

5. HYDROMODIFICATION CONTROL STANDARD AND PERFORMANCE CRITERIA

5.1 INTRODUCTION

Hydromodification control standards will be used by local agencies as part of the development plan review process to manage hydromodification impacts of development projects. This chapter describes the proposed hydromodification control standard, management objective, and performance criteria for new development and redevelopment projects covered by the HMP requirements.

5.2 CONTROL STANDARDS AND PERFORMANCE CRITERIA

Hydromodification control standards, such as those used in the State of Washington and Canada, contain the following interrelated elements:

- The actual hydromodification control standard;
- Applicability statements or exclusions;
- Management (performance) criteria and/or thresholds; and
- Implementation strategies

Standards and criteria can be stream specific, watershed specific, or basin wide. Standards that are directed towards controlling runoff from individual development projects may allow alternative hydromodification controls to be identified on a project specific basis in stormwater basin plans, master plans, and EIR/EIS plans. Watershed planning is well suited for controlling hydromodification because stream erosion and adjustment is a function of the cumulative effects within a watershed. Alternative control requirements may be established through master plans that provide equivalent stream protection through a combination of project, drainage area, and in-stream controls.

In the case of the SCVURPPP NPDES permit, sections of Provision C.3.f provide a broad hydromodification control standard and statements of applicability, as described below. In order

to implement this standard, a recommended management objective and performance criteria were developed based on the findings of the watershed assessments and technical analyses described in Chapters 2, 3, and 4. Findings from these analyses are presented in the discussion following each recommended criterion.

SCVURPPP Hydromodification Control Standard

The following sections of Provision C.3.f provide the hydromodification control standard and applicability statement.

Hydromodification Control Standard

The Dischargers shall manage increases in peak runoff flow and increased runoff volume, for all Group 1 Projects, where such increased flow and/or volume can cause increased erosion of creek beds and banks, silt pollutant generation, or other impacts to beneficial uses. Such management shall be through implementation of a Hydromodification Management Plan (HMP). The HMP will be implemented so that post-project runoff shall not exceed estimated pre-project rates and/or durations, where the increased stormwater discharge rates and/or durations will result in increased potential for erosion or other adverse impacts to beneficial uses, attributable to changes in the amount and timing of runoff. (Provision C.3.f.i)

Applicability -- Exempt Areas

This requirement does not apply to new development and redevelopment projects where the project discharges stormwater runoff into creeks or storm drains where the potential for erosion, or other impacts to beneficial uses, is minimal. Such situations may include discharges into creeks that are concrete-lined or significantly hardened (e.g., with rip-rap, sackrete, etc.) downstream to their outfall in San Francisco Bay, underground storm drains discharging to the Bay, and construction of infill projects in highly developed watersheds, where the potential for single-project and/or cumulative impacts is minimal. Guidelines for identification of such situations shall be included as a part of the HMP. (Provision C.3.f.ii)

(Guidelines for identifying exempt areas are provided in Section 5.3 of this chapter.)

Applicability -- Exempt Projects/ Reduced Requirements

The HMP may identify conditions under which some increases in runoff may not have a potential for increased erosion or other impacts to beneficial uses. Reduced controls or no controls on peak stormwater runoff discharge rates and/or durations may be appropriate in those cases, subject to the conditions in the HMP. In the absence of information demonstrating that changes in post-development runoff discharge rates and durations will not result in increased potential for erosion or other adverse impacts to beneficial uses, the HMP requirements shall apply. (Provision C.3.f.iii)

Management Objective

The Hydromodification Control Standard above states that “the HMP will be implemented so that post-project runoff shall not exceed estimated pre-project rates and/or durations, where the

increased stormwater discharge rates and/or durations will result in increased potential for erosion...” The erosion potential analysis in Chapter 3 provides an index, E_p , to indicate the impact of increased flows on stream stability. E_p can be expressed as the ratio of post-project to pre-project “work done” on the stream. Using this index as a point of reference, the following proposed management objective was developed:

Stormwater discharges from a non-exempt, Group 1 development project shall not cause an increase in the erosion potential of the receiving stream over the pre-project (existing) condition, i.e., an E_p of up to 1.0 will be maintained for stream segments downstream of the project discharge point.

Performance Criteria

The following section presents five proposed performance criteria for meeting the hydromodification control standard.

1. *Projects shall meet the management objective by providing stormwater controls as needed to maintain the pre-project stream erosion potential. Stormwater controls may include a combination of on-site, off-site (drainage area) and in-stream measures.*

Discussion: This criterion incorporates the E_p management objective as well as flexibility to meet the objective with different types of controls. It recognizes that there may be limitations to achieving the objective on-site, due to space limitations, soil conditions, depth to groundwater, economic feasibility, and other factors.

