Attachment A

Provision C.3.f
Alameda Permittees
Hydromodification Management Requirements

Alameda Permittees Hydromodification Management Requirements

1. Onsite and Regional Hydromodification Management (HM) Control Design Criteria

a. *Range of flows to control*: 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[1] up to the pre-project 10-year peak flow, except where the lower endpoint of this range is modified as described in Section 6 of this Attachment.

b. *Goodness of fit criteria*: The post-project flow duration curve shall not deviate above the pre-project flow duration curve by more than 10% over more than 10% of the length of the curve corresponding to the range of flows to control.

c. *Allowable low flow rate*: Flow control structures may be designed to discharge stormwater at a very low rate that does not threaten to erode the receiving water body. This flow rate (also called "Qcp[2]") shall be no greater than 10% of the pre-project 2-year peak flow unless a modified value is substantiated by analysis of actual channel resistance in accordance with an approved User Guide as described in Section 6 of this Attachment.

d. *Standard HM modeling*: On-site and regional HM controls designed using the Bay Area Hydrology Model (BAHM[3]) and site-specific input data shall be considered to meet the HM Standard. Such use must be consistent with directions and options set forth in the most current BAHM User's Manual[4]. Permittees shall demonstrate to the satisfaction of the Executive Officer that any modifications of the BAHM made (per Finding 34) are consistent with the requirements of this Attachment and Provision C.3.f.

e. *Alternate HM modeling and design*: The project proponent may use a continuous simulation hydrologic computer model[5] to simulate pre-project and post-project runoff and to design HM controls. To use this method, the project proponent shall compare the pre-project and post-project model output for a rainfall record of at least 30 years, and shall show that all applicable performance criteria in 1.a-e above are met.

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1 Where referred to in this Order, the 2-year peak flow is determined using a flood frequency analysis based on USGS Bulletin 17 B to obtain the flow peak statistically expected to occur at 2 year intervals. In this analysis, the entire record of hourly rainfall data (e.g., 35-50 years of data) is run through a continuous simulation model (footnote 5), the annual peak flows are identified, rank ordered, and the 2 year flow is generated.

2 Qcp is the allowable low flow discharge from a flow control structure on a project site. It is a means of apportioning the 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.

3 *The Bay Area Hydrology Model – A Tool for Analyzing Hydromodification Effects of Development Projects and Sizing Solutions*, Bicknell, J., D. Beyerlein, A. Feng, September 26, 2006. Available at http://www.scvurppp-w2k.com/permit_c3_docs/Bicknell-Beyerlein-Feng_CASQA_Paper_9-26-06.pdf

4 *The Bay Area Hydrology Model – A Tool for Analyzing Hydromodification Effects of Development Projects and Sizing Solutions*, Bicknell, J., D. Beyerlein, A. Feng, September 26, 2006. Available at http://www.scvurppp-w2k.com/permit_c3_docs/Bicknell-Beyerlein-Feng_CASQA_Paper_9-26-06.pdf

5 Such models include US EPA's Hydrograph Simulation Program—Fortran (HSPF), US Army Corps of Engineers hydrologic Engineering Center-Hydrologic Modeling System (HEC-HMS), and US EPA's Surface Water Management Model (SWMM).

2. Impracticability Provision

Where conditions (e.g., extreme space limitations) prevent a project from meeting the HM Standard for a reasonable cost, and where the project's runoff cannot be directed to a regional HM control within a reasonable timeframe, and where an in-stream measure is not practicable, the project shall use (1) site design for hydrologic source control, and (2) stormwater treatment measures that collectively minimize, slow, and detain[6] runoff to the maximum extent practicable. In addition, the project proponent shall provide for or contribute financially to an alternative HM project as set forth below:

a. *Reasonable cost*: To show that the HM Standard cannot be met at a reasonable cost, the project proponent must demonstrate that the total cost to comply with both the HM standard and the Provision C.3.d. treatment requirement exceeds 2% of the project construction cost, excluding land costs. Costs of HM and treatment control measures shall not include land costs, soil disposal fees, hauling, contaminated soil testing, mitigation, disposal, or other normal site enhancement costs such as landscaping or grading that are required for other development purposes.

b. *Regional HM controls:* A regional HM control shall be considered available if there is a planned location for the regional HM control and if an appropriate funding mechanism for a regional HM control is in place by the time of project construction.

c. *In-stream measures practicability:* In-stream measures shall be considered practicable when an in-stream measure for the project's watershed is planned and an appropriate funding mechanism for an in-stream measure is in place by the time of project construction.

d. *Financial contribution to an alternative HM project:* The difference between 2% of the project construction costs and the cost of the treatment measures at the site (both costs as described in Section 2.a of this Attachment) shall be contributed to an alternative HM project, such as a stormwater treatment retrofit, HM retrofit, regional HM control, or in-stream measure that is not otherwise required by the Board or other regulatory agency. Preference shall be given to projects discharging, in this order, to the same tributary, main stem, watershed, then in the same municipality or county.

3. Record Keeping

Permittees shall collect and retain the following information for all projects subject to HM requirements:

a. Site plans identifying impervious areas, surface flow directions for the entire site, and location(s) of HM measures;

b. For projects using standard sizing charts, a summary of sizing calculations used;

c. For projects using the BAHM, a listing of model inputs;

[6] Stormwater treatment measures that detain runoff are generally those that filter runoff through soil or other media, and include bioretention units, bioswales, basins, planter boxes, tree wells, media filters, and green roofs.

d. For projects using custom modeling, a summary of the modeling calculations with corresponding graph showing curve matching (existing, post-project, and post-project with HM controls curves);

e. For projects using the Impracticability Provision, a listing of all applicable costs and a brief description of the alternative HM project (name, location, date of start up, entity responsible for maintenance);

f. A listing, summary, and date of modifications made to the BAHM, including technical rationale.

4. HM Control Areas

Applicable projects shall be required to meet the HM Standard when such projects are located in areas of HM applicability shown in Figure A-1.[7] Plans to restore a creek reach may re-introduce the applicability of HM requirements; in these instances, Permittees may add, but shall not delete, areas of applicability accordingly.

To assist in location and evaluation of project applicability, Figure A-1 depicts a number of features including:

- hardened channels and culverts at least 24 inches in diameter (green solid or dashed lines);
- natural channels (red lines);
- boundaries of major watersheds (light blue lines); and
- surface streets and highways (gray or black lines).

These data are of varying age, precision and accuracy and are not intended for legal description or engineering design. Watersheds extending beyond the County boundaries are shown for illustration purposes only. Project proponents are responsible for verifying and describing actual conditions of site location and drainage.

5. Figure A-1 is color-coded as follows:

a. **Solid pink areas**: Solid pink designates hilly areas, where high slopes (greater than 25%) occur. The HM Standard and all associated requirements apply in areas shown in solid pink on the map. In this area, the HM Standard does *not* apply if a project proponent demonstrates that all project runoff will flow through enclosed storm drains, existing concrete culverts, or fully hardened (with bed and banks continuously concrete-lined) channels to the tidal area shown in light gray.

b. **Purple/red hatched areas:** These are upstream of areas where hydromodification impacts are of concern due to factors such as bank instability, sensitive habitat, or restoration projects. The HM Standard and all associated requirements apply in areas shown in purple/red (printer-dependant) hatch marking on the map. Projects in these areas may be subject to additional agency reviews related to hydrologic, habitat or other watershed-specific concerns.

[7] The watercourses potentially susceptible to hydromodification impacts are identified based on an assessment approach developed by Balance Hydrologics (2003).

c. **Solid white areas:** Solid white designates the land area between the hills and the tidal zone. This area may be susceptible to hydromodification unless the site is connected to storm drains that discharge to the tidal area. The HM Standard and all associated requirements apply to projects in solid white areas ***unless*** a project proponent demonstrates that all project runoff will flow through fully hardened channels[8]. Short segments of engineered earthen channels (length less than 10 times the maximum width of trapezoidal cross-section) can be considered resistant to erosion if located downstream of a concrete channel of similar or greater length and comparable cross-sectional dimensions. Plans to restore a hardened channel may affect the HM Standard applicability in this area.

d. **Solid gray areas:** Solid gray designates areas where streams or channels are tidally influenced or primarily depositional near their outfall in San Francisco Bay. The HM Standard does not apply to projects in this area. Plans to restore a hardened channel may affect the HM Standard applicability in this area.

e. **Dark gray, Eastern County area:** Dark gray designates the portion of eastern Alameda County that lies outside of the discharge area of this NPDES permit. This area is in the Central Valley Regional Water Quality Control Board's jurisdiction.

6. Potential Exceptions to Figure A-1 Designations

The Program may choose to prepare a User Guide[9] to be used for evaluating individual receiving waterbodies using detailed methods to assess channel stability and watercourse critical flow. This User Guide would reiterate and collate established stream stability assessment methods that have been presented in the Program's HMP.[10] After the Program has collated its methods into User Guide format, received approval of the User Guide from the Executive Officer,[11] and informed the public through such process as an email list-serve, the User Guide may be used to guide preparation of technical reports for: implementing the HM standard using in-stream or regional HM controls; determining whether certain projects are discharging to a watercourse that is less susceptible (from point of discharge to the Bay) to hydromodification (e.g., would have a lower potential for erosion than set forth in these requirements); and/or determining if a watercourse has a higher critical flow and project(s) discharging to it are eligible for an alternative Qcp for the purpose of designing onsite or regional measures to control flows draining to these channels (i.e., the actual threshold of erosion-causing critical flow is higher than 10% of the 2-year pre-project flow). In no case shall the design value of Qcp exceed 50% of the 2-year pre-project flow.

[8] In this paragraph, "fully hardened channels" include enclosed storm drains, existing concrete culverts, or channels whose bed and banks are continuously concrete-lined to the tidal area shown in light gray on the map.
[9] The User Guide may be offered under a different title.
[10] The Program's HMP has undergone Water Board staff review and been subject to public notice and comment.
[11] The User Guide will not introduce a new concept, but rather reformat existing methods; therefore, Executive Officer approval is appropriate.

