Santa Clara Basin Watershed Management Initiative

FINAL

Framework for Conducting Watershed Assessment (Parts A and B)

SANTA CLARA BASIN

WMI

WATERSHED MANAGEMENT INITIATIVE

Prepared By

The Report Preparation Team and Watershed Assessment Consultant

Approved by Core Group February 3, 2000

Santa Clara Basin Watershed Management Initiative

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Framework for Conducting Watershed Assessment (Part A)

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TECHNICAL MEMORANDUM (TM 4g, Task 3b)

To: Core Group

From: Watershed Assessment Consultant, John Davis and Peter Mangarella, Leads

Date: February 29, 2000

Subject: Proposed Procedural Framework for Conducting Watershed Assessment (Part A)

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Introduction

This memorandum describes a suggested procedural framework for using environmental indicators to conduct the WMI watershed assessment per CAP Task 3b. The framework builds on previous work products developed by the WMI, including the Rationale Document developed by the Watershed Assessment Subgroup, the Data Management Subgroup's Short Term Data Management Plan, Work Group A's identification and classification of environmental indicators, and stakeholder comments regarding the quantifiable parameters. *[WAS comment # 2]*.

Purpose

The purpose of this memorandum is to describe the framework for conducting the assessment to enable stakeholders to understand the suggested approach and agree on an approach. The actual assessment approach used will depend largely on the availability and quality of data, but this memorandum is intended to provide a framework that will enable stakeholders to agree as to how data will be used. The primary focus of the assessment is on assisting Santa Clara Basin stakeholders in identifying the condition of the waterbodies to improve the management of the basin's water resources. To ensure that the assessment is useful to all of the stakeholders, the assessment framework is consistent with federal and state water quality assessment methodologies. Use of this framework would allow the WMI assessment information to be used to satisfy Clean Water Act Section 303 (d) and 305(b) requirements.

An important issue with the approach is coordination with regional efforts, and especially the Regional Board's ongoing efforts in developing a Regional Monitoring and Assessment Strategy. Many among the regulators and the regulated have expressed an interest in improving the assessment process and coordinating it with other monitoring and management programs in the San Francisco Bay Area. Information on related regional efforts to develop an improved approach to monitoring and assessment is contained in Attachment A.

The WMI assessment process described in this memorandum is designed to use available data to determine whether beneficial uses/stakeholder interests are supported in various sub-watersheds and stream reaches in the Santa Clara Basin. The results of the assessment will be programmatic since the assessment is relying on available data, and may be refined, as more data becomes available. The goal of the assessment is to begin to identify the factors that affect beneficial use support and achievement of stakeholder interests in Santa Clara Basin's streams as well as provide a scientific basis for selecting and evaluating alternative management strategies.

It should be noted that the assessment process will not always yield definitive answers with respect to the fitness of a waterbody for a beneficial use. It is expected that in many cases data deficiencies and methodological difficulties will allow only partial or qualified conclusions. *[Response to WAS # 4]*.

Background

The framework presented here represents a synthesis of the work that WMI subgroups and work groups have undertaken to develop an objective method for the assessment process. This overall process supporting the development of the assessment framework is summarized in Figure 1, and discussed below.

<u>The Rationale Paper</u>

As a first step, the Watershed Assessment Subgroup reviewed the designated beneficial uses for waterbodies in the Santa Clara Basin and identified four primary beneficial uses and one stakeholder interest for use in the assessment. The preferred approach was described in the "Rationale for Selecting Primary Uses as the Basis for the Santa Clara Watershed Assessment Report." The Core Group approved the Rationale Paper and the proposed approach to the assessment on 6 August 1998.

The designated uses are contained in the most recent revision (1995) of the Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan), and the stakeholder interest is flood management. The concept set forth in the Rationale Paper was that if a waterbody supports these four beneficial uses, it could be assumed that other environmentally related correlated beneficial uses would also be supported. Subsequent comments provided by the Regional Board (Gearheart Memorandum dated 12/1/99) indicated that this is not acceptable; therefore this assessment will focus only on four primary uses. No attempt will be made to interpret the condition of other uses. On that basis, the Regional Board, among others, suggested that the MUN beneficial use would be preferred over GWR because water column criteria for MUN are generally more stringent. For this reason the approach described in the Rationale Paper has been modified by stakeholder decisions taken at the December 2, 1999 Core Group Meeting. Although protection from flooding is not a designated beneficial use it is an interest for many WMI stakeholders, and will be evaluated as an important element to be addressed in the Watershed Management Plan.

The five primary uses/stakeholder interests are:

- Cold freshwater habitat (COLD)
- Preservation of rare and endangered species (RARE)
- Water-contact recreation (REC1)
- Municipal and Domestic Supply (MUN)
- Protection From Flooding (PFF)

The Rationale Paper recommended that these uses/interests serve as the foundation of the assessment. Specifically, a waterbody or stream reach would be considered to be functioning well if it supported the primary uses and stakeholder interest. If it did not support the uses and interests it would be considered to be functioning poorly. Finally, the Rationale Paper linked the general types of data that could be used to characterize the condition and assess support of the uses/interest.

Quantifiable Parameters

Based on the primary uses, Work Group A developed a list of data types or indicators for the parameters that could be used to judge whether a waterbody supports these designated beneficial uses/interest. For most beneficial uses/interests, many indicators were listed. Some indicators, for example dissolved oxygen concentration, are well-established water quality criteria and are accepted by water quality regulators as clear indicators of beneficial use support. Other indicators, for example presence of key macro-invertebrates as an indicator of the suitability of a waterbody as cold water habitat, are relatively new. Biological indicators of this sort are only beginning to be accepted by some water quality regulators as "biocriteria." They typically entail the development of region-specific indices and reference conditions to be useful for assessment efforts. The term 'indicator' used here as defined by Work Group A and in the Quantifiable Parameters memo[1], that is, in the generic sense consistent with EPA's Section 305 (b) Guidance document. This Framework continues this application. *[WAS comment #3]*

Based on the list of data types prepared by Work Group A, the WAC developed tables of quantifiable parameters and, where available, threshold values for the parameters, that could be used to judge the fitness of a waterbody for a particular use. Although the tables of quantifiable parameters are comprehensive, they are difficult to use directly for watershed assessment in the absence of a systematic and agreed upon procedure that shows how the quantifiable parameters would be applied. In fact, the quantifiable parameter tables themselves proved to be somewhat controversial in that some stakeholders viewed them as an attempt to create biological criteria that could be misapplied in a regulatory context. The goal here is to provide a systematic approach to watershed assessment tailored to the needs of the WMI stakeholders. The framework attempts to distinguish between critical parameters and important but less critical parameters, and to respond to different levels of data availability and reliability.

[1] See Quantifiable Parameters and Threshold Levels for Beneficial Uses and Stakeholder Interests, January 25, 1999, adopted at the May 1999 Core Group meeting.

Proposed Procedural Framework for Assessment

Decision tools and their application

The proposed assessment procedure consists of a set of decision tools designed for use with the five primary uses/stakeholder interests but which is equally applicable to any other beneficial uses or stakeholder interests. *[WAS comment #1]* The decision-tools illustrated diagrammatically in Figure 2 are discussed in detail in Part B.

The decision tools will be in the form of logic diagrams that enable systematic determination of the level of support of a primary use/interest through a "weight of evidence" approach. The core of the logic diagrams is the analysis step (enclosed in diamond) which asks a question regarding indicator(s) of the beneficial use. For each analysis step there are three possible outcomes:

1) An affirmative answer to the question leads to a support statement.
2) A negative answer leads to another analysis step.
3) Where there is insufficient data to answer the question, additional, less reliable indicators are considered, the lack of available data sets for the preferred indicator documented, and a decision to collect or compile additional data made.

Data are usually required to complete each analysis step and quantitative or qualitative criteria are also needed (enclosed in rectangles). Where preferred indicator data is not available, this will be noted and referred for consideration in the long-term monitoring plan per CAP Task 2 (Develop Process and Criteria for prioritizing collection of missing data). *[WAS comment #12]*.

The logic diagram process provides a rationale for substituting additional data -- essentially weighing more evidence, that may be less reliable, to enable the Assessment process to provide a finding. It provides the technical teams a pathway for documenting decisions to include broader data types and a checkpoint for qualifying the use of such data. It is understood that as decisions are driven further down the logic path there tends to be a decreasing level of reliability in the data to assess use support and a corresponding decrease in the certainty of the findings based on such data. *[WAS comment #13 & 14.]*

For the purposes of analysis, waterbodies will be divided into segments. A separate determination of the fitness of each segment for each primary use/stakeholder interest will be made using each of the decision tools. Segments will be selected on the basis of physical characteristics. For example, a three-mile long reach of creek that is rock- or concrete-lined and passes through many culverts might be designated as a segment.

Immediately upstream is a five-mile reach of relatively natural channel. This reach might also be designated as a segment.[2] *[WAS comment #5]*

<u>Assessment Principles</u>

The proposed procedure is founded on the concept that direct measures of the fitness of a waterbody to support a primary use/stakeholder interest are preferable to indirect measures. Indirect measures or indicators are proposed only when direct measures are impractical or limitations in the data prevent use of a direct measure. Table 1 contains information on direct measures and indicators of fitness for each of the primary uses/stakeholder interests. This concept of a hierarchy of data types and utility for making the assessment is consistent with EPA guidance[3] on conducting water quality assessments. It also builds on work conducted by Work Group A, which identified relevant data types and classified each data type in terms of potential utility to the assessment process.

The reason direct measures are thought to be preferable to indirect measures is because they are typically more conclusive and provide a higher degree of confidence that a waterbody is or is not fit for a primary use/interest over an extended period of time. For example, for COLD and RARE direct measures of the fitness of a waterbody to support these primary uses/stakeholder interests are available and practical to apply. Observations on the presence and condition of cold water fish and endangered species provide evidence to evaluate support. Cold water fish or endangered species will only be present if conditions in the waterbody have been continuously favorable to the organisms for an extended period of time. If cold water fish or endangered species are present and in good condition in a stream reach the assessor can be confident that the primary use/interest is supported.

The most direct measure of a waterbody's fitness for REC 1 would be information on the health of individuals using the waterbody for recreation. Information of this type is derived from epidemiological studies. Epidemiological studies of the health of bathers are technically difficult, time–consuming and expensive. Thus, direct measurement of fitness for REC1 is impractical. A primary indicator of the waterbody's fitness for REC1 might be the concentration of organisms that produce disease in humans (pathogens). However, it is practically impossible to routinely analyze water samples for the many individual strains of pathogens and so a secondary indicator, such as coliform organism concentrations, is routinely used to determine the fitness of waters for contact recreation.

The most direct measure of support of Municipal and Domestic Supply is finished water quality where finished is defined as tap water, water extracted from water supply wells, or finished water from the water treatment plants. However, this type of analysis provides little information regarding the condition of the source (or "raw") water, which is a better

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[2]This is consistent with the California Salmonid Stream Habitat Restoration Manual, 2nd Edition (1994). Flosi and Reynolds. Department of Fish and Game. Page Q-16

[3] Section 3 of USEPA (1997), *Guidelines for the Preparation of the Comprehensive State Water Quality Assessments (305(b) Reports) and Electronic Updates: Supplement.*

indication of watershed health. Therefore, the primary indicator for this assessment will be water quality during dry weather in streams and reservoirs used for raw water supply. The threshold criteria in this case are drinking water quality standards in the form of Maximum Contaminant Levels (MCLs) or, where MCLs are not available, Action Levels.

The most direct measure of whether a stream reach provides protection from flooding is data on historic flooding along the stream. However, direct measurement is not useful in a rapidly developing watershed and can be misleading given the infrequency of major flood events. The history of flooding in a watershed is not considered a reliable guide to present or future flood hazard. Instead, a more reliable determination of whether a stream reach provides protection from flooding includes a comparison between the capacity of the channel and the estimated flow in the channel in a large storm. The Santa Clara Valley Water District uses protection from the 1-percent storm, that is, a storm with a 1-percent chance of occurrence in a given year, as a measure of the adequacy of flood management facilities. The assessment of the Flood Protection interest would also consider the effects of flood protection activities (e.g., maintenance) in supporting this use.

Treatment of Data Deficiencies

The WMI watershed assessment is to be performed using existing data. Its goal is to extract the maximum amount of meaning from the existing data and to develop as complete a picture of the current condition of the watershed as is possible. It is expected that for many waterbodies and stream reach data will be limited in quantity and quality affecting the reliability of the conclusions. The assessment framework is designed to accommodate data deficiencies. The first questions in the logic diagrams for assessment of each of the five primary uses/interests assume the availability of good data and the ability to make a conclusive determination of whether a primary use/stakeholder interest is fully supported. If the data are insufficient to make a full determination, the later questions rely on more limited or less statistically rigorous data sets that may lead to a partial support statement.

The problem of data deficiencies affects the five primary uses/stakeholder interests differently. For COLD, if no data are available on fish populations in a waterbody some insight can be obtained by considering primary and secondary indicators as shown in Table 1. Macro-invertebrate or water quality data and data on habitat condition may provide information on the suitability of a waterbody for cold water fish. Similarly, for RARE, if data are lacking on the populations of an endangered species, qualitative assessments of habitat condition can provide some insight into the fitness of a river reach for the species.

For REC1, if no bacteriological data are available for a waterbody then there is no other indicator that sheds much light on the waterbody’s fitness for REC1. Bacteriological data are likely to be unavailable for some waterbodies and stream reaches. Chlorophyll data provide a measure of the attractiveness of a waterbody for REC1 but it is difficult to come to a conclusion about fitness based on chlorophyll alone. The REC1 assessment also will address fish consumption related to sport fishing where the primary data type will be fish tissue.

Identification of Limiting Factors

The assessment will attempt to identify factors that may be limiting the use. A final step in the logic diagrams involves the consideration of limiting factors. If a primary use/stakeholder interest is not supported or only partially supported in a waterbody, the relevant data will be examined in an attempt to determine what factors limit the waterbody's ability to support the use.

Products of the Assessment

A principal aim of the Watershed Assessment Report is to organize, present, and convey the most relevant information regarding the condition of the waterbodies as it relates to the primary uses, which include their suitability for supporting aquatic life and for swimming, providing safe drinking water, and how they function in response to high flows.

The results of the assessment will be summarized in a series of annotated tables based on the responses to the framework diagrams for each use and interest. The findings will strive to include as much useful information as possible, including spatial and temporal variation in support, where such data exists to make such a determination. *[WAS comment #18]* The format of the tables will be finalized once the early results of the assessment are available. The content of the tables will be similar to that shown in Tables 2 and 3. A summary table for each stream that lists all the reaches in the stream and the results of each beneficial use will be included. *[WAS comment #24]*.

Implementation of the Assessment

The assessment will be performed by the Watershed Assessment Consultant under the direction of a lead designated from the Report Preparation Team (See Figure 3). It is envisioned that the Report Preparation Team, the Watershed Assessment Subgroup, and the Data Management Subgroup will be involved in providing input to the process and reviewing interim products. The WAC team will be divided into four technical teams as shown in Figure 3. Three of the teams will focus on specific uses and interests while the fourth team will provide data management support. Each team consists of qualified technical specialists in their field charged with carrying out the direction of the Core Group based on the foundation of work established to date, including Work Group A's recommendations and stakeholder comments regarding the quantifiable parameters. The Watershed Assessment Subgroup suggested the concept of "watershed captains" -- a person familiar with each watershed who would actively participate in the assessment process and work with the teams to provide a 'reality check' of the initial results. While the WAC will be working together, this would provide an integrator to review the separate use support analyses and ensure that the findings are consistent *[WAS comment #16]* and will contribute to each team's deliberations. The Watershed Assessment Subgroup representative will keep the Core Group apprised of progress.

The Assessment Team Coordinator will be responsible for ensuring that methods and results of each team are consistent with the overall framework described herein. Review of process steps, quantifiable thresholds, and work products will be conducted at the policy, regulatory, and technical levels by the Subgroups involved, the Core Group, the Report Preparation Team, and if appropriate, an outside technical review panel.

Attachment A
Related Regional Assessment Efforts

There are a variety of regional monitoring and assessment planning efforts that are concurrent with the Santa Clara Basin efforts. Key among these efforts is the Regional Board's Regional Monitoring and Assessment Strategy, a draft of which was distributed to interested parties for comments on June 3, 1999. That draft describes related regional work. The following is brief synopsis of these efforts. The reader may wish to refer to the Regional Board's Strategy document for further details.