2. *On-site controls that are designed to provide flow duration control to the pre-project condition are considered to meet the erosion potential management objective and comply with the HMP.*

Flow duration controls shall be designed such that post-project stormwater discharge rates and durations match pre-project discharge rates and durations from 10% of the pre-project 2-year peak flow up to the pre-project 10-year peak flow.

Discussion: Stream channel erosion is caused by the increase in flow duration for the small and moderate magnitude flows above the threshold for sediment transport and stream bank erosion. Flow duration control maintains the flow duration pattern of the pre-project condition. Maintaining the pre-project flow duration effectively also maintains pre-project runoff volume for the full distribution of flows from the critical threshold flow (Q_c) up to the selected upper limit. Therefore, applying flow duration control to achieve the pre-project condition is considered to be fully protective of the existing condition of the stream segment to which the project discharges. These concepts are described in more detail in TM #7 (Appendix C).

Flow duration matching does not require additional watershed and stream analyses to ensure that E_p is being maintained in the stream. The allowable low flow discharge from the project site (Q_{cp}) can be estimated as 10% of the pre-project 2-year peak flow.¹

¹ In computing Q_{cp} , the allowable low flow discharge from a flow control structure on a project site, the original condition of the site before development must be considered. This does not imply that the developer is being required to provide flow controls to match pre-development conditions; rather, it is a means of apportioning the

Design of stormwater controls for flow duration matching does require continuous long-term hydrologic modeling of the project site. The design of flow duration controls is discussed further in Chapter 6 of this report. The procedure for design of a flow duration basin, including guidelines for matching the pre-project flow duration curve, is provided in Appendix F.

3. *Where on-site measures are not practicable for achieving flow duration control criteria, projects shall comply with the HMP requirements through the use of appropriate site design, source control, and treatment control measures with flow control benefits to the maximum extent practicable. In addition, where available, off-site and/or in-stream controls must be used to meet the management objective (see Performance Criterion #5).*

Discussion: Meeting the flow duration control criteria generally requires some type of detention and/or infiltration facilities that reduce the volume and control the rate of post-project discharge. These types of facilities may not be suitable for all project sites due to space limitations, soil conditions, depth to groundwater, and other factors, and in some cases, these limitations cannot be overcome at a reasonable cost. When flow duration controls are not practicable on-site, and off-site or in-stream control measures are available (see Performance Criterion #5), these additional measures shall be used to meet the management objective. If this option is not available, a project for which flow duration control is impracticable shall use site design, source control, and treatment control measures to achieve performance criteria to the maximum extent practicable. (See discussion under #4 below). Guidance on the use of these criteria is in the implementation of the HMP is presented in Chapter 7.

The primary measure of practicability for application of this performance criterion is the construction cost of measures required to comply with the HMP. Full implementation of the HMP will be considered impracticable if the combined construction cost of both required stormwater treatment and flow control measures¹ exceeds 2% of the project construction cost (excluding land costs). If a developer demonstrates that the cost to fully comply with the HMP and other C.3. treatment requirements will exceed this cost threshold, a determination may be made by the reviewing agency that the project may implement HMP controls on-site to the MEP and contribute to an in-stream solution, if available, up to a maximum cost for all controls of 2% of project cost. Additional guidelines for applying this criterion are provided in Chapter 7.

critical flow in a stream to individual projects that discharge to that stream, such that cumulative discharges do not exceed the critical flow in the stream. A description of the method for computing Q_{cp} is provided in Appendix F.

¹ Costs of control measures should not include other normal site enhancement costs such as landscaping or grading that is required for other purposes.

4. *Projects located on sites less than or equal to 20 acres in size that are not part of a larger phased development (“Small Site Project”) shall comply with the HMP requirements through the use of appropriate site design, source control, and treatment control measures with flow control benefits to the maximum extent practicable. In addition, where available, off-site and/or in-stream controls must be used to meet the management objective (see Performance Criterion #5).*

Discussion: Projects on small sites can have challenges with meeting HMP requirements due to space limitations and economic feasibility. Developers of small sites may also not have the resources to conduct continuous modeling studies to size flow control facilities. In addition, regulators and municipalities agree that it is not desirable or practical from a maintenance standpoint to have a large number of small flow duration basins spread throughout the Valley. One approach for developers of small sites is to contribute funds to an off-site (regional or in-stream) project commensurate with the expected impacts of the project, where off-site projects have been identified and planned and a mechanism for funding established.