Attachment B

Provision C.3.f
Contra Costa Permittees
Hydromodification Management Requirements

Contra Costa Permittees Hydromodification Management Requirements

1. Demonstrating Compliance with the Hydromodification Management (HM) Standard

Project proponents shall demonstrate compliance with the standard by demonstrating that any one of the following four options is met:

a. No increase in impervious area. The project proponent may compare the project design to the pre-project condition and show the project will not increase impervious area and also will not facilitate the efficiency of drainage collection and conveyance. The comparison shall include all of the following:

i. Assessment of site opportunities and constraints to reduce imperviousness and retain or detain site drainage.

ii. Description of proposed design features and surface treatments used to minimize imperviousness.

iii. Inventory and accounting of existing and proposed impervious areas.

iv. A qualitative comparison of pre-project to post-project efficiency of drainage collection and conveyance that demonstrates that opportunities to decrease imperviousness and retain / detain runoff have been maximized. Stormwater treatment IMPs such as those in the *Stormwater C.3 Guidebook* increase time of concentration, particularly for smaller storms, and are considered to substantially reduce drainage efficiency.

b. Implementation of hydrograph modification IMPs. The project proponent may select and size IMPs to manage hydrograph modification impacts, using the design procedure, criteria, and sizing factors specified in the Contra Costa Clean Water Program's *Stormwater C.3 Guidebook*. The use of flow-through planters shall be limited to upper-story plazas, adjacent to building foundations, on slopes where infiltration could impair geotechnical stability, or in similar situations where geotechnical issues prevent use of IMPs that allow infiltration to native soils. Limited soil infiltration capacity in itself does not make use of other IMPs infeasible.

c. Estimated post-project runoff durations and peak flows do not exceed pre-project durations and peak flows. The project proponent may use a continuous simulation hydrologic computer model such as US EPA's Hydrograph Simulation Program—Fortran (HSPF) to simulate pre-project and post-project runoff, including the effect of proposed IMPs, detention basins, or other stormwater management facilities. To use this method, the project proponent shall compare the pre-project and post-project model output for a rainfall record of at least 30 years, using limitations and instructions provided in the Program's *Stormwater C.3 Guidebook*, and shall show the following criteria are met:

i. For flow rates from 10% of the pre-project 2-year runoff event (0.1Q2) to the pre-project 10-year runoff event (Q10), the post-project discharge rates and durations shall not deviate above the pre-project rates and durations by more than 10% over more than 10% of the length of the flow duration curve.

ii. For flow rates from 0.5Q2 to Q2, the post-project *peak flows* shall not exceed pre-project peak flows. For flow rates from Q2 to Q10, post-project peak flows may exceed pre-project flows by up to 10% for a 1-year frequency interval. For example, post-project flows could exceed pre-project flows by up to 10% for the interval from Q9 to Q10 or from Q5.5 to Q6.5, but not from Q8 to Q10.

d. Projected increases in runoff peaks and durations will not accelerate erosion of receiving stream reaches. The project proponent may show that, because of the specific characteristics of the stream receiving runoff from the project site, or because of proposed stream restoration projects, or both, there is little likelihood that the cumulative impacts from new development could increase the net rate of stream erosion to the extent that beneficial uses would be significantly impacted. To use this option, the project proponent shall evaluate the receiving stream to determine the relative risk of erosion impacts and take the appropriate actions as described below and in Table A-1. Projects 20 acres or larger in total area shall not use the medium risk methodology in "b" below.

i. "Low Risk." In a report or letter report, signed by an engineer or qualified environmental professional, the project proponent shall show that all downstream channels between the project site and the Bay/Delta fall into one of the following "low-risk" categories.

(1) Enclosed pipes.

(2) Channels with continuous hardened beds and banks engineered to withstand erosive forces and composed of concrete, engineered riprap, sackcrete, gabions, mats, etc. This category excludes channels where hardened beds and banks are not engineered continuous installations (i.e., have been installed in response to localized bank failure or erosion).

(3) Channels subject to tidal action.

(4) Channels shown to be aggrading, i.e., consistently subject to accumulation of sediments over decades, and to have no indications of erosion on the channel banks.

ii. "Medium Risk." Medium risk channels are those where the boundary shear stress could exceed critical shear stress as a result of hydrograph modification, but where either the sensitivity of the boundary shear stress to flow is low (e.g., an oversized channel with high width to depth ratios) or where the resistance of the channel materials is relatively high (e.g., cobble or boulder beds and vegetated banks). In "medium-risk" channels, accelerated erosion due to increased watershed imperviousness is not likely but is possible, and the uncertainties can be more easily and effectively addressed by mitigation than by additional study.

In a preliminary report, the project proponent's engineer or qualified environmental professional will apply the Program's "Basic Geomorphic Assessment"[12] methods and criteria to show each downstream reach between the project site and the Bay/Delta is either at "low-risk" or "medium-risk" of accelerated erosion due to watershed development. In a following, detailed report, a qualified stream

[12] Contra Costa Clean Water Program *Hydrograph Modification Management Plan*, May 15, 2005, Attachment 4, pp. 6-13. This method must be made available in the Program's *Stormwater C.3 Guidebook.*

geomorphologist[13] will use the Program's Basic Geomorphic Assessment methods and criteria, available information, and current field data to evaluate each "medium-risk" reach. For *each* "medium-risk" reach, the detailed report shall show one of the following:

(1) A detailed analysis, using the Program's criteria, showing the particular reach may be reclassified as "low-risk."

(2) A detailed analysis, using the Program's criteria, confirming the "medium-risk" classification, and:

  (a) A preliminary plan for a mitigation project for that reach to stabilize stream beds or banks, improve natural stream functions, and/or improve habitat values, and

  (b) A commitment to implement the mitigation project timely in connection with the proposed development project (including milestones, schedule, cost estimates, and funding), and

  (c) An opinion and supporting analysis by one or more qualified environmental professionals that the expected environmental benefits of the mitigation project substantially outweigh the potential impacts of an increase in runoff from the development project, and

  (d) Communication, in the form of letters or meeting notes, indicating consensus among staff representatives of regulatory agencies having jurisdiction that the mitigation project is feasible and desirable. In the case of the Regional Water Board, this must be a letter, signed by the Executive Officer or designee, specifically referencing this requirement. (This is a preliminary indication of feasibility required as part of the development project's Stormwater Control Plan. All applicable permits must be obtained before the mitigation project can be implemented.)

iii. "High Risk." High-risk channels are those where the sensitivity of boundary shear stress to flow is high (e.g., incised or entrenched channels, channels with low width-to-depth ratios, and narrow channels with levees) or where channel resistance is low (e.g., channels with fine-grained, erodible beds and banks, or with little bed or bank vegetation). In a "high-risk" channel, it is presumed that increases in runoff flows will accelerate bed and bank erosion.

To implement this option (i.e., to allow increased runoff peaks and durations to a high-risk channel), the project proponent must perform a comprehensive analysis to determine the design objectives for channel restoration and must propose a comprehensive program of in-stream measures to improve channel functions while accommodating increased flows. Specific requirements are developed case-by-case in consultation with regulatory agencies having jurisdiction. The analysis will typically involve watershed-scale continuous hydrologic modeling (including calibration with stream gauge data where possible) of pre-project and post-project runoff flows, sediment transport modeling, collection and/or analysis of field data to characterize

[13] Typically, detailed studies will be conducted by a stream geomorphologist retained by the lead agency (or, on the lead agency's request, another public agency such as the Contra Costa County Flood Control and Water Conservation District) and paid for by the project proponent.

channel morphology including analysis of bed and bank materials and bank vegetation, selection and design of in-stream structures, and project environmental permitting.

2. IMP Model Calibration and Validation

The Program shall monitor flow from Hydrograph Modification Integrated Management Practices (IMPs) to determine the accuracy of its model inputs and assumptions. Monitoring will be conducted with the aim of evaluating flow control effectiveness of the IMPs. The Program will implement monitoring where feasible at future new development projects to gain insight into actual versus predicted rates and durations of flow from IMP overflows and underdrains.

At a minimum, five locations shall be monitored for a minimum of two rainy seasons. If two rainy seasons are not sufficient to collect enough data to determine the accuracy of model inputs and assumptions, monitoring shall continue until such time as adequate data are collected.

The IMP monitoring shall be conducted as described in the IMP Model Calibration and Validation Plan in Section 5 of this Attachment. Monitoring results shall be submitted to the Executive Officer by June 15 of each year following collection of monitoring data. If the first year's data indicate IMPs are not effectively controlling flows as modeled in the HMP, the Executive Officer may require the Program to make adjustments to the IMP sizing factors or design, or otherwise take appropriate corrective action. An IMP Monitoring Report shall be submitted by August 30 of the second year[14] of monitoring. The IMP Monitoring Report shall contain, at a minimum, all the data, graphic output from model runs, and a listing of all model outputs to be adjusted, with full explanation for each. Board staff will review the IMP Monitoring Report and require the Program to make any appropriate changes to the model within a three-month timeframe.

3. Stormwater C.3 Guidebook

a. NRCS Soil Groups: The *Stormwater C.3 Guidebook* shall include IMP sizing factors for use on development sites with Hydrologic Soil Group "B" and "C" soils, which shall be calculated using the methods and references in the *Contra Costa Clean Water Program Hydrograph Modification Management Plan,* dated May 15, 2005.

b. Self-Retaining Areas: The *Stormwater C.3 Guidebook* shall also include appropriate criteria, based on detailed hydrologic analysis, to ensure runoff peak flows and durations from "self-retaining areas" do not exceed pre-project peak flows and durations from these same areas. Until such time as the Executive Officer approves these criteria, no areas shall be considered "self-retaining" for the purposes of designing and implementing HM controls (i.e., stormwater flow and duration controls).

[14] In the case that the monitoring extends beyond two years, an IMP Monitoring Report shall be submitted by August 30 annually until model calibration and validation is complete.

Table B-1: Summary of Option #4

Summary only. If there are conflicts between this summary table and the text of the Hydrograph Modification Management Standard, the text shall apply.

Risk Classification and Definition	To Show Classification Applies	Requirements for HMP Compliance
Low: Enclosed pipes, channels with continuous hardened beds and banks, channels subject to tidal action, and channels shown to be aggrading over time with no sign of bank erosion.	An engineer or qualified environmental professional reviews all downstream reaches between the project site and the Bay/Delta and writes report/letter showing all reaches meet the "low risk" definition.	No additional requirements.
Medium: Channels where the boundary shear stress could exceed critical shear stress as a result of hydrograph modification, but where either the sensitivity of the boundary shear stress to flow is low (e.g., an oversized channel with high width to depth ratios) or where the resistance of the channel materials is relatively high (e.g., cobble or boulder beds and vegetated banks). Accelerated erosion due to increased watershed imperviousness is not likely but is possible, and the uncertainties can be more easily and effectively addressed by mitigation than by additional study. Not allowed for projects 20 acres or larger in total area.	An engineer or qualified environmental professional applies the Program's Basic Geomorphic Assessment* methods and Risk Class criteria and shows in a Preliminary Report that each downstream reach between the project site and the Bay/Delta is either "medium risk" or "low risk."	The project proponent's qualified geomorphologist applies the Program's Basic Geomorphic Assessment* methods and criteria, available information, and current field data to show, for each reach that was characterized as "medium risk" in the Preliminary Report. The geomorphologist prepares a detailed report showing, for each reach, either: The particular reach should be reclassified as "low risk." [No further action for that reach is required.] OR The particular reach is confirmed to be "medium risk". Present a mitigation project plan to stabilize stream bed and/or banks, improve natural stream functions, and/or improve habitat values as described in Section 4.b.ii of the Standard. Approval includes Water Board staff written approval.
High: Channels where the sensitivity of boundary shear stress to flow is high (e.g., incised or entrenched channels, channels with low width-to-depth ratios, and narrow channels with levees) or where channel resistance is low (e.g., channels with fine-grained, erodible beds and banks, or with little bed or bank vegetation).	Default classification if neither "low" or "medium" risk classification applies to all downstream channels between the project site and the Bay/Delta fall.	The project proponent's qualified geomorphologist conducts a Detailed Geomorphic and Hydrologic Assessment* to determine the design objectives for stream restoration and a comprehensive program of in-stream measures to improve channel functions while accommodating increased flows. Specific requirements are developed case-by-case in cooperation with the applicable regulatory agencies. As with all in-stream activities, Water Board staff sign off is required, and input should be sought in the project's early stages.

* These methods are described in Contra Costa Clean Water Program *Hydrograph Modification Management Plan*, May 15, 2005, Attachment 4, and must be described in the Program's *Stormwater C.3 Guidebook*.

4. Model Testing & Refinement

Section 7, Attachment 2 of the Program's HMP describes five simplifying assumptions that the Program may address in the future in order to refine the model that establishes IMP sizing factors. The Program shall complete the following studies and data collection efforts as set forth below:

a. *Model Testing:* The Program states that its model was calibrated to local stream flow data, based on the consultant team's previous experience using the same base model for projects in Contra Costa County streams and calibrating it to local stream gauge data at those times. The Program shall either (1) submit information demonstrating that the HMP model is calibrated to local stream flows, including but not limited to representative data sets, stream gauge data, and associated model calibration parameters; or (2) test the model results presented in the HMP by comparing model output with local stream gauging records in appropriate Bay Area watersheds and adjust the model and its outputs as necessary to produce a more accurate result set. All information supporting this model testing shall be submitted to the Executive Officer by July 1, 2007.

b. *Infiltration Rates:* To verify the HMP's assumption that the Type A soil infiltration rate in Contra Costa County is 0.3 inches per hour, the Program shall measure actual infiltration rates in Type A soils, done as standard percolation tests, in likely development sites in Contra Costa County. If results of this testing show average percolation rates are higher, then the Program shall re-analyze and correct the IMP sizing factors for Type A soils. The results of this work will be reported to the Executive Officer by July 1, 2007.

