L. 1996. Applied River Morphology. Wildland Hydrology. Pagoosa Springs, CO.

Sacramento Stormwater Quality Partnership. 2009. Pilot Project to Assess Decision Support Tools for Hydromodification Management in the Sacramento Area. March.

San Diego Permittees. 2011. Hydromodification Management Plan. March.

San Diego Regional Water Quality Control Board. 2008. TMDLs for Indicator Bacteria in Baby Beach and Shelter Island Shoreline Park. June 11.

San Diego Regional Water Quality Control Board. 2007. TMDLs for Indicator Bacteria Project 1 – Beaches and Creeks in the San Diego Region. December 12.

San Diego Regional Water Quality Control Board. 2002. Baseline Geomorphic and Hydrologic Conditions, Rancho Mission Viejo: Portions of the San Juan and Western San Mateo Watersheds. PCR, PWA, and Balance Hydrologics, Inc. February.San Mateo Countywide Stormwater Pollution Prevention Program (STOPPP). 2005.

Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP). 2005. Hydromodification Management Plan Final Report. April 21.

Santa Clara Valley Urban Runoff Pollution Prevention Program. 2006. Santa Clara Hydromodification Management Plan (HMP). February.

Schueler, T. 1998. Basic Concepts in Watershed Planning. Chapter 1 from The Rapid Watershed Planning Handbook, Center for Watershed Protection, Ellicott City, MD.

Schumm S.A., M.D. Harvey, and C.C. Watson. 1984. Incised channels. Morphology, dynamics and control. Water Resource Publication, Littleton, Colorado.

Simon, A. 1992. Energy, time, and channel evolution in catastrophically disturbed fluvial systems. Geomorphology 5, 345-372.

Simon, A.,M. Doyle, M. Kondolf, F.D. Shields, Jr., B. Rhoads, and M. McPhillips. 2007. Critical evaluation of how the Rosgen Classification and Associated Natural Channel Design Methods fail to Integrate and Quantify Fluvial Processes and Channel Response. Journal of the American Water Resources Association. 43(5):1117-1131.

Southern California Coastal Water Research Project (SCCWRP). 2005. Evaluating HSPF in an Arid, Urbanized Watershed; Journal of the American Water Resources Association.

______. 2007. Surface Water Ambient Monitoring Program (SWAMP) Report on the San Juan Hydrologic Unit. Prepared for the California Regional

______. 2010. Hydromodification Screening Tools: Field Manual for Assessing Channel Susceptibility. Technical Report 606.

______. 2011. Hydromodification Effects on Flow Peaks and Durations in Southern California Urbanizing Watersheds. Technical Report 654.

______. 2012. Hydromodification Assessment and Management in California. Technical Report 667.

South Orange County Permittees. 2012. Draft Hydromodification Management Plan. October.

State of California. 2011. The California Environmental Quality Act, Title 14. California Code of Regulations, Chapter3. Guidelines for Implementation of the California Environmental Quality Act, Section 15332. In-fill Development Projects.

State of California Water Quality Control Board, San Diego Region (Region 9). July.

______. 2011. SCCWRP 2011-2012 Research Plan – Bioassessment. Items 1(a)(b)(c). June.

Tetra Tech, Inc. 2003. Lake Elsinore and Canyon Lake Nutrient Source Assessment for Santa Ana Watershed Authority. January.

Thomas, M.F. 2001. Landscape sensitivity in time and space—an introduction. Catena 42(2-4): 83-98.

Trimble, S.W. and A.C. Mendel 1995. The cow as a geomorphic agent—A critical review. Geomorphology 13(1-4): 233-253.

United States Army Corps of Engineers. 2001. Channel Restoration Design for Meandering Rivers. Caoastal and Hydraulics Laboratory. ERDC/CHL CR-01-1. September.

United States Army Corps of Engineers. 2007. Guidelines for Sampling Bed Material, Technical Supplement 13A, Part 654 of National Engineering Handbook, New England District. August.

United States Environmental Protection Agency. 2008. Managing Weather with Green Infrastructure Municipal Handbook. December.

United States Environmental Protection Agency. 2000. BASINS Technical Note 6 – Estimating Hydrology and Hydraulic Parameters for HSPF. July.

United States Environmental Protection Agency. 2007. National Management Measures to Control Nonpoint Source Pollution from Hydromodification. Office of Wetlands, Oceans and Watersheds. July.

United States Forest Service. 2012. Calveg Mapping Tiles and Accuracy Assessments, Pacific Southwest Region.

USGS Web Site. Water Resources Applications Software. Summary of HSPF – Hydrologic Simulation Program – FORTRAN.

Viessman, Warren, Lewis, Gary L, and Knapp, John W. 1989. Introduction to Hydrology. Harper & Row, New York

Waananen, AO and Crippen, Jr. 1977. Magnitude and frequency of floods in California. US Geological Survey Water-Resources Investigation 77-21. 96 p.

Warrick, J.A. and Milliman, J.D. 2003. Hyperpycnal sediment discharge from semiarid southern California rivers: implications for coastal sediment budgets. Geology, Vol 31, N.9, pp781-784. September.

Watson, C.C., D.S. Biedenharn and B.P. Bledsoe. 2002. Use of incised channel evolution models in understanding rehabilitation alternatives. Journal of the American Water Resources Association 38:151-160.

Watson, C.C., and W. Annable. 2003. Channel Rehabilitation: Processes, Design, and Implementation. Notes for Applied Fluvial Geomorphology and River Restoration Short Course, sponsored by the Guadalupe-Coyote Resource Conservation District. Held at the Santa Clara Valley Water District, San Jose, CA, July 14-18.

Western Regional Climate Center. Climatic data. October 2012

Wolman, M.G. and J.P. Miller. 1960. Magnitude and Frequency of Forces in Geomorphic Processes, Journal of Geology.