Small Site Projects may use small scale, distributed stormwater management techniques such as bioretention facilities, infiltration trenches, filter strips, vegetated swales, and multi-functional landscape areas (a subset of the “site design measures” described in the SCVURPPP permit, also known as integrated management practices) to achieve treatment and flow reduction. The objectives of these site design measures and BMPs used to comply with the HMP are to: 1) reduce runoff volume through the reduction of impervious surface area and provide opportunities for infiltration; and 2) increase the time of concentration¹ of runoff to approximate that of the pre-project condition. Time of concentration can be increased by lengthening flow paths and allowing impervious areas to flow onto pervious areas.

Runoff volume reduction and time of concentrations for small-scale facilities can be computed using a discrete storm event approach until other simplified tools based on continuous simulation modeling are available for sizing flow control BMPs (see Chapter 7). Small Site Projects may demonstrate that this performance criterion is being met by matching pre- and post-project runoff volume and time of concentration (based on the 2- and 10-year storms) to the MEP. The SCVURPPP Co-permittees intend to collect data on the implementation of the HMP at small sites for a period of two years after the start of implementation, and plan to re-evaluate the small site size threshold and approach at that time. Concurrently, SCVURPPP intends to work with other Bay Area countywide stormwater programs toward a consistent set of performance criteria for the region.

¹ Time of concentration is defined as the length of time required for runoff to travel from the most remote point in the drainage area to the point of interest, say a storm drain inlet or receiving water

5. *Off-site (drainage area) or in-stream controls may be implemented to address potential project impacts in lieu of or in combination with on-site controls, where an approved plan, including an appropriate funding mechanism, is in place that accounts for the stream changes expected to result from changes in project runoff conditions. The off-site or in-stream controls or combination of controls shall be designed to achieve the hydromodification management objective threshold of $E_p \leq 1.0$ from the point of discharge to the stream as far downstream as potential impacts will occur.*

Discussion: When a combination of on-site, off-site, and in-stream measures is proposed for hydromodification management, the amount of increase in erosive work done on the stream from the site's discharge (i.e., after the application of any on-site and off-site measures) is used to size the in-stream measures. A project with on-site and/or off-site measures may be allowed to discharge runoff at higher rates and durations than a flow duration matching criterion would allow, as long as the stream is protected using in-stream measures downstream of the project discharge point.

Designing in-stream controls using the E_p method involves a hydrologic and geomorphic evaluation of the stream system downstream of the project. The method requires computing stream flows at several locations within a stream system and the work done on the stream channels before and after development. A continuous hydrologic model is required as well as geometric and geomorphic data at each location.

The District has an SMP (Stream Maintenance Program) and capital improvement projects through which in-stream projects are permitted and approved. Both the SMP and capital projects may provide the basis for an in-stream program to support hydromodification management (see Chapter 7 for discussion).

5.3 EXEMPT AREAS AND PROJECTS

This section of Chapter 5 provides guidelines that Co-permittees can use to identify project types and/or areas within the Santa Clara Basin that may be exempt from hydromodification controls under Permit Provision C.3.f.ii and explains how the various exemptions will be applied. Program staff worked with the Exempt Areas Subgroup of the HMP Work Group, including representatives of Palo Alto (Chair), San Jose, Sunnyvale, and the Water District, to develop the guidelines. Permit Provision C.3.f.ii states:

“This requirement does not apply to new development and redevelopment projects where the project discharges stormwater runoff into creeks or storm drains where the potential for erosion, or other impacts to beneficial uses, is minimal. Such situations may include discharges into creeks that are concrete-lined or significantly hardened (e.g., with rip-rap, sackcrete, etc.) downstream to their outfall in San Francisco Bay, underground storm drains discharging to the Bay, and construction of infill projects in highly developed watersheds, where the potential for single-project and/or cumulative impacts is minimal. Guidelines for identification of such situations shall be included as part of the HMP. However, plans to restore a creek may re-introduce the applicability of HMP controls, and would need to be addressed in the HMP.”

The Permit also recognizes that some projects will be exempt from HMP requirements “*where increased stormwater discharge rates and/or durations will not result in increased potential for erosion or other adverse impacts to beneficial uses*”, e.g. where post-project runoff will not exceed estimated pre-project rates and/or durations (Provision C.3.f.i.).

A project may be exempt from HMP requirements under three conditions:

1. Exemption based on project characteristics (e.g., the project will cause no increase in the potential for erosion or other impact to beneficial uses, such as where the post-project flow rate and/or duration will not exceed the estimated pre-project condition);
2. Exemption based on the condition of the stream segment to which the project ultimately discharges (i.e., there is minimal potential for erosion or other impact on beneficial uses in that segment and downstream segments); or
3. Exemption based on project location, i.e., the project is an infill project in a highly developed watershed.