5. IMP Model Calibration and Validation Plan Objective

As part of the process of continuous improvement of the HMP, the Program shall investigate means to monitor flow from Hydrograph Modification Integrated Management Practices (IMPs). Monitoring shall be conducted with the aim of evaluating flow control effectiveness of the IMPs. The Program shall implement monitoring where feasible at future new development projects at a minimum of five locations and for a minimum of two rainy seasons to gain insight into actual versus predicted rates and durations of flow from IMP overflows and underdrains. If two rainy seasons are not sufficient to collect enough data to determine the accuracy of model inputs and assumptions, monitoring shall continue until such time as adequate data are collected.

a. The Dischargers shall Identify and Establish Monitoring Sites

Program staff shall work with municipal Co-permittees to identify potential monitoring sites on development projects that implement IMPs. Proposed sites should be identified during review of planning and zoning applications so that monitoring stations can be designed and constructed as part of the development project. Monitoring shall begin after the development project is complete and the site is in use.

Criteria for appropriate sites include**,** but are not limited to**,** the following:

- To ensure applicability of results, the development project and IMPs should be typical of development sites and types of IMPs foreseen throughout the County.

In particular, at least one each of the infiltration planter, flow-through planter, and "dry" swale will be selected for monitoring.

- The area tributary to the IMP should be clearly defined, should contain and direct runoff at all rainfall intensities to the IMP. Two monitoring locations shall contain tributary areas that are a mix of pervious and impervious areas, to test the pervious area simplifying assumptions used in the HMP, Table 14, Attachment 2, page 49. If no such locations are constructed by the monitoring period, modeling of mixed (pervious and impervious) tributary areas can substitute for direct monitoring of this type of location.
- The site should be easily accessible at all times of day and night to allow inspection and maintenance of measurement equipment.
- Hourly rain gauge data representative of the site's location should be available.

b. Documentation of Monitoring Sites

The Dischargers shall record and report (i.e., document) pertinent information for each monitoring site. Documentation of each monitoring site shall include:

- Amount of tributary area.
- Condition of roof or paving.
- Grading and drainage to the IMP, including calculated time of concentration.
- Locations and elevations of inlets and outlets.
- As-built measurements of the IMP including depth of soil and gravel layers, height of underdrain pipe above the IMP floor or native soil.
- Detailed specifications of soil and gravel layers and of filter fabric and other appurtenances.
- Condition of IMP surface soils and vegetation.

c. Design, Construction, and Operation of Monitoring Sites

The Dischargers shall ensure that IMPs selected for monitoring are equipped with a manhole, vault, or other means to install and access equipment for monitoring flows from IMP overflows and underdrains.

Development of suitable methods for monitoring the entire range of flows may require experiment. The Program and Water Board are interested in the timing and duration of very low flows from underdrains, as well as higher flows from IMP overflows. The Dischargers shall ensure that equipment is configured to measure the entire range of flows and to avoid potential clogging of orifices used to measure low flows.

The Dischargers shall ensure that construction of IMPs is inspected carefully to ensure IMPs are installed as designed and to avoid potential operational problems. For example, gravel used for underdrain layers should be washed free of fines and filter fabric should be installed without breaks.

The Dischargers shall ensure that, following construction, artificial flows are applied to the IMP to verify the IMP and monitoring equipment are operating correctly and to resolve any operational problems prior to measuring flows from actual rain storms.

The Dischargers shall ensure that monitoring equipment is properly maintained. Maintenance of monitoring equipment will require, initially, inspections during and after storms that produce runoff. The inspection and maintenance schedule may be adjusted as additional experience is gained.

d. Data to be Obtained

The Dischargers shall collect the following data for each IMP, during the monitoring period:

- Hourly rainfall and more frequent rainfall data where available;
- Hourly IMP outflow and 15-minute outflow for all time periods in which sub-hourly rainfall data are available;
- Hourly IMP inflow (if possible) and more frequent inflow (if possible) when sub-hourly rainfall data are available; and
- Notes and observations.

e. Evaluation of Data

The principal use of the monitoring data will be a comparison of predicted to actual flows. The Dischargers shall ensure that the HSPF model is set up as it was to prepare the curves in Attachment 2 of the HMP, with appropriate adjustments for the drainage area of the IMP to be monitored and for the actual sizing and configuration of the IMP. Hourly rainfall data from observed storms shall be input to the model, and the resulting hourly predicted output recorded. Where sub-hourly rainfall data are available, the model shall be run with, and output recorded for, 15-minute time steps.

The Dischargers shall compare predicted hourly outflows to the actual hourly outflows. As more data are gathered, the Dischargers may examine aggregated data to characterize deviations from predicted performance at various storm intensities and durations.

Because high-intensity storms are rare, it will take many years to obtain a suitable number of events to evaluate IMP performance under overflow conditions. Underdrain flows will occur more frequently, but possibly only a few times a year, depending on rainfall and IMP characteristics (e.g., extent to which the IMP is oversized, and actual, rather than predicted, permeability of native soils). However, evaluating a range of rainfall events which do *not* produce underflow will help demonstrate the effectiveness of the IMP.

Attachment C

Provision C.3.f
Fairfield-Suisun Permittees
Hydromodification Management Requirements

Fairfield-Suisun Permittees Hydromodification Management Requirements

1. Onsite and Regional Hydromodification Management (HM) Control Design Criteria

a. *Range of flows to control*: Flow duration controls shall be designed such that post-project stormwater discharge rates and durations match pre-project discharge rates and durations from 20% of the pre-project 2-year peak flow[15] up to the pre-project 10-year peak flow.

b. *Goodness of fit criteria:* The post-project flow duration curve shall not deviate above the pre-project flow duration curve by more than 10% over more than 10% of the length of the curve corresponding to the range of flows to control.

c. *Allowable low flow rate:* Flow control structures may be designed to discharge stormwater at a very low rate that does not threaten to erode the receiving water body. This flow rate (also called "Q*cp16") shall be no greater than 20% of the pre-project 2-year peak flow.*

d. *Standard HM modeling: On-site and regional HM controls designed using the Bay* Area Hydrology Model (BAHM[17]) and site-specific input data shall be considered to meet the HM Standard. Such use must be consistent with directions and options set forth in the most current BAHM User's Manual[18]. Permittees shall demonstrate to the satisfaction of the Executive Officer that any modifications of the BAHM made (per Finding 34) are consistent with this Attachment and Provision C.3.f.

e. *Alternate HM modeling and design:* The project proponent may use a continuous simulation hydrologic computer model19 to simulate pre-project and post-project runoff and to design HM controls. To use this method, the project proponent shall compare the pre-project and post-project model output for a rainfall record of at least 30 years, and shall show that all applicable performance criteria in 1.a-e above are met.

f. *Sizing Charts:* The Program developed design procedures, criteria, and sizing factors for infiltration basins and bioretention units, based on a low flow rate that exceeds the allowable low flow rate. After the Program has modified its sizing factors[20] to the allowable criteria, received approval of the modified sizing factors from the Executive

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[15] Where referred to in this Order, the 2-year peak flow is determined using a flood frequency analysis based on USGS Bulletin 17 B to obtain the flow peak statistically expected to occur at 2 year intervals. In this analysis, the entire record of hourly rainfall data (e.g., 35-50 years of data) is run through a continuous simulation model (footnote 19), the annual peak flows are identified, rank ordered, and the 2 year flow is generated.

[16] Qcp is the allowable low flow discharge from a flow control structure on a project site. It is a means of apportioning the 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.

[17] See *The Bay Area Hydrology Model – A Tool for Analyzing Hydromodification Effects of Development Projects and Sizing Solutions,* Bicknell, J., D. Beyerlein, A. Feng, September 26, 2006. Available at http://www.scvurppp-w2k.com/permit_c3_docs/Bicknell-Beyerlein-Feng_CASQA_Paper_9-26-06.pdf

[18] *The Bay Area Hydrology Model – A Tool for Analyzing Hydromodification Effects of Development Projects and Sizing Solutions,* Bicknell, J., D. Beyerlein, A. Feng, September 26, 2006.

[19] Such models include US EPA's Hydrograph Simulation Program—Fortran (HSPF), US Army Corps of Engineers hydrologic Engineering Center-Hydrologic Modeling System (HEC-HMS), and US EPA's Surface Water Management Model (SWMM).

[20] Current sizing factors and design criteria are shown in Appendix D of the FSURMP HMP.

Officer,[21] and informed the public through such mechanism as an email list-serve, project proponents may meet the HM Standard by using the Program's design procedures, criteria, and sizing factors for infiltration basins and/or bioretention units.

2. Impracticability Provision

Where conditions (e.g., extreme space limitations) prevent a project from meeting the HM Standard for a reasonable cost, and where the project's runoff cannot be directed to a regional HM control within a reasonable timeframe, and where an in-stream measure is not practicable, the project shall use (1) site design for hydrologic source control, and (2) stormwater treatment measures that collectively minimize, slow, and detain[22] runoff to the maximum extent practicable. In addition, the project proponent shall provide for or contribute financially to an alternative HM project as set forth below:

a. *Reasonable cost*: To show that the HM Standard cannot be met at a reasonable cost, the project proponent must demonstrate that the total cost to comply with both the HM standard and the Provision C.3.d. treatment requirement exceeds 2% of the project construction cost, excluding land costs. Costs of HM and treatment control measures shall not include land costs, soil disposal fees, hauling, contaminated soil testing, mitigation, disposal, or other normal site enhancement costs such as landscaping or grading that are required for other development purposes.

b. *Regional HM controls*: A regional HM control shall be considered available if there is a planned location for the regional HM control and if an appropriate funding mechanism for a regional HM control is in place by the time of project construction.

c. *In-stream measures practicability*: In-stream measures shall be considered practicable when an in-stream measure for the project's watershed is planned and an appropriate funding mechanism for an in-stream measure is in place by the time of project construction.

d. *Financial contribution to an alternative HM project*: The difference between 2% of the project construction costs and the cost of the treatment measures at the site (both costs as described in Section 2.a of this Attachment) shall be contributed to an alternative HM project, such as a stormwater treatment retrofit, HM retrofit, regional HM control, or in-stream measure. Preference shall be given to projects discharging, in this order, to the same tributary, main stem, watershed, then in the same municipality or county.

3. Record Keeping

Permittees shall collect and retain the following information for all projects subject to HM requirements:

a. Site plans identifying impervious areas, surface flow directions for the entire site, and location(s) of HM measures;

b. For projects using standard sizing charts, a summary of sizing calculations used;

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[21] The modified sizing factors will not introduce a new concept, but rather make an existing compliance mechanism more stringent; therefore, Executive Officer approval is appropriate.

[22] Stormwater treatment measures that detain runoff are generally those that filter runoff through soil or other media, and include bioretention units, bioswales, basins, planter boxes, tree wells, media, filters, and green roofs.

c. For projects using the BAHM, a listing of model inputs;

d. For projects using custom modeling, a summary of the modeling calculations with corresponding graph showing curve matching (existing, post-project, and post-project with HM controls curves);

e. For projects using the Impracticability Provision, a listing of all applicable costs and a brief description of the alternative HM project (name, location, date of start up, entity responsible for maintenance);

f. A listing, summary, and date of modifications made to the BAHM, including technical rationale.

