PHOENIX LAKE IRWM RETROFIT

Attachment 6 - Monitoring, Assessment, and Performance Measures

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1.0 General Overview of Monitoring, Assessment, and Performance Measures

This attachment presents project monitoring, assessment, and performance measures that will be used to quantify and verify the performance of the Phoenix Lake IRWM Retrofit with respect to its benefits and objectives. The information in this attachment will go into a monitoring plan that will be developed if the grant application is successful.

The Phoenix Lake IRWM Retrofit consists of five projects; Flood Damage Reduction Project, Water Supply Project, Water Quality Project, Ecosystem Restoration Project, and Recreation and Public Access Project. Accordingly, the monitoring, assessment, and performance measures were developed for each of the five projects.

Figure 1 shows an overview of monitoring locations and variables for the Phoenix Lake IRWM Retrofit. The project monitoring defines monitoring elements (*what*) and the reasons for each monitoring element (*why*). It also defines the timing, frequency and duration of monitoring (*when*), the locations of monitoring sites (*where*), and the responsibility for monitoring data collection, analysis and reporting (*who*). The planned project monitoring is designed to guide project operations and aid evaluation of project performance.

What:
Monitored elements to be considered in the planned monitoring, assessment, and performance measures will include:

- Hydrology
- Water quality
- Water temperature

Why:
The monitoring tasks included in the planned monitoring, assessment, and performance measures will guide project operations and aid measurement of specific project performance criteria. Some variables, such as those covered by water quality monitoring, will only be monitored when identified as a specific project issue or an indicator.

When:
Project evaluation monitoring will need to be conducted:

- pre-construction, ideally for two or three seasons before construction, to establish baseline conditions;
- during construction, as necessary, to monitor compliance with design parameters; and,
- post-construction, until such time that achievement of project objectives has been demonstrated, or as set forth in the grant agreement.

Where:
Selection of monitoring sites is a critical step in developing the monitoring, assessment, and performance measures. The selected monitoring sites will be located:

Summary of Monitoring Stations and Monitoring Activities

Project	Monitoring Stations	Monitoring Activities	Continuous or Periodic?
Flood Damage Reduction Project	Trib1	Stream Flow (wet season)	Continuous
	Trib2	Stream Flow (wet season)	Continuous
	PL_S	Lake Stage (wet season)	Continuous
Water Supply Project	PL_S	Lake Stage (dry season)	Continuous
	PL_WQ	Water Quality	Periodic
Water Quality Project	PL_T	Water Temperature	Continuous
Ecosystem Restoration Project	Trib1	Stream flow (dry season)	Continuous
	Trib2	Stream Flow (dry season)	Continuous
	RC1	Stream Flow; Water Temperature; Dissolved Oxygen	Continuous; Continuous; Periodic
	RC1.5	Dissolved Oxygen	Periodic
	RC2	Water Temperature	Continuous
	RC3	Water Temperature	Continuous
	RC4	Stream Flow; Water Temperature	Continuous; Continuous
	CMC1	Water Temperature	Continuous
	CMC2	Water Temperature	Continuous
Recreation and Public Access Project	-	-	