Guidelines for determining whether one of these conditions applies to particular a project are provided below.

Exemption Based on Project Characteristics

The HMP requirements do not apply to projects where there is no potential for erosion or other impact to beneficial uses. These are projects for which estimated post-project flow rates and/or durations will not exceed estimated pre-project conditions. For the purpose of this exemption, “pre-project condition” is defined as the existing condition of the site prior to construction of the project in question, not the original condition of the site.

A simple indicator of the post-project runoff pattern is the amount of impervious surface on the site upon completion of construction. If a project does not increase the amount of directly connected impervious area (DCIA)¹ on the site (i.e., the DCIA of the post-project condition will be the same as or less than the DCIA of the pre-project condition) and does not significantly change the drainage pattern from the site, then the HMP requirements do not apply to that project because it will not cause an increase in stormwater discharge rates, volumes, or durations. An example of this type of project is a redevelopment project that has the same amount of roof area, parking lot, and hardscape as the previous use of the site.

The amount of impervious surface is not the only indicator of pre-project runoff. For example, a project may be able to show that even though the impervious surface area has increased, actual runoff will be less because permeability of the remaining area will be enhanced by the project and there is less directly connected impervious surface. The effect of the project on runoff rates and durations is also determined by any changes in the topography and/or storm drain infrastructure on the site.

¹ Directly connected impervious area is defined as an area covered by an impervious surface that drains directly across other impervious surfaces to a storm drain without first flowing across a pervious surface such as a lawn or vegetated area. For an impervious area to be considered “disconnected”, the downstream pervious area must be large enough to accommodate the increase in stormwater volume and flow from the impervious area.

Several Co-permittees have reported that many of the recent redevelopment projects in their jurisdictions actually reduce the amount of impervious area that was present before construction, due to stricter landscaping requirements and better site design practices. The use of swales, pervious paving and landscape features for stormwater treatment also results in reduction of impervious surfaces.

Even where post project rates and/or durations will increase over pre-project levels, a project may still be exempt if the project proponent can demonstrate that there will be no increase in potential for erosion or other adverse impact to beneficial uses. For this purpose, a project proponent may conduct stream-specific field and modeling studies that are consistent with the method used in this report to estimate the impacts of a particular project.

Exemption Based on Stream Segment Condition

Projects located within areas that drain to stream segments that are unlikely to erode or experience other impacts from increased flows are exempt from HMP requirements. Four guidelines identify such stream segments. Figure 5-1 illustrates the application of these guidelines to the streams in the Santa Clara Valley and the catchment areas that are exempt from HMP requirements as a result.