4. HM Control Areas

Applicable projects shall be required to meet the HM Standard when such projects discharge into the upstream reaches of Laurel or Ledgewood Creeks, as delineated in Figures C-1 and C-2. Plans to restore a creek reach may re-introduce the applicability of HM requirements; in these instances, Permittees may add, but shall not delete, areas of applicability accordingly.

Attachment D

Provision C.3.f
San Mateo Permittees
Hydromodification Management Requirements

San Mateo Permittees Hydromodification Management Requirements

1. Onsite and Regional Hydromodification Management (HM) Control Design Criteria

a. *Range of flows to control:* 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[23] up to the pre-project 10-year peak flow.

b. *Goodness of fit criteria:* The post-project flow duration curve shall not deviate above the pre-project flow duration curve by more than 10% over more than 10% of the length of the curve corresponding to the range of flows to control.

c. *Allowable low flow rate*: Flow control structures may be designed to discharge stormwater at a very low rate that does not threaten to erode the receiving water body. This flow rate (also called "Qcp[24]") shall be no greater than 10% of the pre-project 2-year peak flow.

d. *Standard HM modeling:* On-site and regional HM controls designed using the Bay Area Hydrology Model (BAHM[25]) and site-specific input data shall be considered to meet the HM Standard. Such use must be consistent with directions and options set forth in the most current BAHM User's Manual[26]. Permittees shall demonstrate to the satisfaction of the Executive Officer that any modifications of the BAHM made (per Finding 34) are consistent with the requirements of this Provision.

e. *Alternate HM modeling and design:* The project proponent may use a continuous simulation hydrologic computer model[27] to simulate pre-project and post-project runoff and to design HM controls. To use this method, the project proponent shall compare the pre-project and post-project model output for a rainfall record of at least 30 years, and shall show that all applicable performance criteria in 1.a-e above are met.

2. Impracticability Provision

Where conditions (e.g., extreme space limitations) prevent a project from meeting the HM Standard for a reasonable cost, and where the project's runoff cannot be directed to a regional

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[23] Where referred to in this Order, the 2-year peak flow is determined using a flood frequency analysis based on USGS Bulletin 17 B to obtain the flow peak statistically expected to occur at 2 year intervals. In this analysis, the entire record of hourly rainfall data (e.g., 35-50 years of data) is run through a continuous simulation model (footnote 27), the annual peak flows are identified, rank ordered, and the 2 year flow is generated.

[24] Qcp is the allowable low flow discharge from a flow control structure on a project site. It is a means of apportioning the 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.

[25] The *Bay Area Hydrology Model – A Tool for Analyzing Hydromodification Effects of Development Projects and Sizing Solutions*, Bicknell, J., D. Beyerlein, A. Feng, September 26, 2006. Available at http://www.scvurppp-w2k.com/permit_c3_docs/Bicknell-Beyerlein-Feng_CASQA_Paper_9-26-06.pdf

[26] *The Bay Area Hydrology Model – A Tool for Analyzing Hydromodification Effects of Development Projects and Sizing Solutions*, Bicknell, J., D. Beyerlein, A. Feng, September 26, 2006. Available at http://www.scvurppp-w2k.com/permit_c3_docs/Bicknell-Beyerlein-Feng_CASQA_Paper_9-26-06.pdf.

[27] *Such* models include US EPA's Hydrograph Simulation Program—Fortran (HSPF), US Army Corps of Engineers hydrologic Engineering Center-Hydrologic Modeling System (HEC-HMS), and US EPA's Surface Water Management Model (SWMM).

HM control within a reasonable timeframe, and where an in-stream measure is not practicable, the project shall use (1) site design for hydrologic source control, and (2) stormwater treatment measures that collectively minimize, slow, and detain[28] runoff to the maximum extent practicable. In addition, the project proponent shall provide for or contribute financially to an alternative HM project as set forth below:

a. *Reasonable cost*: To show that the HM Standard cannot be met at a reasonable cost, the project proponent must demonstrate that the total cost to comply with both the HM standard and the Provision C.3.d. treatment requirement exceeds 2% of the project construction cost, excluding land costs. Costs of HM and treatment control measures shall not include land costs, soil disposal fees, hauling, contaminated soil testing, mitigation, disposal, or other normal site enhancement costs such as landscaping or grading that are required for other development purposes.

b. *Regional HM controls*: A regional HM control shall be considered available if there is a planned location for the regional HM control and if an appropriate funding mechanism for a regional HM control is in place by the time of project construction.

c. *In-stream measures practicability*: In-stream measures shall be considered practicable when an in-stream measure for the project's watershed is planned and an appropriate funding mechanism for an in-stream measure is in place by the time of project construction.

d. *Financial contribution to an alternative HM project*: The difference between 2% of the project construction costs and the cost of the treatment measures at the site (both costs as described in Section 2.a. of this Attachment shall be contributed to an alternative HM project, such as a stormwater treatment retrofit, HM retrofit, regional HM control, or in-stream measure. Preference shall be given to projects discharging, in this order, to the same tributary, main stem, watershed, then in the same municipality, or county.

3. Record Keeping

Permittees shall collect and retain the following information for all projects subject to HM requirements:

a. Site plans identifying impervious areas, surface flow directions for the entire site, and location(s) of HM measures;

b. For projects using standard sizing charts, a summary of sizing calculations used;

c. For projects using the BAHM, a listing of model inputs;

d. For projects using custom modeling, a summary of the modeling calculations with corresponding graph showing curve matching (existing, post-project, and post-project with HM controls curves);

e. For projects using the Impracticability Provision, a listing of all applicable costs and a brief description of the alternative HM project (name, location, date of start up, entity responsible for maintenance);

[28] Stormwater treatment measures that detain runoff are generally those that filter runoff through soil or other media, and include bioretention units, bioswales, basins, planter boxes, tree wells, media filters, and green roofs.

f. A listing, summary, and date of modifications made to the BAHM, including technical rationale.

4. HM Control Areas

Applicable projects shall be required to meet the HM Standard when such projects are located in the HM control areas shown in Figure D-1. Plans to restore a creek reach may re-introduce the applicability of HM requirements; in these instances, Permittees may add, but shall not delete, areas of applicability accordingly.

The HM Standard and all associated requirements apply in areas that are shown in green on the map and noted in the map's key as "areas subject to HMP." The other areas are exempt from the HM Standard because they drain to hardened channels or low gradient channels (a characteristic applicable to San Mateo County's particular shoreline properties), or are located in highly developed areas. Plans to restore a hardened channel may affect areas of applicability.

Areas shown in Figure D-1 may be modified as follows:

a. Street Boundary Interpretation. Streets are used to mark the boundary between areas where the HM Standard must be met and exempt areas. Parcels located on the boundary street are considered within the area exempted from the hydromodification requirements. Nonetheless, there may be cases where the drainage from a particular parcel(s) on the boundary street drains westward into the hydromodification required area and, as such, any applicable project on such a parcel(s) would be subject to the hydromodification requirements.

b. Hardened Channel to Exempt Area. If a proposed project subject to the HM Standard is located in a drainage that is determined to flow only through a hardened channel or enclosed pipe along its entire length before emptying into a waterway in the exempt area, the project would be exempted from the HM Standard and its associated requirements. The project proponent must demonstrate, in a statement signed by an engineer or qualified environmental professional, that this condition is met.

c. Boundary Re-Opener. If the municipal regional permit or future permit reissuances or amendments modify the types of projects subject to the hydromodification requirements, the appropriate location for an HMP boundary or boundaries will be re-evaluated at the same time.

Attachment E

Provision C.3.f
Santa Clara Permittees
Hydromodification Management Requirements

Santa Clara Permittees Hydromodification Management Requirements

1. Onsite and Regional Hydromodification (HM) Control Design Criteria

a. *Range of Flows to Control:* 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[29] up to the pre-project 10-year peak flow,[30] except where the lower endpoint of this range is modified as described in Section 6 of this Attachment.

b. *Goodness of fit criteria*: The post-project flow duration curve shall not deviate above the pre-project flow duration curve by more than 10% over more than 10% of the length of the curve corresponding to the range of flows to control.

c. *Allowable low flow rate*: Flow control structures may be designed to discharge stormwater at a very low rate that does not threaten to erode the receiving water body. This flow rate (also called "Qcp[31]") shall be no greater than 10% of the pre-project 2-year peak flow unless a modified value is substantiated by analysis of actual channel resistance in accordance with an approved User Guide as described in Section 6 of this Attachment.

d. *Standard HM modeling*: On-site and regional HM controls designed using the Bay Area Hydrology Model (BAHM[32]) and site-specific input data shall be considered to meet the HM Standard. Such use must be consistent with directions and options set forth in the most current BAHM User's Manual[33]. Permittees shall demonstrate to the satisfaction of the Executive Officer that any modifications of the BAHM made (per Finding 34) are consistent with this attachment and Provision C.3.f.

e. *Alternate HM modeling and design*: The project proponent may use a continuous simulation hydrologic computer model[34] to simulate pre-project and post-project runoff and to design HM controls. To use this method, the project proponent shall compare the pre-project and post-project model output for a rainfall record of at least 30 years, and shall show that all applicable performance criteria in 1.a - e above are met.

[29] The 2-year peak flow is determined using a Log Pearson Type III flood frequency analysis procedure based on USGS Bulletin 17B to obtain the peak flow statistically expected to occur at a 2-year recurrence interval. In this analysis, the appropriate record of hourly rainfall data (e.g., 35-50 years of data) is run through a continuous simulation hydrologic model (footnote 34), the annual peak flows are identified, and the 2-year peak flow is estimated.

[30] The post-project flow duration curve shall not deviate above the pre-project flow duration curve by more than 10% over more than 10% of the length of the curve corresponding to the range of flows to control.

[31] Qcp is the allowable low flow discharge from a flow control structure on a project site. It is a means of apportioning the 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.

[32] *The Bay Area Hydrology Model – A Tool for Analyzing Hydromodification Effects of Development Projects and Sizing Solutions,* Bicknell, J., D. Beyerlein, A. Feng, September 26, 2006. Available at http://www.scvurppp-w2k.com/permit_c3_docs/Bicknell-Beyerlein-Feng_CASQA_Paper_9-26-06.pdf

[33] *The Bay Area Hydrology Model – A Tool for Analyzing Hydromodification Effects of Development Projects and Sizing Solutions,* Bicknell, J., D. Beyerlein, A. Feng, September 26, 2006. Available at http://www.scvurppp-w2k.com/permit_c3_docs/Bicknell-Beyerlein-Feng_CASQA_Paper_9-26-06.pdf

[34] Such models include USEPA's Hydrograph Simulation Program—Fortran (HSPF), US Army Corps of Engineers hydrologic Engineering Center-Hydrologic Modeling System (HEC-HMS), and USEPA's Surface Water Management Model (SWMM).

2. Impracticability Provision

Where conditions (e.g., extreme space limitations) prevent a project from meeting the HM Standard for a reasonable cost, and where the project's runoff cannot be directed to a Regional HM control[35] within a reasonable timeframe, and where an in-stream measure is not practicable, the project shall use (1) site design for hydrologic source control, and (2) stormwater treatment measures that collectively minimize, slow, and detain[36] runoff to the maximum extent practicable. In addition, the project shall contribute financially to an alternative HM project as set forth below:

a. *Reasonable cost*: To show that the HM Standard cannot be met at a reasonable cost, the project proponent must demonstrate that the total cost to comply with both the HM standard and the Provision C.3.d. treatment requirement exceeds 2% of the project construction cost, excluding land costs. Costs of HM and treatment control measures shall not include land costs, soil disposal fees, hauling, contaminated soil testing, mitigation, disposal, or other normal site enhancement costs such as landscaping or grading that are required for other development purposes.

b. *Regional HM control:* A regional HM control shall be considered available if there is a planned location for the regional HM control and if an appropriate funding mechanism for a regional control is in place by the time of project construction.

c. *In-stream measures practicability:* In-stream measures shall be considered practicable when an in-stream measure for the project's watershed is planned and an appropriate funding mechanism for an in-stream measure is in place by the time of project construction.

d. *Financial contribution to an alternative HM project:* The difference between 2% of the project construction costs and the cost of the treatment measures at the site (both costs as described in Section 2.a. of this Attachment) shall be contributed to an alternative HM project, such as a stormwater treatment retrofit, HM retrofit, regional HM control, or in-stream measure. Preference shall be given to projects discharging, in this order, to the same tributary, main stem, watershed, then in the same municipality or county.