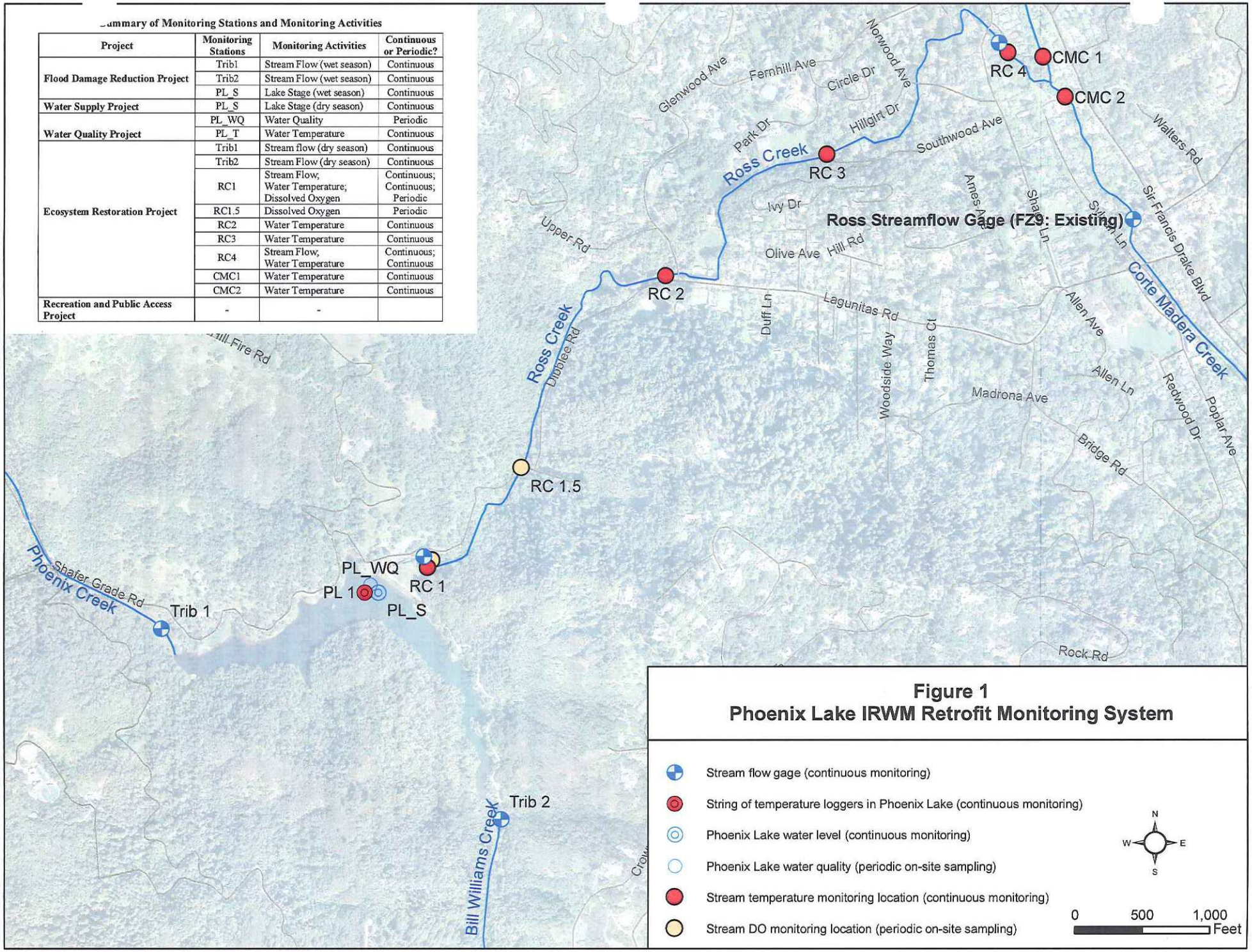

Figure 1
Phoenix Lake IRWM Retrofit Monitoring System

- within the project area;
- upstream of project; and,
- downstream of project.

Who:
The planned project monitoring, assessment, and performance measures will define who will be responsible for the various elements of the monitoring activities. These elements will include:

- Equipment acquisition and maintenance;
- Quality assurance and quality control (QA/QC);
- Data collection;
- Chain of custody for lab samples and specimens;
- Data organization;
- Data analysis and evaluation;
- Reporting;
- Information dissemination;
- Funding; and,
- Review and approval.

The Marin County Flood Control and Water Conservation District, Flood Zone 9 (FZ9) will have the following overall responsibilities, and MMWD will assist in specific duties as indicated.

Monitoring Plan – FZ9 will develop a monitoring plan, prepares a cost estimate, and identifies the funding mechanism for the monitoring plan.

Field Monitoring - FZ9 will implement monitoring activities, organize monitoring data into the accepted reporting format, and conduct QA/QC check of the data.

Data Analysis, Evaluation, and Reporting – FZ9 will analyze and report the monitoring results and conduct performance evaluation.

Database Management – FZ9 will assign a database coordinator to oversee the collection, storage, and dissemination of monitoring data and to ensure that the data management and monitoring deliverables are consistent with the Bay Area IRWMP standards. As part of the Bay Area IRWMP implementation, data will be collected to support assessment of the performance of Phoenix Lake IRWM Retrofit, as well as in meeting the regional goals and objectives identified in the Bay Area IRWMP. Data collection will be ensured to be comparable with the statewide data collection programs, such as the Surface Water Ambient Monitoring Program (SWAMP). Upon completion of the performance assessment, the collected data, along with its associated quality assurance/quality control information, will be provided to the State in a format that can be easily integrated into statewide data collection and tracking programs. As appropriate, the collected data will be contributed to the following statewide data programs:

- California Environmental Resources Evaluation System (CERES), an information system developed by the California Resources Agency to facilitate access to natural resource data; and,
- California Environmental Data Exchange Network (CEDEN), a website developed by the State for coordinated data sharing.