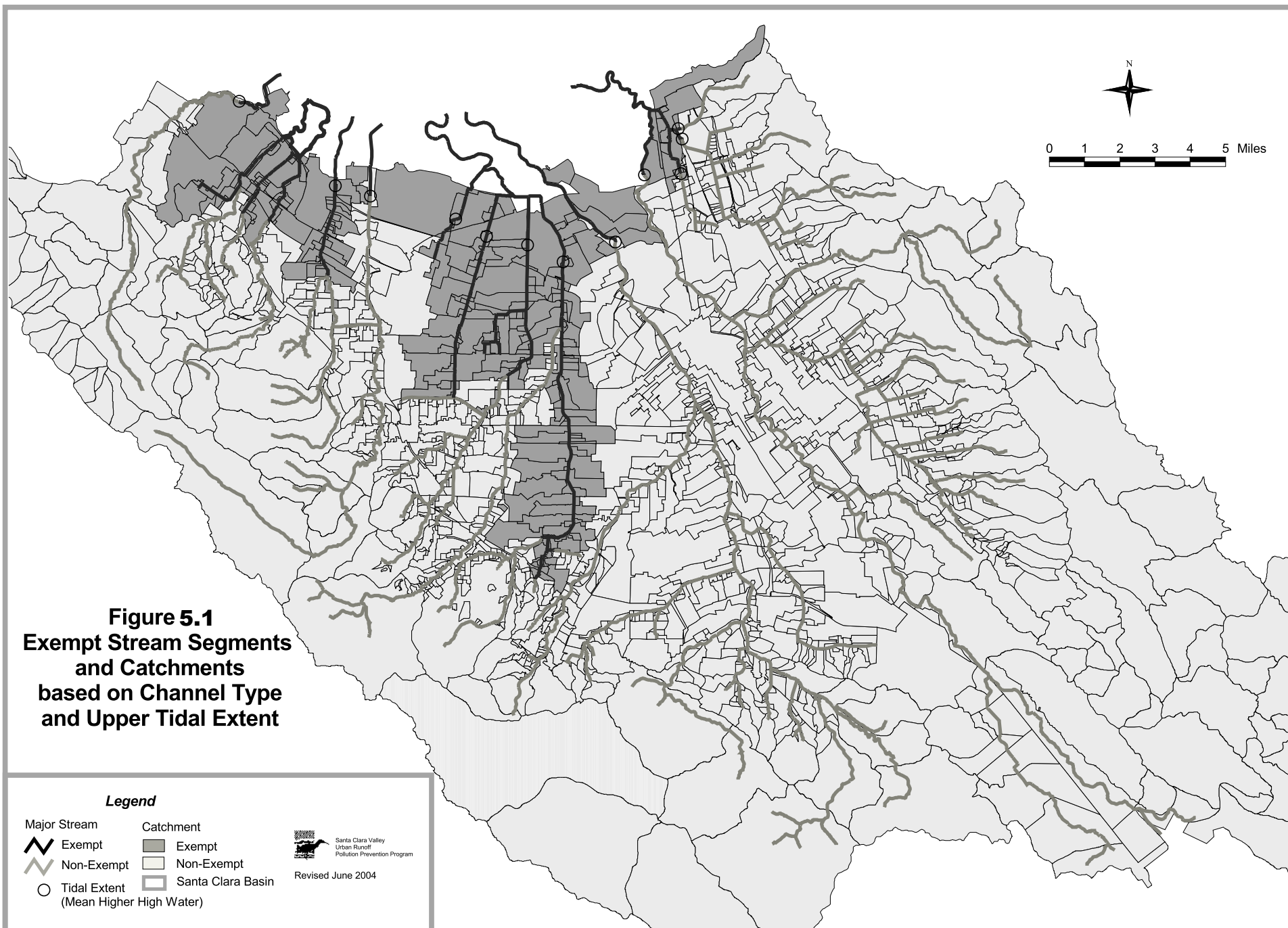
1. Project area drains to a stream channel within the tidally influenced area.

Within tidally influenced areas, the daily fluctuations in flow move sediment within the tidal zone; therefore it is unlikely that increases in flow to these areas would cause further erosion in the stream channel. Figure 5-1 shows the farthest upstream locations of the tidal zone in Santa Clara Valley streams. Areas that discharge stormwater into a stream below this point are exempt.

Tidally influenced stream segments were identified using the SCVWD GIS data layer entitled "Mean Higher High Water (MHHW)." The furthest upstream end of the stream segment identified as "below MHHW" in the GIS database represents the furthest limit of area regularly inundated by tidal flows (SCVWD 2000). The elevation of MHHW was digitized for each Santa Clara Valley stream to indicate the farthest upstream location influenced by this criterion, with the exception of Barron, Matadero and Adobe Creeks, which are no longer tidally influenced due to the construction of tidal gates located farther downstream.

2. Project area drains to a non earthen stream channel that is hardened on three sides and extends continuously upstream from the tidally influenced area.

Stream channels that have already been hardened on all sides are not susceptible to erosion. Permit Provision C.3.f.ii states that channels that are continuously hardened downstream to their outfall to the Bay are exempt from HMP controls. Intermittent hardened segments further upstream that discharge to a non-hardened segment are not exempt. Channel segments and tributary catchment areas considered exempt from HMP requirements are shown on Figure 5-1.



The designation of hardened channel segments on Figure 5-1 is based on the following data sources. The SCVWD's Water Ways Management Model (WWMM) is the primary available information source for channel type and channel material. Specifically, information about channel materials contained in attributes that describe channel bottom and channel sides was used (e.g., concrete, gabion, or rock). For stream segments that did not contain information on channel materials, the channel type attribute was used to identify hardness of channels. Analysis of the data showed that certain channel types were typically hardened on all three sides (i.e., occurred for more than 90% of the records). These channel types included culverts (e.g., box, pipe) and concrete channels (e.g., trapezoidal and rectangular). Where these channel types had no channel material information, they were assumed to be hardened on all three sides. In addition, several non-hardened channel segments were considered exempt because they were less than 1,000 feet in length and had hardened channel segments above and below them, or were within 0.5 miles upstream of a tidal area and had hardened channel segments above them. The data supporting exemption of six specific segments is presented in Appendix G.

Field verification of channel condition is recommended as part of project development. Localized applications of rock riprap do not qualify a reach as "hardened" because bank failure can occur (and has been observed) around riprap due to excess velocities.