3. Record Keeping

Permittees shall collect and retain the following information for all projects subject to HM requirements:

a. Site plans identifying impervious areas, surface flow directions for the entire site, and location(s) of HM measures;

b. For projects using standard sizing charts, a summary of sizing calculations used;

c. For projects using the BAHM, a listing of model inputs;

[35] *Regional HM controls* are flow duration control structures that collect stormwater runoff discharge from multiple projects (each of which should incorporate hydrologic source control measures as well) and are designed such that the HM Standard is met for all the projects at the point where the regional control measure discharges.

[36] Stormwater treatment measures that detain runoff are generally those that filter runoff through soil or other media, and include bioretention units, bioswales, basins, planter boxes, sand filters, and green roofs.

d. For projects using custom modeling, a summary of the modeling calculations with corresponding graph showing curve matching (existing, post-project, and post-project with HM controls curves);

e. For projects using the Impracticability Provision, a listing of all applicable costs and a brief description of the alternative HM project (name, location, date of start up, entity responsible for maintenance);

f. A listing, summary, and date of modifications made to the BAHM, including technical rationale.

4. HM Control Areas

Applicable projects shall be required to meet the HM Standard when such projects are located in the yellow and/or green areas shown in Figure E-1. Plans to restore a creek reach may re-introduce the applicability of HM requirements; in these instances, Permittees may add, but shall not delete, areas of applicability accordingly.

5. Potential Exceptions to Map Designations

The Program may choose to prepare a User Guide[37] to be used for evaluating individual receiving waterbodies using detailed methods to assess channel stability and watercourse critical flow. This User Guide would reiterate and collate established stream stability assessment methods that have been presented in the Program's HMP.[38] After the Program has collated its methods into User Guide format, received approval of the User Guide from the Executive Officer,[39] and informed the public through such process as an email list-serve, the User Guide may be used to guide preparation of technical reports for: implementing the HM standard using in-stream or regional controls; determining whether certain projects are discharging to a watercourse that is less susceptible (from point of discharge to the Bay) to hydromodification (e.g., would have a lower potential for erosion than set forth in these requirements); and/or determining if a watercourse has a higher critical flow and project(s) discharging to it are eligible for an alternative Qcp for the purpose of designing onsite or regional measures to control flows draining to these channels (i.e., the actual threshold of erosion-causing critical flow is higher than 10% of the 2-year pre-project flow). In no case shall the design value of Qcp exceed 50% of the 2-year pre-project flow.

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37 The User Guide may be offered under a different title.

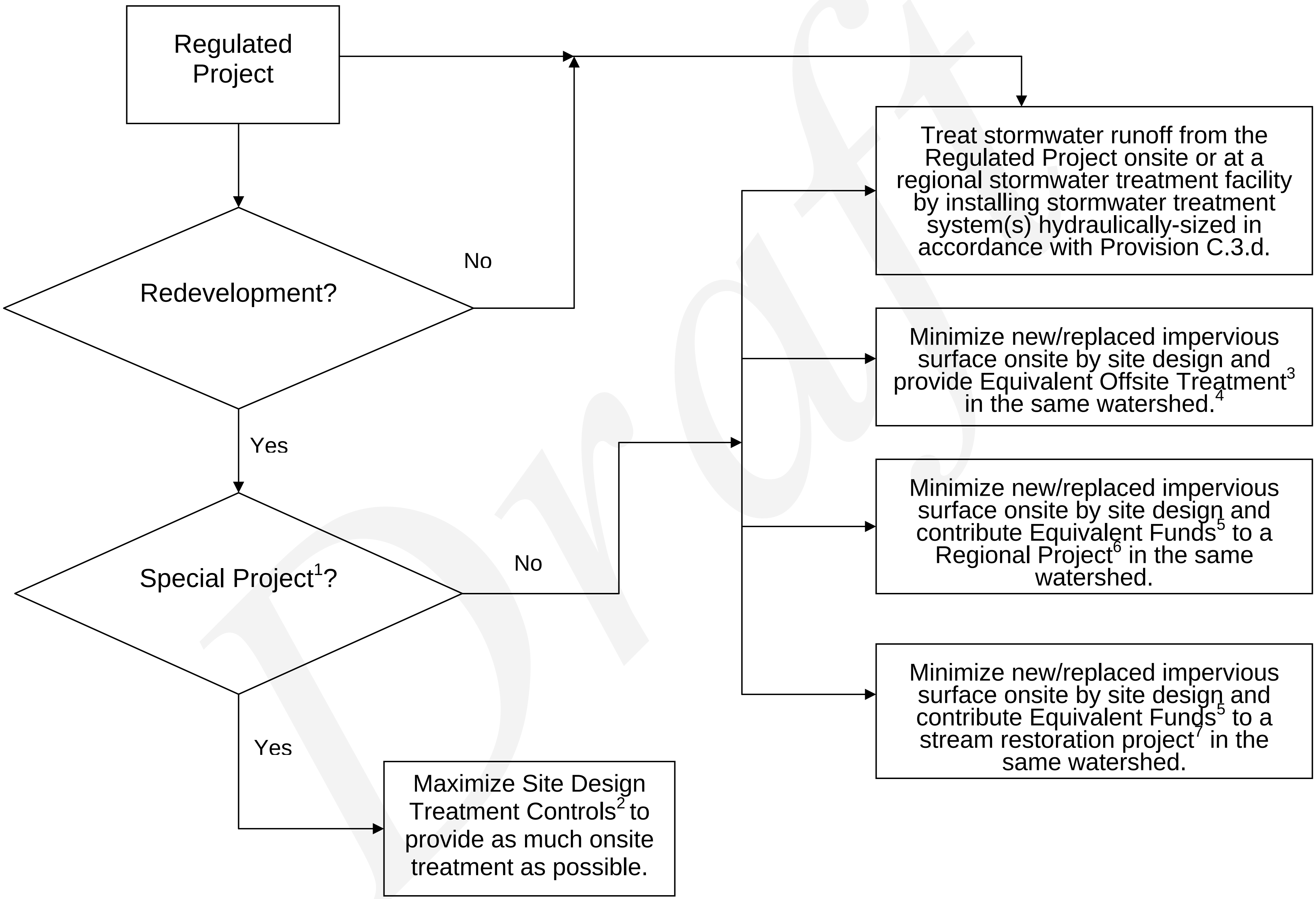
38 The Program's HMP has undergone Water Board staff review and been subject to public notice and comment.

39 The User Guide will not introduce a new concept, but rather reformat existing methods; therefore, Executive Officer approval is appropriate.

Attachment F

Provision C.3.g. Flowchart
Alternative Compliance with Provisions C.3.b. and d.

Municipal Regional Permit, Provision C.3.g. Flowchart
Alternative Compliance with Provisions C.3.b. and d.



Provision C.3.g. Flowchart

[1] Special Projects:

a. Brownfields – As defined by U.S. EPA and that receive subsidy or similar benefits under a program designed to redevelop such sites.

b. Low-income and Senior Housing – As defined under Government Code Section 65589.5(h)(3) or (4) or 65195(b), but limited to the actual low-income or senior housing portion, or impervious area percentage, of the redevelopment project.

c. Transit Oriented Development Projects – Any housing redevelopment project with funding from the Metropolitan Transit Commission (MTC), built as part of the Extension Projects listed in Table 1 of MTC's *Resolution 3434: Transit-Oriented Development (TOD) Policy for Regional Transit Expansion Projects*, *(April 2006 and as updated thereafter)* and built to satisfy the Corridor Thresholds listed in Table 3 of MTC's Resolution 3434.

[2] Maximizing Site Design Treatment Controls is defined as including a minimum of one of the following specific site design and/or treatment measures:

a. Diverting roof runoff to vegetated areas before discharge to storm drain;

b. Directing surface runoff to vegetated areas before discharge to storm drain;

c. Installing landscaped-based stormwater treatment measures (non-hydraulically-sized) such as tree wells or bioretention gardens; or

d. Installing prefabricated/proprietary stormwater treatment controls (non-hydraulically-sized).

[3] Equivalent Offsite Treatment – Hydraulically-sized treatment (in accordance with Provision C.3.d.) of:

a. An equal area of new and/or replaced imperious surface as that created by the Regulated Project;

b. An equivalent amount of pollutant loading as that created by the Regulated Project; or

c. An equivalent quantify of runoff as that created by the Regulated Project.

Offsite projects must be completed by the end of construction of the Regulated Project.

[4] Watershed - A watershed is the area of land drained by a stream or river system. It is where water precipitates and collects, extending from ridges down to the topographic low points where the water drains into a river, bay, ocean, or other water body. A watershed includes surface water bodies (e.g., streams, rivers, lakes, reservoirs, wetlands, and estuaries), groundwater (e.g., aquifers and groundwater basins) and the surrounding landscape. The San Francisco Bay Region consists of seven major hydrologic units (watershed basins) within the Region. Figures 2-2 through 2-9 and Table 2-1 of the Water Board's Basin Plan show and list, respectively, the major water bodies within these hydrologic units. For the purposes of Provision C.3, Regional or offsite stormwater treatment projects that discharge "into the same watershed" means that these projects discharge treated stormwater into the same major waterbody (as delineated in the Basin Plan) as the Regulated Project.

[5] Equivalent Funds – Monetary amount necessary to provide hydraulically-sized treatment (in accordance with Provision C.3.d.) of

a. An equal area of new and/or replaced imperious surface as that created by the Regulated Project;

b. An equivalent amount of pollutant loading as that created by the Regulated Project; or

c. An equivalent quantify of runoff as that created by the Regulated Project.

[6] Regional Project – A regional or municipal stormwater treatment facility that discharges into the same watershed that the Regulated Project does. The Regional Project must be completed within three years after the end of construction of the Regulated Project.

[7] Stream restoration projects must be completed within three years after the end of construction of the Regulated Project.

Attachment G

Provision C.8
Status and Trends Monitoring
Follow-up Analysis and Actions

Status & Trends Monitoring Follow-up Analysis and Actions for Biological Assessment, Water Column Toxicity, Bedded Sediment Toxicity, and Bedded Sediment Pollutants

When results from Biological Assessment, Bedded Sediment Toxicity, and/or Bedded Sediment Pollutants monitoring indicate impacts at a monitoring location, Permittees shall evaluate the extent and cause(s) of impacts to determine the potential role of urban runoff as indicated in Table G-1.

