Special Status Species

Effects on special status plant species (see **Tables 3-12** and **3-13**) are unlikely to occur because they are not expected to be present along canal banks. Some potential negative effects could occur to special status raptors if they are nesting near work areas that may be disturbed by noise. Special status raptors potentially occurring in the study area include Swainson's hawk, Cooper's hawk (*Accipiter cooperi*), Northern Goshawk (*Accipiter gentiles*), White-tailed Kite, and Northern Harrier. As mentioned above, the nesting period for raptors is generally March 1 to August 15.

Because hydrology and water quality conditions in study area streams supporting salmonids are not altered, Central Valley steelhead and fall-run Chinook salmon are not affected by seasonal customer delivery schedule changes.

5.1.3 Seasonal Flood Management Practices

PCWA's use of selected outlet locations along canals to release stormwater during precipitation events with high canal flows for flood management has the potential to affect natural resource conditions in the study area. The following sections describe potential effects of PCWA's flood management practices on natural resources in the study area.

5.1.3.1 Physical Resources

Potential effects on hydrology, water quality, and soils and sediment quality conditions in the study area are described in the below sections.

Hydrology

PCWA's use of select canal outlets for stormwater releases during precipitation events likely results in temporary increases in streamflow in many unnamed drainages within the study area. Flow conditions in study area streams, however, are not expected to be affected by stormwater releases from PCWA's canal system due to the effects of other runoff contributions to streamflow within the watersheds of study area streams. Hydrologic conditions in study area streams during PCWA flood management activities are likely similar to conditions generally exhibited across study area streams during periods of high precipitation runoff.

Water Quality

As described previously, the tributaries and streams in the PCWA raw water distribution area are naturally prone to flooding. High flows during storm events can cause excessive erosion and may carry debris, such as tree branches and trash, into canals and streams. PCWA's flood management practices during these events likely have minimal effects on water quality conditions in study area streams. Additional flow releases from canal outlets may result in a short-term increase in erosion downstream from canal outlets in areas with soils of high erodibility and little riparian vegetation. The increased flows in many unnamed drainages within the study area may result in bank erosion near the canal outlet releases, and potential sediment loading to receiving waters. The potential for bank erosion near the canal outlets may result in increased sediment transport downstream, increased TSS and turbidity, and increased loading of

constituents associated with soils at eroded banks. Water quality conditions in study area streams during PCWA's flood management activities are likely similar to conditions generally observed during periods of high precipitation runoff.

Soils and Sediment Quality

PCWA flood management practices likely have minimal effects on soils and sediment quality in the study area. Unregulated releases from canal outlets during periods of high canal flows would reduce the effects of bank erosion along unlined canals, and the increased flows in unnamed drainages downstream from canal outlets may result in bank erosion near the canal outlet releases, and potential sediment loading to receiving waters.

5.1.3.2 Biological Resources

The following sections describe potential effects of PCWA's flood management practices on terrestrial and aquatic habitat and species, and special-status species.

Terrestrial Habitat and Species

Direct effects to terrestrial habitats and species are not expected. Stormwater releases would reduce the effects of bank erosion along canals and would therefore lessen potential negative impacts resulting from flood flows. The increased flows in many unnamed drainages within the study area may result in bank erosion near the canal outlet releases, and potential sediment loading to receiving waters. This would have the potential to wash away amphibian eggs, if present in the outlet areas, or bury wetland or riparian vegetation. These effects are expected to be minimal due to the limited area affected and similar to conditions generally exhibited across study area streams during periods of high precipitation runoff.

Aquatic Habitat and Species

PCWA's seasonal flood management practices are not likely to affect aquatic habitat and species in the study area. High flows within the PCWA canal system that occur as a result of precipitation runoff are indicative of high flows in study area streams.

Special Status Species

Direct effects to special status species are not expected to result from PCWA flood management practices. Stormwater releases from the canal system would reduce the effects of bank erosion along canals and would therefore lessen potential negative impacts resulting from flood flows. The increased flows in many unnamed drainages within the study area may result in bank erosion near the canal outlet releases, and potential sediment loading to receiving waters. This would have the potential to wash away special status amphibian eggs, if present in the drainages downstream from canal outlets, or bury any special status plant species that may be present. California red-legged frog breeding occurs between late November and March, though most frogs lay eggs in March (USFWS 2002, Stebbins 2003). The foothill yellow-legged frog breeds mid-March through early June, and the western spadefoot toad breeds in late January through July (Stebbins 2003). Special status species are not known to occur in the area of the canal

outlets, and these potential effects are expected to similar to conditions generally exhibited across study area streams during periods of high precipitation runoff.

Steelhead and fall-run Chinook salmon are not likely affected by PCWA flood management practices. As described above, high flows in study area streams are more likely to affect aquatic habitat and species compared to PCWA operations during precipitation events.

5.1.4 Routine Operations

The following sections describe potential effects of PCWA's routine canal system operations on physical and biological resources in the study area.

5.1.4.1 Physical Resources

Potential effects on hydrology, water quality, and soils and sediment quality conditions in the study area are described in the below sections.

Hydrology

PCWA's routine raw water distribution system operations affect hydrologic conditions in Canyon Creek during summer and fall through direct diversions from the stream; however, these effects are negligible in comparison to effects of PG&E hydroelectric operations. During winter and spring, PCWA's routine operations are not likely to affect Canyon Creek hydrology due to potentially high streamflows associated with snowmelt and runoff in the watershed.

PCWA's water diversions to Auburn Ravine during the irrigation season have a positive effect on hydrologic conditions within portions of Auburn Ravine upstream from diversions to Zone 5 customers during late summer and early fall when natural flows in Auburn Ravine are low (Reclamation and PCWA 2002). As described in **Chapter 3**, natural flows in Auburn Ravine decline to very low levels during spring months, with no natural flow during summer months (Reclamation and PCWA 2002, City of Lincoln 1999). PCWA contributions to streamflow in Auburn Ravine during the irrigation season, however, are a fairly small fraction of the flow augmentation in Auburn Ravine during the dry season that occurs through other irrigation conveyance and return flow, hydroelectric generation releases, and treated effluent discharges. Routine PCWA operations do not affect hydrologic conditions in Auburn Ravine outside of the irrigation season.

Based on water balance results for the PCWA canal system and streams from the East Loomis Basin Canal Efficiency Study, routine canal system operations contribute to flows in Secret and Miners ravines year-round (USACE and PCWA 2008). The PCWA canal system provides direct contributions to flows within study area streams through regulated releases to streams used for conveyance and unregulated releases from canal outlets, and indirect contributions through customer return flows. These flow contributions have a positive effect on hydrologic conditions in study area streams.

Water Quality

PCWA's routine raw water distribution system operations likely have minimal effects on water quality conditions in Canyon Creek during summer and fall, such as water temperature, as a result of direct diversions from the stream. However, these effects are negligible in comparison to effects of PG&E hydroelectric operations on water quality. During winter and spring, PCWA's routine operations are not likely to affect water quality in Canyon Creek due to potentially dominating effect of high streamflows associated with snowmelt and runoff in the watershed.

Water quality conditions in Auburn Ravine are likely improved through PCWA's water diversions to Auburn Ravine during the irrigation season. As described in **Chapter 3**, water quality conditions measured at Auburn Ravine below the Auburn Ravine Tunnel outlet were generally better during spring and summer compared to fall and winter sampling events, exhibiting lower concentrations for many constituents in samples collected.

Based on water quality results obtained from canal and stream sites within the Clover Valley Creek, Antelope Creek, Secret Ravine, and Miners Ravine watersheds during baseline sampling events, water temperatures at canal sites were lower than stream sites during late spring and late summer. Water temperatures observed at canal and stream sites during winter and late fall were variable, but remained below 50 °F. DO concentrations measured at canal and stream sites inversely followed water temperature trends described above, exhibiting higher DO concentrations at canal sites during late spring and late summer.

TSS was very low, often below detection limits, and turbidity values were variable across all canal and stream sites monitored in the Clover Valley Creek, Antelope Creek, Secret Ravine, and Miners Ravine watersheds during baseline sampling events. These data suggest that PCWA routine operations do not affect TSS or turbidity in Clover Valley Creek, Antelope Creek, Secret Ravine, or Miners Ravine. Measured pH values were variable across canal and streams sites, while alkalinity and hardness were lower in canal sites compared to stream sites.

SC, ion, and trace element concentrations in samples obtained during baseline sampling events were also consistently lower at canal sites compared to stream sites. These lower constituent concentrations for ions and trace elements suggest that PCWA routine operations potentially provide a water quality benefit to Clover Valley Creek, Antelope Creek, Secret Ravine, and Miners Ravine through flow contributions to streamflow.

Figures providing a comparison of water quality conditions within the PCWA raw water distribution system and Clover Valley Creek, Antelope Creek, Secret Ravine, and Miners Ravine are included in **Appendix B**.

Soils and Sediment Quality

Soils and sediment quality in the study area are not likely to be affected by PCWA's routine operations. PCWA's routine operations do not disturb soils in the study area, or introduce constituents that may affect sediment quality.

5.1.4.2 Biological Resources

Studies conducted through the East Loomis Basin Canal Efficiency Study (USACE and PCWA 2008) suggest that the condition of existing aquatic and terrestrial resources in the study area are dependent on the canal system. While canal operations (including unregulated releases and customer return flows) contribute to flows in Secret Ravine and Miners Ravine, and their tributaries year-round, the canal system contributions dominate dry season flows.

Terrestrial Habitat and Species

Habitat would not be expected to be adversely affected by changes in flow. Some benefits may be experienced by amphibians and wetland/riparian vegetation from improvements in water quality. Some minor damage could be caused to habitats by placement of debris and soil near canals.

Aquatic Habitat and Species

Routine PCWA operations are not likely to affect aquatic habitat and species in Canyon Creek. Flow augmentation in Auburn Ravine by PCWA during spring and summer increases streamflows and supports greater habitat diversity, increased quantity and quality of habitats, and lower summer water temperatures that would be found under natural conditions (Reclamation and PCWA 2002, City of Lincoln 1999). Therefore, current water management practices in Auburn Ravine, including routine PCWA operations, enhance aquatic habitat conditions and potential anadromous salmonid production in Auburn Ravine (Reclamation and PCWA 2002, City of Lincoln 1999).

As described above, routine PCWA canal system operations contribute to flows in Clover Valley Creek, Antelope Creek, Secret Ravine, and Miners Ravine year-round. The PCWA canal system provides direct contributions to flows within these streams through unregulated releases from canal outlets, and indirect contributions through customer return flows, especially during the dry season. These flow contributions have a positive effect on aquatic habitat and species conditions in Clover Valley Creek, Antelope Creek, Secret Ravine, and Miners Ravine.

Special Status Species

Habitat would not be expected to be adversely affected by changes in flow. Some benefits may be experienced by special status amphibians and vegetation from improvements in water quality. Some minor damage could be caused to special status species plants, if present, by placement of debris and soil near canals.

Routine PCWA operations within the Auburn Ravine watershed are beneficial for Chinook salmon and steelhead (Reclamation and PCWA 2002). Increased flows in Auburn Ravine as a result of PCWA's streamflow augmentation (up to 50 cfs), especially during late summer and early fall, support more consistent habitat conditions to rearing steelhead.

As described above, hydrologic and water quality conditions in Clover Valley Creek, Antelope Creek, Secret Ravine, and Miners Ravine are generally improved through routine PCWA operations. Populations of fall-run Chinook salmon and Central Valley steelhead in Secret and

Miners ravines likely benefit from consistent contributions to streamflow from the PCWA canal system during routine operations.

The infrequent presence of special status fish in Clover Valley Creek and Antelope Creek, is likely affected by PCWA routine operations.

5.2 REGULATORY FRAMEWORK FOR POTENTIAL EFFECTS OF SYSTEMWIDE OPERATIONS

The following sections provide the regulatory framework for the potential effects of PCWA operations activities described above. The regulatory framework discussion is organized by Federal, State, and local regulations, and is summarized in **Table 5-3**.

5.2.1 Federal Regulations

Federal laws and regulations associated with the potential effects of PCWA operations activities are described below.

5.2.1.1 Clean Water Act

PCWA activities during yearly PG&E outages were found to have minimal effects on water quality conditions in study area streams. In particular, turbidity and copper levels temporarily increased at canal and stream sites after flows were restored to the canal system following reservoir outages. These increases may indicate the transport of fine sediments and potential mobilization of constituents bound to sediments, such as copper, into receiving waters of the U.S. In general, PCWA activities during yearly PG&E outages are subject to the provisions under the CWA, but they are not required to be permitted. Sections 101(a)(2) and 303(c) of the CWA state the national goal of working with states to establish water quality goals that provide for the protection of beneficial uses, such as the propagation of fish, shellfish, and wildlife and for recreation in and on the water, and agricultural, industrial, and other purposes including navigation. These water quality goals are explained further in **Chapter 4** under the Porter-Cologne Water Quality Control Act.

Seasonal PCWA delivery schedule changes potentially have minimal to no water quality effects, and would not likely result in water quality effects at canal outlets. Minimal effects are associated with the potential for sediment and/or debris to enter the canals from canal banks if PCWA personnel disturb soil along canal banks when entering them to switch out orifice plates. If this occurs, TSS and turbidity levels could temporarily increase. However, it is unlikely that these levels could exceed water quality standards promulgated in the CWA and identified in the Porter-Cologne Water Quality Control Act.

PCWA flood management practices may cause minimal effects on the water quality of receiving water tributaries and streams. Stormwater releases from intermediate canal outlets reduce the effects of bank erosion along canals and lessen potential negative effects along unlined canals resulting from flood flows. However, the canal releases and increased flows to unnamed drainages within the study area may result in bank erosion below the canal outlets, and potential sediment loading to receiving waters, and increased TSS and turbidity in study area streams.