Regional Board's Regional Monitoring and Assessment Strategy

The Regional Board is in the process of developing a Monitoring and Assessment strategy that once implemented will help focus the monitoring efforts of the regulated community, and to assist the Regional Board in making policy and decisions. The goals of the strategy include coordinating monitoring efforts in the Bay and watersheds, standardizing monitoring protocols, improving the technical basis of the Board's policies and actions, and providing for watershed decision-making and study. A goal for the strategy is the desire to improve the technical basis for the State's waterbody assessment process. This would be achieved by going beyond the typical reliance on chemical and toxicological data to include those physical, biological, and/or chemical indicators that together best characterize the extent to which waterbodies support beneficial uses. A second important concept in the strategy is the acknowledgement that waterbody classifications (and associated benchmark conditions for judging support) should take into account factors such as extent of watershed development and/or channel conditions. Implementation of the strategy (which is targeted for completion around September 2000) will include an information management element, and a phased implementation with pilot watersheds.

Bay Area Stream Protection Policy

A related initiative of the Region Board is to develop a Bay Area Stream Protection Policy. The Policy is intended to address the relationship between beneficial uses and more quantitative physical, chemical, and/or biological indicators, and develop recommendations for the protection of beneficial uses.

Bay Area Stormwater Management Agencies Association (BASMAA) Regional Monitoring Strategy

BASMAA developed recently a Regional Monitoring Strategy in order to better coordinate and focus the monitoring programs of the individual member agencies. The objectives of this strategy address effects of storm water on beneficial uses, improved estimates for loadings of pollutants of concern to San Francisco Bay, and evaluation of effectiveness of storm water management source and treatment controls. The strategy is focused initially on development of environmental indicators and associated monitoring parameters and protocols, and consequently fits in well with the Regional Board's goals, and the goals of the WMI.

Regional Monitoring Program

The Regional Monitoring Program (RMP) is focused on monitoring trace elements and chemicals in the main Bay segments, as well as conducting special research studies. This program is a joint effort between the Regional Board and SFEI and is funded from discharger fees. The Program is currently under review and one of the objectives of the review is modify the program to better coordinate watershed and Bay water quality monitoring. The RMP monitoring plan is scheduled to be modified based on the review by 2002.

Watershed Science Approach

The Watersheds Science Approach (WSA) was published in September 1998 by SFEI. The purpose of the WSA is to foster integration of the various scientific disciplines to better understand the interactions among terrestrial and aquatic environments. The WSA emphasizes the role of geomorphology and provides guidance on classification schemes for stream reaches. Another recommendation of the WSA is the need to understand the historic ecology of the watershed as a necessary first step in understanding the effects of human activities on the watershed.

California Aquatic Bioassessment Workgroup

The Department of Fish and Game, the State Water Resources Control Board, and the U.S. Environmental Protection Agency sponsor the California Aquatic Bioassessment Workgroup. The group formed in 1994 to coordinate scientific efforts towards developing and testing aquatic bioassessment protocols in California. The Workgroup operates a Website (www.dfg.ca.gov/cabw) to facilitate disseminating pertinent technical literature. Such protocols have been developed and applied by other states with some success.

Bayland Ecosystem Goals Report

The recently completed Baylands Ecosystem Habitat Goals Report characterizes the status and quality of wetlands habitat in the Bay Area and includes recommendations regarding preservation and enhancement of wetlands habitat. The report provides data on the Lower South Bay wetlands that will be useful in assessing the Baylands portion of the Basin.

Water Environment Research Foundation Project

The Santa Clara Valley Urban Runoff Pollution Prevention Program was awarded a grant to evaluate the utility of environmental indicators on Coyote Creek and for an industrial catchment. The project has included the collection an analysis of physical, hydrologic, chemical, and biological indicators along the main stem of Coyote Creek. The results of the study will assist the WMI in evaluating the utility of indicators for conditions specific to the Basin.

Table 1
Some Direct and Indirect Measures of Fitness of a Waterbody to Support Primary Uses/Stakeholder Interests[a]

Primary Use/Stakeholder Interests	Direct Measure of Supportive Condition	Is Direct Measurement of Condition Practical?	Primary Indicators	Secondary Indicators
COLD	Presence of population of cold water fish	Yes	Presence of key macroinvertebrate species Water temperature Flow	Water quality Habitat conditions (e.g., substrate particle size distribution, canopy cover, etc.)
RARE	Presence of population of endangered species	Yes	Habitat conditions	*Anecdotal evidence*
REC1 (Water Contact)	Healthy recreationists (based on epidemiological data)	No	Pathogen counts (e.g., typhoid bacteria, cryptosporidium cysts, etc.)	Coliform counts
REC1 (Consumption)	Fish tissue chemical contamination	Yes	Health of food chain	Water and sediment quality
MUN	Drinking water quality	Yes	Source water quality	Pollution sources and proximity to source waters
Flood Management	Comparison of estimated flood flows with channel capacity (FEMA Maps)	Yes	Historic flood damage	Stream classification methodologies

[a]Note that table is provided for illustrative purpose only. A more considered evaluation of direct and indirect measures of fitness will be included in a later memorandum.

Table 2
Example of Assessment Summary for Reach WR6

Waterbody: Widow Reed Creek Reach: WR6 Location: RM7-RM9.5

Use/Interest	Data Quality	Criteria Used	Assessment	Existing Conditions Support Use/Interest?	Limiting Factors
COLD	Good	Population data for fish and macro-invertebrates	Healthy steelhead and cased caddis fly populations. Generally good conditions.	Yes	
RARE	Fair	Population data	Potential endangered species include steelhead and red-logged frogs, steelhead present. No data on frogs.	No	Lack of off-stream channels and pools limiting to frogs
REC1	Good	Total coliform counts	More than 90%of monthly coliform samples meet standard, generally good conditions	Yes	
MUN	Good	Water quality data	Source water data comprehensive and good QA/QC	Yes	
Flood Management	Good	Channel capacity estimation	Channel cannot pass 1% peak flow without flooding	No	Channel capacity

Table 3
Example of Assessment Summary WR5

Waterbody: Widow Reed Creek RM5-RM7 Reach: WR5 Location:

Use/Interest	Data Quality	Criteria Used	Assessment	Existing Conditions Support Use/Interest?	Limiting Factors
COLD	Poor	Habitat data	No data on steelhead or macro-invertebrates, habitat conditions are similar to Reach WR6 suggesting fish presence	Possibly	None evident
RARE	Poor	Habitat data	No data on endangered species potentially present (steelhead and red-legged frog)	No	Lack of off-stream channels and pools limiting to frogs
REC1	Good	Total coliform counts	Only 75% of monthly coliform samples meet standard	No	Large storm drain discharges at upstream end of reach
MUN		Not applicable	Reach does not contribute to water supply	Not Applicable	
Flood Management	Good	Channel capacity estimation	Channel cannot pass 1% peak flow without flooding	No	Channel capacity

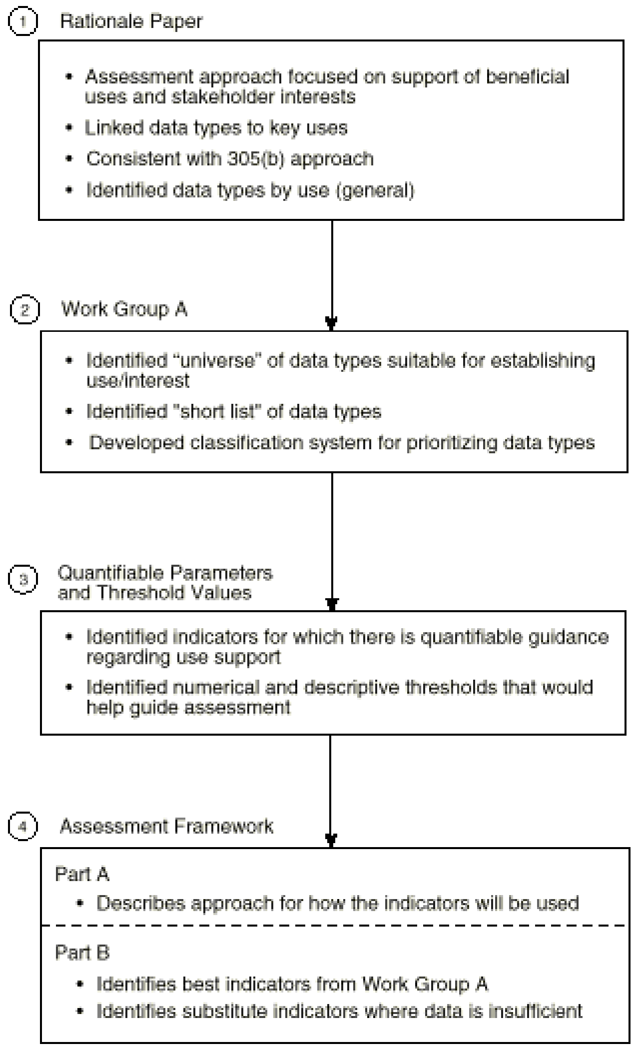

Figure 1. Steps Involved in Developing Assessment Framework

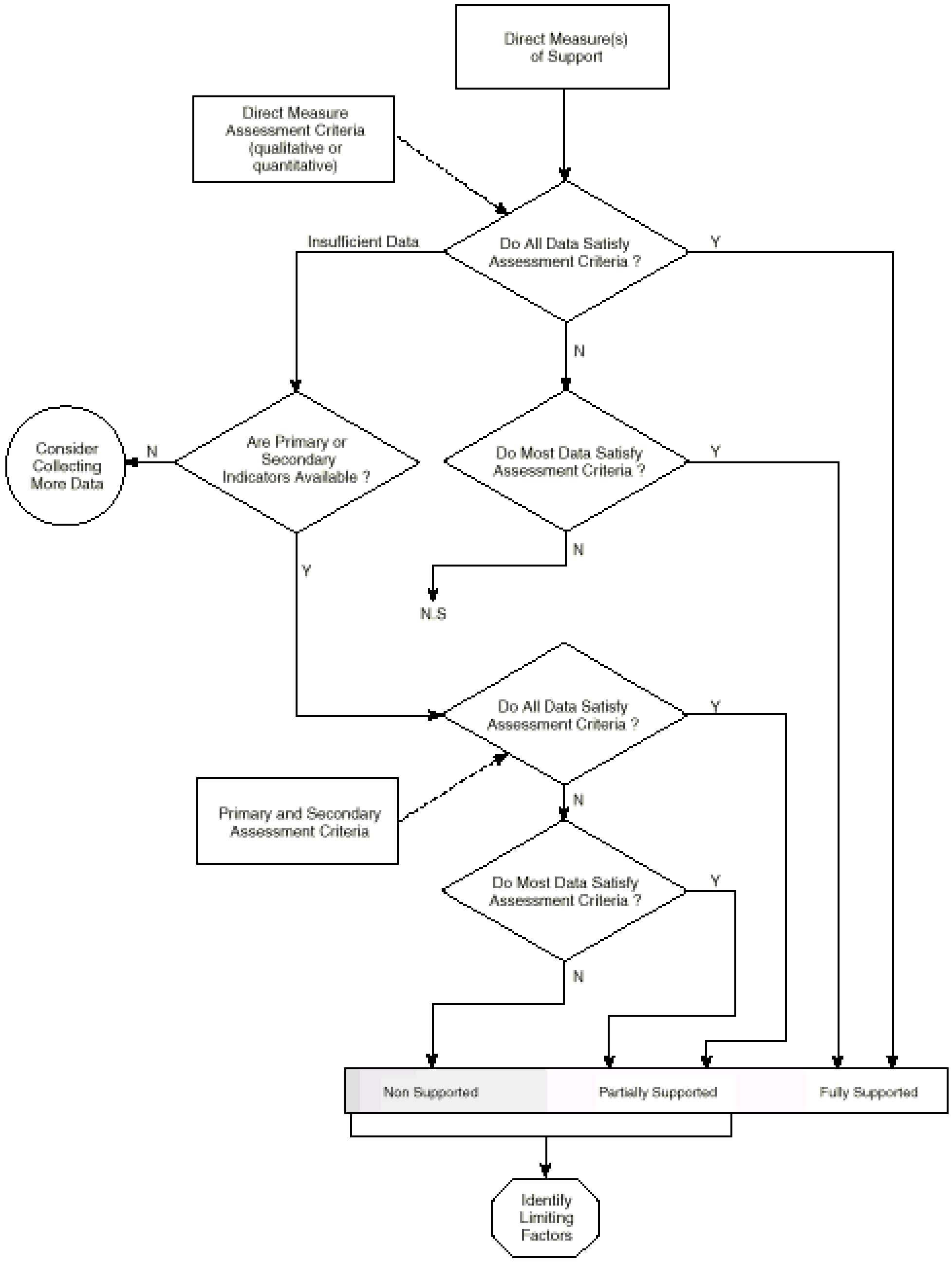

Figure 2. Conceptual Logic Diagram That Illustrates Sequence of Analysis and Decision Steps

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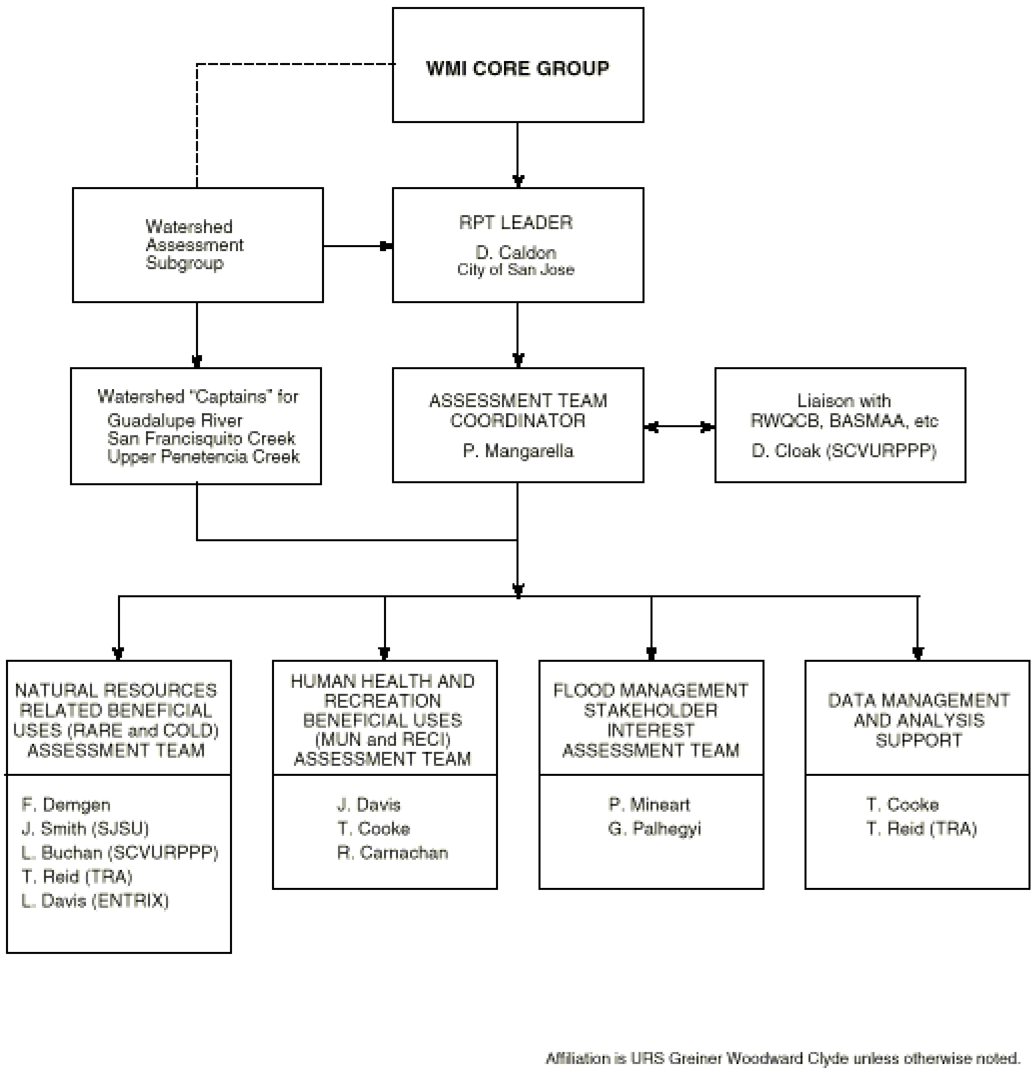

Figure 3. Participants in Developing and Implementing Assessment Framework

Santa Clara Basin Watershed Management Initiative

FINAL

Framework for Conducting Watershed Assessment (Part B)

Prepared By

The Report Preparation Team and Watershed Assessment Consultant

Approved by Core Group February 3, 2000

FINAL TECHNICAL MEMORANDUM (TM 4g-B, Task 3b)

To: Core Group

From: Watershed Assessment Consultant
Leads: John Davis and Peter Mangarella

Date: February 29, 2000

Subject: Proposed Framework for Conducting Watershed Assessment (Part B)

Purpose

The purpose of this memorandum is to illustrate how the data types developed by Work Group A and the associated threshold values (Quantifiable Parameters TM#4b, January 25, 1999) will be applied in a systematic way to address the assessment of uses and interests identified in the Rationale Paper.