Table G-1. Sediment Triad Approach to Determining Follow-Up Actions

Chemistry Results[40]	Toxicity Results[41]	Bioassessment Results[42]	Action
No chemicals exceed Threshold Effect Concentrations (TEC), mean Probable Effects Concentrations (PEC) quotient <0.5 and pyrethroids<1.0 Toxicity Unit (TU)	No Toxicity	No indications of alterations	No action necessary
No chemicals exceed TECs, mean PEC quotient <0.5 and pyrethroids<1.0 TU	Toxicity	No indications of alterations	1) Take confirmatory sample for toxicity. 2) If toxicity repeated, attempt to identify cause and spatial extent. 3) Where impacts are under Permittee's control, take management actions to minimize upstream sources causing toxicity; initiate no later than the second fiscal year following the sampling event.
No chemicals exceed TECs, mean PEC quotient <0.5 and pyrethroids<1.0 TU	No Toxicity	Indications of alterations	Identify the most probable cause(s) of the physical habitat disturbance. Where impacts are under Permittee's control, take management actions to minimize the impacts causing physical habitat disturbance; initiate no later than the second fiscal year following the sampling event.
No chemicals exceed TECs, mean PEC quotient <0.5 and pyrethroids<1.0 TU	Toxicity	Indications of alterations	1) Identify cause(s) of impacts and spatial extent. 2) Where impacts are under Permittee's control, take management actions to minimize impacts; initiate no later than the second fiscal year following the sampling event.
3 or more chemicals exceed PECs, the mean PEC quotient is > 0.5, or pyrethroids >1.0 TU	No Toxicity	Indications of alterations	1) Identify cause of impacts. 2) Where impacts are under Permittee's control, take management actions to minimize the impacts caused by urban runoff; initiate no later than the second fiscal year following the sampling event.
3 or more chemicals exceed PECs, the mean PEC quotient is > 0.5, or pyrethroids >1.0 TU	Toxicity	No indications of alterations	1) Take confirmatory sample for toxicity 2) If toxicity repeated, attempt to identify cause and spatial extent. 3) Where impacts are under Permittee's control, take management actions to minimize upstream sources; initiate no later than the second fiscal year following the sampling event.
3 or more chemicals exceed PECs, the mean PEC quotient is > 0.5, or pyrethroids >1.0 TU	No Toxicity	No Indications of alterations	If PEC exceedance is Hg or PCBs, address under TMDLs
3 or more chemicals exceed PECs, the mean PEC quotient is > 0.5, or pyrethroids >1.0 TU	Toxicity	Indications of alterations	1) Identify cause(s) of impacts and spatial extent 2) Where impacts are under Permittee's control, take management actions to address impacts.

[40] MacDonald, D.D., G.G. Ingersoll and T.A. Berger. 2000. "Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Ecosystems." *Archives of Environmental Contamination and Toxicology* 39(1):20-31.
[41] Toxicity is exhibited when *Hyallela* survival statistically different than and < 20% of control.
[42] Alterations are exhibited if metrics indicate substantially degraded community.

Attachment H

Provision C.8
Standard Monitoring Provisions

All monitoring activities shall meet the following requirements:

1. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity. [40 CFR 122.41(j)(1)]
2. Permittees shall retain records of all monitoring information, including all calibration and maintenance of monitoring instrumentation, and copies of all reports required by this Order for a period of at least five (5) years from the date of the sample, measurement, report, or application. This period may be extended by request of the Water Board or USEPA at any time and shall be extended during the course of any unresolved litigation regarding this discharge. [40 CFR 122.41(j)(2), CWC section 13383(a)]
3. Records of monitoring information shall include [40 CFR 122.41(j)(3)]:
   a. The date, exact place, and time of sampling or measurements;
   b. The individual(s) who performed the sampling or measurements;
   c. The date(s) analyses were performed;
   d. The individual(s) who performed the analyses;
   e. The analytical techniques or methods used; and,
   f. The results of such analyses.
4. All sampling, sample preservation, and analyses must be conducted according to test procedures approved under 40 CFR part 136, unless other test procedures have been specified in the monitoring Provisions or approved by the Executive Officer. [40 CFR 122.41(j)(4)]
5. The CWA provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this Order shall, upon conviction, be punished by a fine of not more than $10,000, or by imprisonment for not more than two years, or both. If a conviction of a person is for a violation committed after a first conviction of such person under this paragraph, punishment is a fine of not more than $20,000 per day of violation, or by imprisonment of not more than four years, or both. [40 CFR 122.41(j)(5)]
6. Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified in the monitoring Provisions. [40 CFR 122.41(l)(4)(iii)]
7. All chemical, bacteriological, and toxicity analyses shall be conducted at a laboratory certified for such analyses by the California Department of Health Services or a laboratory approved by the Executive Officer.
8. For priority toxic pollutants that are identified in the California Toxics Rule (CTR) (65 Fed. Reg. 31682), the Permittees shall instruct its laboratories to establish calibration standards that are equivalent to or lower than the Minimum Levels (MLs) published in Appendix 4 of the Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (SIP). If a Permittee can demonstrate that a particular ML is not attainable, in accordance with procedures set forth in 40 CFR 136, the lowest quantifiable concentration of the lowest calibration standard analyzed by a specific analytical procedure (assuming that all the method specified sample weights, volumes, and processing steps have been followed) may be used instead of the ML listed in Appendix 4 of the SIP. The Permittee must submit documentation from the laboratory to the Water Board for approval prior to raising the ML for any priority toxic pollutant.

9. The Clean Water Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or non-compliance shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than six months per violation, or by both. [40 CFR 122.41(k)(2)]

10. Monitoring shall be conducted according the USEPA test procedures approved under 40 CFR 136, "Guidelines Establishing Test Procedures for Analysis of Pollutants under the Clean Water Act" as amended, unless other test procedures have been specified in this Order or by the Executive Officer.

11. If the discharger monitors any pollutant more frequently than required by the Permit using test procedures approved under 40 CFR part 136, unless otherwise specified in the Order, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the reports requested by the Water Board. [40 CFR 122.41(l)(4)(ii)]

Attachment I

Provision C.10.
A Rapid Trash Assessment Protocol
Version 8
November 15, 2004

Surface Water Ambient Monitoring Program
California Regional Water Quality Control Board
San Francisco Bay Region

RAPID TRASH ASSESSMENT PROTOCOL

Surface Water Ambient Monitoring Program
California Regional Water Quality Control Board, San Francisco Bay Region

Monitoring Design. The rapid trash assessment can be used for a number of purposes, such as ambient monitoring, evaluation of management actions, determination of trash accumulation rates, or comparing sites with and without public access. Ambient monitoring efforts should provide information at sites distributed throughout a waterbody, and several times a year to characterize spatial and temporal variability. Additionally, the ambient sampling design should document the effects of episodes that affect trash levels such as storms or community cleanup events. Pre- and post-project assessments can assist in evaluating the effectiveness of management practices ranging from public outreach to structural controls, or to document the effects of public access on trash levels in waterbodies (e.g., upstream/downstream). Such evaluations should consider trash levels over time and under different seasonal conditions. Revisiting sites where trash was collected during previous assessments enables the determination of accumulation rates. This methodology was developed for sections of wadeable streams, but can be adapted to shorelines of lakes, beaches, or estuaries. Ultimately, the monitoring design will strongly affect the usefulness of any rapid trash assessment information.

Site Definition. Upon arrival at a designated monitoring site, a team of two people or more defines or verifies a 100-foot section of the stream or shoreline to analyze, associated with a sampling location or station. When a site is first established, it is recommended that the 100-foot distance be accurately measured. The length should be measured not as a straight line, but as 100 feet of the actual stream or shore length, including sinuous curves. Where possible, the starting and ending points of the survey should be easily identified landmarks, such as an oak tree or boulder, and noted on the worksheet ("Upper/Lower Boundaries of Reach"), or documented using a global positioning system (GPS), so that future assessments are made at the same location. The team should confer and document the upper boundary of the banks to be surveyed, based on evaluation of whether trash can be carried to the water body by wind or water (e.g., an upper terrace in the stream bank). The team documents the location of the high water line based on site-specific physical indicators, such as a debris line found in the riparian vegetation along the stream channel. If the high water line cannot be determined, it is suggested that bankfull height be documented, noting that the high water line could not be determined. Trash located below the high water line can be expected to move into the streambed or be swept downstream during the next winter season. Visually extend all boundaries in order to encompass the 100' section. Defining site characteristics will facilitate the comparison of trash assessments conducted at the same site at different times of the year.

Survey. It is highly recommended that all trash items within an assessed site be picked up, so that the site can be revisited and re-assessed for impairment and usage patterns. A survey, including notes and scoring, will take approximately one to two hours based on how trash-impacted the site is and how many people are working together. The first time a site is assessed, the process will generally take longer than on subsequent visits. Begin the survey at the downstream end of the selected reach so that trash can be seen in the undisturbed stream channel. Tasks can be divided according to the number of team members. In one scenario of a team with two members, one team member begins walking along the bank or in the water (wear waders) at the edge of the stream or shore, looking for trash on the bank up to the upper bank boundary, and above and below the high water line. This person picks up trash and tallies the items on the trash assessment worksheet as either above or below the high water line based on the previously determined boundary. The other person walks in the streambed and up and down the opposite bank, picking up and calling out specific trash items found in the water body and on the opposite bank both above and below the high water line, for the tally person to mark down appropriately on the trash assessment sheet. All team members pick up the trash items as they are found. Keep in mind that the person tallying will not be able to pick up nearly as much trash as the other team members. All team members make sure to avoid injuries by using gloves. Avoid touching trash with unprotected hands!

The person tallying the trash indicates on the sheet whether the trash was found above the high water line on the bank, or below the high water line either on the bank or in the stream (i.e., tally dots or circles (•) for above high water line, tally lines (|) for below). If it is evident that items have been littered, dumped, or accumulated via downstream transport, make a note in the designated rows near the bottom of the tally sheet - this will help when assessing scores. A trash grabber, metal kitchen tongs, or a similar tool should be used to help pick up trash. Be sure to look under bushes, logs, and other plant growth to see if trash has accumulated underneath. The ground and substrate should be inspected to ensure that small items such as cigarette butts and pieces of broken glass or Styrofoam are picked up and counted. The tally count is an important indicator of trash impairment and should be used in conjunction with the total score to assist in site comparisons. It is important not to miss items that can affect human health such as diapers, fecal matter, and needles; these items can strongly affect the total score.

Once the team is finished with the tallying, use the tally sheet margins to count up two totals for each trash item line, one total for items found above the high water line, and one total for items found below the high water line. Now sum the totals of above and below for each trash category, and write in next to each trash category. Be sure to complete the worksheets before leaving the site while everything is still fresh in the memory. The team should discuss each parameter and agree on a score based on a discussion of the condition categories. Discuss and document possible influential factors affecting trash levels at the site, such as a park, school, or nearby residences or businesses. Within each trash parameter, narrative language is provided to assist with choosing a condition category. The worksheet provides a range of numbers within a given category, allowing for a range of conditions encountered in the field. For instance, trash located in the water leads to lower scores than trash above the high water line. Not all specific trash conditions mentioned in the narratives need to be present to fit into a specific condition category (e.g., "site frequently used by people"), nor do the narratives describe all possible conditions. Scores of "0" should be reserved for the most extreme conditions. Once the scores are assigned for the six categories, sum the final score and include specific notes about the site at the end of the sheet. A site should be assessed several times in a given year, during different seasons, to characterize the variability and persistence of trash occurrence for water quality assessment purposes.

Trash Assessment Parameters. The rapid trash assessment includes a range of parameters that capture the breadth of issues associated with trash and water quality. The first two parameters focus on qualitative and quantitative levels of trash, the second two parameters estimate actual threat to water quality, and the last two parameters represent how trash enters the water body at a site, either through on-site activities or downstream accumulation.

1. **Level of Trash.** This assessment parameter is intended to reflect a qualitative "first impression" of the site, after observing the entire length of the reach. Sites scoring in the "poor" range are those where trash is one of the first things noticeable about the waterbody. No trash should be obviously visible at sites that score in the "optimal" range.