2.0 Flood Damage Reduction Project

2.1 Project Goals and Objectives

The goal of the Flood Damage Reduction Project is to enable Phoenix Lake to function as a flood detention basin to reduce flood damages downstream. The objective of flood detention operations is to attenuate flows produced in the upper Ross Creek watershed sufficiently to reduce the peak discharge to lower Ross Creek, and hence lower Corte Madera Creek, during the 1-percent-chance-annual flood (or 100-year flood) by about 650 cfs[1]. In order to achieve this objective, Phoenix Lake needs to provide about 460 acre-feet of flood storage capacity[2] for floodwater attenuation. Accordingly, flood detention operations call for rapid drawdown of the lake level to elevation 140 ft ahead of a forecasted heavy storm event and storage of floodwaters up to elevation 180 ft.

2.2 Performance Measures

Table 1 is a summary of performance measures that will be used to quantify and verify project performance with respect to the project goal and objective identified for the Flood Damage Reduction Project. Table 1 (and the following sentences) also summarizes how monitoring data and measures will be used to evaluate project performance in meeting the overall goals and objectives of the Bay Area IRWMP.

As a flood damage reduction project, reducing flood damage would, of course, be the desired outcome. Since flood reduction is achieved by way of flood detention, the flow hydrograph below Phoenix Lake dam, the peak flow at the Ross streamflow gage, and the extent of floodplain inundation are selected as the output indicators (or measures to effectively track output). The *attenuated* flow hydrograph below Phoenix Lake dam, the *reduced* peak flow at the Ross streamflow gage, the *reduced* extent of floodplain inundation, and the *reduced* flood damage (i.e., event benefit) relative to the without-Project conditions are selected as the outcome indicators to evaluate the change that is a direct result of the Flood Damage Reduction Project. These output and outcome indicators, particularly for the without-Project conditions, can not be directly measured. As such, the following analyses will be conducted:

[1] Phoenix Lake can also reduce peak flows for smaller floods. The amounts of peak flow reduction at the Ross streamflow gage for the 50-year, 25-year, 10-year, and 5-year floods are estimated to be approximately 600 cfs, 510 cfs, 370 cfs, and 270 cfs, respectively.

[2] Including the storage of about 410 acre-ft between elevations 140 ft and 180 ft and a surcharge storage of about 50 acre-ft.

- Hydrologic modeling to simulate water levels of Phoenix Lake and flow hydrograph at Ross streamflow gage under without-Project conditions and compare those with the observed data under with-Project conditions (modeling tool: HEC-HMS).
- Hydraulic modeling to simulate the flood extent and depth for both with- and without-Project conditions (modeling tool: MIKE FLOOD).
- Floodplain inundation mapping for both with- and without-Project conditions (mapping tool: GIS)
- Flood damage analysis for both with- and without-Project conditions (method: as described in Attachment 7 (Economic Analysis: Flood Damage Reduction Costs and Benefits)).

The simulated flows developed through the hydrologic modeling will be used as flow inputs for the hydraulic modeling. The simulated flood extent and depth developed through the hydraulic modeling will be used to conduct floodplain inundation mapping and flood damage analysis.

Table 1 Flood Damage Reduction Project Performance Measures

Project Goal	• Reduce flood damage downstream
Bay Area IRWMP Goals and Objectives Met by Project (Refer to the Table in Section 1.10 of Attachment 3, Work Plan)	• A7; B3; C2; E8
Desired Outcomes	• Reduce peak discharge to Ross Creek and lower Corte Madera Creek • Reduce flood damage downstream
Output Indicators (Measures)	• Flow hydrograph below Phoenix Lake dam • Peak flow at Ross streamflow gage • Extent of floodplain inundation
Outcome Indicators (Measures)	• Attenuated flow hydrograph below Phoenix Lake dam relative to the without-Project condition • Reduced peak flow at Ross streamflow gage relative to the without-Project condition • Reduced extent of floodplain inundation relative to the without-Project condition • Reduced flood damage relative to the without-Project condition
Measurement Tools and Methods	• HEC-HMS hydrologic modeling • MIKE FLOOD hydraulic modeling • GIS floodplain inundation mapping • Flood damage analysis (method: as described in Attachment 7 (Economic Analysis: Flood Damage Reduction Costs and Benefits))
Targets	• Reduce the 1-percent-chance-annual flood (or 100-year flood) by about 650 cfs at Ross streamflow gage relative to the without-Project conditions • Reduce the 50-year, 25-year, 10-year, and 5-year floods by about 600 cfs, 510 cfs, 370 cfs, and 270 cfs, respectively at Ross streamflow gage relative to the without-Project conditions