Introduction

This memorandum describes in detail the procedural framework for conducting the WMI watershed assessment that was outlined in a companion memorandum (referred to as Part A of the Assessment Framework (TM 4G-A) dated January 25, 2000). The Part A memorandum describes how the procedural framework evolved from the Core Group's direction to focus the assessment efforts on those uses and interests that had been identified as important to stakeholder goals. The concept was to test the process before applying it broadly to all beneficial uses and interests. In this same spirit, Work Group A's list of key data types or indicators narrows data compilation to those data sets that can best be used to judge whether waterbodies support beneficial uses and stakeholder interests. The Part A memorandum also describes assessment principles, decision tools, treatment of data deficiencies, and examples of the products of the assessment. Figure A shows how the Assessment Framework builds on the assessment principles and the selection of environmental indicators and threshold values, and leads into the next steps of data compilation and evaluation.

This memorandum, TM #4g-B, describes the decision tools that will be used to assess whether each waterbody or stream reach supports the five uses/stakeholder interests set forth by the Core Group in August 1998. The approach is intended to be flexible and expand; similar decision tools could be developed for any other beneficial uses and stakeholder interests as agreed upon by the stakeholder process.

Decision Tools

The proposed assessment procedure consists of a set of decision tools designed for use with the five selected beneficial uses/stakeholder interests but which is equally applicable to any other beneficial uses or stakeholder interests. The decision tools are in the form of logic diagrams that enable systematic determination of the level of support of a primary use/interest through a “weight of evidence” approach. Figures 1-5 show the logic diagrams for each of the selected uses and interests.

Data are usually required to complete each analysis step and quantitative or qualitative criteria are also needed (enclosed in rectangles). So the first step in the logic diagrams is to evaluate the adequacy (or sufficiency) of the data required for the assessment. This evaluation will be based on several factors, the quality of the data, the spatial and temporal coverage of the data, and where transferability of data is being considered, the extent to which the data are relevant to the conditions being assessed. Relevant guidance for conducting this evaluation is provided in Draft Guidance for Water Quality-Based Decisions: The TMDL Process (US EPA, 1999). Criteria for conducting the evaluation of data adequacy and associated uncertainty are discussed below under Uncertainty Analysis.

Where preferred indicator data are not available, alternative indicator data will be used. The logic diagram process provides a rationale for substituting additional data--essentially weighing more evidence, that may be less reliable, to enable the assessment process to provide a finding. It provides the technical teams a pathway for documenting decisions to include broader data types and a checkpoint for qualifying the use of such data.

The unavailability of preferred indicator data will be noted and depending on the nature of the data needs, will be referred to for the initial field sampling program or the long-term monitoring plan per CAP Task 12 (Develop Process and Criteria for prioritizing collection of missing data). Figure B illustrates the steps in the data evaluation and collection of additional data that will lead to refining the initial programmatic-level assessment.

The core of the logic diagrams is the analysis step (enclosed in diamond) which asks a question regarding indicator(s) of the beneficial use. For each analysis step there are two possible outcomes:

1) An affirmative answer to the question leads to a support statement.
2) A negative answer leads to another analysis step.

It is understood that as decisions are driven further down the logic path there tends to be a decreasing level of reliability in the indicators to assess use support and a corresponding decrease in the certainty of the findings based on such data. This information is important in the subsequent uncertainty analysis.

Linkage between Decision Tools and Quantifiable Parameters

Based on the list of data types prepared by Work Group A, the WAC developed tables of quantifiable parameters and, where available, threshold values for the parameters (TM#4b, January 25, 1999). The purpose of the threshold values is to help judge the level of support of a waterbody for a particular use/interest. The quantifiable parameters and threshold values serve as the "watershed assessment criteria" for use with the decision-tools. Table 1 shows these parameters and threshold values together with an identifying number (Id No.) and the original reference number used in the January 25 Quantifiable Parameters Memo (TM#4b). The criteria used in the decision process (enclosed in rectangles in the logic diagrams shown in Figures 1 through 5) are linked to the information contained in Table 1 by the identifying numbers. The overall process is intended to link stakeholder-valued data with scientifically accepted threshold values as well as tracking the current availability of this data for this assessment. (See Figure A: Steps in the Assessment Framework.)

Many comments were received on the original tables of quantifiable parameters and these were summarized in TM#4c dated May 5, 1999. Some of the watershed assessment criteria and threshold values have been modified in response to the comments. For some quantifiable parameters, there were differences of opinion with respect to appropriate threshold values; and in these cases stakeholder comments and recommendations for alternative threshold values were resolved through a meeting held on 12/20/99 between the WAC and stakeholders. Table 1 was revised to reflect the agreed upon threshold values. Also in response to stakeholder comments, the WAC developed a series of tables (Table 2A through 2D) that provide more detailed water quality, sediment quality, and fish tissue criteria. Table 1 includes selected criteria from Table 2 that will likely be used in the assessment; but may be supplemented or replaced with other criteria from Table 2 depending on the type and availability of data.

Uncertainty Analysis

Prior to finalizing support statements, an uncertainty analysis will be conducted to evaluate the level of confidence in the support statement. In general the WAC will follow the guidance for performing an uncertainty analysis as provided in two documents: Guidelines for Preparation of the Comprehensive State Water Quality Assessments (305(b) Reports) and Electronic Updates (US EPA, 1997), and Draft Guidance for Water Quality-Based Decisions: The TMDL Process (US EPA, 1999). The guidelines address different types of data including physical habitat, biological, toxicological and physical/chemical data to determine aquatic life use support.

The methodology designates four levels of uncertainty: Level 1 through Level 4. Level 4 data are of the highest quality and provide a relatively low level of uncertainty. Level 1 data may be considered adequate for performing assessments, but involve less rigorous approaches, and therefore result in a greater degree of uncertainty.

Three categories of criteria are used to designate the level of uncertainty:

1. technical components refer to the comprehensiveness of the study design, including methodology and level of documentation,
2. spatial and temporal coverage of the data refers to the age of the data, the amount of data, and the spatial extent of the data, and
3. data quality refers to the QA/QC conducted; for example, the extent of replication, quality considerations in site selection, and rigor associated with laboratory analyses. Also, data quality can be affected by the expertise/experience of the personnel collecting and analyzing the data.

Table 3 is an example of the criteria recommended by EPA to evaluate uncertainty in bioassessment data (US EPA, 1997). The criteria for Level 4 bioassessment data include monitoring of two assemblages (or one if the data are of high quality), regional reference conditions, a biotic index, broad coverage of monitoring locations for 1-2 sampling seasons, high quality data, and the use of a professional biologist for the survey and assessment. Level 1 criteria include visual observations of biota, no reference conditions, limited monitoring or extrapolations from other sites, and data of unknown or low quality. Also, Level 1 data do not require the participation of a professional biologist.

These guidelines are most appropriate for addressing the COLD beneficial use. The WAC will tailor the EPA guidance consistent with the data types to be used in the assessment of COLD, and will develop comparable criteria for other uses and interests consistent with EPA and other agency (e.g, DHS) guidance. These criteria will be shared with interested stakeholders through the Watershed Assessment Subgroup and/or an ad hoc technical workgroup for their review and approval as part of the assessment.

Determination of Level of Support

The proposed analysis is founded on the concept that direct measures of the fitness of a waterbody to support a primary use/stakeholder interest are preferable to indirect measures. In the logic diagrams indirect measures or indicators are proposed only when direct measures are impractical, and/or limited data prevent the use of a direct measure. This concept of a hierarchy of data types is consistent with EPA guidance on conducting water quality assessments. It also builds on work conducted by Work Group A, which identified relevant data types and classified each data type in terms of potential utility to the assessment process.

The logic diagrams also show the anticipated level of support statement that would be made given the outcome of the analysis steps. Although the goal is to establish clear findings of the level of support for each use, the assessment process, no matter how well conceived will not always yield definitive answers. It is expected that in many cases, data deficiencies and methodological difficulties will allow only partial or qualified conclusions. In such cases an uncertainty analysis as discussed above will be conducted prior to finalizing the determination of support levels.

In order to provide a basis for the level of support statements, the assessment report will document, for each watershed, the results from each step in the logic diagram and qualifications and limitations where appropriate.

Water Contact Recreation (REC1)

Water Contact Recreation is defined in the Basin Plan as *"Uses of water for recreational activities involving body contact with water where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, whitewater activities, fishing, and uses of natural hot springs."*

The decision tool for water contact recreation (REC1) is shown in Figures 1A and 1B. The primary indicators used to determine the fitness of a waterbody for REC1 are fecal coliform and

E. Coli densities. These indicators are well established and accepted by the scientific community, including the WMI's first Technical Review Panel.   Threshold levels for these indicators are contained in the Basin Plan. If sufficient coliform data are available a determination of full support of REC1 can be made based on the data. In some cases, it may be possible to make a determination of partial support if criteria are met during the recreation season although not at other times, or if criteria at a bathing beach are met even though they are not met for the entire waterbody or stream segment.

It is recognized that the use of coliform bacteria as an indicator of fitness for REC1 is imperfect. If any epidemiological data is available for a waterbody, for example data on the incidence of skin or eye infections among swimmers, it will also be considered in the evaluation.

After evaluating the microbial data, the assessment will consider evidence for the presence of chemical irritants in the water (including large departures from neutral pH) that could affect the suitability for water contact recreation. Such irritants could include hydrocarbons, or volatile organics. Similarly evidence of hazardous chemicals in sediments would affect the support determination.

Important secondary indicators include aesthetics and safety. A waterbody that meets bacteriological and water and sediment criteria for REC 1 may still not support body contact recreation because it is aesthetically unappealing, too shallow to use, or inaccessible. Where data are available for these indicators they will be considered early on the support determination. Data associated with these factors can also be considered to strengthen the findings, support sensitivity analyses and in assisting in identifying candidate limiting factors.

The REC1 beneficial use also includes fishing and Figure 1B provides the logic diagram for assessing fish consumption as a beneficial use. The focus of the assessment is on fish tissue data, with supporting information provided by information on health advisories or postings that may have been implemented by the County Health Department or other agencies. If there are data on shellfish tissues, the analysis will extend to shellfish as well.

Cold Freshwater Habitat (COLD)

Cold Freshwater Habitat is defined in the Basin Plan as *"uses of water that support cold water ecosystems, including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates."*

The decision tool for Cold Freshwater Habitat (COLD) is shown in Figure 2. Use support for COLD is best determined directly by examination of the assemblage of organisms in a waterbody or stream reach. Such organisms integrate the effects of hydrology, water quality, and habitat conditions. Steelhead, trout and certain macroinvertebrates make up the faunal community in cold water stream in the Santa Clara Basin. If healthy, self-sustaining populations of these species are present then the COLD primary use is supported. A sustainable population is a population that can be expected to persist indefinitely in a waterbody if no significant, long- term environmental changes occur.

The first analysis step involves examination of data on the presence of juvenile steelhead and trout in a stream reach. The primary criteria for the first step are the characteristics of fish and macroinvertebrate populations. If the data indicates that juvenile fish populations are consistently present then any existing macroinvertebrate community data would be examined to determine whether intolerant species (stoneflies and cased caddis flies) are present. If so, a “classic” cold water fishery exists and the COLD designation is fully supported. If not, then water temperature data will be examined. If water temperature data indicates a greater than normal range for cold water species then the steelhead and trout present would be presumed to have adapted to “local temperature” conditions. Streams with artificially high summertime flows in the Santa Clara Valley may support salmonids that are tolerant of a wider range of temperatures compared to those set forth in the Basin Plan. The COLD designation would be fully supported in these cases. If water temperatures are in the normal range for cold water streams then the COLD designation would be only partially supported because an ecosystem component (intolerant macroinvertebrates) would be missing.

It should be noted that this approach relies primarily on the presence of specific macroinvertebrates that are good indicators of water quality and are important in the aquatic food chain. It does not rely on macroinvertebrate indices, although such information would be useful, that are currently being researched (e.g., the WERF Project on Coyote Creek) as possible measures of stream health and/or for providing biocriteria for regulatory purposes.

If data indicates that steelhead and trout are sometimes present or populations are below historic levels then the COLD use is partially supported. If the records of salmonid presence are deficient, the need for additional data collection would be evaluated.

Chinook salmon only occupy a stream for a few months during the fall and winter. If Chinook are regularly present then the COLD use is seasonally supported because conditions favor salmonids in the high-flow months but may not in the low-flow months.

If no salmonids are present, ecosystem characteristics will be used as secondary watershed assessment criteria for determination of support for COLD. They include substrate characteristics, cover, water temperature, and barriers to migration, etc. Use of these criteria will enable determination of the potential of a waterbody to support COLD uses.

In the case of COLD (and to some extent RARE), where the species of interest are migratory during their life stages, it will be necessary to integrate the findings by reach in order to adequately evaluate the extent of support. For example, an interior reach of stream could potentially support steelhead but could be limited by physical, hydrologic, and/or chemical barriers that may prevent access to the interior reach.

Although the emphasis as described in the logic diagram is on biological and physical indicators, chemical indicators are also important as possible limiting factors. Moreover, the assessment of chemical indicators in relation to water quality standards is a key element in the 303(d) listing process and the subsequent TMDL requirements. Thus, the evaluation of COLD will include a thorough consideration of chemical indicators. The constituents to be considered will be those selected by Workgroup A based on current and proposed 303(d) listings. This list consists of the following constituents: metals (copper, nickel, mercury, and selenium), pesticides (diazinon, chlorpyrifos, DDT, dieldrin, chlordane), and others (PCBs, sediment, and dioxin-like compounds). The assessment threshold criteria appropriate for this use will be water quality, sediment, and fish tissue objectives for aquatic life protection as provided in Table 2.

Preservation of Rare and Endangered Species (RARE)

Preservation of rare and endangered species is defined in the Basin Plan as *"uses of waters that support habitats necessary for the survival and successful maintenance of plant and animal species established under state and/or federal law as rare, threatened, or endangered."*

The decision tool for the RARE primary use is shown in Figure 3. As with the COLD designation, support of the RARE use is best determined directly by examination of the creatures in a waterbody or stream reach. The primary criteria are the characteristics of the populations of the special status species. It is recognized, however, that data on special status species is often limited and may be difficult to obtain.

The decision tool is designed for use with special status species that are dependent on streams or riparian habitat. Exclusively upland species will not be considered. Thus, an initial step in the analysis of the RARE primary use is to review the list of special status plant and animal species found in the Santa Clara Basin that was developed by Work Group A based on the Department of Fish and Game's Natural Diversity Database and other sources. This list will then be screened to develop a shorter list consisting only of stream- or riparian zone-dependent special status species. This list will be provided to interested Stakeholders through the Watershed Assessment Subgroup or an ad hoc technical group for their review and approval, and will be subject to Core Group approval.

The first step in the analysis of a particular stream reach or waterbody would be to determine whether a special status species could reasonably be expected to inhabit the waterbody or its environs. The purpose of this step is to eliminate consideration of special status species whose habitat requirements are never likely to have been met, or could be met, in a given waterbody. For example, a reach of stream in the foothills could never support clapper rails even if the reach is in perfect condition. On the other hand, it will be important to consider the characteristics of a Baylands reach that may have provided habitat for clapper rails historically, and could again with appropriate management.

Once a list of the special status species that may be present or could potentially be present in a stream reach is developed then the fitness of the reach to support each special status species would be considered separately. The first step is to determine if the species is present. If it is present then it is next necessary to determine if its population is sustainable. If so, then the RARE use for the species is fully supported. If not, it is partially supported. The WAC wishes to point out to the Core Group that when the WAC Team developed the assessment framework for this use, it was felt that information on species presence as well as information on suitable habitat were both important indicators, and this is reflected in the logic diagram. This is a departure from Workgroup A's earlier recommendation that the assessment would be based primarily on habitat. The WAC took this liberty because Workgroup A's focus was not on the methods for conducting the assessment, and that their discussion of the approach to focus on habitat was relatively brief and incidental to the group's discussion.

If the special status species is not present, the prevailing environmental conditions will be examined to determine whether they are consistent with the species' habitat requirements. Habitat requirements will serve as secondary indicators of fitness. If habitat is suitable for an organism although the organism is currently absent, there may be some immediate potential for support of the organism with modest management changes. If they are not, then the RARE use for the species is not supported.