Despite these minimal effects, these flood management practices are in compliance with State and Federal flood management requirements and it is unlikely that the effects would be considered an infringement of CWA regulations.

Routine/Daily PCWA operations may have minimal water quality effects. Water quality conditions in canals during routine/daily operations were observed to be generally better than stream water quality conditions. For example, water temperatures measured were lower and DO levels were higher at canal sites compared to stream sites during late spring and late summer. TSS, turbidity, SC, ion, and trace element levels measured were also generally lower year-round at canal sites compared to stream sites. Because these are overall positive potential effects, CWA is not likely to apply to PCWA's routine/daily operations.

TABLE 5-3
SUMMARY OF REGULATORY FRAMEWORK AND POTENTIAL BEST MANAGEMENT PRACTICES THAT MAY APPLY TO PCWA OPERATIONS ACTIVITIES

PCWA Operations Activity				Effect	Natural Resource Areas Potentially Affected										Relevant Regulations									Best Management Practices (BMP)	Type of BMP		
					Physical			Biological							Federal				State				Local				
								Terrestrial Habitat and Species			Aquatic Habitat and Species	Special Status															
Yearly Outages	Delivery Schedule Change	Flood Management	Routine Operations		Hydrology	Water Quality	Soils and Sediment Quality	Wetlands	Nesting birds	Other		Salmonids	Amphibians	Raptors	Plants	Clean Water Act	Endangered Species Act	Magnuson-Stevens and Sustainable Fisheries Act	Migratory Bird Treaty Act	Porter Cologne	California Endangered Species Act	Fully Protected Species	Native Plant Protection Act	Placer County Conservation Plan		Pre-Implementation	Implementation	Ongoing/Post-Implementation
✓		✓		Bank erosion along unlined canals and at canal outlets and sediment loading to receiving waters		✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓		✓	**Improve Canal Bank Stability and Install Sediment Traps in Areas of Soil Disturbance**	✓		
																									Install Erosion-Control Blankets			
																									Install Temporary Fiber Rolls			
																									Apply Spray-On Soil Binders			
																									Install Velocity Dissipaters at Canal Outlets			
																									Line Banks below Canal Outlets			
		✓			✓	✓	✓	✓			✓	✓	✓			✓	✓				✓	✓	✓			**Avoid Potential Wet Weather Effects**			
																									Patrol Canals and Remove Potential Obstructions to Prevent Erosion and Property Damage			
																									Minimize Water Purchases from PG&E Before and During High Precipitation Events			
																									Distribute Flood Releases from Canal System by Releasing Flows at Numerous Intermediate Outlets			
	✓		✓	Disturbance or damage to sensitive species and habitat potentially present in the area.				✓	✓	✓	✓		✓	✓	✓		✓				✓	✓	✓	✓	✓	**Protect Sensitive Species and Sensitive Species Habitat**			
																									Provide Staff with Species Identification Training	✓		
																									Evaluate Sites with Sensitive Species and Mark/Protect Sensitive Species Habitat			
		✓					✓	✓	✓	✓	✓	✓	✓	✓	✓		✓				✓	✓	✓	✓	✓	**Avoid Species-Sensitive Areas**		✓	
																									Avoid Disturbance to Sensitive Species			
✓				Constituent loading to receiving waters from O&M activities		✓		✓			✓	✓	✓			✓	✓	✓		✓	✓	✓		✓	**Prevent Degraded Water from Entering Streams**			
																									Modify Reservoir Operations to Gradually Restore Reservoir Releases to Canals at Slower Rate		✓	
✓	✓	✓	✓	All potential effects	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	**Implement PCWA BMP Program**			✓

5.2.1.2 Endangered Species Act

PCWA operations during annual PG&E outages potentially have minimal effects on special status species. PCWA's rotating outages at Clover Valley and Mammoth reservoirs, and resultant canal dewatering below the reservoirs, may result in minimal effects on special status terrestrial species, including slight decreases in the extent of wetland habitats for special status species. For special status aquatic species, canal dewatering during outages and resultant decreased canal system contributions to streamflow in Clover Valley Creek, Antelope Creek, Secret Ravine, and Miners Ravine may affect Central Valley steelhead and/or critical habitat for Central Valley steelhead. The Federal ESA, regulated by USFWS and NMFS, habitat modification or degradation could be considered a "take" of federally listed species. In which case, an incidental take permit, under Section 10 of the Federal ESA, or a Federal interagency consultation, under Section 7 of the Federal ESA, is required.

Seasonal PCWA customer delivery schedule changes are not likely to affect special status species. Special status plants, if present, may be trampled while PCWA personnel access delivery points, and special status raptors, if present, may be affected by PCWA access to canals. Because these effects are likely minimal and easily avoidable if special status species are present, it is unlikely that Federal ESA permits would be required.

PCWA flood management practices potentially have minimal effects on terrestrial special status species. High-flow releases from canal outlets could wash away amphibian eggs downstream from the outlets, if present, and sediment loading to receiving waters may bury wetland or riparian vegetation. Central Valley steelhead are not likely affected by PCWA flood management practices. High streamflows during precipitation events are more likely to affect aquatic habitat and species than PCWA operations. Because these effects are minimal, and easily avoidable, it is unlikely that Federal ESA permits would be required.

Routine/Daily PCWA operations likely have positive effects on special status species within the PCWA raw water distribution area. Contributions from the PCWA raw water distribution system typically augment streamflows in Auburn Ravine, Clover Valley Creek, Antelope Creek, Secret Ravine, and Miners Ravine, which benefits Central Valley steelhead. These streamflow contributions are particularly evident during summer months, and provide more consistent habitat conditions to rearing Central Valley steelhead. Some benefits to amphibians and wetland/riparian vegetation may also be realized through improvements to water quality as a result of canal system contributions to streamflow. Because the potential negative effects of daily routine operations are negligible and easily avoidable, it is unlikely that Federal ESA permits would be required.

5.2.1.3 Magnuson-Stevens Fishery Conservation and Management Act and the 1996 Sustainable Fisheries Act

PCWA operations during yearly PG&E outages have minimal effects on suitable habitat considered essential for the sustenance of commercial fisheries. Historic decreases in streamflow associated with canal dewatering during outages likely contribute to the delayed spawning

migration of fall-run Chinook salmon observed in the Dry Creek watershed, or may cause redd dewatering. Although the concept of EFH is similar to that of "Critical Habitat" under the Federal ESA, measures recommended to protect EFH by NMFS are advisory, not prescriptive.

5.2.1.4 Migratory Bird Treaty Act

PCWA operations during annual PG&E outages potentially have minimal effects on migratory bird species. Canal dewatering may cause slight decreases in the extent of wetland habitats and affect the species that use wetland habitats, such as foraging birds. However, it is unlikely that these effects would constitute a "take" of a migratory bird species or habitat (as defined by the MBTA) and therefore would not be subject to the MBTA.

5.2.2 State Regulations

Laws and regulations governed by the State of California and associated with the potential effects of PCWA operations activities are described below.

5.2.2.1 Porter-Cologne Water Quality Control Act

The regulatory framework for water quality effects resulting from PCWA operations during yearly PG&E outages, seasonal delivery schedule changes, flood management practices, and routine/daily operations, are similar to those described previously under the CWA.

Of the Criteria for Priority Toxic Pollutants in California, cadmium, copper, and zinc were three criteria parameters monitored for during PCWA outage activities. Neither cadmium nor zinc criteria were exceeded. The freshwater CCC for copper (9 µg/L) was exceeded at sites monitored during the PG&E yearly outages (November 2, 2006) within the Antelope Creek, Secret Ravine, and Miners Ravine watersheds, but the exceedances are likely associated with heavy rain and runoff contributions to flow at sites during sampling.

Of the water quality objectives associated with beneficial uses of the Sacramento River in the Sacramento-San Joaquin Basin Plan, barium, copper, iron, zinc, DO, pH, and turbidity were monitored during PCWA outage activities. The water quality objective for copper (based on specific levels of hardness calculated from measured calcium and magnesium levels) was exceeded at the Antelope Creek monitoring site on November 2, 2006 (10 µg/L for an objective of 9.3 µg/L based on the associated hardness of 70 mg/L), but the exceedance is likely associated with heavy rain and runoff contributions to flow at the site during sampling.

5.2.2.2 California Endangered Species Act

Under the California ESA, the effects on special status species from PCWA operations during PG&E yearly outages, seasonal delivery schedule changes, flood management practices, and routine/daily operations, are similar to those described previously under the Federal ESA. However, the California ESA addresses the incidental take of State-listed species as threatened or endangered. DFG is the enforcement agency of the California ESA.

5.2.2.3 California Fish and Game Code-Fully Protected Species

Under the Fish and Game Code-Fully Protected Species, the effects on special status species from PCWA operations of annual PG&E outages, seasonal delivery schedule changes, flood management practices, and routine/daily operations, are similar to those described previously under the Federal ESA. However, this code addresses the incidental take of fully protected species. DFG is unable to authorize incidental take of fully protected species, such as White-tailed Kite and the California Black Rail, when activities are proposed in areas inhabited by those species. Therefore, the take of any fully protected species for project implementation is prohibited.

5.2.2.4 California Native Plant Protection Act

This act applies to endangered and "rare" plant species, subspecies, and varieties of wild native plants in California. Annual PG&E outages, seasonal delivery schedule changes, and routine/daily operations may have minimal effects on endangered and "rare" plant species in the PCWA raw water distribution area if vegetation is damaged during fieldwork. However, these effects are easily avoidable through effective BMP implementation. Routine/daily operations are likely to benefit wetland/riparian vegetation from improvements in water quality and increased flows.

5.2.3 Local Requirements and Considerations

The following sections describe the framework for local requirements during PCWA maintenance activities.

5.2.3.1 Placer County Conservation Plan

As described in **Chapter 4**, the PCCP includes plans with goals to protect fish and wildlife and their habitat and protect streams, wetlands, and other water resources, as well as coverage under several environmental permits to be issued to Participating Entities. With PCCP long-term environmental permits, such as ESA and NCCP incidental take, Section 404, a renewable Section 401 certification, "Joint Procedures" approved by the USACE may be used by the Participating Entities for aquatic resource permit processing under the CWA, and a programmatic master streambed alteration agreement, PCWA will be covered for activity projects that require it.

The regulatory framework for PCWA operations activities related to the PCCP are the same as those described for CWA, ESA, Porter-Cologne Water Quality Control Act, California ESA, and California Fish and Game codes.

5.3 BEST MANAGEMENT PRACTICE OPTIONS TO ADDRESS POTENTIAL EFFECTS OF SYSTEMWIDE OPERATIONS ACTIVITIES

BMPs are measures designed to reduce or prevent potential effects of a particular activity on the surrounding environment. The term originated from rules and regulations in Section 208 of the CWA. The "best" practice is cost effective and site specific. BMPs can be both structural and nonstructural. Structural BMPs include facilities constructed to prevent or minimize effects, and nonstructural BMPs include changes in activities or operation management, such as scheduling around periods when potential effects are greatest, and often focus more on controlling pollutants at the source.

BMPs to address potential effects of PCWA operations can be applied during three different stages: (1) pre-implementation, (2) during implementation, and (3) ongoing or post-implementation. Some BMPs can be implemented during more than one stage. The list of BMP options is not comprehensive; instead, it provides examples of BMPs that may be implemented to minimize particular potential effects of PCWA canal operations activities. As part of these BMP recommendations, BMP monitoring and evaluation are recommended for determining BMP effectiveness. Potential BMPs to reduce potential effects of PCWA operations activities on natural resources are summarized in **Table 5-3**, and described below.

5.3.1 Pre-Implementation Best Management Practices

Pre-implementation BMPs are those that are applied in preparation for the activity because they may take more time to develop before they become effective or because they involve complex setup procedures. Below are potential pre-implementation BMPs for reducing potential effects of PCWA operations activities on natural resources in the study area.

5.3.1.1 Improve Canal Bank Stability and Install Sediment Control Measures at Canal Outlets

Canal bank erosion along unlined canals, which may occur after canal flows are restored following dewatering activities (such as PCWA operations during yearly PG&E outages) and by PCWA flood management practices, may be minimized through implementation of BMPs to improve canal bank stability. PCWA is already implementing BMPs to provide canal bank stability by lining canals with gunite. Stabilizing vulnerable or disturbed areas along unlined canal banks can decrease erosion and associated sediment transport and deposition. Areas vulnerable to erosion may be those with steep slopes, little to no vegetation, and loose soil. Areas along canal banks that have been disturbed by previous canal activities, recreation along canals, or storm events, are particularly vulnerable to erosion. Additionally, sediment-control measures may be installed at canal outlets, where possible, to reduce sediment and associated constituents, and loading to receiving waters during PCWA operations activities. Maintaining site stabilization should be implemented year-round by keeping wet season sediment-trapping devices available and operational. The following sections describe potential BMPs to improve canal bank stability and reduce sediment loading to receiving waters.

Install Velocity Dissipaters at Canal Outlets

Velocity dissipaters are strategically placed rock along the flow line in a stream or at a canal outlet to dissipate energy and slow the flow of water released at canal outlets, thereby reducing the potential for erosion and sediment loading downstream. Rocks are often set in mortar in a way that is designed to interrupt water passage and spread concentrated flows over and through protruding rock. For example, rocks could be set in a step pool formation based on natural channel design concepts. Dissipators can be underlain with geotextile fabric to reduce the potential for eroding the underlying soil. Other types of dissipaters include solid concrete structures, riprap, baffles, pipe junctions, and drop boxes.

Line Banks below Canal Outlets

Through lining banks below canal outlets with gunite, where possible, bank stability is improved and the potential for erosion is decreased. Although lining is also addressed in this manual as an O&M activity, it is also considered a BMP as it is applied to areas along the canal system that have been disturbed by previous canal activities, recreation along canals, or storm events, are particularly vulnerable to erosion. PCWA is already implementing this type of BMP, where possible.