2.3 Monitoring System

The monitoring system for the Flood Damage Reduction Project is shown in Figure 1 and Table 2 is a summary of the monitoring plan. Two streamflow gages will be installed at the mouths of the two major tributaries of Phoenix Lake (Bill Williams Creek and Phoenix Creek) and a lake level gage will be installed upstream of the spillway. The locations of the two streamflow gages will be carefully selected so that the lake level will not cause any backwater effects on gage readings. These new gages will provide data to guide operations of the Flood Damage Reduction Project and provide data for hydrologic modeling analysis as described below:

- The observed base flow pattern of the two streamflow gages will be used as one of the indications about the watershed saturation condition. Higher than normal base flows in the wet season indicates the watershed is saturated and the first-step drawdown of the lake level should be initiated (i.e., drawdown to elevation 160 ft).
- The observed lake level will be used to guide the operation of the spillway gate during a flood event.
- The observed flows at the two streamflow gages, the observed lake level, and the calculated discharges from the low-level outlet and the spillway based on the observed lake level will be used for hydrologic modeling analysis to determine the without-Project hydrologic condition which is needed for the evaluation of the performance of the Flood Damage Reduction Project.

Table 2 Summary of Monitoring Plan for the Flood Damage Reduction Project

	Description
What	• Hydrology (streamflow and lake level in the wet season)
Why	• Provide data to guide project operations • Provide data for hydrologic modeling analysis as needed for evaluation of project performance
When	• Continuous streamflow in the wet season: o *Post-construction* • Continuous lake level in the wet season: o *Post-construction*
Where	• Stream flow at the mouths of the two major tributaries of Phoenix Lake • Lake level upstream of the spillway
Who	• FZ9

2.4 Data Analysis, Evaluation, and Reporting

Data will be collected and stored in all years. Analysis, evaluation and reporting will be done only in flood years by FZ9. Hydrologic modeling, hydraulic modeling and floodplain mapping, flood damage analysis, and reporting will be conducted in flood

years to evaluate project performance. The flood year report will contain the following elements:

- Introduction (Background and Objectives);
- Project operations in the wet season;
- Streamflow and lake level monitoring results in the wet season;
- Hydrologic modeling;
- Hydraulic modeling and floodplain mapping;
- Flood damage analysis; and,
- Evaluation of project performance.

3.0 Water Supply Project

3.1 Project Goals and Objectives

The goal of the Water Supply Project is to increase the yield of Phoenix Lake and thereby provide more reliability and flexibility to MMWD's water supply. The Phoenix Lake IRWM Retrofit will restore the spillway crest to its pre-1985 elevation 180 ft, thereby increasing the storage capacity of the lake. The added storage capacity will increase the lake annual yield by up to 120 acre-ft for water supply to the MMWD system, with a long-term average and a shortage year yield by about 107 acre-feet and 50 acre-ft, respectively (see Appendix 2 of Attachment 8, Hydrology Report, Table 3). Accordingly, water supply operations require operating the lake at el. 180 ft for extended periods, particularly during the dry season.

3.2 Performance Measures

Table 3 is a summary of performance measures that will be used to quantify and verify project performance with respect to the project goal and objective identified for the Water Supply Project. Table 3 (and the following sentences) also summarizes how monitoring data and measures will be used to evaluate project performance in meeting the overall goals and objectives of the Bay Area IRWMP. Phoenix Lake was and will continue to be used by MMWD for water supply in the dry season. The desired outcome of the Water Supply Project is to increase the volume of water supply available during the dry season. Increasing the volume of available water supply is achieved by installing a 6-ft high spillway gate to raise the normal lake level in the dry season from current elevation 174 ft to the pre-1985 elevation (i.e., 180 ft). Either lake level or volume of water in the dry season can be used as output indicators, and the increased normal lake level or volume of water in the dry season relative to the without-Project conditions can be used as outcome indicators. The project performance of the Water Supply Project can be evaluated simply based on the direct measurement of increased lake level or volume of water in the dry season relative to the without-Project conditions.