2. **Actual Number of Trash Items Found.** Based on the tally of trash along the 100-foot stream reach, total the number of items both above and below the high water line, and choose a score within the appropriate condition category based on the number of tallied items. Where more than 100 items have been tallied, assign the following scores: 5: 101-200 items; 4: 201-300 items; 3: 301-400 items; 2: 401-500 items; 1: 501-600 items; 0: over 600 items. Use similar guidelines to assign scores in other condition categories.

   Sometimes items are broken into many pieces. Fragments with higher threat to aquatic life such as plastics should be individually counted, while paper and broken glass, with lower threat and/or mobility, should be counted based on the parent item(s). Broken glass that is scattered, with no recognizable original shape, should be counted individually. The judgment of whether to count all fragments or just one item also depends on the potential exposure to downstream fish and wildlife, and waders and swimmers at a given site. Concrete is trash when it is dumped, but not when it is placed. Consider tallying only those items that would be removed in a restoration or cleanup effort.

3. **Threat to Aquatic Life.** As indicated in the technical notes, below, certain characteristics of trash make it more harmful to aquatic life. If trash items are persistent in the environment, buoyant (floatable), and relatively small, they can be transported long distances and be mistaken by wildlife as food items. Larger items can cause entanglement. Some discarded debris may contain toxic substances. All of these factors are considered in the narrative descriptions in this assessment parameter.

4. **Threat to Human Health.** This category is concerned with items that are dangerous to people who wade or swim in the water, and with pollutants that could accumulate in fish in the downstream environment, such as mercury. The worst conditions have the potential for presence of dangerous bacteria or viruses, such as with medical waste, diapers, and human or pet waste.

5. **Illegal Dumping and Littering.** This assessment category relates to direct placement of trash items at a site, with "poor" conditions assigned to sites that appear to be dumping or littering locations based on adjacent land use practices or site accessibility.

6. **Accumulation of Trash.** Trash that accumulates from upstream locations is distinguished from dumped trash by indications of age and transport. Faded colors, silt marks, trash wrapped around roots, and signs of decay suggest downstream transport, indicating that the local drainage system facilitates conveyance of trash to water bodies, in violation of clean water laws and policies.

Technical Notes on Trash and Water Quality

Trash is a water pollutant that has a large range of characteristics of concern. Not all litter and debris delivered to streams are of equal concern to water quality. Besides the obvious negative aesthetic effects, most of the harm of trash in surface waters is imparted to aquatic life in the form of ingestion or entanglement. Some elements of trash exhibit significant threats to human health, such as discarded medical waste, human or pet waste, and broken glass. Also, some household and industrial wastes may contain toxic substances of concern to human health and wildlife, such as batteries, pesticide containers, and fluorescent light bulbs that contain mercury. Larger trash such as discarded appliances can present physical barriers to natural stream flow, causing physical impacts such as bank erosion. From a management perspective, the persistence and accumulation of trash in a waterbody are of particular concern, and signify a priority area for prevention of trash discharges. Also of concern are trash "hotspots" where illegal dumping, littering, and/or accumulation of trash occur.

Rapid Trash Assessment. Trash assessment includes a visual survey of the waterbody (e.g., streambed and banks) and adjacent areas from which trash elements can be carried to the waterbody by wind, water, or gravity. The delineation of these adjacent areas is site-specific and requires some judgment and documentation. The rapid trash assessment worksheet is designed to represent the range of effects that trash has on the physical, biological, and chemical integrity of water bodies, in accordance with the goals of the Clean Water Act and the California Water Code. The worksheet also provides a record for evaluation of the management of trash discharges, by documenting sites that receive direct discharges (i.e., dumping or littering) and those that accumulate trash from upstream locations.

Trash Characteristics of Concern. For aquatic life, buoyant (floatable) elements tend to be more harmful than settleable elements, due to their ability to be transported throughout the waterbody and ultimately to the marine environment. Persistent elements such as plastics, synthetic rubber and synthetic cloth tend to be more harmful than degradable elements such as paper or organic waste. Glass and metal are less persistent, even though they are not biodegradable, because wave action and rusting can cause them to break into smaller pieces. Natural rubber and cloth can degrade but not as quickly as paper (U.S. EPA, 2002). Smaller elements such as plastic resin pellets (a by-product of plastic manufacturing) and cigarette butts are often more harmful to aquatic life than larger elements, since they can be ingested by a large number of small organisms which can then suffer malnutrition or internal injuries. Larger plastic elements such as plastic grocery bags are also harmful to larger aquatic life such as sea turtles, which can mistake the trash for floating prey and ingest it, leading to starvation or suffocation. Floating debris that is not trapped and removed will eventually end up on the beaches or in the ocean, repelling visitors and residents from the beaches and degrading coastal and open ocean waters.

Trash in water bodies can threaten the health of people who use them for wading or swimming. Of particular concern are the bacteria and viruses associated with diapers, medical waste (e.g., used hypodermic needles and pipettes), and human or pet waste. Additionally, broken glass or sharp metal fragments in streams can cause puncture or laceration injuries. Such injuries can then expose a person's bloodstream to microbes in the stream's water that may cause illness. Also, some trash items such as containers or tires can pond water and support mosquito production and associated risks of diseases such as encephalitis and the West Nile virus.

Leaf litter is trash when there is evidence of intentional dumping. Leaves and pine needles in streams provide a natural source of food for organisms, but excessive levels due to human influence can cause nutrient imbalance and oxygen depletion in streams, to the detriment of the aquatic ecosystem. Clumps of leaf litter and yard waste from trash bags should be treated as trash in the water quality assessment, and not confused with natural inputs of leaves to streams. If there is a question in the field, check the type of leaf to confirm that it comes from a nearby riparian tree. In some instances, leaf litter may be trash if it originates from dense ornamental stands of nearby human planted trees that are overloading the stream's assimilative capacity for leaf inputs. Other biodegradable trash, such as food waste, also exerts a demand on dissolved oxygen, but aquatic life is unlikely to be adversely affected unless the dumping of food waste is substantial and persistent at a given location.

Wildlife impacts due to trash occur in creeks, lakes, estuaries, and ultimately the ocean. The two primary problems that trash poses to wildlife are entanglement and ingestion. Marine mammals, turtles, birds, fish, and crustaceans all have been affected by entanglement in or ingestion of floatable debris. Many of the species most vulnerable to the problems of floatable debris are endangered or threatened by extinction.

Entanglement results when an animal becomes encircled or ensnared by debris. It can occur accidentally, or when the animal is attracted to the debris as part of its normal behavior or out of curiosity. Entanglement is harmful to wildlife for several reasons. Not only can it cause wounds that can lead to infections or loss of limbs; it can also cause strangulation or suffocation. In addition, entanglement can impair an animal's ability to swim, which can result in drowning, or in difficulty in moving, finding food, or escaping predators (U.S. EPA, 2001).

Ingestion occurs when an animal swallows floatable debris. It sometimes occurs accidentally, but usually animals feed on debris because it looks like food (i.e., plastic bags look like jellyfish, a prey item of sea turtles). Ingestion can lead to starvation or malnutrition if the ingested items block the intestinal tract and prevent digestion, or accumulate in the digestive tract, making the animal feel "full" and lessening its desire to feed. Ingestion of sharp objects can damage the mouth, digestive tract and/or stomach lining and cause infection or pain. Ingested items can also block air passages and prevent breathing, thereby causing death (U.S. EPA, 2001).

Common settled debris includes glass, cigarettes, rubber, construction debris and more. Settleables are a problem for bottom feeders and dwellers and can contribute to sediment contamination. Larger settleable items such as automobiles, shopping carts, and furniture can redirect stream flow and destabilize the channel.

In conclusion, trash in water bodies can adversely affect humans, fish, and wildlife. Not all water quality effects of trash are equal in severity or duration, thus the trash assessment methodology was designed to reflect a range of trash impacts to aquatic life, public health, and aesthetic enjoyment. When considering the water quality effects of trash while conducting a trash assessment, remember to evaluate individual items and their buoyancy, degradability, size, potential health hazard, and potential hazards to fish and wildlife. Utilize the narratives in the worksheet, refer to the technical notes and trash parameter descriptions in the text as needed, and select your scores after careful consideration of actual conditions.

<u>References:</u>

U.S. Environmental Protection Agency, 2001. Draft Assessing and Monitoring Floatable Debris.

U.S. Environmental Protection Agency, 2002. The Definition, Characterization and Sources of Marine Debris. Unit 1 of Turning the Tide on Trash, a Learning Guide on Marine Debris.

Rapid Trash Assessment Worksheet

Surface Water Ambient Monitoring Program, San Francisco Bay Regional Water Quality Control Board

WATERSHED/STREAM: ______________________________ DATE/TIME: _______________
MONITORING GROUP, STAFF: _________________________ SAMPLE ID: _______________
SITE DESCRIPTION (Station Name, Number, etc.): ______________________________________

	CONDITION CATEGORY			
Trash Assessment Parameter	**Optimal**	**Sub optimal**	**Marginal**	**Poor**
1. Level of Trash	On first glance, no trash visible. Little or no trash (<10 pieces) evident when streambed and stream banks are closely examined for litter and debris, for instance by looking under leaves.	On first glance, little or no trash visible. After close inspection small levels of trash (10-50 pieces) evident in stream bank and streambed.	Trash is evident in low to medium levels (51-100 pieces) on first glance. Stream, bank surfaces, and riparian zone contain litter and debris. Evidence of site being used by people: scattered cans, bottles, food wrappers, blankets, clothing.	Trash distracts the eye on first glance. Stream, bank surfaces, and immediate riparian zone contain substantial levels of litter and debris (>100 pieces). Evidence of site being used frequently by people: many cans, bottles, and food wrappers, blankets, clothing.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Actual Number of Trash Items Found	0 to 10 trash items found based on a trash assessment of a 100-foot stream reach.	11 to 50 trash items found based on a trash assessment of a 100-foot stream reach.	51 to 100 trash items found based on a trash assessment of a 100-foot stream reach.	Over 100 trash items found based on a trash assessment of a 100-foot stream reach.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Threat to Aquatic Life	Trash, if any, is mostly paper or wood products or other biodegradable materials. Note: A large amount of rapidly biodegradable material like food waste creates high oxygen demand, and should not be scored as optimal.	Little or no (<10 pieces) transportable, persistent, buoyant litter such as: hard or soft plastics, Styrofoam, balloons, cigarette butts. Presence of settleable, degradable, and non-toxic debris such as glass or metal.	Medium prevalence (10-50 pieces) of transportable, persistent, buoyant litter such as: hard or soft plastics, Styrofoam, balloons, cigarette butts Larger deposits (< 50 pieces) of settleable debris such as glass or metal. Any evidence of clumps of deposited yard waste or leaf litter.	Large amount (>50 pieces) of transportable, persistent, buoyant litter such as: hard or soft plastics, balloons, Styrofoam, cigarette butts; toxic items such as batteries, lighters, or spray cans; large clumps of yard waste or dumped leaf litter; or large amount (>50 pieces) of settleable glass or metal.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Threat to Human Health	Trash contains no evidence of bacteria or virus hazards such as medical waste, diapers, pet or human waste. No evidence of toxic substances such as chemical containers or batteries. No ponded water for mosquito production. No evidence of puncture and laceration hazards such as broken glass or metal debris.	No bacteria or virus hazards or sources of toxic substances, but small presence (<10 pieces) of puncture and laceration hazards such as broken glass and metal debris. No presence of ponded water in trash items such as tires or containers that could facilitate mosquito production.	Presence of **any one** of the following: hypodermic needles or other medical waste; used diaper, pet waste, or human feces; any toxic substance such as chemical containers, batteries, or fluorescent light bulbs (mercury). Medium prevalence (10-50 pieces) of puncture hazards.	Presence of **more than one** of the items described in the marginal condition category, or high prevalence of any one item (e.g. greater than 50 puncture or laceration hazards).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Rapid Trash Assessment Worksheet