5.3.1.2 Avoid Potential Wet Weather Effects

Avoidance of potential adverse effects of PCWA operations activities during wet weather, when and where feasible, can be very effective. Avoided adverse effects may include canal bank erosion and sediment loading into receiving streams during wet weather events. Examples of BMP options are as follows:

Patrol Canals and Remove Potential Obstructions to Prevent Erosion and Property Damage

Large debris that gets into the canals, such as fallen tree limbs, may obstruct water flow within the canal system and may lead to canal bank erosion and/or property damage if not removed. Through implementing this BMP, PCWA staff would periodically patrol the canal system before the wet season and after heavy storm events and remove potential obstructions in a timely manner. PCWA is already implementing this type of BMP.

Minimize Amount of Water Purchased from PG&E During Periods of High Precipitation

Before and during precipitation events likely to cause in substantial precipitation runoff, PCWA may reduce water purchases from PG&E to increase canal capacity for conveyance of precipitation runoff. Through reducing the flow conveyed by PCWA's canal system during precipitation events, PCWA may decrease the potential for canal bank erosion. PCWA is already implementing this type of BMP.

Distribute Flood Releases from Canal System by Releasing Flows at Numerous Intermediate Outlets

During precipitation events when flows and water levels in the canals are high, water can be released from several intermediate canal outlets to dissipate flows throughout the system at lower

flow rates and reduce the potential for downstream erosion and sedimentation. PCWA is already implementing this type of BMP, where possible.

5.3.1.3 Protect Sensitive Species and Sensitive Species Habitat

Taking steps to ensure the protection of sensitive species and sensitive species habitat before an activity occurs involves both structural and nonstructural solutions.

Provide Staff with Species Identification Training

As a nonstructural solution to protecting sensitive species habitat in the PCWA raw water distribution system, PCWA personnel can be trained to recognize special status habitat and species before O&M activities. With this information, potential effects to species, such as trampling special status vegetation and habitat, and effects on raptor nests from noise disturbance, may be prevented. As part of this training program, PCWA field staff will be provided with an identification table with photos and descriptions to assist in identifying special status species known or expected to occur near work areas. PCWA is already implementing this type of BMP.

Evaluate Sites with Sensitive Species and Mark/Protect Sensitive Species Habitat

If special status species and/or associated habitats are identified, temporary fencing, signs, or colored ribbon may be used to mark the known location of the species or habitat, such as rare plants or trees with active raptor nests, to help prevent disturbance to the habitat or species during operations activities. PCWA is already implementing this type of BMP.

5.3.2 Implementation Best Management Practices

Implementation BMPs are management measures applied while the activity is being implemented. The following sections provide potential implementation BMPS to reduce potential effects of PCWA operations activities on natural resources.

5.3.2.1 Avoid Sensitive Species Areas

During operations activities, PCWA personnel can do several things to prevent potential effects on terrestrial species and disturbance to terrestrial species habitat. Examples of BMP options follow.

Avoid Disturbance to Sensitive Species

To avoid potentially disturbing sensitive species in the vicinity of operations activities, PCWA staff may stay on roads, paths, or other previously disturbed areas whenever possible. This BMP option also involves helping equipment and vehicles confined to roads, paths, or other previously disturbed areas to avoid disturbing sensitive species in the vicinity. PCWA is already implementing this type of BMP, where possible.

5.3.2.2 Prevent Degraded Water from Entering Streams

BMPs may be implemented to prevent or reduce the amount of degraded water from PCWA's canal system from entering streams. Based on results from water quality monitoring, water

quality conditions downstream from O&M activities that involve canal dewatering can exhibit high turbidity, TSS, and concentrations of constituents associated with sediment or other material.

Modify Canal Operations to Gradually Restore Reservoir Releases to Canals at Slower Rate

Modifying PCWA reservoir management practices during PG&E yearly outages can be effective for reducing sediment loading into receiving waters. When possible, water releases from Mammoth and Clover Valley reservoirs to canals following outages during the PG&E yearly outages may be restored at a slow and graduated rate. These graduated reservoir releases may decrease the potential mobilization and transport of settled materials and constituent loading to receiving waters after canal flows are restored.

5.3.3 Ongoing or Post-Implementation Best Management Practices

Ongoing or post-implementation BMPs are typically management and preventative measures. One potential ongoing or post-implementation BMP was identified to minimize potential effects of PCWA operations activities, and is described below.

5.3.3.1 Implement PCWA Best Management Practice Program

An ongoing PCWA BMP program would serve to update and maintain BMPs, as well as track BMP effectiveness. The program would also provide staff training for BMP implementation during PCWA O&M activity implementation.

BMP alternatives are continually being developed and information on BMP effectiveness is continually changing. It is important to stay updated on BMP news so as to provide for the most effective BMP implementation.

BMP maintenance increases the durability and effectiveness of structural BMPs. In fact, unmaintained BMPs can increase potential effects. For example, if an erosion-control blanket is not well-maintained it could become dislodged and be swept down a canal as debris.

Staff BMP implementation training would consist of a BMP training manual and periodic training sessions on effective BMP implementation in the field. Several of the pre-implementation BMPs, such as species identification training, would be part of this program.

5.4 SUGGESTIONS FOR FURTHER STUDIES

Based on results of NRMP studies, PCWA operations may affect natural resources conditions within the study area. Higher concentrations of trace metals, particularly aluminum and copper, were observed at sites monitored within the PCWA canal system compared to stream sites for sampling events associated with PCWA's operations during the PG&E yearly outages. These data may inconclusively suggest that the PCWA canal system is a source for loading of some constituents to study area streams.

Additional routine and event-based water quality monitoring should be conducted at sites within the PCWA canal system, and stream sites upstream and downstream from canal system contributions, to characterize potential effects of PCWA operations activities on water quality conditions. One of the focal points for additional studies should be to evaluate aluminum and copper inputs to study area streams from the PCWA canal system. Potential sites for routine and operations event-based water quality monitoring include:

- Boardman Canal below Mammoth Reservoir
- End of Boardman Canal outlet
- End of Yankee Hill Canal outlet
- Secret Ravine at Loomis Basin Park
- Secret Ravine at Rocklin Road
- Clover Valley Reservoir release to Clover Valley Creek and Antelope Canal

Additionally, sediment quality monitoring at numerous sites exhibiting variable soil conditions along the canal system and study area streams may be help to determine potential sources of trace metals in PCWA canals and study area streams. Soil sampling for representative soil types should be coordinated with routine and operations event-based water quality monitoring. Soil samples should be collected from undisturbed sites of representative soil types, as characterized by PCWA (2005), near and upstream from canal and stream water quality monitoring sites, and within watersheds of Clover Valley Creek, Antelope Creek, Secret Ravine, and Miners Ravine.

CHAPTER 6.0
POTENTIAL EFFECTS, REGULATORY FRAMEWORK, AND BEST MANAGEMENT PRACTICES FOR MAINTENANCE ACTIVITIES

This chapter provides an overview of the potential effects of PCWA raw water distribution system maintenance activities on natural resource conditions in the study area, the regulatory framework for effects, and potential BMPs to reduce effects of the maintenance activities on natural resources.

6.1 POTENTIAL EFFECTS OF MAINTENANCE ACTIVITIES ON NATURAL RESOURCES

Potential effects of scheduled and as-needed, site-specific PCWA raw water distribution system maintenance activities are described below.

6.1.1 Scheduled Maintenance Activities

The following sections address scheduled maintenance activities conducted by PCWA within their raw water distribution system.

6.1.1.1 Canal Cleaning and Flushing

PCWA's canal cleaning and flushing activities have the potential to affect natural resource conditions in the study area. The following sections describe potential effects of canal cleaning and flushing activities on natural resources.

Physical Resources

Potential effects of PCWA canal cleaning and flushing activities on hydrology, water quality, and soils and sediment quality conditions in the study area are described in the following sections.

Hydrology

PCWA operations during canal cleaning and flushing activities do not affect hydrologic conditions in Canyon Creek or Auburn Ravine. During the canal cleaning and flushing, PCWA canal system contributions to streamflow in Canyon Creek and Auburn Ravine, and/or diversions from Canyon Creek and Auburn Ravine, do not change as a result of PCWA operations.

Continuous-flow data collected from canal and stream sites within PCWA's lower Zone 1 service area during WDY 2006 (October 16, 2005, to October 15, 2006) were evaluated to determine effects of canal cleaning and flushing activities on hydrologic conditions in Clover Valley Creek, Antelope Creek, Secret Ravine, and Miners Ravine. Continuous-flow monitoring locations used for maintenance evaluations, and their respective watersheds, are listed in **Table 6-1**.

TABLE 6-1
CONTINUOUS-FLOW MONITORING STATIONS IN ZONE 1 FOR MAINTENANCE

Secret Ravine Watershed	Miners Ravine Watershed
Secret Ravine at Horseshoe Bar Road	Miners Ravine at Lomida Lane
Yankee Hill Canal Outlet	Ferguson Canal Outlet
Turner Canal Outlet	Stallman Canal Outlet
Boardman Canal Outlet	Baughman Canal Outlet
Secret Ravine at Rocklin Road	Miners Ravine near North Sunrise Avenue

Table 6-2 provides PCWA's schedule of canal outages for cleaning and flushing during March 2006. During these outages for canal cleaning and flushing, canal flows were typically interrupted during business hours to dewater canal segments and allow removal of sediment and debris from canals by PCWA staff.

TABLE 6-2
CANALS OUTAGES FOR CLEANING AND FLUSHING DURING 2006

Canal	Time	Dates
Mammoth Reservoir to Boardman Canal Outlet	7:00 a.m. to 11:00 p.m.	March 13, 14, 15, 16, 17, 20, 21, 22, 23, 24
Baughman Canal		
Ferguson Canal		
Stallman Canal		
Yankee Hill Canal		
Turner Canal		
Turner Pump Canal		
Laird Pump Canal		

Average daily flows for canal and stream sites evaluated during WDY 2006 canal cleaning and flushing activities are shown in **Figure 6-1** for sites within the Secret Ravine watershed, and in **Figure 6-2** for sites within the Miners Ravine watershed. As illustrated in **Figures 6-1** and **6-2,** canal system contributions to flow within study area streams through unregulated releases from canal outlets is variable during periods associated with canal cleaning activities.

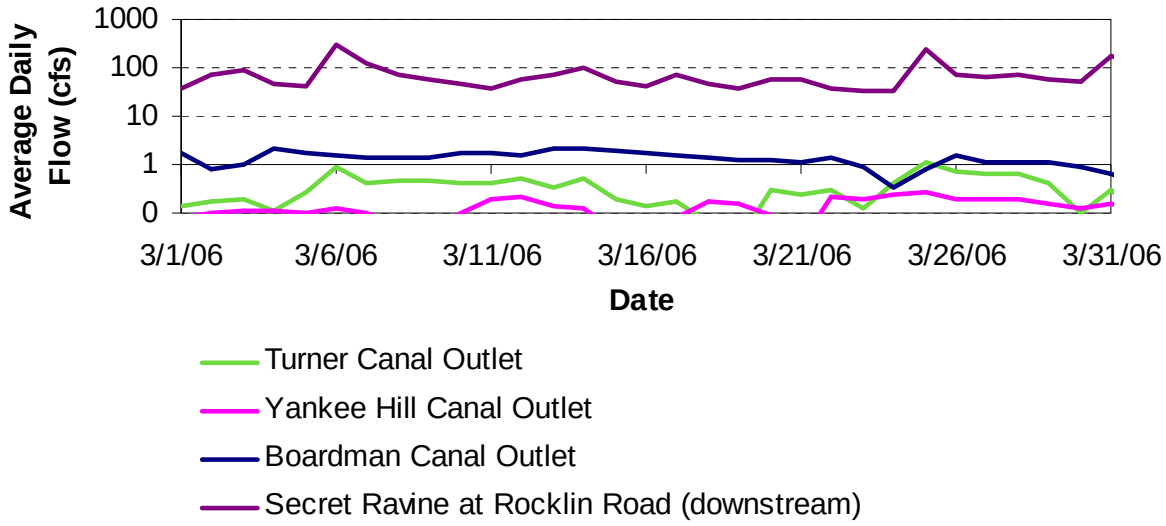

FIGURE 6-1
CANAL OUTLET AND SECRET RAVINE RESPONSES TO CANAL CLEANING AND FLUSHING ACTIVITIES

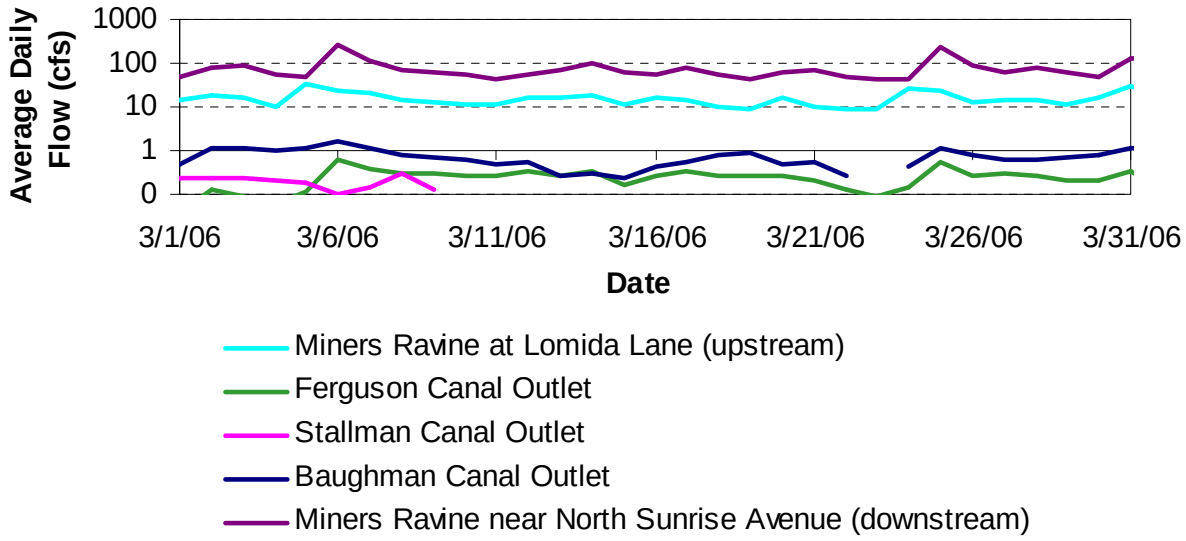

FIGURE 6-2
CANAL OUTLET AND MINERS RAVINE RESPONSES TO CANAL CLEANING AND FLUSHING ACTIVITIES

Based on the average daily flows for sites provided in **Figures 6-1** and **6-2,** the short-duration reduction in flows within the PCWA canal system during canal cleaning and flushing activities is not expected to affect flow conditions in Secret and Miners ravines. Effects on flow conditions in Antelope Creek and Clover Valley Creek are likely similar to conditions shown for Secret and Miners ravines. Precipitation runoff within the watersheds of study area streams is likely to have a much greater influence on stream flow conditions during the time periods that PCWA conducts canal cleaning and flushing activities. Precipitation during March 2006 is shown in **Figure 6-3**.