Table 3 Water Supply Project Performance Measures

Project Goal	• Increase the yield of Phoenix Lake and thereby provide more reliability and flexibility to MMWD's water supply
Bay Area IRWMP Goals and Objectives Met by Project (Refer to the Table in Section 1.10 of Attachment 3, Work Plan)	• A10; B1; B2; B5; B6; B9; C3; E1; E2; F2
Desired Outcomes	• Increase the volume of water supply available during the dry season
Output Indicators (Measures)	• Lake level or volume of water in the dry season
Outcome Indicators (Measures)	• Increased normal lake level or volume of water in the dry season relative to the without-Project condition
Measurement Tools and Methods	• Direct measurement of increased lake level or volume of water in the dry season relative to the without-Project condition
Targets	• Increase the lake yield by up to about 120 acre-feet in the dry season

3.3 Monitoring System

The monitoring system for the Water Supply Project is shown in Figure 1 and Table 4 is a summary of the monitoring plan. The proposed lake level gage for the Flood Damage Reduction Project will also be used for the Water Supply Project. Measurement of lake levels in the wet season will be mainly used for the Flood Damage Reduction Project, while measurement of lake levels in the dry season will be mainly used for the evaluation of project performance of the Water Supply Project.

Table 4 Summary of Monitoring Plan for the Water Supply Project

	Description
What	• Hydrology (lake level in the dry season)
Why	• Provide data to evaluate project performance
When	• Continuous lake level in the dry season: o *Post-construction*
Where	• The same stream flow and lake level monitoring stations as in the Flood Damage Reduction Project
Who	• MMWD

3.4 Data Analysis, Evaluation, and Reporting

Data analysis and evaluation will be done by MMWD. Reporting will be done annually. The annual report will contain the following elements:

- Introduction (Background and Objectives)
- Project operations
- Lake level monitoring results in the dry season
- Evaluation of project performance

4.0 Water Quality Project

4.1 Project Goals and Objectives

The goal of the Water Quality Project is to improve the quality of water in Phoenix Lake for municipal water supply and public recreation. The lake experiences floating algae blooms, particularly during summertime. This reduces water clarity and the overall aesthetic appeal of the lake to fishermen and other recreationalists who visit the lake. Algae also affect the filtration process and increase MMWD's costs to treat Phoenix Lake water at its Bon Tempe Treatment Plant. Low dissolved oxygen in the lake hypolimnion creates a potential for dissolution of sediment-bound metals (iron and manganese). The algae and low dissolved oxygen can lead to taste and odor problems in the treated drinking water.

The Water Quality Project has two elements that address the water quality issues in the lake: (1) epilimnetic circulation device and (2) hypolimnetic circulation device. The eplimnetic circulation device is designed to reduce the growth of floating algae and thereby improve water quality, lake clarity, and reduce treatment costs, particularly during the summertime when lake supply is most needed. The hypolimnetic circulation device aims to oxygenate the hypolimnion and prevent dissolution of sediment-bound metals (iron and manganese). These two circulation devices will be carefully designed so that the thermal structure of the lake (i.e., stratification) will not be affected.

4.2 Performance Measures

Table 5 is a summary of performance measures that will be used to quantify and verify project performance with respect to the project goal and objective identified for the Water Quality Project. Table 5 (and the following sentences) also summarizes how monitoring data and measures will be used to evaluate project performance in meeting the overall goals and objectives of the Bay Area IRWMP.

The following measures are selected as output indicators:

- Chlorophyll-*a* concentration in the epilimnion, an indicator of algae levels in the epilimnion;
- Secchi depth, an indicator of clarity of water;
- Dissolved oxygen concentration in the hypolimnion; and,

- Concentrations of iron and manganese in the hypolimnion

Decreased Chlorophyll-*a* concentration in the epilimnion, increased Secchi depth, increased dissolved oxygen in the hypolimnion, and decreased concentrations of iron and manganese in the hypolimnion relative to the pre-construction conditions are selected as outcome indicators. The project performance of the Water Quality Project will be evaluated based on the direct measurement of output indicators relative to the pre-construction conditions. The effects of the two circulation devices on the thermal structure of the lake will also be evaluated.