3. Project drains to Sunnyvale East or West Channels

The Sunnyvale East and West Flood Control Channels and areas draining to them are considered exempt from HMP requirements. These channels were constructed by the Water District in 1964-1967 and 1959, respectively, to provide drainage for a large area of Sunnyvale between Stevens Creek and Calabazas Creek, where natural channels did not historically exist. (This exemption does not apply to the Stevens or Calabazas Creek watersheds.)

The Sunnyvale East and West Channels are constructed of diked earthen materials that have been compacted during construction. They occur in a low-lying area of the Valley and have significant areas of tidal influence in their northern sections. For these reasons, the potential for erosion in these channels from increased flows resulting from upstream hydromodification is minimal. Additional justification for the exemption of these channels is presented in Appendix G.

4. Project drains to an underground storm drain that discharges directly to San Francisco Bay.

The permit specifically exempts projects that drain to "underground storm drains discharging to the Bay", as these will not cause erosion in stream segments. Areas in which such projects would be located are likely contained within the areas exempted due to discharge to tidally influenced stream segments. The final determination should be made from the project storm drain maps.

Exemption for Infill Projects in Highly Developed Watersheds

Analysis

Provision C.3.f.ii states that HMP controls do not apply to “*construction of infill projects in highly developed watersheds, where the potential for single-project and/or cumulative impacts is minimal.*” Two approaches that the Program explored for identifying highly developed watersheds, the percent imperviousness approach and the percent developed or “build-out” approach, are described in Section 2.8. Analysis of these two approaches resulted in development of guidelines for identifying the projects that will be exempt using a combination of the two: a subwatershed that is 90% built-out is considered a highly developed watershed, and the definition of an infill project is based on percent imperviousness of the subwatershed, as described in the following section.

Guideline for Identifying Exempt Projects

Provision C.3.f.ii states that HMP requirements do not apply to infill projects in highly developed watersheds. That is, in order to be exempt, a project has to be categorized as “infill” and located in a highly developed watershed. Thus, there are two steps to the application of this guideline.

Step 1. Is the project in a highly developed watershed?

Subwatersheds with developed areas constituting 90% or greater of the total subwatershed area (i.e., 90% built out) are considered highly developed watersheds.

Step 2. Is the project an infill project?

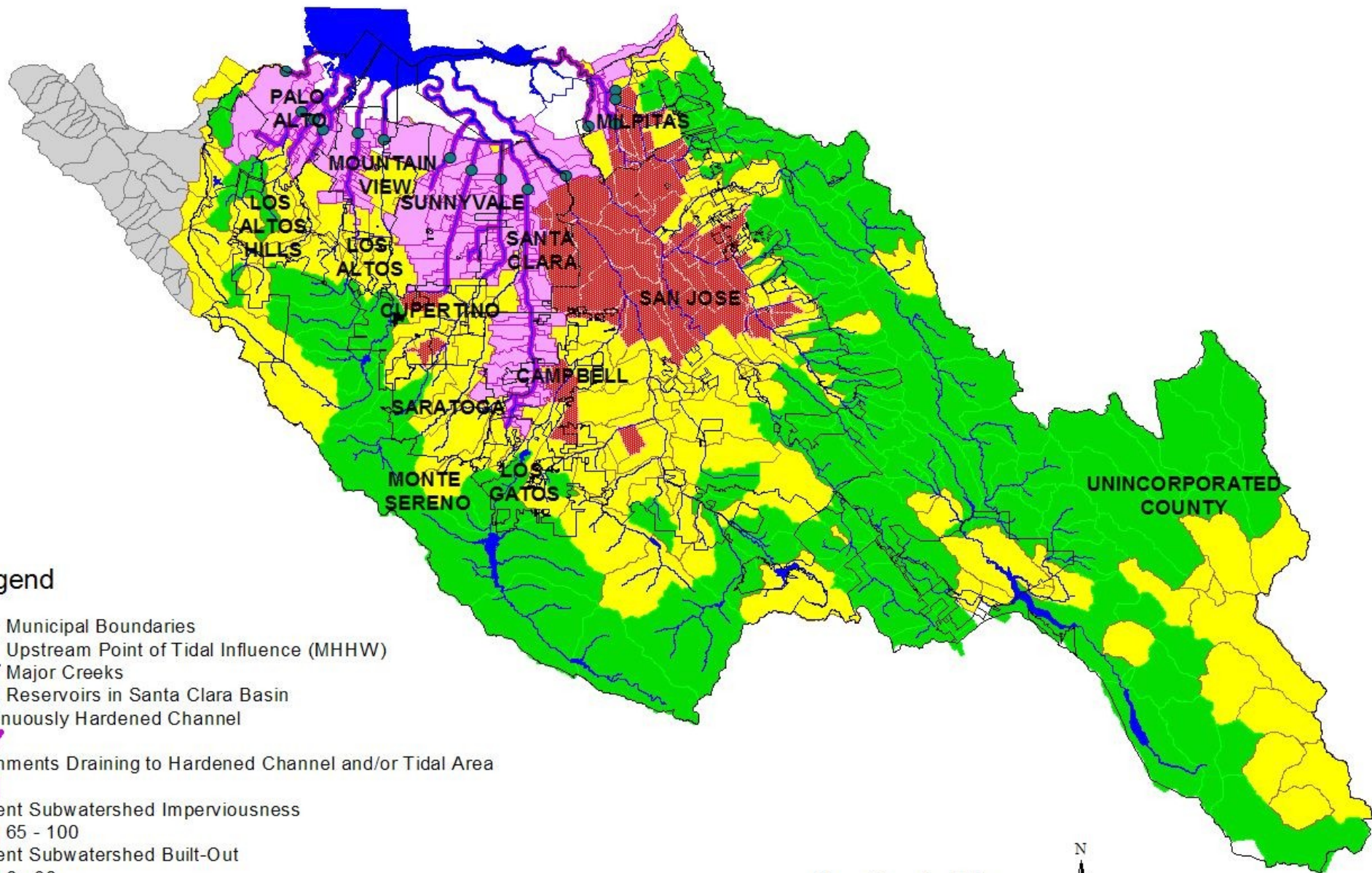
The definition of an infill project is as follows:

- a. All projects in subwatersheds with 65% or more of impervious surface; or
- b. Projects less than 50 acres (total size) in subwatersheds with less than 65% of impervious surface.












All projects that meet the definition of infill development and are located within subwatersheds with 90% or greater build out are considered exempt from HMP requirements; however, they are still encouraged to incorporate site design, source control, and treatment control measures that have flow control benefits.

Figure 5-2 presents a draft Santa Clara Valley map with classification of subwatershed areas for determining applicability of HMP requirements. The green-shaded areas are subwatersheds that are less than 90% built out, and all Group 1 projects within those areas must meet the HMP requirements (i.e., the management objective and performance criteria described in this chapter). The purple areas are catchment areas that drain to tidal zones or hardened channels; projects within these areas are exempt from HMP requirements. The red areas represent subwatersheds that are 65% or more impervious and 90% or more built-out; projects within the red areas are also exempt from HMP requirements. The yellow shading represents subwatershed areas that are more than 90% built out, but less than 65% impervious. Projects in the yellow area are exempt if they are less than 50 acres in total land area; projects in the yellow area that are greater than 50 acres must meet HMP requirements.

Classification of Subwatershed and Catchment Areas For Determining Applicability of HMP Requirements



Legend

-  Municipal Boundaries
-  Upstream Point of Tidal Influence (MHHW)
-  Major Creeks
-  Reservoirs in Santa Clara Basin
-  Continuously Hardened Channel
-  Catchments Draining to Hardened Channel and/or Tidal Area
-  Percent Subwatershed Imperviousness
-  65 - 100
-  0 - 90
-  90 - 100
-  Watershed Area Outside of SCVURPPP Permit Area

0 2 4 Miles




A quick reference guide to the map is presented below:

<u>Map Area Color</u>	<u>Applicability of HMP</u>
Purple	Exempt
Red	Exempt
Yellow	Exempt if < 50 acres total area Applicable if > 50 acres total area
Green	Applicable

The Program has provided the map files and metadata to the Co-permittees for use in their GIS systems to allow more accurate determination of specific project locations on the map. The Program will continue to work with Co-permittees to verify and correct potential inaccuracies in the map and make additional updates as needed.

Encouragement of Voluntary Measures

These guidelines advise Co-permittees to recommend that all Group 1 project developers, even those exempted from HMP requirements, incorporate flow reduction into the project design, as part of site design and treatment controls, to the extent possible on the project site. This is less important for those areas that discharge to a tidal zone, a hardened channel or directly to the Bay.

Application of Exemption Guidelines

A flow chart for determining whether HMP requirements apply to a particular development project is presented in Figure 5-3.