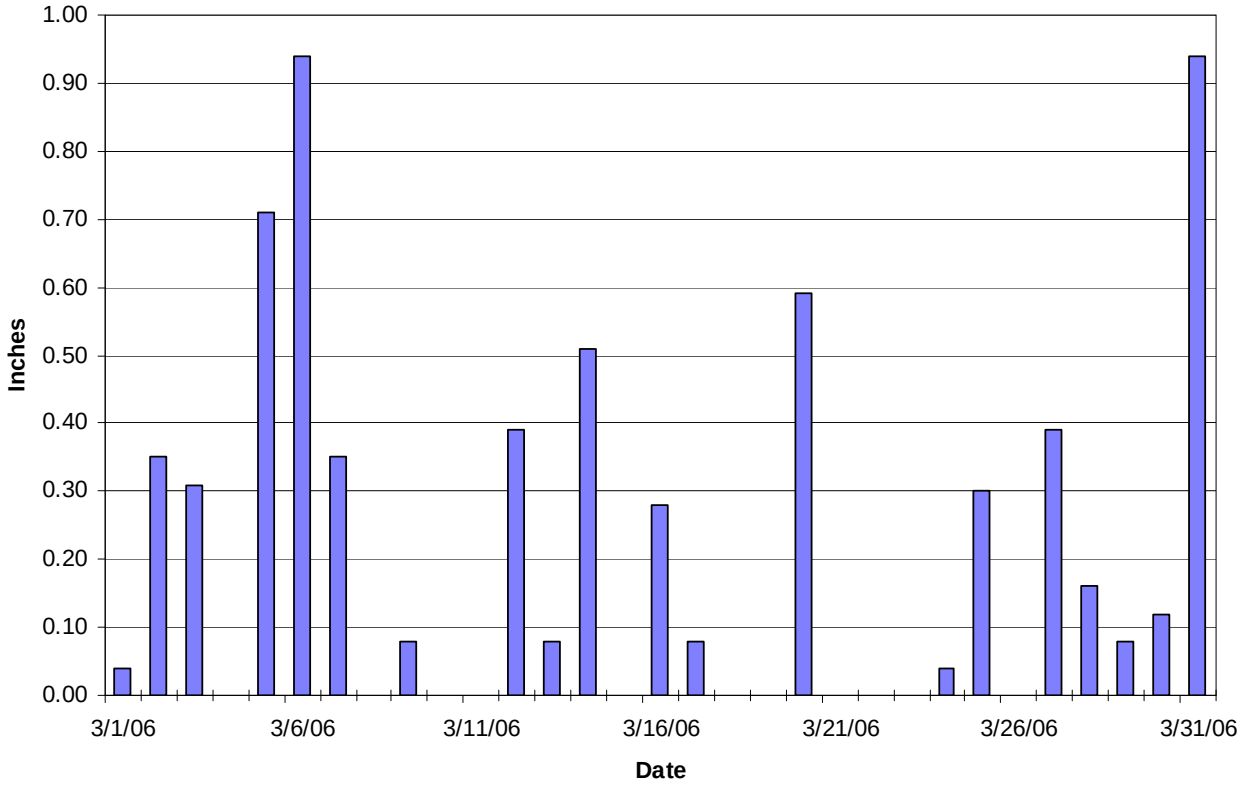

FIGURE 6-3
PRECIPITATION AT CHINA GARDEN ROAD GAGE DURING MARCH 2006

Water Quality

Water quality conditions were monitored at 15 locations within the PCWA canal system and study area streams during PCWA canal cleaning activities. All water quality monitoring locations are located within Zone 1 of the PCWA service area. These locations, shown in **Figures 5-1 and 5-2**, were selected according to canal cleaning locations. **Table 6-3** lists the monitoring site names, site type, associated watershed(s), and information for the canal cleaning activities for which sampling occurred at those locations.

Monitoring for canal cleaning and flushing events along the Boardman, Yankee Hill, Baughman, and Ferguson canals was conducted on March 15, 2007, March 22, 2007, March 26, 2007, and March 27, 2007, respectively. Monitoring sites were located along the canals and stream sites in the Secret Ravine and Miners Ravine watersheds. Results from water quality monitoring and potential effects of canal cleaning activities are discussed below. Water quality conditions were not evaluated in the Auburn Ravine, Clover Valley Creek, and Antelope Creek watersheds, but are likely to be similar to conditions described for Secret Ravine and Miners Ravine. Figures providing a comparison of water quality conditions within the PCWA raw water distribution system and study area streams monitored during canal cleaning activities are included in **Appendix C**.

TABLE 6-3
WATER QUALITY MONITORING LOCATIONS IN THE PCWA SERVICE AREA FOR CANAL CLEANING ACTIVITIES

Site Name	Site Identification	Type	Watershed(s)	Canal Cleaning Start/End Time	Weather
Boardman Canal Cleaning, Graveyard Outlet to Hansen Outlet					
Boardman Canal below Mammoth Reservoir	YB81	Canal	Miners Ravine /Secret Ravine	Start: 3/15/2007, 7:15am End: 3/15/2007, 3:50pm	Warm and dry
Boardman Canal at Hansen Outlet Release	HANSENR	Canal	Miners Ravine		
Miners Ravine at Lomida Lane	MINERSRV7	Stream	Miners Ravine		
Miners Ravine at Moss Lane	MINERSRV5	Stream	Miners Ravine		
Yankee Hill Canal Cleaning					
Boardman Canal at Head of Turner Canal	YB154	Canal	Miners Ravine/ Secret Ravine	Start: 3/22/2007, 6:15pm End: 3/22/2007, 3:25pm	Cool and dry
Yankee Hill Canal Outlet Release	YANKEECR	Canal	Secret Ravine		
Tributary to Secret Ravine from Yankee Hill Canal	YHTRIB2	Stream	Secret Ravine		
Secret Ravine at Rocklin Road	SECRETRV3	Stream	Secret Ravine		
Baughman Canal Cleaning, Head of Ferguson Canal to Baughman Canal Outlet					
Baughman Canal at Head of Ferguson Canal	YB145	Canal	Miners Ravine	Start: 3/26/2007, 6:10am End: 3/26/2007, 1:00pm	Cool with rain at around 2:00 p.m.
Baughman Canal Outlet Release	BAUGHMANCR	Canal	Miners Ravine		
Tributary to Miners Ravine from Baughman Canal	BCTRIB1	Drainage	Miners Ravine		
Miners Ravine near N. Sunrise Avenue	MINERSRV3	Stream	Miners Ravine		
Ferguson Canal Cleaning					
Baughman Canal at Head of Ferguson Canal	YB145	Canal	Miners Ravine	Start: 3/27/2007, 6:10am End: 3/27/2007, 11:55am	Cool and dry
Ferguson Canal Outlet Release	FRGCR	Canal	Miners Ravine		
Tributary to Miners Ravine from Ferguson Canal	FRGTRIB1	Drainage	Miners Ravine		
Miners Ravine at Auburn-Folsom Road	MINERSRV4	Stream	Miners Ravine		

Secret Ravine Watershed

As shown in **Table 6-3**, water quality monitoring in the Secret Ravine watershed was conducted during one canal cleaning event on March 22, 2007, that occurred along a section of the Yankee Hill Canal. Water quality was monitored at two canal sites, upstream and downstream from the canal section that was cleaned (YB154 and YANKEECR, respectively), and two stream sites downstream from the Yankee Hill Canal Outlet release (YHTRIB2 and SECRETRV3). These monitoring sites are listed below from the most upstream to the most downstream locations:

- **Boardman Canal at the Head of Turner Canal (YB154):** Located along the Boardman Canal at the head of the Turner Canal.
- **Yankee Hill Canal Outlet Release (YANKEECR)**
- **Yankee Hill Canal Tributary (YHBTRIB2)**
- **Secret Ravine at Rocklin Road (SECRETRV3)**

As shown in **Figure 6-1**, potential flow contributions from the Yankee Hill Canal comprise a small proportion of streamflow at SECRETRV3. Precipitation runoff within the Secret Ravine watershed is likely to have a much greater influence on water quality conditions in Secret Ravine during the time periods that PCWA conducts canal cleaning and flushing activities.

Water Temperature and Dissolved Oxygen

Minimal to no effects on water temperatures and DO levels were observed at the two stream sites (YHTRIB2 and SECRETRV3) downstream from the canal cleaning activity during this event. Water temperatures at the canal outlet release downstream from the canal cleaning activity, YANKEECR, increased from about 62ºF to up to 67ºF for about 15 minutes, then stabilized to reflect water temperature conditions similar to values measured upstream from canal cleaning. The temporary increase in water temperature is likely attributed to the displacement and flushing of water that collected in shallow pools and exposed to direct sunlight in the canal after the canal was dewatered. Measured DO levels across canal and stream sites exhibited similar, but inverse trends.

pH, Alkalinity, and Hardness

Based on measurements at sites during monitoring, canal cleaning activities do not appear to affect pH conditions in Secret Ravine. Measured pH levels at YANKEECR increased for a short duration after canal cleaning, and then stabilized to reflect pH levels similar to values measured upstream from canal cleaning. Measured pH levels at YANKEECR increased by more than 1 unit up to 9.2 during canal flushing after cleaning activities, subsequently decreased by more than 2 units to 6.9, then stabilized at 7.7. The pH measured at YHTRIB2 also increased slightly after canal cleaning, but did not fluctuate at SECRETRV3. Alkalinity and total hardness measured at sites during the canal cleaning monitoring event fluctuated slightly at YANKEECR, but remained consistent at both stream sites downstream from the canal cleaning activity. Stream sites monitored demonstrated higher buffering capacity (alkalinity) and lower total hardness compared to canal sites.

Total Suspended Solids and Turbidity

Despite a temporary increase in TSS and turbidity levels observed at YANKEECR after canal cleaning activities, no effects were observed at stream monitoring sites during this canal cleaning monitoring event.

Specific Conductivity and Ions

No effects on SC, calcium, iron, magnesium, potassium, or sodium levels were observed at stream sites in the Secret Ravine watershed during monitoring for canal cleaning activities. Minimal increases in iron concentrations were observed at YANKEECR after flows were restored to Yankee Hill Canal, but were not reflected in samples collected at stream sites downstream. SC, calcium, magnesium, potassium, and sodium values measured at stream sites were higher than canal sites. Water quality results also suggest that chloride, nitrate, and sulfate concentrations at stream sites are not affected by canal cleaning activities.

Trace Elements

Aluminum, barium, copper, and zinc concentrations at YANKEECR increased after flows were restored to Yankee Hill Canal, but do not appear to affect concentrations in samples collected at stream sites downstream. Cadmium concentrations measured at all sites during the canal cleaning monitoring event were below the detection limit (0.5 μg/L).

Miners Ravine Watershed

Water quality conditions in the Miners Ravine watershed were evaluated during canal cleaning and flushing activities along sections of the Boardman, Baughman, and Ferguson canals, on March 15, 2007, March 26, 2007, and March 27, 2007, respectively. On March 15, 2007, water quality was monitored at two canal sites upstream and downstream from canal cleaning activities, and two stream sites in Miners Ravine also upstream and downstream from canal cleaning activities:

- **Boardman Canal below Mammoth Reservoir (YB81)**
- **Hansen Outlet Release (HANSENR)**: located at the Hansen outlet from the Boardman Canal. Regulated releases from this canal flow into an unnamed tributary that contributes flows into Miners Ravine.
- **Miners Ravine at Lomida Lane (MINERSRV7)**: located at Lomida Lane upstream from the confluence with the unnamed tributary to Miners Ravine receiving regulated releases from HANSENR.
- **Miners Ravine at Moss Lane (MINERSRV5)**: located at Moss Lane, downstream from the confluence with the unnamed tributary to Miners Ravine receiving regulated releases from HANSENR.

On March 26, 2007, water quality parameters were monitored at two canal sites upstream and downstream from canal cleaning activities, and two stream sites downstream from canal cleaning activities:

- **Baughman Canal at the Head of Ferguson Canal (YB145):** located upstream from the cleaning event at the head of the Ferguson Canal.
- **Baughman Canal Outlet Release (BAUGHMANCR)**
- **Tributary to Miners Ravine from Baughman Canal (BCTRIB1)**
- **Miners Ravine near N. Sunrise Avenue (MINERSRV3)**

Due to the extensive length of the unnamed tributary to Miners Ravine from Baughman Canal and long travel time from BAUGHMANCR to BCTRIB1, samples obtained during canal cleaning activities at BCTRIB1 and MINERSRV3 were intended to provide a relative comparison of water quality conditions in receiving waters downstream from BAUGHMANCR.