Table 5 Water Quality Project Performance Measures

Project Goal	• Improve the quality of water in Phoenix Lake for municipal water supply and public recreation
Bay Area IRWMP Goals and Objectives Met by Project (Refer to the Table in Section 1.10 of Attachment 3, Work Plan)	• A10; A11; B5; D3; D4; D7; E2; E3; F2; F4; F5; F6; F8; F9
Desired Outcomes	• Prevent algae blooms • Improve clarity of water • Improve overall aesthetic appeal • Increase dissolved oxygen in the hypolimnion • Improve fishing conditions
Output Indicators (Measures)	• Chlorophyll-*a* concentration in the epilimnion • Secchi depth • Dissolved oxygen concentration in the hypolimnion • Concentrations of iron and manganese in the hypolimnion
Outcome Indicators (Measures)	• Decreased Chlorophyll-*a* concentrations in the epilimnion relative to the pre-construction conditions • Increased Secchi depth relative to the pre-construction conditions • Increased dissolved oxygen in the hypolimnion relative to the pre-construction conditions • Decreased concentrations of iron and manganese in the hypolimnion relative to the pre-construction conditions
Measurement Tools and Methods	• Direct measurement of the output indicators for both pre-construction and post-construction conditions
Targets	• Reduced algae blooms • Dissolved oxygen concentrations in the hypolimnion above 5 mg/L • Reduced concentrations of iron and manganese in the hypolimnion relative to pre-construction conditions

4.3 Monitoring System

The monitoring system for the Water Quality Project is shown in Figure 1 and Table 6 is a summary of the monitoring plan. Considering the lake is relatively small, only one location is needed for water quality and water temperature monitoring. This location is near the dam and near the circulation devices so that the performance by the circulation devices can be evaluated by comparing the difference between pre-construction and post-construction conditions.

Table 6 Summary of Monitoring Plan for the Water Quality Project

	Description
What	• Water quality (Secchi depth and vertical profiles of Chlorophyll-*a*, dissolved oxygen, and iron and manganese) • Water temperature (vertical profiles of water temperature)
Why	• Provide data to evaluate project performance
When	• Monthly sampling of water quality in the months from April through October: o *Pre-construction* o *Post-construction* • Continuous monitoring of water temperature in the months from April through October: o *Pre-construction* o *Post-construction*
Where	• Near the dam and near the proposed circulation devices
Who	• MMWD

4.4 Data Analysis, Evaluation, and Reporting

Data analysis and evaluation will be done by MMWD. Reporting will be done annually. The annual report will contain the following elements:

- Introduction (Background and Objectives)
- Hydrologic conditions
- Data acquisition, equipment, and results
    - Continuous reservoir water temperature profile monitoring
    - Monthly reservoir in-situ water quality sampling of Secchi depth and vertical profiles of Chlorophyll-*a*, dissolved oxygen, and iron and manganese
- Evaluation of project performance

5.0 Ecosystem Restoration Project

5.1 Project Goals and Objectives

The goal of the Ecosystem Restoration Project is to improve aquatic habitat conditions below the dam in Ross Creek and lower Corte Madera Creek by cooling water temperatures in these creeks during the dry season. Cooling of water temperatures requires augmenting the design of the Flood Damage Reduction Project's low-level drain pipeline intake to allow precisely controlled low flow release of hypolimnion cold water in the stratification period from the 140 ft level intake through a proposed special low-flow control gate.

Under current operations, since the existing 30" pipe low-level outlet is normally kept closed, overflows above the spillway crest are the primary outflows from the lake to downstream and these outflows are from the warm surface layer of the lake. A special low-flow control gate is proposed in the Ecosystem Restoration Project to allow precise controlled low flow release of hypolimnion cold water in the stratification period from the 140 ft level intake.

5.2 Performance Measures

Table 7 is a summary of performance measures that will be used to quantify and verify project performance with respect to the project goal and objective identified for the Ecosystem Restoration Project. Table 7 (and the following sentences) also summarizes how monitoring data and measures will be used to evaluate project performance in meeting the overall goals and objectives of the Bay Area IRWMP.

The desired outcome of the Ecosystem Restoration Project is to reduce water temperature in Ross Creek below Phoenix Lake dam and water temperature in the lower Corte Madera Creek below the Ross Creek confluence. Reducing water temperature in Ross Creek below Phoenix Lake dam is achieved by augmenting the design of the Flood Damage Reduction Project's low-level drain pipeline intake to allow precisely controlled low flow release of hypolimnion cold water in the stratification period from the 140 ft level intake through a proposed special low-flow control gate.