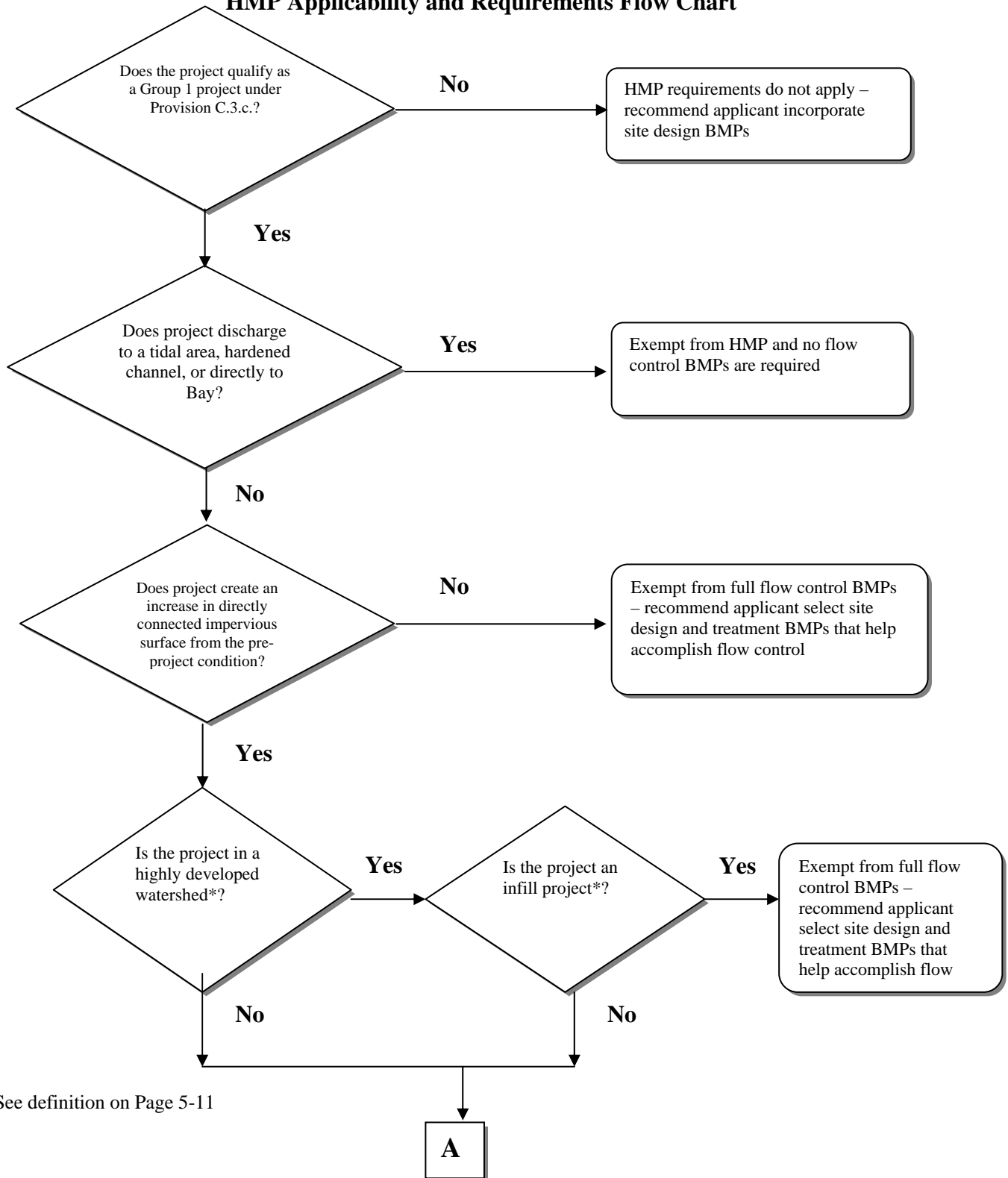
Future Analyses

The District and its consultants have recently completed field investigations to determine the most downstream limit (MDL) of reach-wide, active erosion on a number of creeks in the Santa Clara Valley. Each MDL reach is characterized by an upstream end where the creek is at the threshold of a medium-to-high level of erosion. Further development which increases the impervious area upstream of the MDL could accelerate the erosion at the upstream end of the reach and increase the length of creek that is unstable.

The SCVURPPP Co-permittees have not had the opportunity to fully evaluate the MDL concept and determine how it fits within the framework of the HMP. The Program plans to facilitate the review of the MDL analyses, both by the Co-permittees and by the HMP Expert Panel, and then work with the Management Committee to determine the need to integrate some or all of the MDL analyses in the implementation of the HMP. This review and any additional analyses will be completed within the first two years of implementation of the HMP.

Figure 5-3

HMP Applicability and Requirements Flow Chart



* See definition on Page 5-11

Figure 5-3 (Cont'd)
HMP Applicability and Requirements Flow Chart