For the RARE use to be fully supported in a particular waterbody or stream reach, all special status species that can reasonably be expected to be present must be present in sustainable populations. If only some species are supported then the RARE use is only partially supported.

Municipal and Domestic Supply (MUN)

Municipal Water Supply is defined in the Basin Plan as: *"Uses of water for community, military, or individual water supply systems, including, but not limited to, drinking water supply."*

The decision tool for assessing MUN is shown in Figure 4. Water supply in Santa Clara County is provided by a combination of local sources and imported water deliveries. Local sources consist of reservoirs and streams which provide water primarily for recharge of the ground water aquifer. Although values differ from year to year, approximately one-half of the Santa Clara Basin's drinking water supplies are obtained from groundwater that is recharged from local surface waters.

The criterion for evaluating support of this use is meeting the state and EPA drinking water standards in streams and reservoirs. These standards in the State of California are expressed in the forms of Maximum Contaminant Levels (MCLs): Primary MCLs are levels developed for human health protection, and Secondary MCLs are established to ensure adequate taste, odor, and appearance. The evaluation of exceedances would be conducted for those constituents for which primary and secondary MCLs have been adopted.

For constituents for which primary MCLs have not been adopted, DHS may establish Actions Levels (ALs) that are health-based advisory levels, but not enforceable standards. Exceedances of ALs may prompt statutory requirements (e.g., for consumer notice), or recommendations for source removal.

The logic diagram for this use would first evaluate meeting the drinking water standards (MCLs and ALs) in streams and reservoirs during dry weather. Dry weather is defined as periods between runoff events and therefore includes the dry season and that portion of the wet season between runoff events (specific time criteria for defining these periods will be developed as part of the assessment). In this step, samples obtained during dry weather would be compared with drinking water standards. If standards were not met, a condition of non-support would result. If standards were met, a second test would compare water quality from samples obtained during wet weather with drinking water standards. If wet weather water quality met the standards, a condition of full support would be determined. However, if wet weather samples exceeded standards (and dry weather samples met standards), a condition of partial support would be determined.

If on the basis of evaluating water quality there was a determination of non- or partial support, limiting factors would be identified. The analysis would focus on those constituents that prompted the finding of non- or partial support. Such factors could include anthropogenic and natural sources of pollutants, or hydrologic factors that contribute to water quality degradation.

The identification of factors would rely in part on information developed from previous source water assessments conducted either by the water purveyor (e.g., sanitary surveys) or the DHS (e.g., as part of the DHS Drinking Water Source Assessment and Protection (DWSAP) Program.

Protection From Flooding (PFF)

Flood Protection has been defined by the Flood Management Subgroup in their January 4, 2000 memorandum to the RPT as follows: *"Flood Protection consists of activities, including planning, which reduce the potential for flood damages to homes, schools, businesses, transportation networks and other public and private buildings and infrastructure, implemented in a practical, cost-effective, and environmentally sensitive manner."* (see Glossary for further definition of flood protection activities.)

Figure 5 shows the decision tool for Protection From Flooding (PFF). Determination of whether the PFF interest is supported will depend first on a comparison of planned floodway capacity with calculated design flows under various conditions. The calculations will utilize hydrologic modeling results developed by the Santa Clara Valley Water District. These models were developed by the Corps of Engineers and are recognized by the Flood Emergency Management Agency (FEMA) as standards for determining flood plains and stream capacities. The Santa Clara Valley Water District has established the criterion that floodways in the District's jurisdiction should be able to convey the flood corresponding to the 100-year return interval without damage to property or hazard to public safety. This criteria is consistent with National Flood Insurance Program which is administered by FEMA.

The assessment will evaluate support under two development conditions: current conditions, and future conditions (the date corresponding to future conditions will be that used by the District, and may vary depending on watershed or reach.) If floodway capacity is adequate to convey the design flows under current conditions and future conditions, a finding of full support will be made. However, if capacity is sufficient for current conditions, but not future conditions, a finding of partial support will be made.

In addition to the assessment of capacity based on modeling results, we will also assess whether maintenance of the floodway is being conducted such that the planned capacity is being achieved, and erosion prevention/repair is being conducted along streambanks to protect private property. The assessment of maintenance will utilize maintenance criteria (e.g., maintenance activity and frequency) provided by the District. If maintenance criteria are not being met, a finding of partial support or non support will be made depending on the extent to which the lack of maintenance is felt to be reducing the capacity of the channel or otherwise affecting private property (e.g., from streambank erosion).

Note that this interest is based primarily on hydrologic and sediment related indicators, and operational indicators. Important environmental indicators are being addressed as part of the assessment of the beneficial uses, and need not be incorporated into the logic diagram for this use. Ultimately the results of the assessments for the beneficial uses and stakeholder interests will be integrated by watershed and across beneficial uses and interests to begin to identify possible conflicts and opportunities between the PFF interest and other beneficial uses.

Identification of Limiting Factors

If use of the logic diagrams leads to the conclusion that a beneficial use or stakeholder interest is not supported or only partially supported in a stream reach, the factors responsible for non-support or partial support will be identified. The nature of the limiting factors and the ease with which they can be identified will vary depending on the use. In some cases, the limiting factors will be fairly obvious and will emerge directly from the assessment process. For example, if a stream reach has insufficient capacity to convey the 1% flood it would exceed the threshold value of the quantifiable parameter for the stakeholder interest, flood protection. The stream reach would be judged to be non-supportive of flood protection and the limiting factor would be channel capacity.

Identification of limiting factors for the beneficial uses COLD and RARE can be expected to be much more difficult and complicated. If use of the COLD logic diagram leads to the conclusion that a stream reach does not support a salmonid population then the reasons may not be obvious because the ecological requirements of salmonid species are specific and complex. Potential limiting factors include water temperature, dissolved oxygen content, depth of flow in the main channel, velocity of flow, composition of the bottom of the channel, extent of shading of the water surface, extent of in-stream cover, ratio of pools to riffles, size of pools and availability of food.

The identification of limiting factors will be focused on the physical, chemical and biological conditions in the stream and the riparian corridor that cause non or partial support of primary uses. It will not address the ultimate or indirect cause of non- or partial support, for example urbanization and its effect on stream hydrology. In addition, the analysis will be based only on existing data. Existing data may be insufficient to make more than a tentative identification of limiting factors particularly for the COLD and RARE beneficial uses. Some examples of potential limiting factors for the four beneficial uses and the stakeholder interest are shown in Table 4. The identification of potential limiting factors also will assist the stakeholders in addressing management alternatives and potential conflicts amongst uses and interests (see following discussion).

Integration of Assessment Results and Management Alternatives

Following the assessment of individual uses and interests by stream reach, the results of the assessment will be combined on a watershed basis and will integrate the results for the uses and interests. This integration will result in a matrix which shows areas of support and non-support, and, where appropriate, potential limiting factors. The goal of this integration step is to address the overall health of the watershed and also is intended to address many of the stakeholder concerns regarding possible conflicts between PFF and beneficial uses.

The identification of levels of support and limiting factors will help stakeholders develop management alternatives that specifically address environmental problems in the Santa Clara Basin's streams. For example, use of the logic diagrams might lead to a conclusion that a stream reach in a county park is non-supportive of water contact recreation. Access to the stream is good and the depth of flow is sufficient for recreational use but coliform concentrations in the water commonly exceed threshold values. Coliform concentrations are the limiting factor. Examination of the site reveals that elevated summertime coliform concentrations are largely attributable to small flows of excess landscape irrigation and washwater from a large urban storm drain that discharges upstream of the park. Management alternatives might include diversion of the small volume summertime discharge to the sanitary sewer, treatment of the small volume discharge or rerouting of the storm drain to discharge downstream of the park.

In some instances, identification of limiting factors may reveal conflicts between one beneficial use and another. For example, lack of in-stream cover and channel capacity in a stream reach may respectively limit the cold water fishery beneficial use (COLD) and the flood management stakeholder interest. Typically, any steps taken to increase in-stream cover and improve support of the COLD beneficial use would further reduce the ability of the channel to pass flood flows and support the flood management stakeholder interest. Awareness of the conflict will prompt stakeholders to seek unconventional management alternatives that promote support of both desired uses. Examples might include floodwater bypasses that allow low and moderate flows to pass through a relatively natural vegetated stream channel while very large flows are conveyed in a separate high-capacity lined channel or multi-stage channels that carry small, moderate and large flows in different parts of the same channel.

GLOSSARY

Augmented Summer Flow: Summer flows augmented by reservoir or pipeline releases; used in the context of Table 1. An example of an augmented flow system is the Guadalupe River.

Direct Measures: Data types that provide a relatively direct measure of the extent to which a waterbody supports a beneficial use and/or stakeholder interest. (adapted from Table 4, Work Group A memo of January 25, 1999).

Design Flow: The flow of water from a drainage area that, on the average and over a long period of time, has a 1 percent chance (probability of 0.01) of being equaled or exceeded in any given year. It is sometimes referred to as the 100-year flood but should not be thought of as an event which occurs regularly every 100th year.

Flood Protection: Flood Protection consists of activities, including planning, which reduce the potential for flood damages to homes, schools, businesses, transportation networks and other public and private buildings and infrastructure, implemented in a practical, cost-effective, and environmentally sensitive manner. Flood protection activities include both corrective measures and preventive measures. Corrective measures include, but are not limited to, activities such as construction of levees, floodwalls, detention facilities, and floodproofing. Additional ongoing maintenance activities such as sediment removal, vegetation control, and erosion prevention and/or repairs are necessary on all facilities to keep them operating as intended. Preventative measures include, but are not limited to, activities such as floodplain zoning, subdivision ordinances, floodplain preservation, habitat and open-space preservation, and education.

Floodway (Planned): Natural or modified watercourses consisting of a combination of stream channel and adjacent areas planned to convey flood flows. (FEMA defines Regulatory Floodways as the stream channels and adjacent areas within which encroachments are prohibited if they would raise calculated water surface elevations by 1.0 feet or more.) A Planned Floodway would include the stream channel and adjacent areas planned to convey high flows but may also be used for other compatible uses. For example, these uses might include recreation and/or agriculture.

Natural Summer Flow: Stream reaches that support steelhead and resident trout during low flow periods in absence of flow augmentation. Examples of natural summer flow stream systems are San Francisquito Creek and watersheds above most reservoirs. .

Primary Indicators: Data types that are considered reliable indicators of important environmental conditions that affect the extent to which a water body may support beneficial uses and stakeholder interests. A reliable indicator is defined as an indicator for which there is a generally accepted threshold value; and therefore it is clear how data for that indicator will be evaluated in the assessment. (adapted from Table 4, Work Group A memo of January 25, 1999).

Secondary Indicators: Data Types that are considered less reliable measures or indicators of less important environmental conditions that affect the extent to which a water body can support beneficial uses and/or stakeholder interests. (adapted from Table 4, Work Group A memo of January 25, 1999).

Sustainable Population: A population in dynamic equilibrium with various ecological relationships (predator/prey, competition, birth-death, recruitment, etc.) and resilient enough to withstand natural perturbations in environmental conditions such as climate change, and habitat modification.

Uncertainty Analysis: An evaluation of the uncertainty associated with beneficial use and stakeholder interest support statements. The evaluation is based on various criteria including data quality and data coverage and follows EPA Guidance for Preparation of the Comprehensive State Water Quality Assessments (305(b) reports) (EPA, 1997).

Table 1
Watershed Assessment Criteria

Id No.	Correspond Id No. in Table 2 (QP Memo 4b Jan. 25, 1999)	Work Group A/ WAC Recommended Data Type	Quantifiable Parameter	WAC Recommended Threshold Level	Beneficial Use/ Stakeholder Interest Being Assessed	Stakeholder Comments and Recommendations of Alternative Threshold Levels/ Actions Taken in Response to Comments
1	5	Fecal coliform	Density most probable number (MPN) per 100 ml	water contact rec.: log mean <200, 90th % <400;[a] shellfish harvesting: median<14, 90th %<43,[a] drinking water supply: log mean <20[a] (applies only to data from specific, nominal sampling frequencies as defined in RWQCB and EPA documents)	REC1 MUN	
2	6	E. coli	Density in colonies per 100 ml	water contact rec.: 235-576 col/100ml depending on intensity of use[b] (applies only to data from specific, nominal sampling frequencies as defined in RWQCB and EPA documents)	REC1	

Table 1 (*continued*)
Watershed Assessment Criteria

3	N/A	Aesthetics	Water clarity (murkiness) Trash[c] Floating debris/algae[f,g] Odor[f,g] Oil and grease[f,g]	Average (spatial and temporal) Secchi depth >2 ft Streams: <1 lb/mile average dry weight material along stream banks or floating on water surface[d] (averaged spatially and temporally) lakes: <1 lb/mile average dry weight material along lakeshore[e] (averaged spatially and temporally) cover <5% of surface area absence of offensive odor absence of visible oil sheen	REC1	
4	36	Water depth	Depth	depends on activity (for fish requirements see id # 26)	COLD REC1	
5	2	Fish assemblage (see Table 2 of QP Memo 4b of Jan. 25, 1999 for more detail)	Relative abundance of indicator species	DFG Fish in Good Condition guidance to the extent that it applies to COLD; judgment by experts[h]	COLD	Threshold level changed by WAC per 12/20/99 ad hoc technical group.
6	1	Macro-invertebrate data: Stoneflies and cased caddis flies Mayflies and hydrosyche (netted caddis flies)	 Presence as indicator of cold freshwater habitat Density sufficient to provide adequate food supply	 none generally accepted; judgment by experts 10/square foot[i]; judgment by experts	COLD	Resolved per discussion at 12/20/99 ad hoc technical group; J. Carter (USGS) will review protocol.

Table 1 (*continued*)
Watershed Assessment Criteria

7	46	Temperature	Mean daily temperature (degrees F)	trout/steelhead (augmented flow[j]): ≤57°F (Jan-Apr); ≤63°F (May); ≤ 70°F (Jun-Nov); ≤61°F (Dec) with a daily T_{max} ≤75°F (Jul-Sep)[k] trout/steelhead (low summer flow[l]): ≤57°F (Jan-Apr); ≤60°F (May-Dec) with a daily T_{max} ≤75°F (Jul-Sep)[k] chinook salmon: ≤59°F (Jan-Mar); ≤ 70°F (Apr-Jun); ≤64°F (Sep-Oct); ≤59°F (Nov-Dec) (fish not present in Jul/Aug and generally not viable in Sep/Oct)[k]	COLD	Resolved per discussion at 12/20/99 ad hoc technical group and 1/9/00 SFT comments. Keith Anderson, Streams For Tomorrow: The SCVWD considers June to be a smolt out-migration month; therefore, smolt temperatures should govern from their perspective.
8	47	Dissolved oxygen	Dissolved oxygen	7 mg/l, 3 month median not less than 80% of saturation[f,m]	COLD	Revised per discussion at 12/20/99 ad hoc technical group.
9	48	Total suspended solids (TSS)	Concentration (mg/l)	<25 (prevent gills from clogging)[n] <80 (successful development of fish eggs and larvae)[n] <400 (natural movements and migration, light penetration, fish ability to see and obtain food)[n]	COLD	
10	50	Turbidity	Nephalomenter turbidity units (NTUs)	<10 NTU average daily (augmented flow[j]) <5 NTU average daily (low summer flow[l]) <5 NTU (secondary MCL)[o,p] <0.5-1 (primary MCL)[p]	COLD MUN	

Table 1 (*continued*)
Watershed Assessment Criteria

11	51	Stream type	Rosgen stream type	will vary depending on geology, topography, hydrologic, and sediment regimes of watershed[q]	COLD	Ms. Buchan's comments are noted.
12	52	Channel substrate	Dominant particle size of channel materials	will vary depending on stream type[q]	COLD	
13	53	Streambank erosion potential	Rate of channel lateral migration	will vary depending on stream type[q]	COLD	Mr. Fowler's comments are noted.
14	54	Width to depth ratio	Ratio of channel width to channel depth	will vary depending on stream type[q]	COLD	
15	55	Bankfull, stage, discharge and width	Channel geometry and flow of bankfull discharge	will vary depending on stream type[q]	COLD	
16	56	Altered channel materials and dimensions	Occurrence of altered channel materials and dimensions	exceedance of percentage of stream length in altered condition that results in significant changes in upstream or downstream channel stability[q]	COLD	
17	57	Special status species: Instream, riparian, and wetland habitat	Amount, distribution, quality, and continuity of instream, riparian, and wetland habitat	sufficient spatial and temporal connectivity within and between watersheds – connectivity must provide chemically and physically unobstructive routes to areas critical for fulfilling life history requirements of aquatic and riparian dependent species.[r]	COLD RARE	
18	58	Instream spawning habitat: Location and extent (area)	% of streambed having suitable spawning habitat[s]	>1%[m]	COLD	QP supported per discussion at 12/20/99 ad hoc technical group.