On March 27, 2007, water quality was monitored at two canal sites upstream and downstream from canal cleaning activities, and two stream sites downstream from canal cleaning activities:

- **Baughman Canal at the Head of Ferguson Canal (YB145)**
- **Ferguson Canal Outlet Release (FRGCR)**: located at the Ferguson Canal Outlet. Unregulated releases from this canal flow into an unnamed tributary that contributes flows into Miners Ravine.
- **Tributary to Miners Ravine from Ferguson Canal (FRGTRIB1)**: located at Rock Crest Place along the unnamed tributary receiving unregulated releases from the FRGCR.
- **Miners Ravine at Auburn-Folsom Road (MINERSRV4)**: located on the west side of Auburn-Folsom Road downstream from the confluence with the unnamed tributary to Miners Ravine receiving regulated releases from FRGCR.

As shown in **Figure 6-2**, potential direct flow contributions from the Ferguson and Baughman canals comprise a small proportion of streamflow at MINERSRV3. Precipitation runoff within the Miners Ravine watershed is likely to have a much greater influence on water quality conditions in Miners Ravine during the time periods that PCWA conducts canal cleaning and flushing activities.

Water Temperature and Dissolved Oxygen

Based on water quality monitoring results, water temperature conditions in Miners Ravine were not affected by the March 15, 2007, and March 26, 2007, canal cleaning activities. Water temperatures observed at HANSENR on March 15, 2007, increased for a short duration, then stabilized to reflect water temperature conditions similar to values measured upstream from canal cleaning. During the March 27, 2007, canal cleaning monitoring event, water temperatures increased for a short duration at FRGCR, and water temperatures observed at FRGTRIB1 and MINERSRV4 also slightly increased, potentially as an effect of canal cleaning activities. DO

levels measured across stream sites in the Miners Ravine watershed were not affected by canal cleaning activities.

pH, Alkalinity, and Hardness

Although measured pH levels temporarily increased at the canal outlets after flows were restored to the canals following canal cleaning, minimal effects were observed at stream sites during the canal cleaning monitoring events. Sharp decreases and subsequent increases in pH observed at canal release outlets were likely responses to the displacement and flushing of water that collected in shallow pools and exposed to direct sunlight in the canal after the canal was dewatered. Alkalinity of water samples collected was higher across stream sites in the Miners Ravine watershed compared to the canal sites. The higher buffering capacity (alkalinity) at stream sites likely attributed to the minimal effects observed on pH at Miners Ravine sites. The canal cleaning activities also did not appear to affect total hardness values observed at stream sites within the Miners Ravine watershed. Although minimal effects were observed in tributaries receiving unregulated releases from canal outlets on March 26 and 27, 2007, no effects were observed in Miners Ravine. **Figure 6-4** shows pH values measured in the Miners Ravine watershed during the March 27, 2007, canal cleaning event.

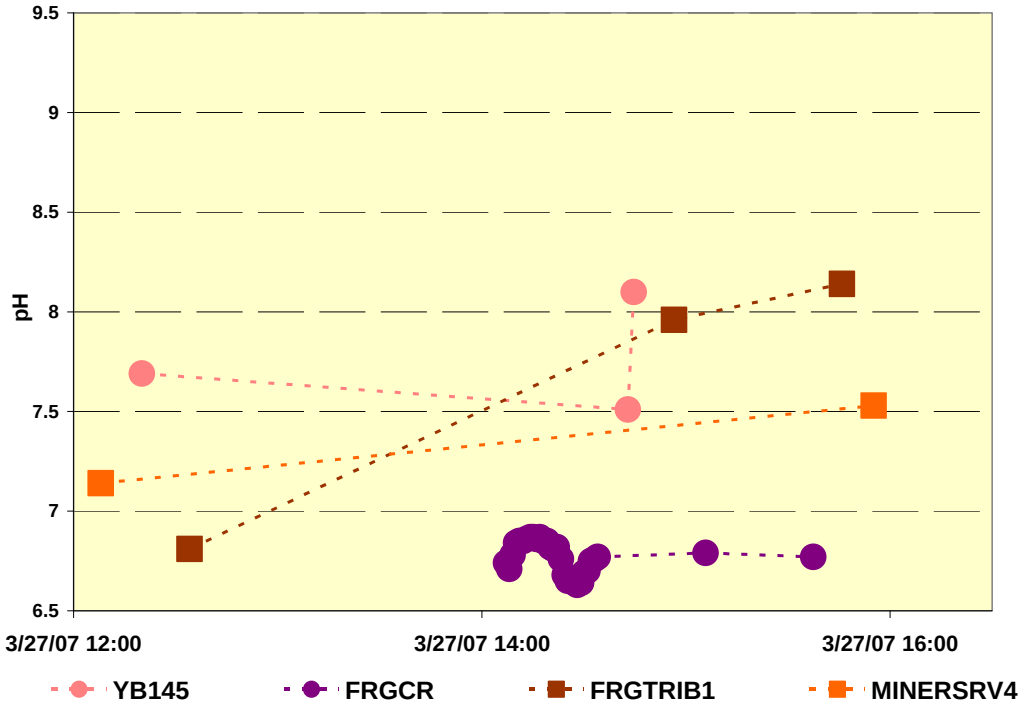

FIGURE 6-4
MEASURED PH LEVELS AT MINERS RAVINE WATERSHED SITES DURING MARCH 27, 2007, CANAL CLEANING EVENT

Total Suspended Solids and Turbidity

Despite a temporary increase in TSS and turbidity levels observed at canal outlet releases after flows were restored to canals following canal cleaning activities, no related effects were observed at stream monitoring sites in the Miners Ravine watershed during sampling events.

Specific Conductivity and Ions

Based on water quality results, canal cleaning activities did not affect SC and ion concentrations in Miners Ravine. Although calcium, iron, magnesium, potassium, sodium, chloride, and sulfate concentrations increased at canal outlet releases after flows were restored to canals following canal cleaning activities, no changes in SC and ion concentrations were observed at stream monitoring sites. In general, SC and ion concentrations were higher at Miners Ravine watershed stream sites compared to canal sites.

Trace Elements

Following canal cleaning activities, concentrations of aluminum, barium, copper, and zinc increased to very high levels at canal outlet releases for a short duration. During the March 15, 2007, canal cleaning event, aluminum concentrations measured in samples collected in Miners Ravine increased from 120 to 710 µg/L, potentially as a result of canal cleaning activities and aluminum loading to the unnamed tributary to Miners Ravine below the Hansen Outlet (**Figure 6-5**). Aluminum levels also increased at BCTRIB1 and FRGCR on March 26, 2007, and March 27, 2007, respectively, but did not increase at Miners Ravine sites monitored downstream. **Figures 6-5, 6-6** and **6-7** show aluminum concentrations for canal and stream sites monitored during canal cleaning activities.

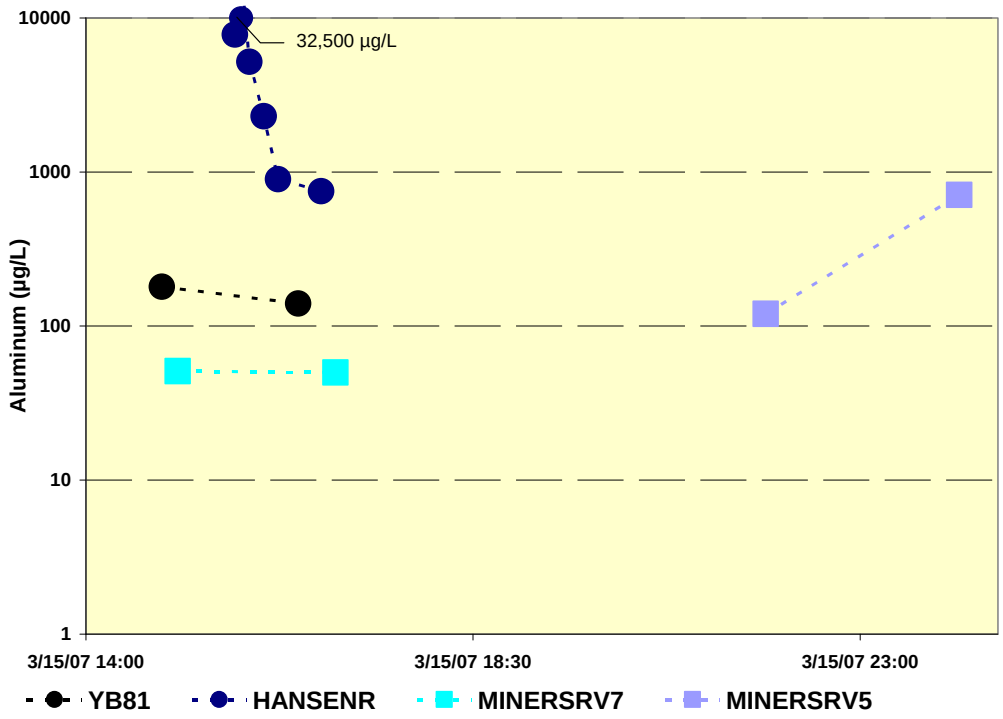

FIGURE 6-5
MEASURED ALUMINUM LEVELS AT MINERS RAVINE WATERSHED SITES DURING MARCH 15, 2007, CANAL CLEANING EVENT

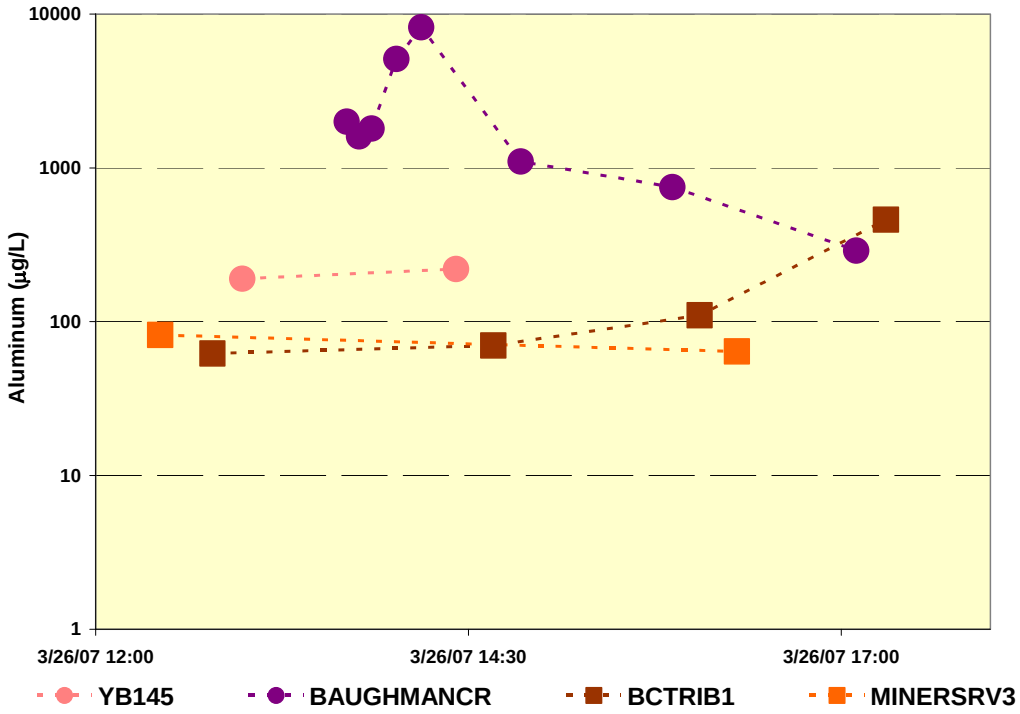

FIGURE 6-6
MEASURED ALUMINUM LEVELS AT MINERS RAVINE WATERSHED SITES DURING MARCH 26, 2007, CANAL CLEANING EVENT

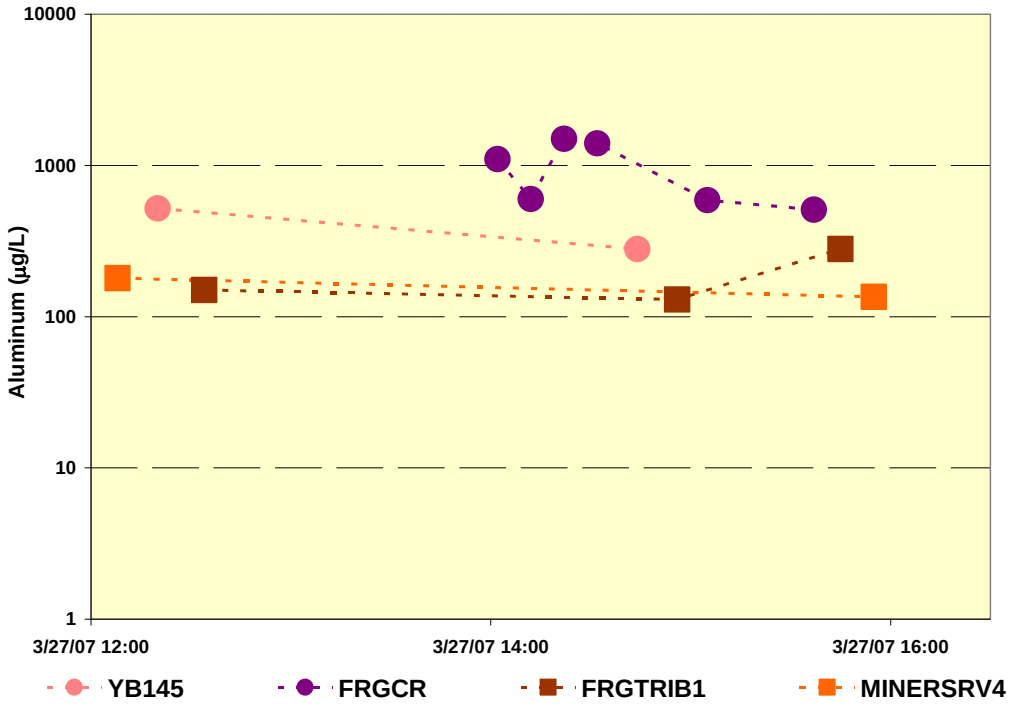

FIGURE 6-7
MEASURED ALUMINUM LEVELS AT MINERS RAVINE WATERSHED SITES DURING MARCH 27, 2007, CANAL CLEANING EVENT

Barium, copper, and zinc concentrations increased at canal outlet releases for a short duration (about 1 hour) following canal cleaning activities. Water quality data collected during monitoring suggest that these increased concentrations at canal outlets generally did not result in increased concentrations at stream sites downstream from the canal outlet releases. However, the concentration of copper and zinc at MINERSRV5 did increase from 3.2 to 8.8 µg/L, and from 5.1 to 7.6 µg/L, respectively, during the March 15, 2007, monitoring event. These increases may be attributed to canal cleaning activities. **Figures 6-8 and 6-9** show barium results for sites monitored during the March 26, 2007, and March 27, 2007, canal cleaning events. Copper and zinc results for Miner Ravine watershed sites monitored during the March 15, 2007, canal cleaning event are shown in **Figures 6-10** and **6-11**. Cadmium concentrations measured at all sites during the canal cleaning monitoring event were below the detection limit (0.5 µg/L).