Reduced water temperature in Ross Creek immediately below Phoenix Lake dam and reduced water temperature in Corte Madera Creek immediately below the Ross Creek confluence relative to the without-Project conditions are selected as outcome indicators. The project performance of the Ecosystem Restoration Project in reducing water temperature in Ross Creek immediately below Phoenix Lake dam will be evaluated based on the direct measurement of the difference in observed water temperature between the surface layer and the hypolimnion of the lake. Water temperature mixing analysis will be used to determine the reduced water temperature in the lower Corte Madera Creek immediately below the Ross Creek confluence relative to the without-Project conditions.

Table 7 Ecosystem Restoration Project Performance Measures

Project Goal	• Improve aquatic habitat conditions below the dam in Ross Creek and lower Corte Madera Creek by cooling water temperatures in these creeks during the dry season
Bay Area IRWMP Goals and Objectives Met by Project (Refer to the Table in Section 1.10 of Attachment 3, Work Plan)	• A10; B2; B5; C3; D3; F2; F3; F4; F5; F6; F7; F9
Desired Outcomes	• Reduce water temperature in Ross Creek below Phoenix Lake dam • Reduce water temperature in the lower Corte Madera Creek below the Ross Creek confluence
Output Indicators (Measures)	• Water temperature in Ross Creek immediately below Phoenix Lake dam • Water temperature in Corte Madera Creek immediately below the Ross Creek confluence
Outcome Indicators (Measures)	• Reduced water temperature in Ross Creek immediately below Phoenix Lake dam relative to the without-Project conditions (which would be the difference in observed water temperature between the surface layer and the hypolimnion of the lake). • Reduced water temperature in Corte Madera Creek immediately below the Ross Creek confluence relative to the without-Project conditions
Measurement Tools and Methods	• Water temperature mixing analysis will be used to determine the reduced water temperature in Corte Madera Creek immediately below the Ross Creek confluence relative to the without-Project conditions
Targets	• Water temperature in Ross Creek below Phoenix Lake dam below 17°C

5.3 Monitoring System

The monitoring system for the Ecosystem Restoration Project is shown in Figure 1 and Table 8 is a summary of the monitoring plan. The monitoring includes continuous water temperature monitoring at four locations along Ross Creek and two locations in Corte Madera Creek, one above the Ross Creek confluence and another below the confluence. The monitoring also includes monthly dissolved oxygen sampling at two locations in Ross Creek; one is immediately below Phoenix Lake dam and another is about 1,500 ft below the dam. The monitoring also includes continuous stream flow measurement at two locations in Ross Creek; one is immediately below Phoenix Lake dam and another at the mouth of Ross Creek. Flow measurement in Ross Creek will be used to estimate accretion flow along the reach, and the flow measurement in the two major tributaries of

Phoenix Lake will be used to guide the precise release of water from the low-level drain intake control gate.

Table 8 Summary of Monitoring Plan for the Ecosystem Restoration Project

	Description
What	• Water temperature • Water quality (dissolved oxygen) • Hydrology (stream flow)
Why	• Provide data to evaluate project performance • Provide lake inflow data to guide the precise release of water from the low-level control gate
When	• Continuous monitoring of water temperature for the period of April through October: o *Pre-construction* o *Post-construction* • Monthly sampling of dissolved oxygen in the months of April through October: o *Pre-construction* o *Post-construction* • Continuous stream flow for the period of April through October: o *Pre-construction* o *Post-construction*
Where	• Four water temperature locations along Ross Creek and two water temperature locations in Corte Madera Creek with one above the Ross Creek confluence and another below the confluence • Two dissolved oxygen locations in Ross Creek; one immediately below Phoenix lake dam and another 1,500 ft below the dam • Two stream flow locations in Ross; one immediately below Phoenix Lake dam and another at the mouth of Ross Creek • The same two stream flow locations as the Flood Damage Reduction Project to measure lake inflows in the dry season
Who	• FZ9

5.4 Data Analysis, Evaluation, and Reporting

Data analysis and evaluation will be done by FZ9. Reporting will be done annually. The annual report will contain the following elements:

- Introduction (Background and Objectives)
- Project operations
- Monitoring results of Phoenix Lake inflows and Ross Creek accretion flows in the dry season
- Monitoring results of stream water temperature and dissolved oxygen
- Evaluation of project performance

6.0 Recreation and Public Access Project

6.1 Project Goals and Objectives

The goal of the Recreation and Public Access Project is to improve public access and recreational opportunities, while at the same time lessen user impacts on the natural environment and improving watershed function. The following four key project components will be completed to achieve the goal:

- Replace the non-functioning stream crossing on Bill Williams Creek with a multi-plate arch culvert to reduce erosion, improve access, and provide fish passage;
- Improve trail conditions around Phoenix Lake to reduce erosion and sediment delivery, and to improve access and visitor safety;
- Upgrade visitor facilities, such as bathrooms, benches, and informational kiosks around Phoenix Lake to enhance the user experience, provide public education, and lessen user impacts to the surrounding environment;
- Construct road-related sediment reduction projects to reduce erosion and sediment impacts to Phoenix Lake and its tributaries by storm proofing watershed maintenance and emergency access roads.

6.2 Performance Measures

Table 9 is a summary of performance measures that will be used to quantify and verify project performance with respect to the project goal and objective identified for the Recreation and Public Access Project. Table 9 (and the following sentences) also summarizes how monitoring data and measures will be used to evaluate project performance in meeting the overall goals and objectives of the Bay Area IRWMP.

The desired outcome of the Recreation and Public Access Project is to accommodate visitors, increase visitor satisfaction, and reduce environmental impacts from erosion and sedimentation. Increased number of visitors, increased satisfaction of visitors, and reduced road and trail-related erosion relative to pre-construction conditions are selected as outcome indicators. Field surveys on the number of visitors and their satisfaction will be conducted on holidays and/or weekends to evaluate project performance. Pre- and post-construction photo documentation, and qualitative surveys of road and trail conditions, will be used to measure performance of environmental impact reductions.

Table 9 Recreation and Public Access Project Performance Measures

Project Goal	• Improve public access and recreational opportunities, while at the same time lessening user impacts on the natural environment and improving watershed function
Bay Area IRWMP Goals and Objectives Met by Project (Refer to the Table in Section 1.10 of Attachment 3, Work Plan)	• A6; A8; C1; C2; C3; D1; D6; D7; D10
Desired Outcomes	• Accommodate visitors • Increase satisfaction of visitors • Reduce environmental impacts from erosion and sedimentation
Output Indicators (Measures)	• Number of visitors • Amount of erosion and sedimentation
Outcome Indicators (Measures)	• Increased number of visitors relative to pre-construction conditions • Increased satisfaction of visitors relative to pre-construction conditions • Decreased amount of erosion and sediment generated from roads and trails
Measurement Tools and Methods	• Field survey on the number of visitors and their satisfaction on holidays and/or weekends • Pre/Post-construction photo documentation • Qualitative erosion and sediment surveys
Targets	• Increased number of visitors • Increased satisfaction of visitors • Reduction in environmental impacts from road and trail erosion

6.3 Monitoring System

Table 10 is a summary of the monitoring plan. The plan includes field surveys that will be conducted on holidays and/or weekends with regard to the number of visitors and their satisfaction, photo documentation of erosion repair sites, qualitative surveys of road and trail conditions, and qualitative surveys of sediment accumulation in streams adjacent to erosion sites.

Table 10 Summary of Monitoring Plan for the Recreation and Public Access Project

	Description
What	• Number of visitors • Satisfaction of visitors • Amount of erosion
Why	• Provide data to evaluate project performance
When	• Field survey of visitors on holidays and/or weekends: o *Pre-construction* o *Post-construction* • Photo documentation of erosion repair sites o *Pre-construction* o *Post-construction* • Qualitative surveys of road and trail conditions o *Pre-construction* o *Post-construction* • Qualitative surveys of sediment accumulation in streams adjacent to erosion sites o *Pre-construction* o *Post-construction*
Where	• Field survey
Who	• MMWD

6.4 Data Analysis, Evaluation, and Reporting

Data analysis and evaluation will be done by MMWD. Reporting will be done every two years. The two-year report will contain the following elements:

- Introduction (Background and Objectives)
- Field survey of visitors
- Photo documentation of erosion repair sites
- Qualitative survey of road and trail conditions
- Qualitative survey of sediment accumulation in streams adjacent to erosion repair sites
- Evaluation of project performance