Table 1 (*continued*)
Watershed Assessment Criteria

19	59	Instream spawning habitat: Quality (spawning substrate composition)	% fine grain soils (particles that will pass through a number 20 sieve)[t] % particles 1-10 cm % particles 1-7 cm	<15% (for embryo survival by providing gravel permeability, pore space, and DO)[u] >60% (provide suitable substrate for redd construction, Chinook)[v,w,x] >60% (provide suitable substrate for trout/steelhead, augmented[j] and low summer flow[l] streams)[v,w,x]	COLD	
20	60	Instream rearing habitat: Location and extent (area)	% pools[y] % riffles[y]	>30% of stream length (excluding glides)[m,z] >15% of stream length[m,z]	COLD	Revised per discussion at 12/20/99 ad hoc technical group.
21	61	Instream rearing habitat: Quality (pool depth)	Low flow pool depth	mean of 1.5 ft and more than 5% of pools have depths greater than or equal to 2.5 ft[aa]	COLD	
22	62	Instream rearing habitat: Quality (cover/hiding)	Overhead cover[bb] Instream cover[cc]	≥50% of riffle area[m,dd] ≥10% of pool perimeter[m,dd]	COLD	
23	63	Instream rearing habitat: Quality (riffle substrate composition)	d_{50} in riffles (median size of gravel in riffle)	median >= 50 mm (2 inches)[ee,ff,gg]	COLD	Revised per discussion at 12/20/99 ad hoc technical group.
24	64	Shaded riverine aquatic habitat	Stream shading[hh]	70% minimum[ii]; 85% optimum[jj]	COLD	Revised per discussion at 12/20/99 ad hoc technical group and 12/27/99 SFT comments.

25	65	Riparian vegetation: Type, location, and coverage	Site index for species diversity: Diversity of vegetation appropriate for the site conditions (soil, elevation, aspect) Age class distribution of large woody vegetation % surface cover and undisturbed area	maintain or restore potential site index[kk] well distributed[kk] at least 95%[kk]	COLD	
26	35	Water depths and velocities for fish rearing and migration: Rearing Migration	Flow depth in riffles Velocity Flow depth Flow depth in riffles[ll] Flow depth in riffles[ll]	>0.4 ft[mm,nn] >1 ft/sec[mm,nn] >0.15 ft (out migration)[mm,nn] >0.6 ft (up migration for Chinook, Oct-Dec.)[mm,nn] >0.5 ft (up migration for steelhead under augmented flow or low flow, Jan-April)[mm,nn]	COLD	Revised per discussion at 12/20/99 ad hoc technical group.

Table 1 (*continued*)
Watershed Assessment Criteria

27	43	Location of physical barriers to migration	Man-made barriers to fish passage	height of barrier present should allow upstream and downstream fish passage at all flows[oo]	COLD	
28	N/A	Assemblages of special status species	Special status species population, diversity, health, sustainability (including protection from invasive species)	general guidance developed at national level by federal agencies as part of implementing ESA; ultimately, assessment relies on judgment of local experts	RARE	
29	N/A	Habitat requirements for individual special status species	Habitat requirements for special status species developed by resource agencies and others for Santa Clara County. List developed by Work Group A.	general guidance developed at national level by federal agencies as part of implementing ESA; ultimately, assessment relies on judgment of local experts	RARE	
30	8, 9, 10	Chlordane (see Tables 2A-2D for more detail)	Concentration: Water quality (human health) Water quality (aquatic life) Sediment quality Fish tissue	 0.1 ug/l (drinking water)[p] 0.00059 ug/l (fish consumption)[pp] 0.0043 ug/l (chronic, freshwater)[pp] 2.4 ug/l (acute, freshwater)[pp] 8.9 ppb (freshwater)[qq] 18 ng/g wet	 MUN REC1 COLD REC1 REC1	

Table 1 (*continued*)
Watershed Assessment Criteria

31	12	Copper (see Tables 2A-2D for more detail)	Concentration: Water quality (human health) Water quality (aquatic life)	 1.3 mg/l (drinking water)[p] 1.3 mg/l (water plus fish consumption)[pp] hardness dependent; calculate as in Table 2B (chronic/acute, freshwater)[pp]	 MUN REC1 COLD	
32	11	Chlorpyrifos (see Tables 2A-2D for more detail)	Concentration: Water quality (human health) Water quality (aquatic life)	 20 ug/l (drinking water)[p] 0.02 ug/l (chronic, freshwater)[rr] 0.083 ug/l (acute, freshwater)[p]	 MUN COLD	
33	13, 14, 15	DDT (see Tables 2A-2D for more detail)	Concentration: Water quality (human health) Water quality (aquatic life) Sediment quality Fish tissue	 0.59 ppt (drinking water and fish consumption)[pp] 0.001 ug/l (chronic, freshwater)[pp] 1.1 ug/l (acute, freshwater)[pp] 50 ppb (freshwater)[qq] 69 ng/g wet	 MUN REC1 COLD REC1 REC1	
34	16	Diazinon (see Tables 2A-2D for more detail)	Concentration: Water quality (human health) Water quality (aquatic life)	 14 ug/l (drinking water)[p] 0.04 ug/l (chronic, freshwater)[ss] 0.08 ug/l (acute, freshwater)[ss]	 MUN COLD	

Table 1 (*continued*)
Watershed Assessment Criteria

35	17, 18, 19	Dieldrin (see Tables 2A-2D for more detail)	Concentration: Water quality (human health) Water quality (aquatic life) Sediment quality Fish tissue	 0.00014 ug/l (drinking water and fish consumption)[pp] 0.056 ug/l (chronic, freshwater)[pp] 0.24 ug/l (acute, freshwater)[pp] 6.67 ppb (freshwater)[qq] 1.5 ng/g wet	 MUN REC1 COLD REC1 REC1	
36	20, 21, 22	Dioxin (see Tables 2A-2D for more detail)	Concentration: Water quality (human health) Water quality (aquatic life) Sediment quality Fish tissue	 $3x10^{-8}$ mg/l (drinking water)[p] $1.4x10^{-11}$ mg/l (fish consumption)[pp] <0.00001 ug/l (chronic, freshwater)[p] <0.01 ug/l (acute, freshwater)[p] 0.0088 ppb (freshwater)[qq] 0.15 pg/g wet	 MUN REC1 COLD REC1 REC1	
37	32	MTBE (see Tables 2A-2D for more detail)	Concentration: Water quality (human health)	 5 ug/l (secondary MCL); 13 ug/l (public health goal)(both drinking water)[p]	 MUN	Tables for chemical indicators were added to address issues raised by several stakeholders. See Tables 2A – 2D.
38	7	Nitrate (as NO_3) Nitrate + nitrite (sum as nitrogen) (see Tables 2A-2D for more detail)	Concentration: Water quality (human health)	45 mg/l (CA DHS primary MCL)[p] 10 mg/l (U.S. EPA primary MCL)[p]	MUN	

Table 1 (*continued*)
Watershed Assessment Criteria

39	27, 28, 29	PCB (includes aroclors 1242, 1254, 1221, 1232, 1248, 1260, and 1016) (see Tables 2A-2D for more detail)	Concentration: Water quality (human health) Water quality (aquatic life) Sediment quality Fish tissue	 0.5 ug/l (drinking water)[p] 0.00017 ug/l (fish consumption)[pp] 0.014 ug/l (chronic, freshwater)[pp] 2 ug/l (acute, freshwater)[p] 277 ppb (freshwater)[qq] 23 ppm	 MUN REC1 COLD REC1 REC1	
40	30, 31	Selenium (see Tables 2A-2D for more detail)	Concentration: Water quality (human health) Water quality (aquatic life) Fish tissue	0.05 mg/l (primary MCL)[p] 5 ug/l total recoverable (chronic, freshwater)[pp] see Table 2B for calculation method (acute, freshwater)[pp] 11.7 ug/g wet	MUN COLD REC1	
41	23, 24, 25	Mercury (see Tables 2A-2D for more detail)	Concentration: Water quality (human health) Water quality (aquatic life) Sediment quality Fish tissue	 2 ug/l (drinking water)[p] 0.051 ug/l total recoverable (fish consumption)[pp] 0.025 ug/l (chronic, freshwater)[pp] 1.6 ug/l (acute, freshwater)[pp] 486 ppb (freshwater)[qq] 0.233 ug/g wet	 MUN REC1 COLD REC1 REC1	

Table 1 (*continued*)
Watershed Assessment Criteria

42	26	Nickel (see Tables 2A-2D for more detail)	Concentration: Water quality (human health) Water quality (aquatic life)	0.1 mg/l (primary MCL)[p] 4.6 mg/l total recoverable (fish consumption)[pp] hardness dependent; calculate as in Table 2B (chronic/acute, freshwater)[pp]	MUN REC1 COLD	
43	45	TDS	TDS concentration	500 mg/l[o]	MUN	
44	33	Current channel capacity with respect to 100-year flow event	Design existing capacity (cfs)	provides 100-year level of protection	PFF	
45	N/A	Access	Large aquatic plants	streams: >1 kg (biomass) emergent, submerged, or floating vegetation per m^2 of water surface area along < 80% of the stream segment being evaluated lakes: >1 kg (biomass) emergent, submerged, or floating vegetation per m^2 of water surface area along < 80% of the shoreline	REC1	

References/Notes

a. California Regional Water Quality Control Board. 1995. *San Francisco Bay Basin Water Quality Control Plan*, Table 3-1. Oakland, CA.
b. ibid, Table 3-2.
c. Stormwater Committee, Victoria, Australia. 1999. *Urban Stormwater: Best Practice Environmental Management Guidelines.* "Trash" is defined as anthropogenic material larger than 5 mm in size. This includes wrecked or discarded equipment such as shopping carts but not vegetative material such as yard clippings or leaf litter.
d. Measured in transects across the bankfull channel width.
e. Measured in the zone around the circumference of the lake from the highest water mark or beach head (where applicable) to waist-level water depth.
f. California Regional Water Quality Control Board. 1995. *San Francisco Bay Basin Water Quality Control Plan*, Chapter 3. Oakland, CA.
g. U.S. Environmental Protection Agency. 1999. *Draft Guidance for Water Quality-Based Decisions: The TMDL Process (2nd Ed.).* EPA-841-D-99-001. Document suggests parameters for assessing aesthetics but not the corresponding threshold levels.

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h. Smith, Jerry J. 1982. Modified from *Fishes of the Pajaro River System.* University of California Publications in Zoology, 115: 83-169.
i. Karr, James R. and Ellen W. Chu. 1998. *Restoring Life in Running Waters*. Island Press. Covelo, CA.
j. High summer flows augmented by reservoir or pipeline releases (example: Guadalupe River).
k. U.S. Army Corps of Engineers, Sacramento District. 1999. *Draft Final Mitigation and Monitoring Plan, Guadalupe River Flood Control Project in Downtown San Jose.* Table F-1 (Suitability Indices for Water Temperature Effects on All Life Stages of Steelhead and Chinook Salmon).
l. Stream reaches that support steelhead and resident trout during low flow periods (examples: San Francisquito and Penetentia Creeks).
m. Smith, Jerry J. 1998. Personal communication. San Jose State University.
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t. American Standards for Testing and Materials. 1985. *Unified Soil Classification.* Methodology No. D2487-85.
u. McNeil, William J. and Warren H. Ahnell. 1964. *Success of Pink Salmon Spawning Relative to Size of Spawning Bed Materials.* U.S. Fish and Wildlife Service Special Scientific Report, Fisheries No. 469.
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w. Chapmann, D.W. 1988. *Critical Review of Variables Used to Define Effects of Fines in Reeds of Large Salmonids,* Transactions of the American Fisheries Society. Vol. 117, No. 1.
x. Burns, James. 1970. *Spawning Bed Sedimentation Studies in Northern California Streams*. Inland Fisheries Division, California Department of Fish and Game.
y. Used as defined in *Habitat Inventory Methods* in *California Salmonid Stream Habitat Restoration Manual.* 1998. California Department of Fish and Game.
z. Smith, Jerry J. 1998. *Distribution and Abundance of Juvenile Coho and Steelhead in Gazos, Waddell, and Scott Creeks.* Unpublished report.
aa. Flosi, G. and F.L. Reynolds. 1994. *California Salmonid Stream Habitat Restoration Manual, 2nd ed*. California Dept. of Fish and Game, State of California Resources Agency.
bb. Includes overhanging streambank vegetation and large woody debris that spans stream channels.
cc. Includes instream vegetation, debris, surface turbulence, rocks, undercut banks, rip rap, and large woody debris.
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Table 1 (*continued*)
Watershed Assessment Criteria

References/Notes (cont'd)

gg. U.S. Environmental Protection Agency. 1998. *Total Maximum Daily Load for Sediment: Redwood Creek, California*. Region 9, San Francisco, CA. This reference is a source for the proposed protocol only.

hh. Defined as providing shading over a percent of the wetted channel edge length at mean summer flow during the hours of 10:00 a.m. to 2:00 p.m.

ii. Santa Clara Valley Water District. 1994. *Coyote Creek Reach 3 Mitigation and Monitoring Program.* Page 16.

jj. U.S. Army Corps of Engineers, Sacramento District. 1999. *Draft Final Mitigation and Monitoring Plan, Guadalupe River Flood Control Project in Downtown San Jose.* Appendix F: Monitoring methods. Page F-9.

kk. California Dept. of Forestry. 1996. *Hillslope Monitoring Program*. Sacramento, CA.

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ss. Menconi, M. and C. Cox. 1994. *Hazard Assessment of the Insecticide Diazinon to Aquatic Organisms in the Sacramento-San Joaquin River System*. California Dept. of Fish and Game, Administrative Report. Rancho Cordova, CA.

Table 2A
Potentially Applicable Water Quality Criteria for Human Health Protection

SUMMARY OF POTENTIALLY APPLICABLE GOALS FOR HUMAN HEALTH PROTECTION – Drinking Water and Aquatic Organism Consumption (MUN, REC1); WAC Recommended Threshold Levels are in ***bold italic***
(chemical constituents of concern are from the final 1998 303(d) list for Santa Clara Basin waterbodies and the southern portion of San Francisco Bay)

Constituent (units)	**Drinking Water Standards (CA & Federal) Maximum Contaminant Levels (MCLs)**					**CA Public Health Goal in Drinking Water (CA OEHHA)**	**CA State Action Level (CA DHS)**	**Taste & Odor Thresholds**	**U.S. EPA IRIS**
	California Dept. of Health Services		**U.S. EPA**						**Reference Dose as a Drinking Water Level (70 kg body wt.; 2 liters/ day water cons.; 20% source from drinking water)**
	Primary MCL	**Secondary MCL**	**Primary MCL**	**Secondary MCL**	**MCL Goal**		**Toxicity**		
Nitrate (mg/l)	***45*** (as NO_3); ***10*** (total nitrate plus nitrite; sum as N)		10 (as N); ***10*** total nitrate plus nitrite; sum as N)		10 (as N)	10 (as N); ***10*** (total nitrate plus nitrite; sum as N)			11
Chlordane (ug/l)	***0.1***		2		zero	0.03			
Chlorpyrifos (ug/l)									21
Copper (mg/l)	***1.3*** (can be exceeded in no more than 10% of samples at tap)	1.0	***1.3*** (can be exceeded in no more than 10% of samples at tap)	1.0	***1.3***	0.17			
DDT (ug/l)									
Diazinon (ug/l)							***14***		
Dieldrin (ug/l)							0.05		
Dioxin (mg/l)	***3x10^{-8}***		***3x10^{-8}***		zero				
Mercury (ug/l)	***2***		***2***		***2***				
Nickel (mg/l)	***0.1***								0.14
PCB (ug/l)	***0.5***		***0.5***		zero				
Selenium (mg/l)	***0.05***		***0.05***		***0.05***				0.035
MTBE (ug/l)		***5*** (based on taste/odor)				***13***	35	15 to 95	
Furan compounds (ug/l)									7

Table 2A *(continued)*
Potentially Applicable Water Quality Criteria for Human Health Protection

SUMMARY OF POTENTIALLY APPLICABLE GOALS FOR HUMAN HEALTH PROTECTION - Drinking Water and Aquatic Organism Consumption (MUN, REC1); WAC Recommended Threshold Levels are in ***bold italic***
(chemical constituents of concern are from the final 1998 303(d) list for Santa Clara Basin waterbodies and the southern portion of San Francisco Bay)