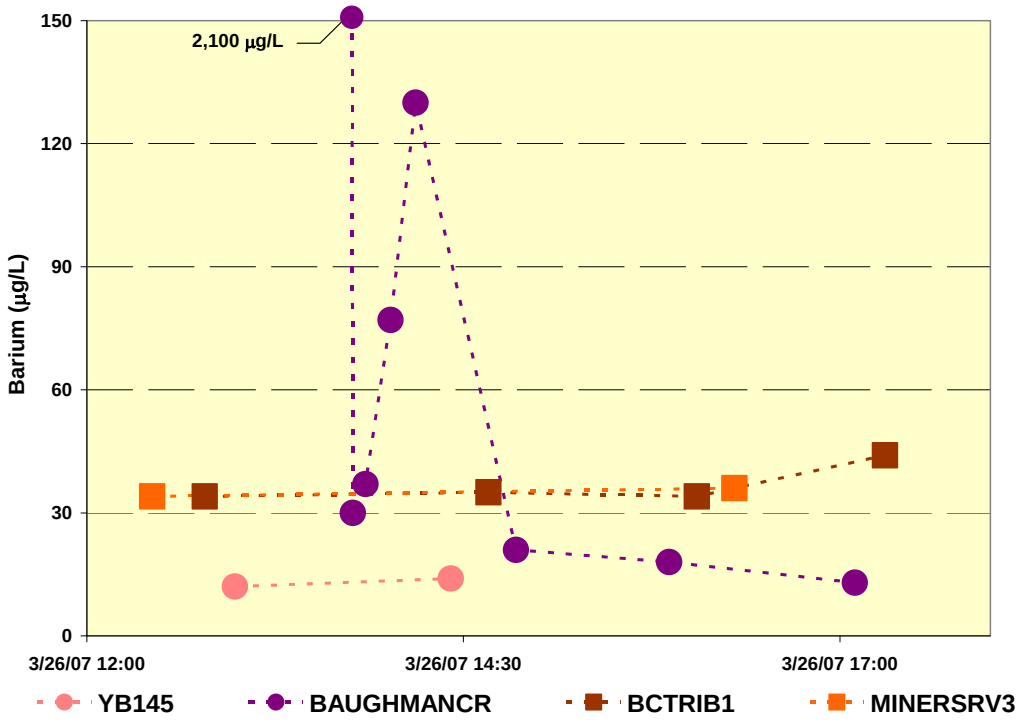

FIGURE 6-8
MEASURED BARIUM LEVELS AT MINERS RAVINE WATERSHED SITES DURING MARCH 26, 2007, CANAL CLEANING EVENT

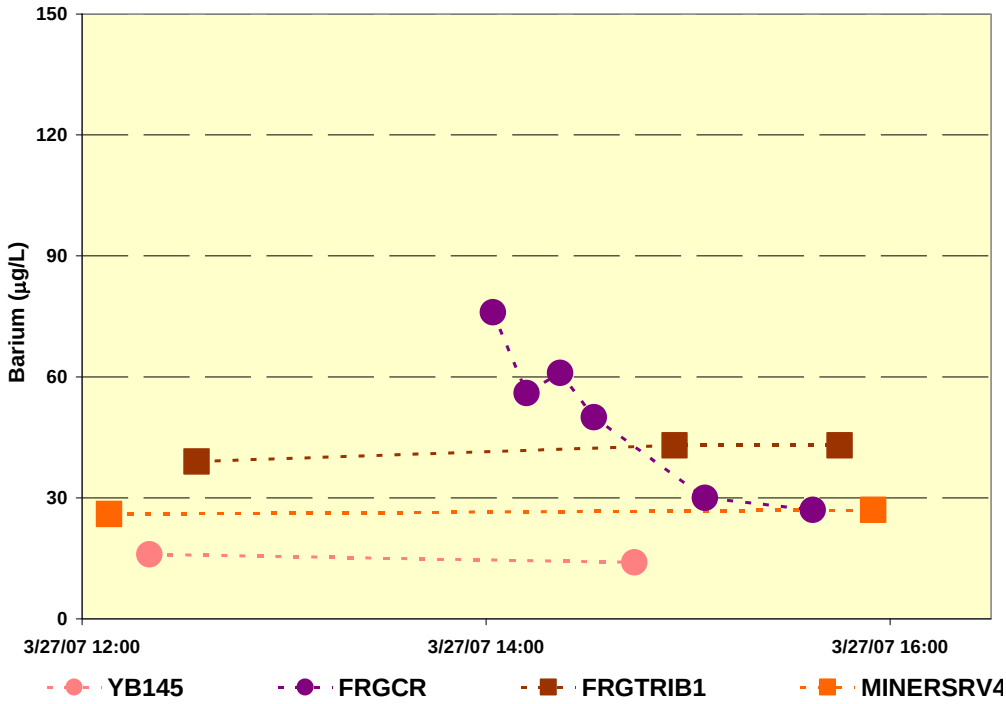

FIGURE 6-9
MEASURED BARIUM LEVELS AT MINERS RAVINE WATERSHED SITES DURING MARCH 27, 2007, CANAL CLEANING EVENT

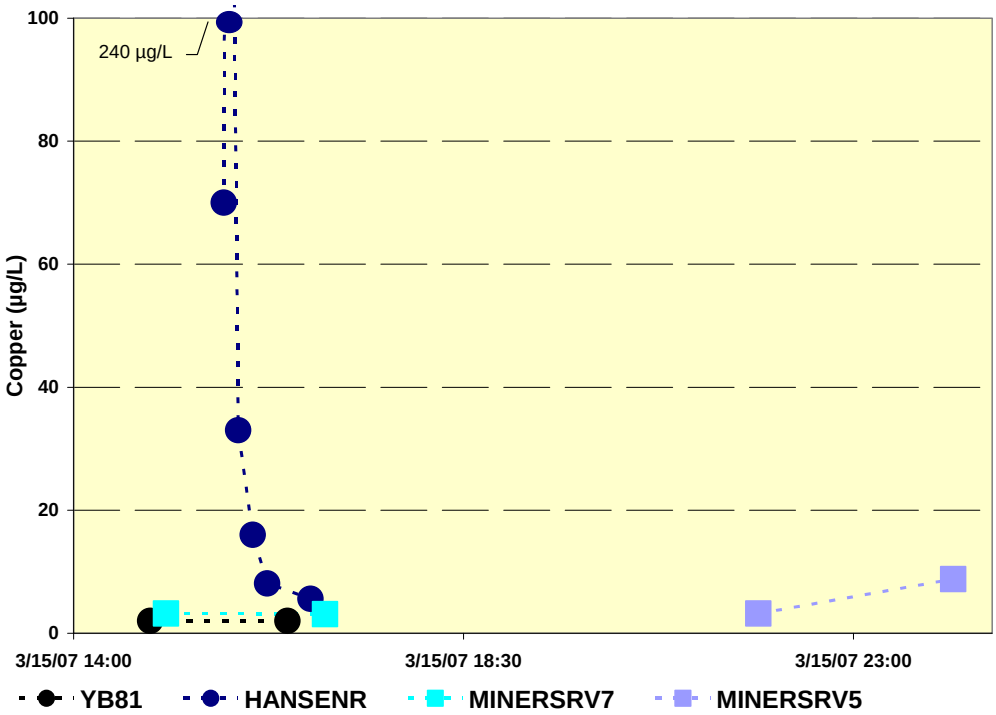

FIGURE 6-10
MEASURED COPPER LEVELS AT MINERS RAVINE WATERSHED SITES DURING MARCH 15, 2007, CANAL CLEANING EVENT

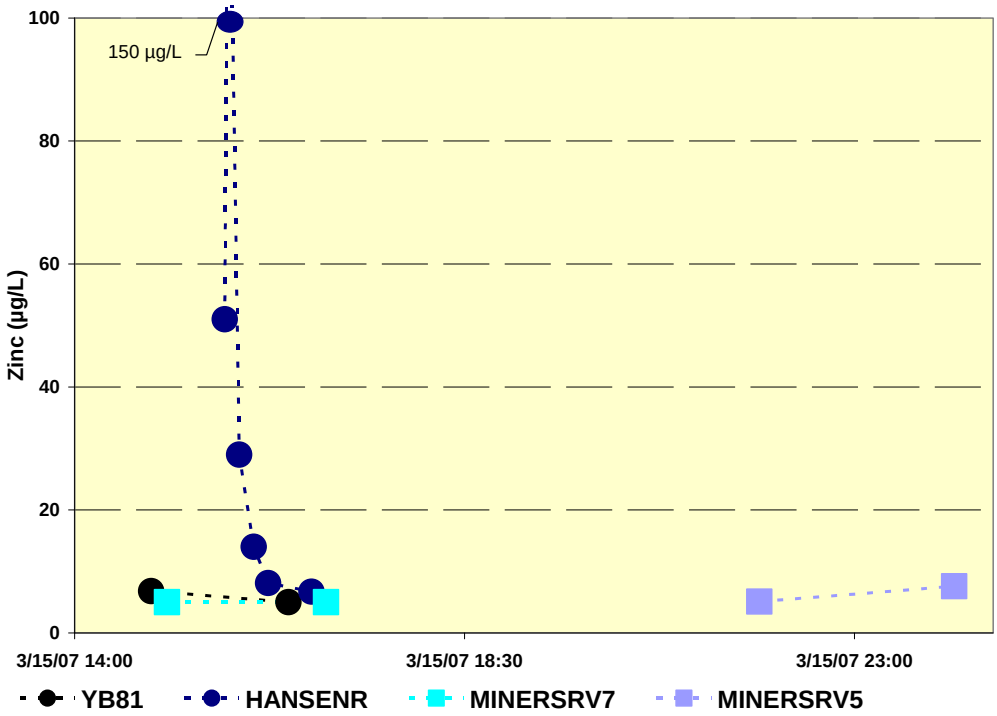

FIGURE 6-11
MEASURED ZINC LEVELS AT MINERS RAVINE WATERSHED SITES DURING MARCH 15, 2007, CANAL CLEANING EVENT

Soils and Sediment Quality

As described in **Chapter 2**, debris and sediment removed from the canals are typically deposited along canal banks. To quantify the effects of canal cleaning on soil and sediment quality, soils were collected along canal banks where debris had been deposited. Soils were collected in two high-density polyethylene 500-ml canisters from the banks of five canals, the Antelope, Boardman, Yankee Hill, Baughman, and Ferguson canals. These canals were cleaned on February 14, 2007, and March 15, 22, 26, and 27, 2007, respectively. All soil samples were collected on March 30, 2007. These canals were selected and their soils sampled on March 30, 2007, to provide an understanding of the effects of cleaning on soil quality over time. As shown in **Table 6-4**, the selected canals locations for sampling provide data for evaluating soil quality effects after 44, 15, 8, 4, and 3 days, respectively. High air temperatures during the period when the first canal cleaning activity evaluated for soil quality effects to the date of sample collection ranged from 40°F to 80°F, with lows ranging from 27°F to 56°F (**Figure 6-12**). As shown in **Figure 6-3**, rain fell intermittently during the days before the first canal cleaning event and to the sampling date. Air temperature and precipitation may affect the persistence of constituents in soils directly, through chemical and physical interactions, and indirectly, by influencing microbiological communities in soils. At the time of sampling, the weather was sunny, dry, with a high air temperature of 74°F.

TABLE 6-4
QUALITY OF SEDIMENTS REMOVED FROM CANALS DURING CLEANING AND FLUSHING ACTIVITIES

Constituent (mg/kg)	Ferguson Canal		Baughman Canal		Yankee Hill Canal		Boardman Canal		Antelope Canal	
	Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation
Aluminum	9,750	+/-1,768	10,000	+/-0	10,800	+/-1,697	4,200	+/-141	12,500	+/-2,121
Barium	89	+/-9.2	62	+/-0.7	62	+/-9.9	41	+/-4.2	125	+/-7.1
Calcium	1,850	+/-354	915	+/-92	4,950	+/-71	1,400	+/-141	2,300	+/-566
Cadmium	Below Detection		Below Detection		0.45	NA	Below Detection		Below Detection	
Copper	90	+/-28.3	52	+/-7.8	75	+/-36	22	+/-0.7	55	+/-43
Iron	12,500	+/-2,121	9,500	+/-141	8,450	+/-9,264	6,000	+/-141	20,500	+/-707
Potassium	1,750	+/-354	1,450	+/-71	545	+/-573	860	+/-198	3,000	+/-1,131
Magnesium	3,400	+/-566	2,600	+/-0	2,070	+/-1,739	2,350	+/-212	4,500	+/-283
Sodium	69	+/-11	58	+/-2.8	375	+/-446	54	+/-0	130	+/-14
Zinc	71	+/-1.4	61	+/-3.5	99	+/-73	16	+/-4.2	54	+/-2.8
Days after Cleaning	3		4		8		15		44	

Ten chemical parameters were measured in soil samples collected: aluminum, barium, cadmium, calcium, copper, iron, magnesium, potassium, sodium, and zinc. Results of chemical analyses are shown in **Table 6-4**.