Surface Water Ambient Monitoring Program, San Francisco Bay Regional Water Quality Control Board

	CONDITION CATEGORY			
Trash Assessment Parameter	**Optimal**	**Sub optimal**	**Marginal**	**Poor**
5. Illegal Dumping **Illegal Littering**	D: No evidence of illegal dumping. No bags of trash, no yard waste, no household items placed at site to avoid proper disposal, no shopping carts. L: Any trash is incidental litter (< 5 pieces) or carried downstream from another location.	D: Some evidence of illegal dumping. Limited vehicular access limits the amount of potential dumping, or material dumped is diffuse paper-based debris. L: Some evidence of litter within creek and banks originating from adjacent land uses (<10 pieces).	D: Presence of **one** of the following: furniture, appliances, shopping carts, bags of garbage or yard waste, coupled with vehicular access that facilitates in-and-out dumping of materials to avoid landfill costs. L: Prevalent (10-50 pieces) in-stream or shoreline littering that appears to originate from adjacent land uses.	D: Evidence of chronic dumping, with **more than one** of the following items: furniture, appliances, shopping carts, bags of garbage, or yard waste. Easy vehicular access for in-and-out dumping of materials to avoid landfill costs. L: Large amount (>50 pieces) of litter within creek and on banks that appears to originate from adjacent land uses.
D-SCORE	10 9	8 7 6	5 4 3	2 1 0
L-SCORE	10 9	8 7 6	5 4 3	2 1 0
6. Accumulation of Trash	There does not appear to be a problem with trash accumulation from downstream transport. Trash, if any, appears to have been directly deposited at the stream location.	Some evidence (<10 pieces) that litter and debris have been transported from upstream areas to the location, based on evidence such as silt marks, faded colors or location near high water line.	Evidence that (10 to 50 pieces) trash is carried to the location from upstream, as evidenced by its location near high water line, siltation marks on the debris, or faded colors.	Trash appears to have accumulated in substantial quantities at the location based on delivery from upstream areas, and is in various states of degradation based on its persistence in the waterbody. Over 50 items of trash have been carried to the location from upstream.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Total Score ________________

SITE DEFINITION:
UPPER/LOWER BOUNDARIES OF REACH: ______________________________________
HIGH WATER LINE: ____
UPPER EXTENT OF BANKS OR SHORE: ______________________________________
____

NOTES:
____
____
____
____
____
____
____

TRASH ITEM TALLY (Tally with (•) if found above high water line, and (|) if below)

Rapid Trash Assessment Worksheet

Surface Water Ambient Monitoring Program, San Francisco Bay Regional Water Quality Control Board

PLASTIC # Above___ # Below____	**METAL** # Above___ # Below____
Plastic Bags	Aluminum Foil
Plastic Bottles	Aluminum or Steel Cans
Plastic Bottle Caps	Bottle Caps
Plastic Cup Lid/Straw	Metal Pipe Segments
Plastic Pipe Segments	Auto Parts (specify below)
Plastic Six-Pack Rings	Wire (barb, chicken wire etc.)
Plastic Wrapper	Metal Object
Soft Plastic Pieces	**LARGE (specify below)** # Above___ # Below____
Hard Plastic Pieces	Appliances
Styrofoam cups pieces	Furniture
Styrofoam Pellets	Garbage Bags of Trash
Fishing Line	Tires
Tarp	Shopping Carts
Other (write-in)	Other (write-in)
BIOHAZARD # Above___ # Below____	**TOXIC** # Above___ # Below____
Human Waste/Diapers	Chemical Containers
Pet Waste	Oil/Surfactant on Water
Syringes or Pipettes	Spray Paint Cans
Dead Animals	Lighters
Other (write-in)	Small Batteries
CONSTRUCTION DEBRIS#Above___#Below__	Vehicle Batteries
Concrete (not placed)	Other (write-in)
Rebar	**BIODEGRADABLE** # Above___ # Below____
Bricks	Paper
Wood Debris	Cardboard
Other (write-in)	Food Waste
MISCELLANEOUS # Above___ # Below____	Yard Waste (incl. trees)
Synthetic Rubber	Leaf Litter Piles
Foam Rubber	Other (write-in)
Balloons	**GLASS** # Above___ # Below____
Ceramic pots/shards	Glass bottles
Hose Pieces	Glass pieces
Cigarette Butts	**FABRIC AND CLOTH** # Above___# Below____
Golf Balls	Synthetic Fabric
Tennis Balls	Natural Fabric (cotton, wool)
Other (write-in)	Other (write-in)
Total pieces Above: **Below:**	**Grand total:**
Tally all trash in above rows; make notes below as needed to facilitate scoring.	
Littered:	
Dumped:	
Downstream Accumulation:	

SPECIFIC DESCRIPTION OF ITEMS FOUND:____

____

____

ATTACHMENT J

Provision C.10.
Benefits and Shortcomings of
The Rapid Trash Assessment Methodology

Internal Memo
California Regional Water Quality Control Board
San Francisco Bay Region

MEMO
To: Dale Bowyer, San Francisco Bay Regional Water Quality Control Board
From: Matt Cover, San Francisco Bay Regional Water Quality Control Board
RE: Trash Assessment Methods

Benefits and shortcomings of the Rapid Trash Assessment (RTA) methodology

1. The qualitative and semi-quantitative scoring categories of the RTA provide useful information on trash levels as they relate to *beneficial uses* (human health and aquatic life) in tributaries. These scores do not necessarily reflect beneficial uses in downstream waterbodies (i.e. San Francisco Bay and the Pacific Ocean), where trash is of greater concern. These scoring categories (made during the initial site visit only) could be used as regulatory action levels, as they are directly related to beneficial uses, but they do not reflect loading to downstream waters.
2. The RTA method is most useful when revisiting a site after cleanup, in order to examine trash *deposition rates* over a known time period. Dry-season deposition rates reflect *localized* loading of trash from littering and dumping (because very little trash is transported downstream by water during the dry season). The dry-season deposition rate could be used as a regulatory target, as it is a direct measure of loading (although localized in nature). The wet-season deposition rate reflects *retention* of trash that is being carried through stream channels, is not a defensible regulatory action level as it does not necessarily reflect loading or beneficial uses.
3. Perhaps the most valuable outcome of the RTA monitoring exercise is suggesting hypotheses about *local sources* of trash (littering vs. dumping, wind-blown transport from specific locations, etc.) that can inform the development of site-specific management plans. These observations are often based on *unquantifiable* properties of the trash, such as level of decomposition, surface weathering, deposition location, company logos, etc. Therefore it is critical for RTA field technicians to record their observations and hypotheses about local sources and potential management actions immediately following the trash assessment. Although these hypotheses are very useful for site-specific management, they are not related to regulatory action levels
4. The RTA does not assess delivery of trash to downstream waters (i.e. the bay) during floods, which is when the vast majority of trash is transported downstream. Even if the assumption is made that all trash that is deposited at a stream site eventually is transported to downstream receiving waters, it is likely that a vast majority of trash is not retained by the system and is transported directly to downstream waters, given the transport efficiency of the stormwater transport system.
5. Trash conditions measured with the RTA at a site may or may not reflect conditions just upstream or downstream. There is tremendous spatial variation in trash levels, due to the patchiness of loading and differences in the ability of channels to retain trash during floods. Thus, results of RTA surveys should be considered site specific, and may not reflect conditions elsewhere in the watershed.

Summary of shortcomings of the RTA methodology

RTA scores do not necessarily reflect beneficial uses in downstream waterbodies (i.e. San Francisco Bay and the Pacific Ocean), where trash is of greater concern. The RTA does not assess delivery of trash to downstream waters (i.e. the bay) during floods, which is when the vast majority of trash is transported downstream. There is tremendous spatial variation in trash levels, so that trash conditions measured with the RTA may not reflect conditions just upstream or downstream.

Storm-based sampling of trash transport (SSTT)

Since trash debris in the bay and ocean is the biggest concern, direct measurements of trash loading to the bay will be more informative. Various structural devices have been used to collect trash in stormwater conveyance systems, including Continuous Deflector Separators (CDS), end-of-pipe trash nets or baskets, and catch basin inserts and screens (e.g. Allison et al. 1997). While very effective at removing trash, full-capture devices can be quite expensive to install (> $100,000 per unit) and require regular maintenance.

Direct measurement of trash transport during floods would have many benefits. Trash volumes could be plotted against stream discharge (from local stream gages), in order to develop "trash rating curves" (see Figure 1, below, from Allison et al. 1997). Once rating curves are developed for a watershed, total loading to the bay could be inferred from discharge data. Trash transport measurements in multiple watersheds would allow for the direct comparison of trash loading, in order to identify high priority watersheds for management treatments. In the same way, measurement of trash transport in sub-basins within a watershed would quickly allow the identification of the most important trash source areas. This process would insure that structural controls are placed in the most beneficial locations. Trash transport measurements would also produce data on volumes of trash and other debris that is collected during storm events, in order to select the appropriate control device, mesh size, and maintenance schedule. For example, sub-basins that deliver large volumes of organic debris (leaves and wood) and little trash would not be a good candidate for a full-capture device.

Storm-based sampling of trash transport is most easily and safely performed in small streams less than 15 feet (~5 meters) wide. Sampling should be performed for a set period of time, usually 15-60 minutes, during the rising limb of the hydrograph of a storm event. Two persons are required to deploy and retrieve the net. In some cases it may be possible to secure the net in place; in other cases the net may need to be held in place for the duration of sampling. A 5mm mesh net is placed across the stream, with the base of the net at the stream bottom. All debris that is collected in the net during a set period of time is sorted (e.g. trash vs. leaf litter), so that volumes and dry weights of trash can be determined. Trash volumes need to be related to streamflow at the time of sampling in order for a trash "rating curve" to be developed. If there is not a streamflow record available for the stream that is being sampled, streamflow data from a nearby small stream with similar hydrologic response can be used.

A device for measuring trash transport can be built very easily and cheaply from materials available at hardware stores with the following equipment:

- 15 foot x 3 foot wire screen with ¼ inch mesh (~5 mm interior diameter), $12
- Two 48-inch long metal stakes, $10

Each end of the screen is fastened to the metal stakes with zip ties.

This equipment and SSTT methodology is currently being tested by Matt Cover of the Regional Board's Surface Water Ambient Monitoring Program (SWAMP).

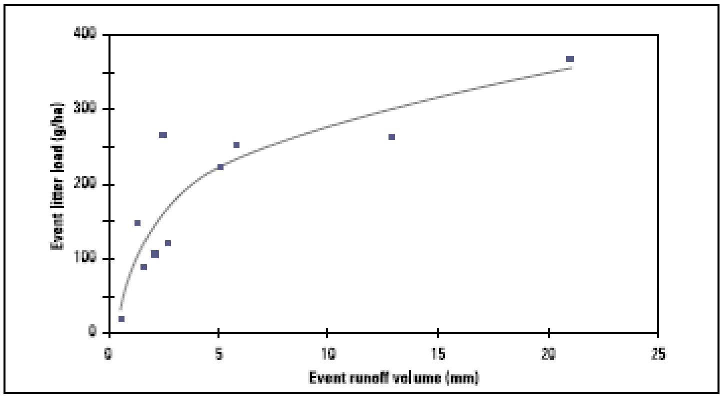


Figure 1: Dry litter loads as a function of runoff in Melbourne, Australia (from Allison et al. 1997)

Reference

Allison, R., F. Chiew, and T. McMahon. 1997. Stormwater gross pollutants. Cooperative Research Center for Catchment Hydrology Industry Report 97/11. Clayton, Australia.

Attachment K

Standard NPDES Permit Provisions