Constituent (units)	Drinking Water Health Advisories or suggested No-Adverse-Response levels (SNARLs) (for toxicity other than cancer risk)		One-in-a-Million incremental Cancer Risk Estimates for Drinking Water				
			Cal/EPA		U.S. EPA		*CA Prop. 65*
	U.S. EPA	*Nat'l Academy* of Sciences	Potency Factor as a Drinking Water Level	U.S. EPA IRIS	Drinking Water Health Advisory or SNARL	National Academy of Sciences	Regulatory Level as a Drinking Water Level
Nitrate (mg/l)	10 (10-day, as N)						
Chlordane (ug/l)	60 (10-day)		0.029/0.027 (assumes 70 kg body weight and 2 liters/day water consumption)	0.1	0.03	0.028	0.25 (regulatory dose level divided by 2 liters/day average consumption)
Chlorpyrifos (ug/l)	***20***						
Copper (mg/l)							
DDT (ug/l)			0.1 (assumes 70 kg body weight and 2 liters/ day water consumption)	0.1000		0.042	1.0 (regulatory dose level divided by 2 liters/day average consumption)
Diazinon (ug/l)	0.6	***14***					
Dieldrin (ug/l)	0.5 (for child)/ 2.0 (for adult) (both 7-year)		0.0022 (assumes 70 kg body weight and 2 liters/day water consumption)	0.002	0.002	0.0019	0.02 (regulatory dose level divided by 2 liters/day average consumption)
Dioxin (mg/l)	$1x10^{-8}$ (for child)/$4x10^{-8}$ (for adult) (both 7-year)	$7x10^{-7}$	$2.7x10^{-10}$ (assumes 70 kg body weight and 2 liters/day water consumption)		$2x10^{-10}$		$2.5x10^{-9}$ (regulatory dose level divided by 2 liters/ day average consumption)
Mercury (ug/l)	***2***						
Nickel (mg/l)	***0.1***						
PCB (ug/l)		50 (7-day)	0.0045 (assumes 70 kg body weight and 2 liters/day water consumption)	0.1	0.005	0.16 (for arochlor 1260)	0.045/0.05 (draft for molecules with 60% chlorine or greater by molecular weight) (regulatory dose level divided by 2 liters/day average consumption)
Selenium (mg/l)							
MTBE (ug/l)	20 to 40						
Furan compounds (ug/l)							

Table 2A *(continued)*
Potentially Applicable Water Quality Criteria for Human Health Protection

SUMMARY OF POTENTIALLY APPLICABLE GOALS FOR HUMAN HEALTH PROTECTION - Drinking Water and Aquatic Organism Consumption (MUN, REC1); WAC Recommended Threshold Levels are in ***bold italic***
(chemical constituents of concern are from the final 1998 303(d) list for Santa Clara Basin waterbodies and the southern portion of San Francisco Bay)

Constituent (units)	U.S. EPA National Ambient Water Quality Criteria Human Health and welfare Protection				
	Non-Cancer Health Effects		One-in-a-Million cancer Risk Estimate		
	Sources of Drinking Water (water + organisms)	Other Waters (aquatic organism consumption only)	Sources of Drinking Water (water + organisms)	Other Waters (aquatic organism consumption only)	Taste & Odor or Welfare
Nitrate (mg/l)	10 (as N)				
Chlordane (ug/l)			0.00057	***0.00059***	
Chlorpyrifos (ug/l)					
Copper (mg/l)	***1.3***				1.0
DDT (ug/l)			***0.00059***	***0.00059***	
Diazinon (ug/l)					
Dieldrin (ug/l)			***0.00014***	***0.00014***	
Dioxin (mg/l)			1.3×10^{-11}	1.4×10^{-11}	
Mercury (ug/l)	0.14 (as total recoverable)	0.15 (as total recoverable)			
Nickel (mg/l)	0.61 (as total recoverable)	***4.6*** (as total recoverable)			
PCB (ug/l)			0.000044 (applies separately to aroclors 1242, 1254, 1221, 1232, 1248, 1260, and 1016)	0.000045 (applies separately to aroclors 1242, 1254, 1221, 1232, 1248, 1260, and 1016)	
Selenium (mg/l)					
MTBE (ug/l)					
Furan compounds (ug/l)					

Table 2A *(continued)*
Potentially Applicable Water Quality Criteria for Human Health Protection

SUMMARY OF POTENTIALLY APPLICABLE GOALS FOR HUMAN HEALTH PROTECTION - Drinking Water and Aquatic Organism Consumption (MUN, REC1); WAC Recommended Threshold Levels are in ***bold italic***
(chemical constituents of concern are from the final 1998 303(d) list for Santa Clara Basin waterbodies and the southern portion of San Francisco Bay)

Constituent (units)	*Proposed CA Toxics Rule Criteria (U.S. EPA)*			*CA Ocean Plan*
	Human Health (30-day Average)			**Numerical Water Quality Objectives Human Health (30-day Average)**
	Inland Surface Waters		**Enclosed Bay & Estuaries**	
	Sources of Drinking Water (water + organisms)	*Other Waters* **(aquatic organism consumption only)**	**(aquatic organism consumption only)**	**(aquatic organism consumption only)**
Nitrate (mg/l)				
Chlordane (ug/l)	0.00057	***0.00059***	0.00059	0.000023
Chlorpyrifos (ug/l)				
Copper (mg/l)	***1.3*** (as total recoverable)			
DDT (ug/l)	***0.00059***	***0.00059***	0.00059	0.00017
Diazinon (ug/l)				
Dieldrin (ug/l)	***0.00014***	***0.00014***	0.00014	0.00004
Dioxin (mg/l)	$1.3x10^{-11}$	***$1.4x10^{-11}$***	$1.4x10^{-11}$	3.9×10^{-12} (for sum of 2,3,7,8-chlorinated dibenzodioxin and dibenzofuran concentrations multiplied by their respective USEPA Toxicity Equivalency Factors)
Mercury (ug/l)	0.05 (as total recoverable)	***0.051*** (as total recoverable)	0.051 (as total recoverable)	
Nickel (mg/l)	0.61 (as total recoverable)	***4.6*** (as total recoverable)	4.6 (as total recoverable)	
PCB (ug/l)	0.00017	***0.00017***		0.000019 (for the sum of aroclors 1016, 1221, 1232, 1242, 1248, 1254, and 1260)
Selenium (mg/l)				
MTBE (ug/l)				
Furan compounds (ug/l)				

Table 2B
Potentially Applicable Water Quality Criteria for Aquatic Life Protection

SUMMARY OF POTENTIALLY APPLICABLE GOALS FOR AQUATIC LIFE PROTECTION (COLD, RARE); WAC Recommended Threshold Levels are in ***bold italic***

(chemical constituents of concern are from the final 1998 303(d) list for Santa Clara Basin waterbodies and the southern portion of San Francisco Bay)

Constituent (units)	**Freshwater Aquatic Life Protection**					**Saltwater Aquatic Life Protection**			
	Recommended Criteria			**Toxicity Information (Lowest Observed Effect Level)**		**Recommended Criteria**			**Toxicity Information (Lowest Observed Effect Level)**
	Continuous Concentration (4-day Average)	**Maximum Concentration (1-hour Average)**	*Instantaneous* **Maximum**	**Acute**	**Chronic**	**Continuous Concentration (4-day Average)**	**Maximum Concentration (1-hour Average)**	**Instan-taneous Maximum**	**Acute**
Chlordane (ug/l)	***0.0043***		***2.4***			0.004		0.09	
Chlorpyrifos (ug/l)	0.041	***0.083***				0.0056	0.011		
Copper (ug/l)	calculate as total recoverable: (e{0.8545[ln(hardness)]-1.465}) where hardness is mg/l as $CaCO_3$; for dissolved, multiply result of total recoverable calculation by 0.960	calculate as total recoverable: (e{0.9422[ln(hardness)]-1.464}) where hardness is mg/l as $CaCO_3$; for dissolved, multiply result of total recoverable calculation by 0.960				2.4 (dissolved)	2.9 (total recov.): 2.4 (dissolved)		
DDT (ug/l)	***0.001***		***1.1***			0.001		0.13	
Diazinon (ug/l)			0.009						
Dieldrin (ug/l)	0.0019		2.5			0.0019		0.71	
Dioxin (ug/l)				***<0.01***	***<0.00001***				
Mercury (ug/l)	0.012 (total recoverable); 0.012 (dissolved)	2.4 (total recoverable); 2.1 (dissolved)				0.025 (total recoverable); 0.025 (dissolved)	2.1 (total recov.); 1.8 (dissolved)		
Nickel (ug/l)	calculate as total recoverable: (e{0.8460[ln(hardness)]+1.1645}) where hardness is mg/l as $CaCO_3$; for dissolved, multiply result of total recoverable calculation by 0.997	calculate as total recoverable: (e{0.8460[ln(hardness)]+3.3612}) where hardness is mg/l as $CaCO_3$; for dissolved, multiply result of total recoverable calculation by 0.998				8.3 (total recoverable); 8.2 (dissolved)	75 (total recov.); 74 (dissolved)		
PCB (ug/l)	***0.014*** (applies separately to aroclors 1242, 1254, 1221, 1232, 1248, 1260, 1016)			***2***		0.03 (applies separately to aroclors 1242, 1254, 1221, 1232, 1248, 1260, 1016)			10
Selenium (ug/l)	***5*** (total recoverable)	20 (total recoverable)				71 (total recoverable); 71 (dissolved)	294 (total recov.); 290 (dissolved)		

Table 2B *(continued)*
Potentially Applicable Water Quality Criteria for Aquatic Life Protection

SUMMARY OF POTENTIALLY APPLICABLE GOALS FOR HUMAN HEALTH PROTECTION - Drinking Water and Aquatic Organism Consumption (MUN, REC1); WAC Recommended Threshold Levels are in ***bold italic***

(chemical constituents of concern are from the final 1998 303(d) list for Santa Clara Basin waterbodies and the southern portion of San Francisco Bay)

Constituent (Units)	Proposed California Toxics Rule Criteria (U.S. EPA)						California Ocean Plan – Numerical Water Quality			
	California Inland Surface waters – Freshwater Aquatic Life Protection			*California Enclosed bays & Estuaries –* Saltwater Aquatic life protection			Marine Aquatic Life Protection			*Other*
	Continuous Concentration (4-day Average)	Maximum Concentration (1-hour Average)	*Instantaneous* Maximum	Continuous Concentration (4-day Average)	Maximum Concentration (1-hour Average)	*Instantaneous* Maximum	6-month Median	Daily Maximum	*Instantaneous* Maximum	
Chlordane (ug/l)	***0.0043***		***2.4***	0.0043		0.09				
Chlorpyrifos (ug/l)										***0.02*** (interim freshwater; Menconi & Paul, CA DFG 1994)
Copper (ug/l)	calculate as total recoverable: ***(e{0.8545[ln(hardness)]-1.702})*** where hardness is mg/l as $CaCO_3$; for dissolved, multiply result of total recoverable calculation by ***0.960***	calculate as total recoverable: ***(e{0.9422[ln(hardness)]-1.700})*** where hardness is mg/l as $CaCO_3$; for dissolved, multiply result of total recoverable calculation by ***0.960***		3.7 (total recov.); 3.1 (dissolved)	5.8 (total recov.); 4.8 (dissolved)		3	12	30	
DDT (ug/l)	***0.001***		***1.1***	0.001		0.13				
Diazinon (ug/l)										***0.08*** (acute); ***0.04*** (chronic) (freshwater aquatic life; Menconi & Cox, CA DFG 1994)
Dieldrin (ug/l)	***0.056***	***0.24***		0.0019		0.71				
Dioxin (ug/l)										
Mercury (ug/l)	0.91 (total recoverable); 0.77 (dissolved)	***1.6*** (total recoverable); ***1.4*** (dissolved)		1.1 (total recov.); 0.94 (dissolved)	2.1 (total recov.); 1.8 (dissolved)		0.04	0.16	0.4	***0.025*** (total recov. and dissolved)
Nickel (ug/l)	calculate as total recoverable: ***(e{0.8460[ln(hardness)]-0.0584})*** where hardness is mg/l as $CaCO_3$; for dissolved, multiply result of total recoverable calculation by ***0.997***	calculate as total recoverable: ***(e{0.8460[ln(hardness)]-2.255})*** where hardness is mg/l as $CaCO_3$; for dissolved, multiply result of total recoverable calculation by ***0.998***		8.3 (total recov.); 8.2 (dissolved)	75 (total recov.); 74 (dissolved)		5	20	50	
PCB (ug/l)	***0.014***			0.03						
Selenium (ug/l)	***5*** (total recoverable)	calculate as total recov.: ***1/[(selenite fraction/185.9 ug/l)+(selenate fraction/12.83 ug/l)]*** where selenite fraction + selenate fraction = 1		71 (total recov.); 71 (dissolved)	291 (total recov.); 290 (dissolved)		15	60	150	

Table 2C
Potentially Applicable Sediment Criteria

SUMMARY OF POTENTIALLY APPLICABLE GOALS (REC1, COLD, RARE); WAC Recommended Threshold Levels are in ***bold italic***

(chemical constituents of concern are from the final 1998 303(d) list for Santa Clara Basin waterbodies and the southern portion of San Francisco Bay)

Constituent (units in dry weight)	**Toxicity Effects Levels (see note at bottom for sources)**								**Freshwater**	**Soil Background**	**U.S. EPA**
	Freshwater Sediment			**Marine Sediment**					**Sediment**	**Level (National**	**Proposed Criteria**
	Threshold Effects Level (TEL)	**Probable Effects Level (PEL)**	**Upper Effects Threshold (UET)**	**Threshold Effects Level (TEL)**	**Effects Range - Low (ERL)**	**Effects Range-Median (ERM)**	**Probabl e Effects Level (PEL)**	**Apparent Effects Threshold (AET)**	**Background Levels (see note at bottom for sources)**	**Geometric Mean) (see note at bottom for sources)**	**(based on equilibrium partitioning**
Chlordane (ppb)	4.5	***8.9***	30 (based on impacts to benthic community	2.26	0.5	6	4.79	>4.5 (based on Echinoderm larvae bioassay)			
DDT (ppb)			50 (based on impacts to benthic community	1.19	1	7	4.77	12 (based on Echinoderm larvae bioassay)			
(Dieldrin (ppb)	2.85	***6.67***	300 (based on impacts to benthic community	0.715	0.02	8	4.3	1.9 (based on Echinoderm larvae bioassay)			11,00 (freshwater); 20,000 (marine) ug/kg OC (ppm organic carbon)
Dioxin (ppb)			***0.0088*** (value on dry weight basis) (based on Hyallela azteca bioassay)								
PCB (ppb)	34.1	***277***	26 (based on Microtox bioassay)	21.55	22.7	180	188.79	130 (based on Microtox bioassay)			
Furan compounds (debenzofuran (ppb)			***5,100*** (based on Hyallela azteca bioassay)					110 (based on Echinoderm larvae bioassay)			
Mercury (ppb)	174	***486***	560 (based on Microtox bioassay)	130	150	696	710	410 (based on Microtox bioassey)	4 to 51	58	
Selenium (ppb)								1,000 (based on Amphipod bioassay)	290	260	
Copper (ppb)	35,700	197,000	86,000 (based on impacts to benthic community	18,700	34,000	108,20 0	270,000	390,000 (based on Microtox and Oyster larvae bioassay)	10,000 to 25,000	17,000	
Nickel (ppb)	18,000	35,900	43,000 (based on Hyallela azteca bioassay)	15,900	20,900	42,800	51,600	110,000 (based on Echioderm larvae bioassay)	9,900	13,000	

Note: toxicity levels are from Buchman, M.F., 1998. NOAA Screening Quick Reference Tables, NOAA HAZMAT Report 97-2, Seattle WA, Hazardous Materials Response and Assessment Division, National Oceanic and Atmospheric Administration, 12 pages.
This document is a compilation of information from several sources including research from the Great Lakes and Puget Sound.

Note: background freshwater sediment values are from the same source as above; the values come from several original sources, primarily from International Joint Commission Sediment Subcommittee (1988).

Note: background soil concentrations are from the same source as above; the values originate in Shacklette and Boerngen, 1984; USGS Prof. Paper 1270.

Note: meaning of terms used from Buchman, M.F., 1988:

ERL: represents the value at which toxicity may begin to be observed in sensitive species.

ERM: the median concentration of the samples labeled as toxic.

TEL: the concentration below which adverse effects are expected to occur only rarely.

AET: generally equivalent to the concentration observed in the highest non-toxic sample; only the lowest of five potential AETs is listed.

UET: for freshwater sediments, the UET is the lowest AET from a compilation of endpoints.