Samples collected had very high concentrations of aluminum, calcium, iron, magnesium, and potassium across all sites. High concentrations of these constituents are not likely attributed to PCWA raw water distribution system O&M activities, because PCWA O&M activities do not introduce these constituents to the study area. High background concentrations of these constituents in study area soils are most likely due to the chemical composition of minerals in parent material comprising soils.

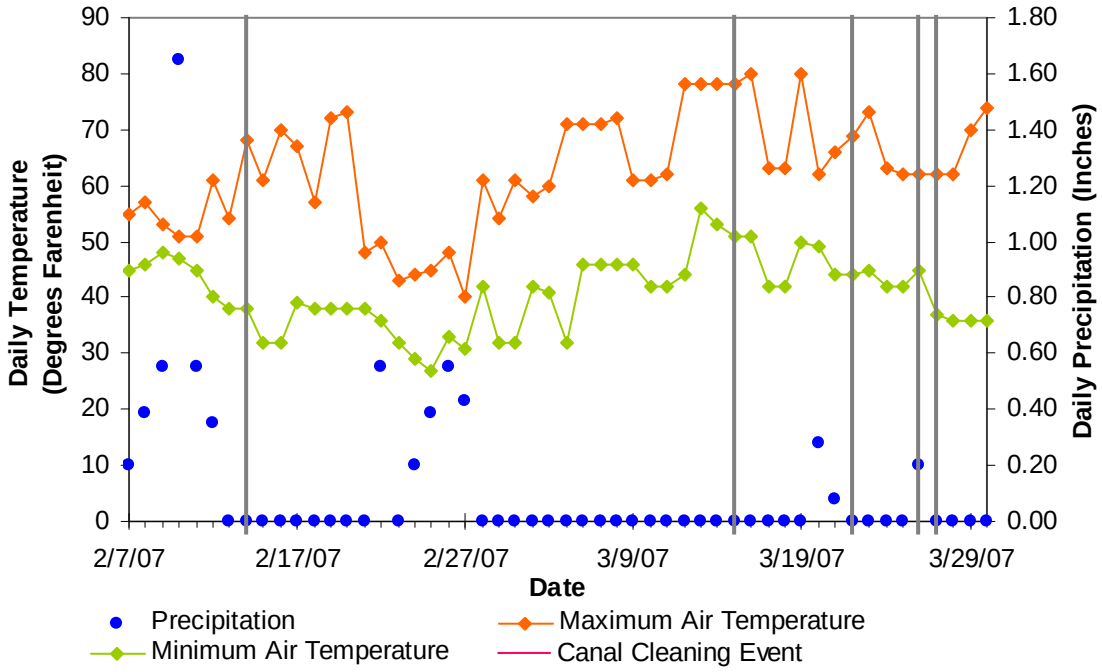

FIGURE 6-12
DAILY AIR TEMPERATURES AND PRECIPITATION BEFORE SOIL SAMPLING FOR CANAL CLEANING EVENTS

Copper concentrations in soil samples collected across some sites were higher than the mean concentration of copper in soils in the region, while cadmium and zinc concentrations across all sites were consistent with regional mean concentrations for soils shown in **Table 6-5** (Holmgren et al. 1993). These higher copper concentrations may be associated with the removal of sediments from the canal with higher copper concentrations attributed to PCWA's algaecide applications, and deposition of the soils along the canal banks. Barium and sodium concentrations in soil samples collected after PCWA canal cleaning activities varied across sites, but are not expected to be affected by PCWA canal cleaning activities.

Soil compaction and erosion may occur as a result of equipment access and use along canal banks during canal cleaning activities. Mechanical equipment may also introduce chemical contaminants (i.e., petroleum products) to soils at access sites.

TABLE 6-5
GEOMETRIC MEAN CONCENTRATIONS OF CADMIUM, COPPER, AND ZINC IN SOILS

Constituent (mg/kg)	State of California Geometric Mean	California Subtropical Land Resource Region Geometric Mean
Cadmium	0.253	0.254
Copper	37.3	43.4
Zinc	82.7	90.4

Source: Holmgren et al. 1993.
Key:
mg/kg = milligrams per kilogram

Biological Resources

The following sections describe potential effects of PCWA canal cleaning and flushing activities on terrestrial and aquatic habitat and species in the study area.

Terrestrial Habitat and Species

Minimal decreases in study area streams due to a short duration reduction of flows in the PCWA canal system could result in temporary, very minimal decreases in the extent of wetland habitats that may be indirectly supported by canal deliveries. This could have minimal effects on species that use these wetland habitats, such as foraging birds and breeding amphibians, by decreasing the amount of available habitat. Reductions in water levels could expose amphibian eggs in the shallow, vegetated margins of drainages or adjacent wetlands. Potential effects from temporary water reductions on species that use these habitats are expected to be minimal. Flushing after canal cleaning could erode banks and wash away amphibian eggs that may be present on stream margins. The typical timing of the cleaning period in the early part of the year occurs within the breeding period for several amphibian species.

Changes in water quality could indirectly affect terrestrial habitats and species. Increased sedimentation from flushing activities could bury amphibian eggs. Increases in trace elements (such as aluminum and copper) could have some negative effects on plants and wildlife on the margins of canals and tributaries. Amphibians in particular are known to be sensitive to such water quality changes, although effects vary dramatically by type and concentration of contaminant, species, and life stage.

Habitats and species could potentially be affected directly or indirectly by impacts to soils and sediments from equipment, including compaction, erosion, and introduction of petroleum products. Effects on habitats and species could include plant mortality or decreased plant growth. These types of impacts are expected to be relatively minimal and small in aerial extent.

If equipment is used for removal of debris, damage could be caused to habitats by movement of equipment or by placement of debris and soil near canals. Some potential negative effects could occur if raptors are nesting near work areas that may be disturbed by noise. Raptors potentially occurring in the study area include Red-shouldered Hawk, American Kestrel, Red-tailed Hawk, and Great Horned Owl. The nesting period for raptors is generally March 1 to August 15.

Aquatic Habitat and Species

Changes in water quality conditions, particularly aluminum and copper concentratons, observed in study area streams following canal cleaning activities may affect aquatic habitat and species. Most aquatic organisms are relatively unaffected by suspended zinc (Eisler 1993). However, high levels of zinc could result in destruction of the gill epithelium and tissue hypoxia. The temporary increases in zinc in Miners Ravine were still below the acute toxicity levels, and would not substantially affect the fish in Miners Ravine.

Aluminum can affect gill function and growth rates. Aluminum bioavailability is closely tied to pH levels. At elevated aluminum concentrations and pH between 5.5 and 7.0, fish and invertebrates may suffer asphyxiation caused by aluminum adsoption on gill surfaces (NMFS 2006). At lower pH levels, aluminum toxicity can result in erosion of gill epithelium and mortality (NMFS 2006). The EPA standard for the 1-hour maximum concentration exposure of fish to aluminum is 750 µg/L, while the 4-day maximum continuous concentration is 87 µg/L (NMFS 2006). The level of effect is dependent upon other environmental conditions, such as pH and water temperature. Higher pH levels in the water increase the buffering capacity for the effects of aluminum on fishes.

The increase in the aluminum concentration observed at MINERSRV5 following canal cleaning during the March 15, 2007, canal cleaning event may result in negative effects to fish. Because the increase in the aluminum concentration (maximum measured at 710 µg/L) were likely short-lived, and because the pH levels were above 6.5, the long-term effects on the fish present was probably minimal. An increase in aluminum concentrations in study area streams as a result of canal cleaning activities that to levels above 750 µg/L for a prolonged period of time may affect fish, but the degree of effects would be dependent on the length of time and pH levels.

Potential effects of copper on fish include reduced olfactory sensors, and possibly temporary decreased feeding activity. The toxicity of copper on fish is dependent on the chemical form, water hardness, and the lifestage and species exposed. Elevated copper concentrations can result in reduced olfactory sensitivity, affecting the ability to detect predators and prey. Elevated copper concentrations could also reduce survival of benthic macroinvertebrates – prey for many fish species. Copper levels in Miners Ravine resulting from canal cleaning operations on March 15 increased from about 5 µg/L to about 10 µg/L. The increase was likely for a short duration (few hours), but could result in impacts that affect fish gills and benthic invertebrates that are prey for many fish species.

Although not observed during water quality monitoring activities, temporary increases in TSS and/or turbidity levels in streams may affect aquatic species and habitat. Increased sedimentation and turbidity resulting from erosion and/or flushing of sediment associated with canal cleaning activities may result in short-term effects on fish. Prolonged exposure to high levels of suspended sediment can create a loss of visual capability, leading to a reduction in feeding and growth rates; a thickening of the gill epithelium, potentially causing the loss of respiratory function; a clogging and abrasion of gill filaments; and increases in stress levels, reducing the tolerance of fish to disease and toxicants (Waters 1995). In addition, high suspended sediment levels will cause the movement and redistribution of fish populations and

can affect physical habitat. Once the suspended sediment is deposited, it can reduce water depths in pools, decreasing the amount of physical habitat for juvenile and adult fish (Waters 1995). Increased sediment loading can also degrade food-producing habitat downstream of the project area. Sediment loading can interfere with photosynthesis of aquatic flora and result in the displacement of aquatic fauna.

Many fish, including juvenile salmonids, are sight feeders. Turbid waters reduce the fish's efficiency in locating and feeding on prey. Some fish, particularly juveniles, can get disoriented and leave areas where their main food sources are located, which can result in reduced growth rates.

Avoidance is the most common result of increases in turbidity and sedimentation. Fish will not occupy areas that are not suitable for survival, unless they have no other option. Therefore, habitat can become limiting in systems where high turbidity precludes a species from occupying habitat required for specific life stages.

Special Status Species

Minimal streamflow decreases in study area streams due to a short duration reduction of flows in the PCWA canal system could result in temporary, very minimal decreases in the extent of wetland habitats that may be indirectly supported by canal deliveries. This could have minimal effects on special status species that use these wetland habitats, such as special status foraging birds and breeding amphibians, by decreasing the amount of available habitat. Reductions in water levels could expose eggs of special status amphibian species that may occur in the shallow, vegetated margins of drainages or adjacent wetlands. Potential effects from temporary water reductions on species that use these habitats are expected to be minimal. As described above, flushing after canal cleaning could erode banks and wash away amphibian eggs, including those of special status species, which may be present on stream margins. The typical timing of the cleaning period in the early part of the year occurs within the breeding period for several special status amphibian species. The California red-legged frog breeding occurs between late November and March, though most frogs lay eggs in March (USFWS 2002, Stebbins 2003). The foothill yellow-legged frog breeds between mid-March through early June, and the western spadefoot toad breeds late January through July (Stebbins 2003).

Special status plant species (see **Tables 3-12** and **3-13**), if present along the PCWA canal system, could potentially be affected directly or indirectly by impacts to soils and sediments from equipment, including compaction, erosion, and introduction of petroleum products. Effects on species could include plant mortality or decreased plant growth. These types of effects are expected to be unlikely to occur.

If equipment is used to remove debris, damage could be caused to special status plant species, if present, by movement of equipment or by placement of debris and soil near canals. Some potential negative effects could occur if raptors are nesting near work areas that may be disturbed by noise. Special status raptors potentially occurring in the study area include Swainson's hawk, Cooper's hawk, Northern Goshawk, White-tailed Kite, and Northern Harrier. As mentioned above, the nesting period for raptors is generally March 1 to August 15.

Potential water quality effects discussed above could indirectly affect terrestrial habitats and species. Increased sedimentation from flushing activities could bury special status amphibian eggs, if present. Increases in trace elements (such as aluminum and copper) could have some negative effects on special status plants and wildlife, if present, on the margins of canals and tributaries. Amphibians in particular are known to be sensitive to such water quality changes, although effects vary dramatically by species, life stage, and parameters.

Increased levels of aluminum and copper in study area streams during and after canal cleaning activities could potentially affect steelhead and Chinook salmon. As described above, aluminum can affect gill function and growth rates. Pacific salmonids are considered susceptible to copper toxicity, with a mean acute toxicity level at 29.11 µg/L (NMFS 2006). Avoidance by Chinook salmon can occur at levels as low as 0.7 µg/L, and at 1.6 µg/L for rainbow trout. Increased copper levels can result in diminished olfactory sensitivity, which affects the fishes' ability to detect predators, prey, and also to affect imprinting of smolts on their natal stream (NMFS 2006). Exposure to levels at 25 µg/L for 1 and 4 hours indicate a substantial decrease in the number of receptors in the olfactory bulb due to cellular necrosis (cell death) in Chinook salmon. Rainbow trout can tolerate higher concentrations at the 1-hour increment, but have similar effects at the 4-hour interval. Social interactions can also be impaired with copper exposure. Increased stress levels of subordinate fish may also lead to increased copper uptake across the gills. Elevated copper concentrations could also reduce survival of benthic macroinvertebrates – prey for juvenile salmonids. Select examples from research studies of adverse effects with copper to Chinook salmon and steelhead are provided in **Table 6-6**.