PEL: the level above which adverse effects are expected to occur frequently.

Table 2D
Potentially Applicable Fish Tissue Criteria

SUMMARY OF POTENTIALLY APPLICABLE GOALS (REC1); WAC Recommended Threshold Levels are in ***bold italic*** (chemical constituents of concern are from the final 1998 303(d) list for Santa Clara Basin waterbodies and the southern portion of San Francisco Bay)				
Constituent (units)	**Fish Tissue Concentration**			**San Francisco Estuary Institute Regional Monitoring Program**
	U.S. EPA Human Health Cancer Risk of 10^{-5}	**U.S. EPA Non-Cancer Hazard Quotient of 1**	**U.S. Food and Drug Administration Guidance/Action/ Tolerance Level**	**Screening Values (based upon consumption rate of 30 g/day) (see note below)**
Chlordane (ppm)	0.083	0.65	0.3	***18 ng/g wet*** (for sum of chlordanes)
Chlorpyrifos (ppm)		32		
DDT (ppm)	0.32	5.4	5	***69 ng/g wet*** (for sum of DDTs)
Diazinon (ppm)		9.7		
Dieldrin (ppm)	0.0067	0.54	0.3	***1.5 ng/g wet***
Dioxin (ppm)				***0.15 pg/g wet*** (for dioxin toxic equivalents)
PCB (ppm)	0.014	0.22 (0.75 for arochlor 1016)	2	***23*** (for sum of arochlors)
Furan compounds (dibenzofuran)(ppm)		43		(included with dioxin toxic equivalents)
Mercury (ppm)		1.1	1	***0.233 ug/g wet***
Selenium (ppm)		54		***11.7 ug/g wet***

Note: Screening values calculated based on 1995 EPA guidance. Defined as concentrations of target analytes in fish or shellfish tissue that are of potential public health concern.

Table 3
Example Approach for Performing Uncertainty Analysis of Bioassessment Data

Level of Information	Technical Components	Spatial/Temporal Coverage	Data Quality
1	• Visual observation of biota • Reference conditions not used • Simple documentation	• Limited monitoring • Extrapolations from other sites	• Unknown or low precision and sensitivity • Professional biologist not required
2	• One assemblage (usually invertebrates) • Reference conditions pre-established by professional biologist • Biotic index or narrative evaluation of historical records	• Limited to a single sampling • Limited sampling for site-specific studies	• Low to moderate precision and sensitivity • Professional biologist may provide oversight
3	• Single assemblage usually the norm • Reference condition may be site-specific, or composite of sites (e.g., regional) • Biotic index (interpretation may be supplemented by narrative evaluation of historical records)	• Monitoring of targeted sites during a single season • May be limited sampling for site-specific studies • May include limited spatial coverage for watershed-level assessments	• Moderate precision and sensitivity • Professional biologist performs survey or provides training for sampling • Professional biologist performs assessment
4	• Generally two assemblages, but may be one if high data quality • Regional (usually based on sites) reference conditions used • Biotic index (single dimension or multimetric index)	• Monitoring during 1-2 sampling seasons • Broad coverage of sites for either site-specific or watershed assessments • Conducive to regional assessments using targeted or probabilistic design	• High precision and sensitivity • Professional biologist performs survey and assessment

Source: Guidelines for Preparation of the Comprehensive State Water Quality Assessments (305(b) Reports) and Electronic Upgrades: Supplement EPA-841-B-97-002B, September 1997.

Table 4
Example of Potential Limiting Factors from Assessment of Selected Beneficial Uses and Stakeholder Interest

COLD*	RARE	REC1	MUN	PFF
temperature exceeds criteria for critical life stages of steelhead	limited riparian habitat for salamanders	limited access	MTBE exceeds Action Level at selected drinking water wells	floodway capacity limited by sedimentation in channels
insufficient riffle abundance limits macroinvertebrate population and food supply for fish, or limits fast water feeding habitat to allow fish to feed	barriers to migration of anadramous fish	aesthetic limitations: late summer algal blooms and associated odors		excess woody debris limits floodway capacity
low dissolved oxygen during low summer flow periods	red legged frogs limited by predation from bullfogs	risk of exposure to pathogens, especially during wet weather		floodway lacks capacity to meet future conditions for 1% flood
chemical toxicity during wet weather events		risk to human health from consumption of fish		
lack of woody debris and other instream cover		posted for no fishing		

*these are all factors that may affect one reach, and will be listed in order of probable importance.

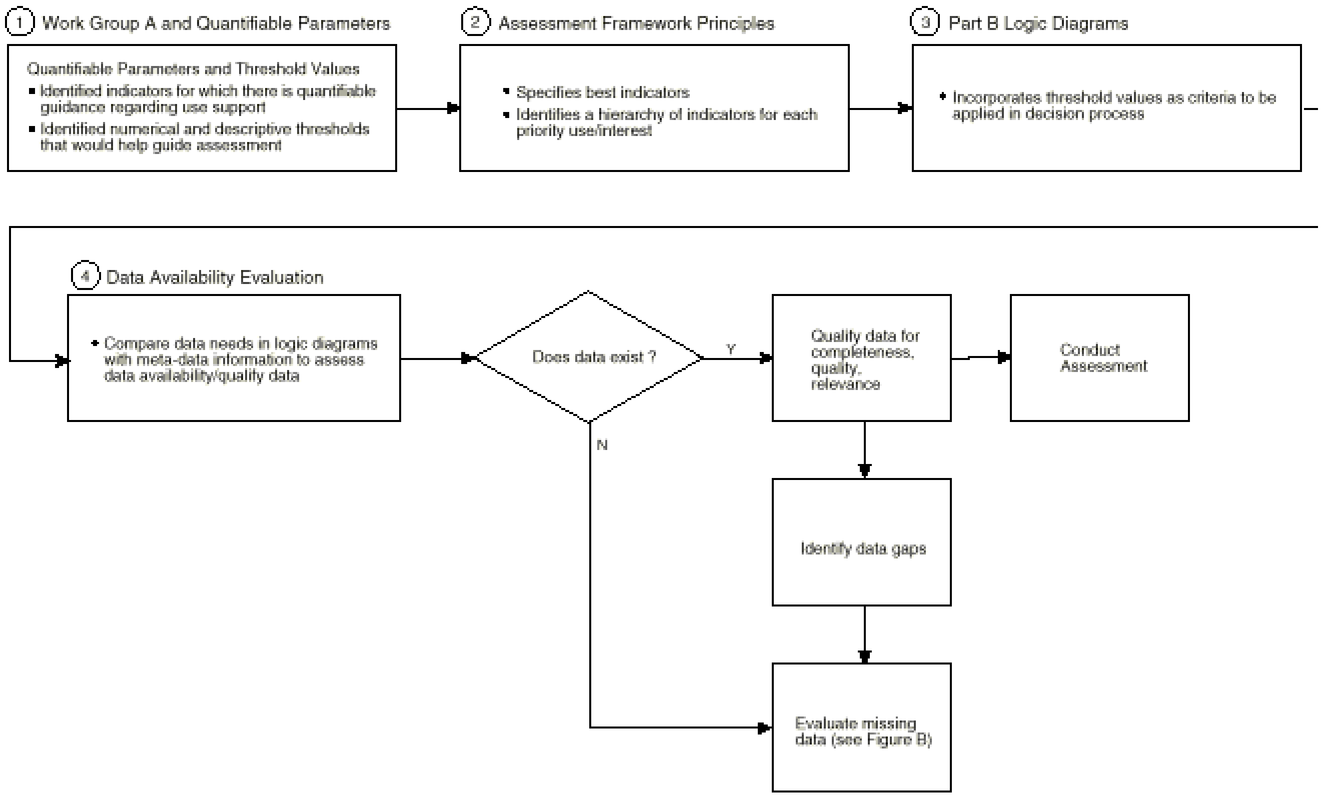

Figure A. Steps in Assessment Showing How Part B of Assessment Framework Leads to Data Availability Evaluation

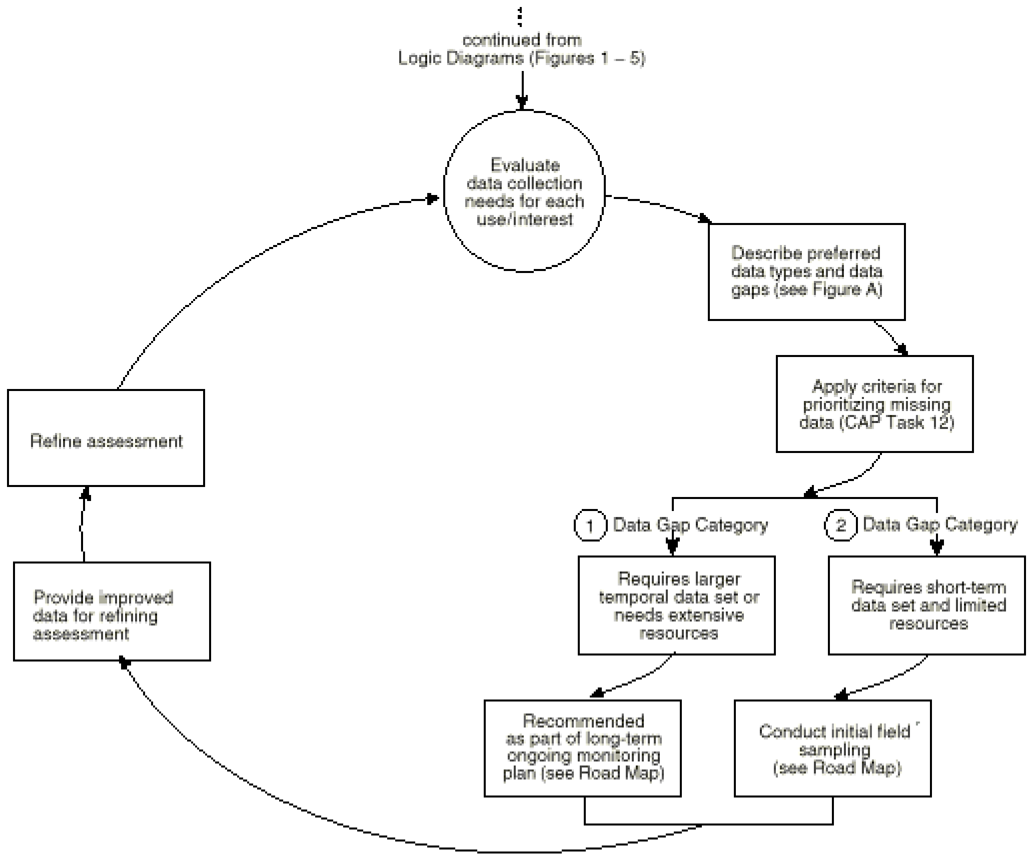

Figure B. Steps Involved in Evaluating Data Collection Needs and Refining Assessment

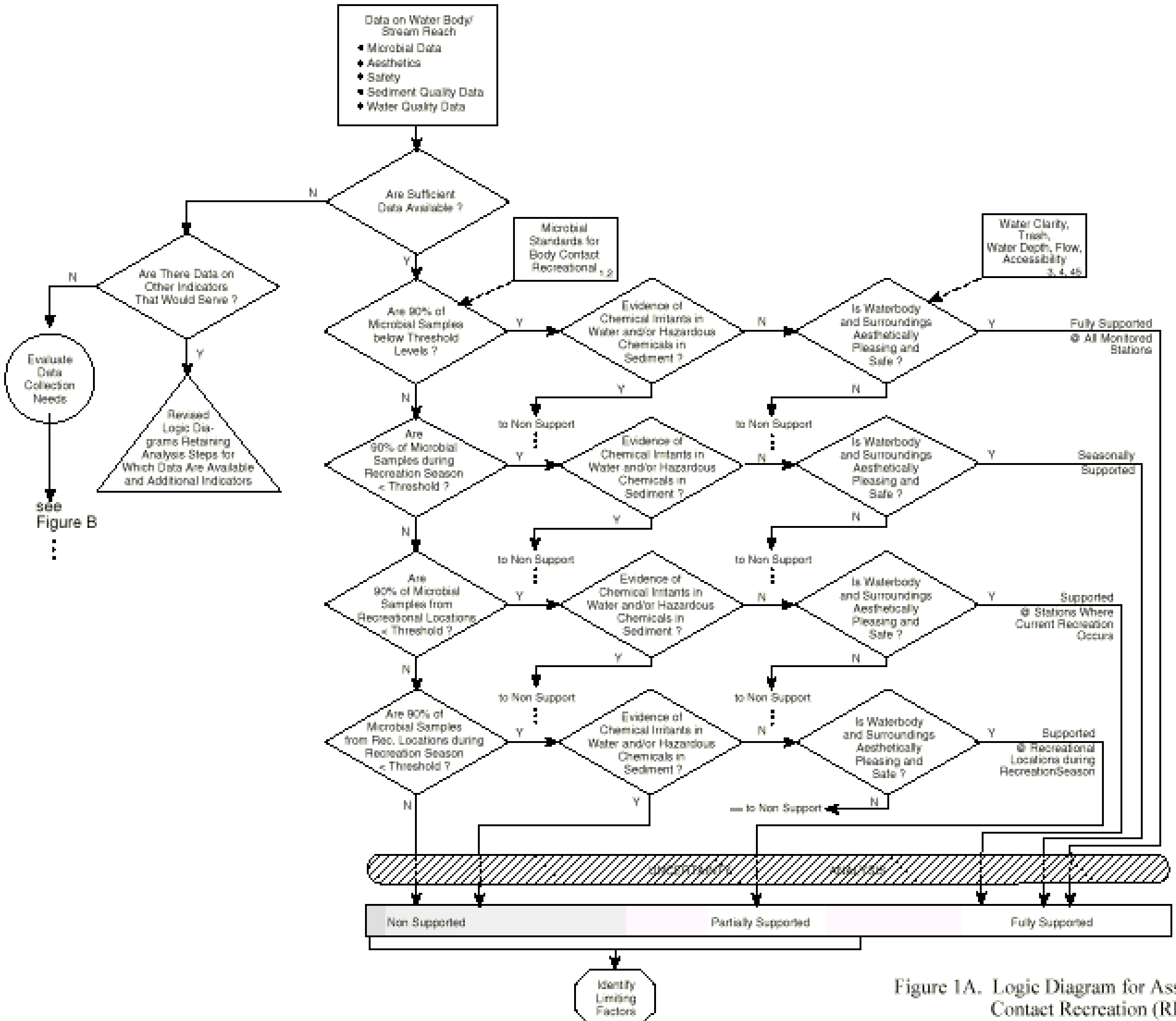

Figure 1A. Logic Diagram for Assessing Water Contact Recreation (REC1) Beneficial Use

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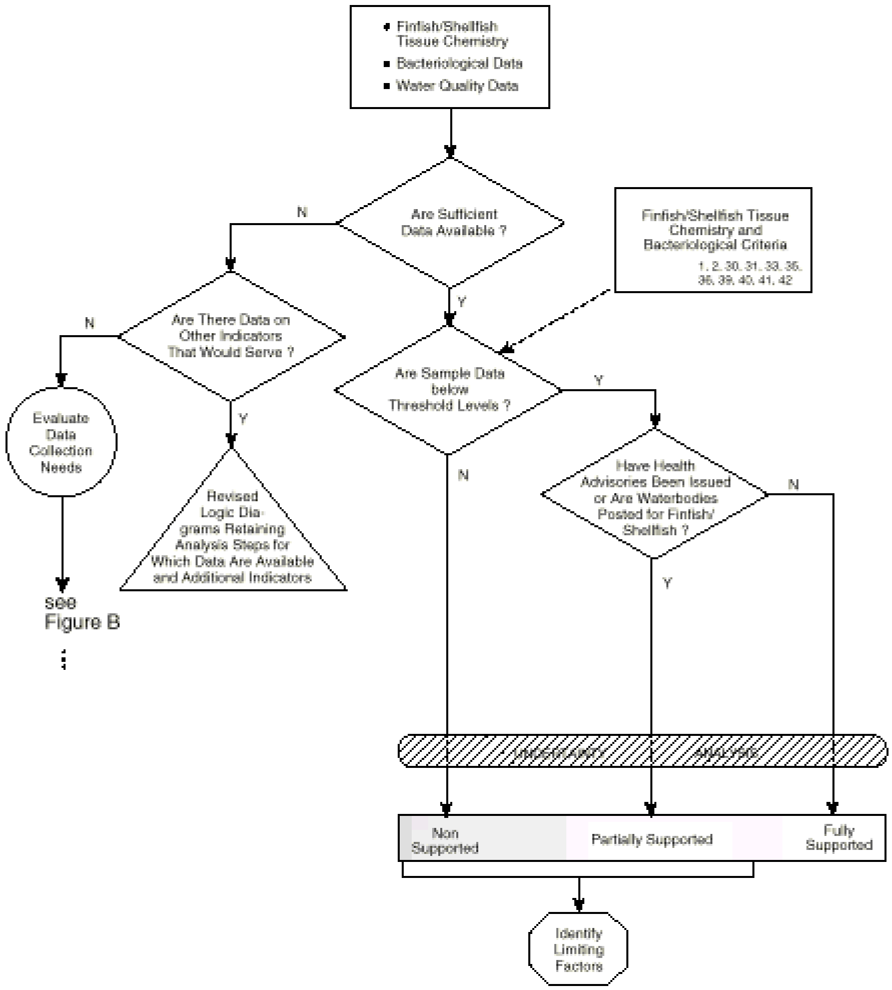

Figure 1B. Logic Diagram for Assessing Support of Finfish/Shellfish Consumption as Part of Sport Fishing (REC1) Beneficial Use

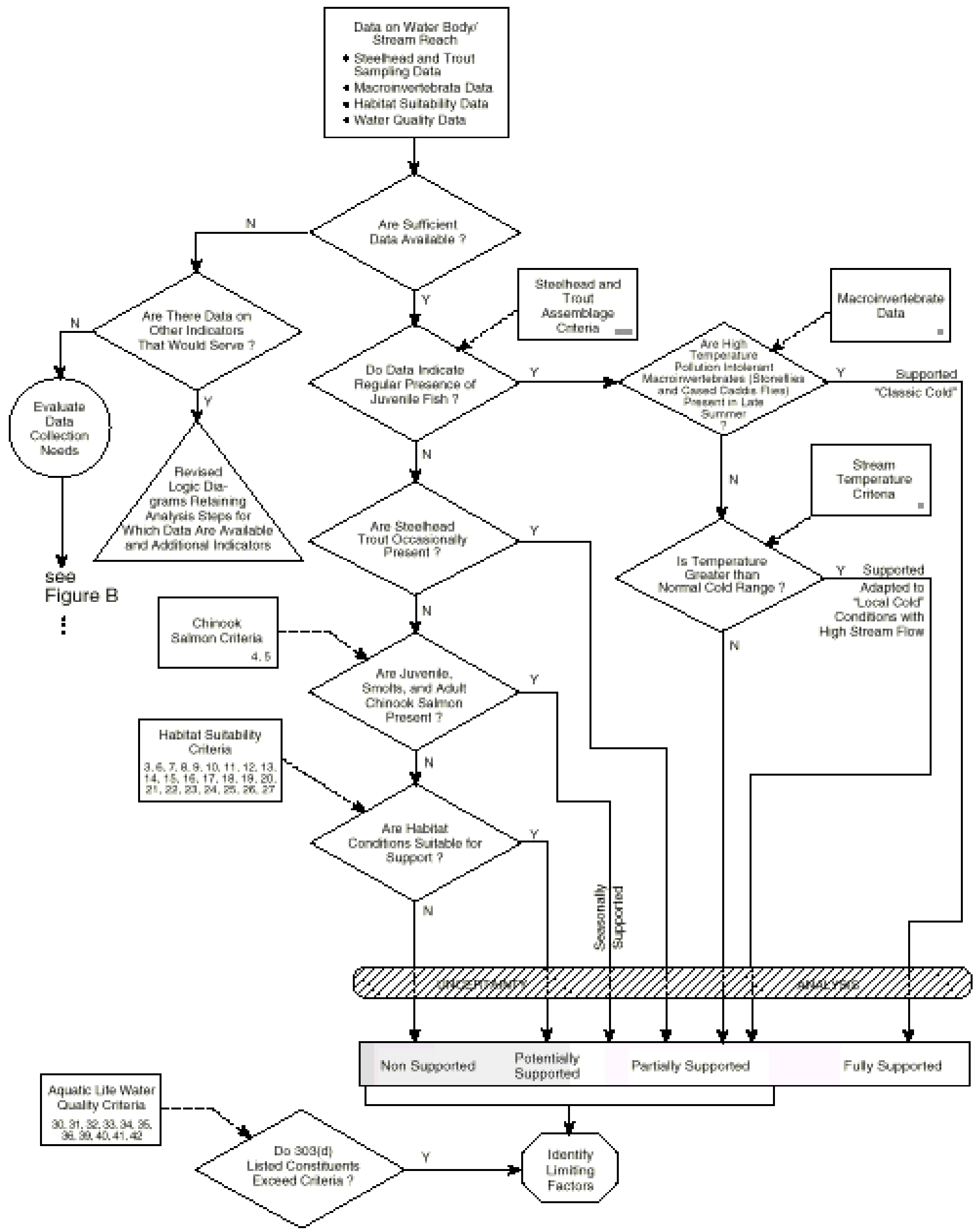

Figure 2. Logic Diagram for Assessing Cold Freshwater Habitat (COLD) Beneficial Use

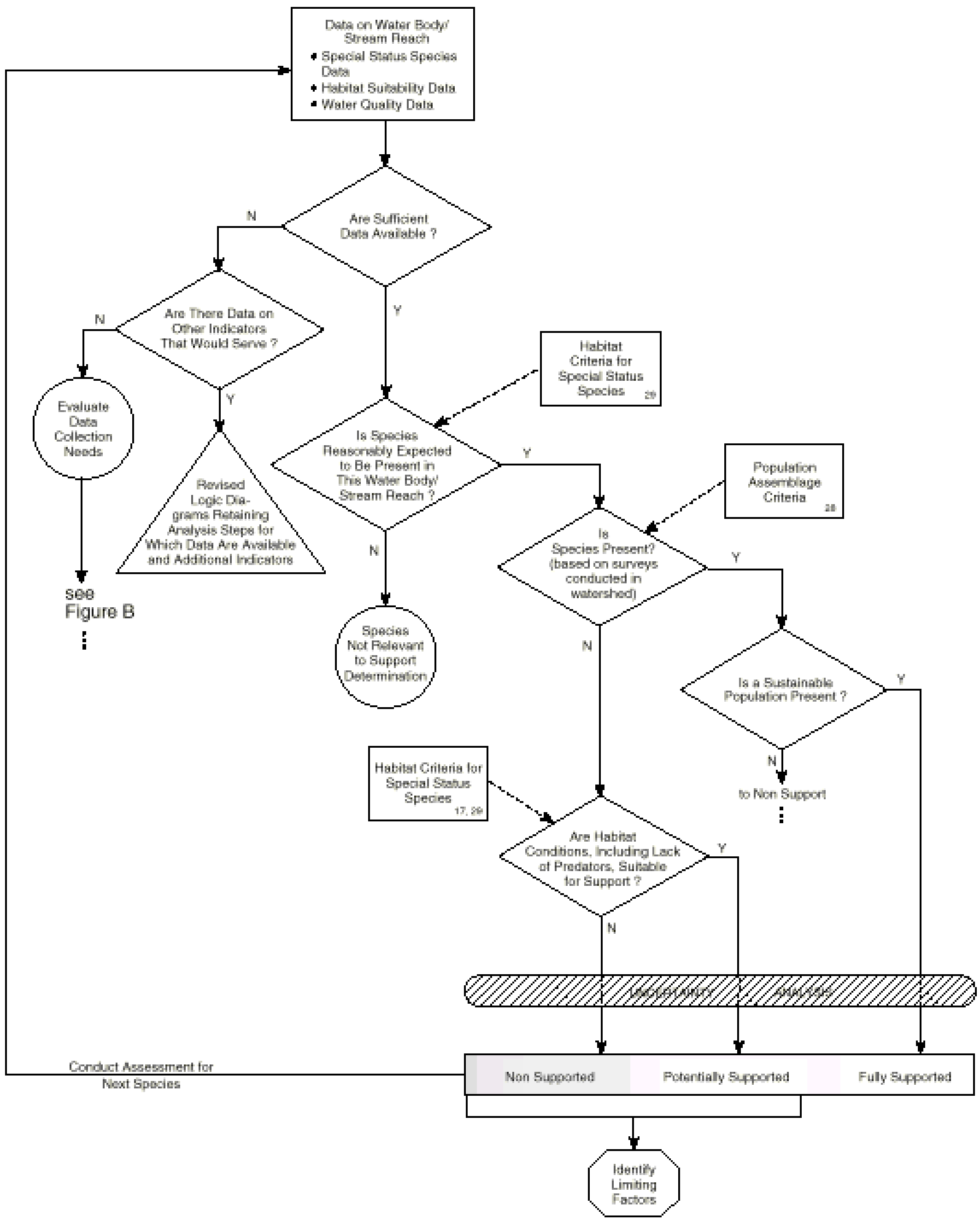

Figure 3. Logic Diagram for Assessing Support of Preservation of Rare and Endangered Species (RARE) Beneficial Use

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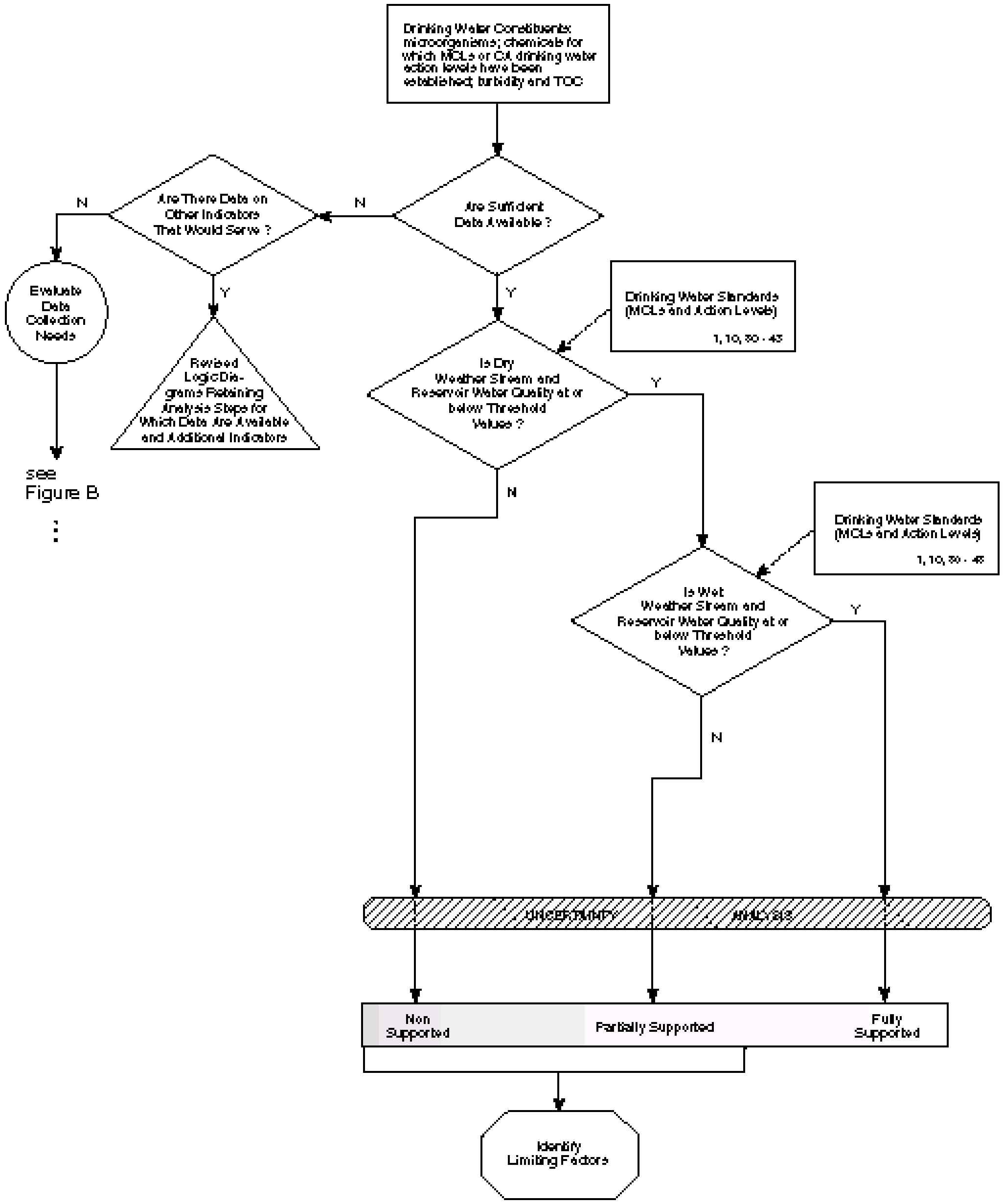
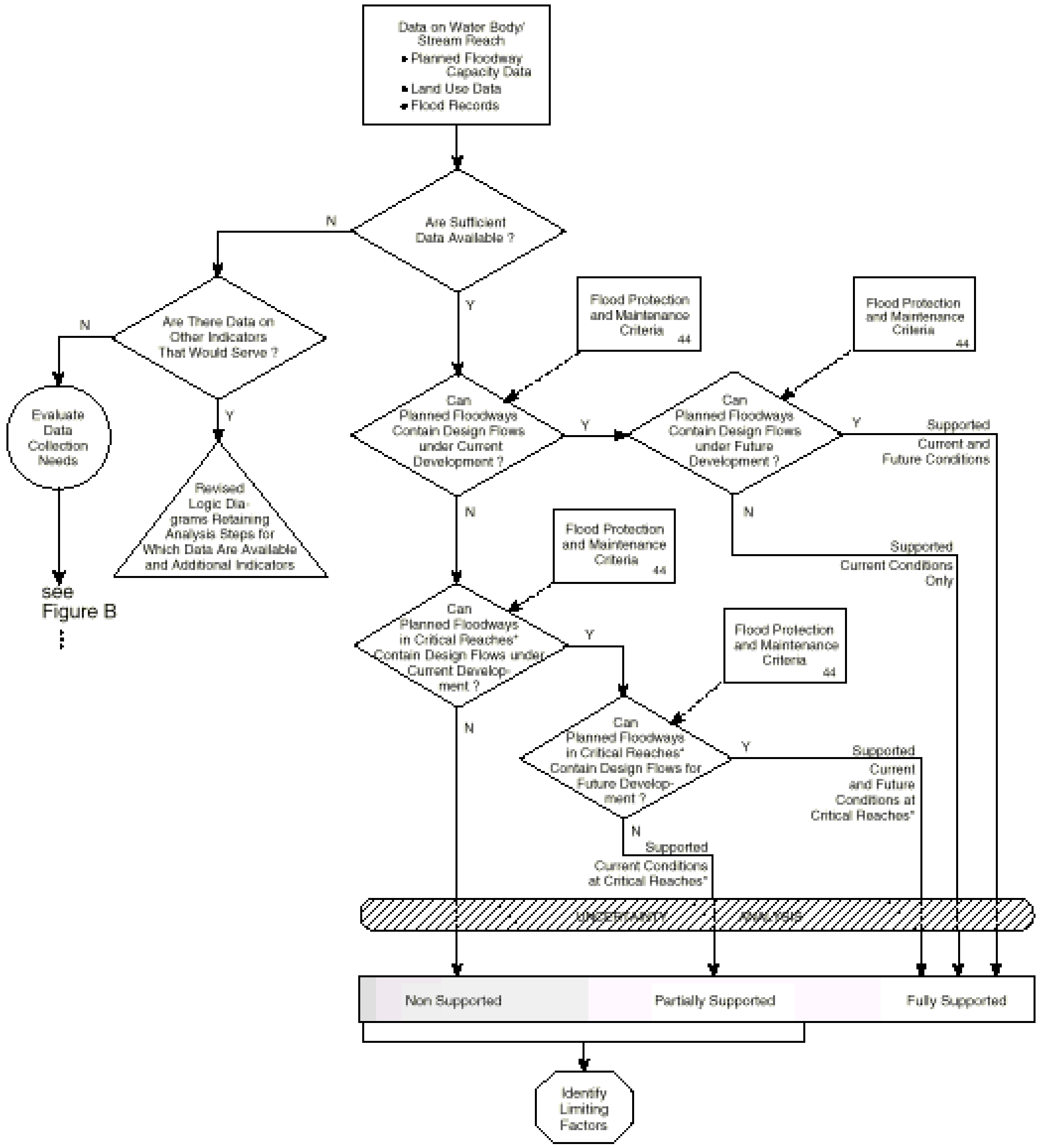


Figure 4. Logic Diagram for Assessing Municipal and Domestic Supply (MUN) Beneficial Use



* Critical reaches include urban reaches or other reaches where flooding could result in a high level of property damage or loss of life.

Figure 5. Logic Diagram for Assessing Flood Management Stakeholder Interest

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