TABLE 6-6
EXAMPLES OF ADVERSE EFFECTS WITH COPPER TO SALMONIDS

Species (lifestage)	Effect	Effect Concentration (µg/L)[a]	Effect statistic	Hardness[b]	Exposure duration	Source
Chinook salmon (*Oncorhynchus tshawytscha*)						
Juvenile	Avoidance in laboratory exposures	0.75	LOEC	25	20 minutes	Hansen et al. 1999
Juvenile	Loss of avoidance ability	2	LOEC	25	21 days	Hansen et al. 1999
Adult	Spawning migrations in wild apparently interrupted	10-25	LOEC	40	Indefinite	Mebane 2000
NA	Reduced growth (as weight)	1.9	EC_{10}	25	120 days	Chapman 1982
Fry	Death	19	LC_{50}	24	96 hours	Chapman 1978
Steelhead (*Oncorhynchus mykiss*)						
Juvenile – Rainbow trout	Avoidance in laboratory exposures	1.6	LOEC	25	20 minutes	Hansen et al. 1999
NA – Rainbow trout	Loss of homing ability	22	LOEC	63	40 weeks	Saucier et al. 1991
NA	Reduced growth (as weight)	45 to >51	NOEC	24-32	60 days	Mudge et al. 1993
Fry	Death	9-17	LC_{50}	24-25	96 hours	Chapman 1978, Marr et al. 1996
Adult	Death	57	LC_{50}	42	96 hours	Chapman and Stevens 1978
Juvenile	Death	24-28	NOEC	24-32	60 days	Mudge et al. 1993
Egg-to-fry	Death	11.9	EC_{10}	25	120 days	Chapman 1982

Source: NMFS 2007. An Overview of Sensory Effects on Juvenile Salmonids Exposed to Dissolved Copper.

Notes:

[a] Effects of exposure durations stem from laboratory and field experiments; therefore, in some experiments, multiple routes of exposure may be present (i.e., aqueous and dietary) and water chemistry conditions will likely differ.

[b] Toxicity of copper may be influenced by hardness.

Key

EC_{10} = Effective concentration adversely affecting 10 percent of the test population or percent of the measured response

LC_{50} = The concentration that kills 50 percent of the test population

LOEC = Lowest observed adverse effect concentration (may not be a threshold, but simply the lowest concentration tested

NA = Not available

NOEC = No observed adverse effect concentration

6.1.1.2 Weed and Brush Control

The following sections describe potential effects of weed and brush control activities conducted by PCWA on natural resource conditions in the study area. Additionally, the regulatory framework for the weed and brush control activities is provided, along with descriptions of potential BMPs that may reduce potential effects.

Physical Removal of Vegetation

Effects of PCWA's physical removal of vegetation during scheduled canal maintenance activities are described below.

Physical Resources

Potential effects of PCWA's physical removal of vegetation along canal banks on hydrology and water quality conditions in study area streams, and soils and sediment quality in the study area are described below.

Hydrology

Flows within canals are generally not disrupted while PCWA undertakes physical removal of vegetation within or along the canal system. Therefore, physical removal of vegetation is not likely to affect hydrologic conditions within study area streams.

Water Quality

Potential water quality effects of physical removal of vegetation are expected to be minimal to none. Minimal effects on TSS and turbidity may occur if the removal of vegetation results in the dislodging or loosening of soil along canal banks causes loose sediment to be deposited into the canals. During this activity, the removed vegetation is either deposited away from canals or hauled away in trucks, which prevents from potential deposition of debris in the canals. No dewatering or flushing activities are associated with the physical removal of vegetation.

Soils and Sediment Quality

Potential effects of PCWA activities during physical removal of vegetation likely depend on the equipment used for removal, and type and location of vegetation. Equipment used along canal banks may increase erosion, and motorized equipment may introduce petrochemicals to soils and affect sediment quality. These potential effects are likely to be minor.

Biological Resources

The following sections describe potential effects of physical removal of vegetation within the PCWA raw water distribution system on terrestrial and aquatic habitat and species in the study area.

Terrestrial Habitat and Species

Physical removal of vegetation would result in direct loss of vegetation and habitat. Native trees may be trimmed or removed. Bird nests or eggs in vegetation to be trimmed or removed may be disturbed or destroyed. Habitats and species could potentially be affected directly or indirectly by impacts to soils and sediments from equipment used for vegetation removal, including compaction, erosion, and introduction of petroleum products. Potential effects on habitats and

species may include plant mortality or decreased plant growth. These types of impacts are expected to be relatively minimal and small in aerial extent.

If equipment is used to remove vegetation, some potential negative effects could occur if raptors nesting near work areas are disturbed by noise. Raptors potentially occurring in the study area include Red-shouldered Hawk, American Kestrel, Red-tailed Hawk, and Great Horned Owl. The nesting period for raptors is generally March 1 to August 15.

Aquatic Habitat and Species

As described above, flows within canals are generally not disrupted while PCWA undertakes physical removal of vegetation within or along the canal system, and potential water quality effects of physical removal of vegetation are expected to be minimal to none. Therefore, physical removal of vegetation is not likely to affect aquatic habitat and species within study area streams.

Special Status Species

Physical removal of vegetation could result in direct loss of or damage to special status plant species or elderberry shrubs that may host the valley elderberry longhorn beetle, if present. Special status bird nests or eggs in vegetation to be trimmed or removed, if present, may be disturbed or destroyed.

Special status plant species (see **Tables 3-12** and **3-13**), if present, could potentially be affected directly or indirectly by impacts to soils and sediments from equipment used for vegetation removal, including compaction, erosion, and introduction of petroleum products. Effects on species could include plant mortality or decreased plant growth. These types of impacts are expected to be unlikely to occur.

If equipment is used for removal of vegetation, some potential negative effects could occur if raptors are nesting near work areas that may be disturbed by noise. Special status raptors potentially occurring in the study area include Swainson's hawk, Cooper's hawk, Northern Goshawk, White-tailed Kite, and Northern Harrier. As mentioned above, the nesting period for raptors is generally March 1 to August 15.

Algaecide Application

PCWA's raw water distribution system algaecide applications have the potential to affect natural resource conditions in the study area. The following sections describe potential effects of algaecide applications on natural resources.

Physical Resources

The following sections describe potential effects of PCWA's algaecide applications on the hydrology and water quality of study area streams, and soils and sediment quality.

Hydrology

Flows within canals are generally not disrupted while PCWA carries out algaecide applications within the canal system. Therefore, algaecide applications conducted by PCWA in the raw water distribution system are not likely to affect hydrologic conditions in study area streams.

Water Quality

As shown in **Figures 2-8** to **2-11** and discussed in **Table 2-1**, PCWA has 21 established points of algaecide application within the system, with "spot" treatments at other locations as conditions warrant. Water quality conditions at canal and stream sites within the Secret Ravine watershed were monitored during two application events at Boardman Canal below Mammoth Reservoir on May 16, 2007, and August 15, 2007. The locations and times of sampling were selected to determine potential effects of algaecide applications on water quality conditions in receiving waters. These locations are shown in **Figures 5-3 and 5-4**. **Table 6-7** provides details of the algaecide application monitoring events. Potential water quality effects described for sites monitored within the Secret Ravine watershed are assumed to be representative of the potential effects in watersheds of other study area streams affected by PCWA maintenance activities. Figures providing a comparison of water quality conditions within the PCWA raw water distribution system and study area streams monitored during algaecide applications are included in **Appendix C**.

TABLE 6-7
WATER QUALITY MONITORING LOCATIONS FOR ALGAECIDE APPLICATIONS AT BOARDMAN CANAL BELOW MAMMOTH RESERVOIR

Site Description	Site Identification	Site Type	Application Start /End Time	Weather
Boardman Canal below Mammoth Reservoir[1]	YB81	Canal	Start: 5/16/2007, 8:30 a.m. End: 5/16/2007, 12:00 p.m.	Warm and dry
Yankee Hill Canal Outlet Release	YANKEECR	Canal		
Tributary to Secret Ravine from Yankee Hill Canal	YHTRIB2	Stream		
Secret Ravine at Rocklin Road	SECRETRV3	Stream		
Boardman Canal below Mammoth Reservoir[2]	YB81	Canal	Start: 8/15/2007, 8:25 a.m. End: 8/15/2008, 12:00 p.m.	Warm and dry
Yankee Hill Canal Outlet Release	YANKEECR	Canal		
Tributary to Secret Ravine from Yankee Hill Canal	YHTRIB2	Stream		
Secret Ravine at Rocklin Road	SECRETRV3	Stream		

Notes
[1] Cutrine application conducted by PCWA with a target dosage of 800 μg/L
[2] Cutrine-Plus® application conducted by PCWA with a target dosage of 800 μg/L

Water Temperature and Dissolved Oxygen

No effects on water temperatures were observed during the algaecide application events. Measured changes in water temperatures during the algaecide events are consistent with diurnal fluctuations with the highest temperatures occurring during the afternoon, and lowest temperatures occurring at night and during the early morning. No effects on DO levels were observed during algaecide application activities.

pH, Alkalinity, and Hardness

Minimal effects on pH were observed during the algaecide application monitoring events. Measured pH levels increased slightly at YANKEECR and subsequently increased at YHTRIB2 and SECRETRV3. These results are shown in **Figure 6-13** below. According to the Material Safety and Data Sheet for Cutrine-Plus®, the pH of the algaecide ranges from 10.3 to 10.5 (Applied Biochemists 2006). The high pH allows the copper to stay in solution even under conditions of high hardness and alkalinity.

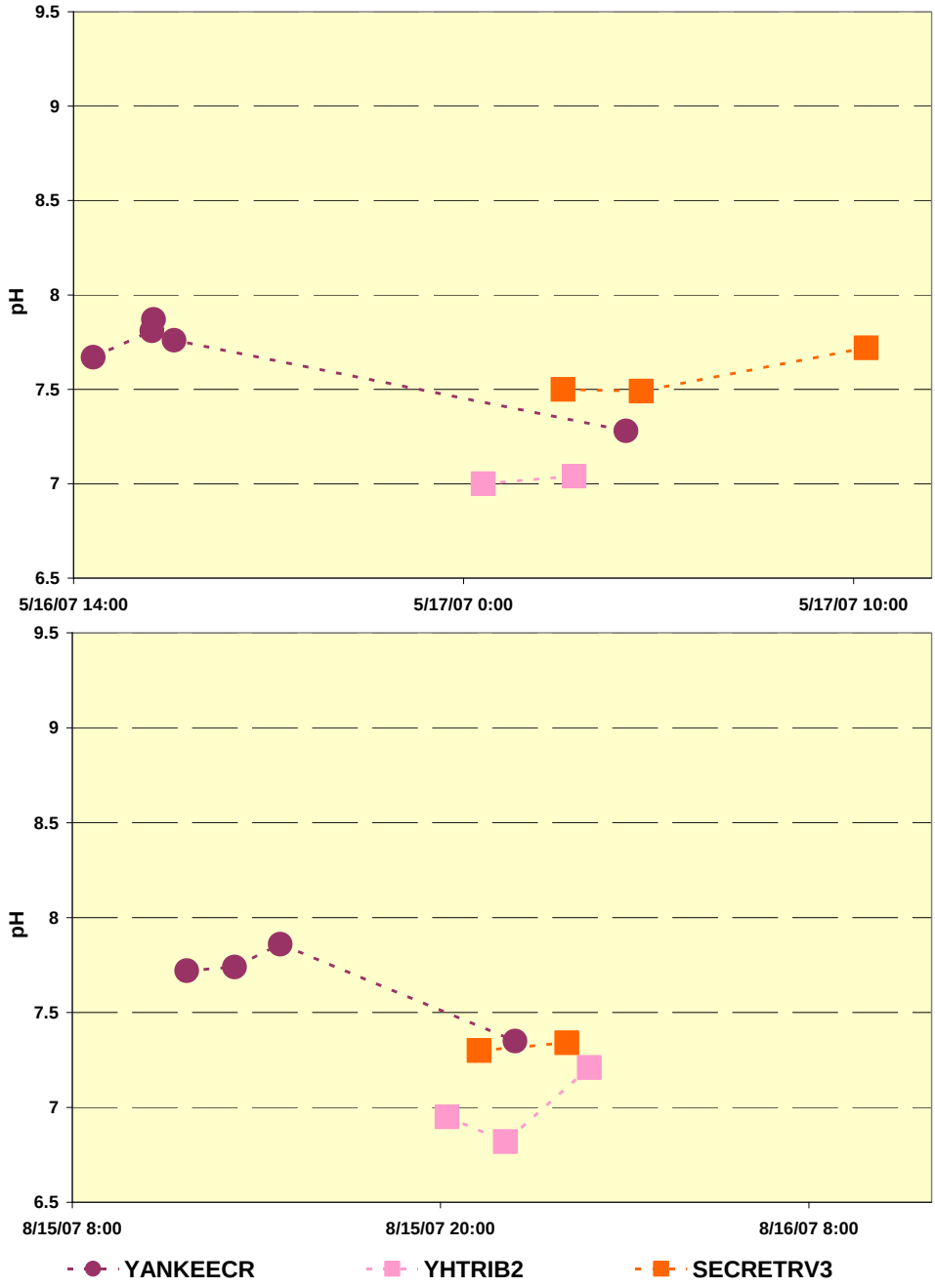

FIGURE 6-13
MEASURED PH LEVELS AT SECRET RAVINE WATERSHED SITES DURING MAY 16, 2007, AND AUGUST 15, 2007, ALGAECIDE APPLICATION EVENTS

No effects on alkalinity and calculated total hardness were observed during algaecide application events. In general, alkalinity and total hardness levels were higher at stream sites compared to canal sites.

Total Suspended Solids and Turbidity

TSS was not sampled during the algaecide application events. No effects on turbidity were observed during the events.

Specific Conductivity and Ions

Measured values in samples collected during monitoring suggest that SC and major ion (calcium, iron, magnesium, potassium, sodium, chloride, nitrate, and sulfate) concentrations at Secret Ravine watershed sites were not affected by algaecide applications.

Trace Elements

Algaecide applications do not appear to affect aluminum, barium, cadmium, and zinc concentrations in study area streams. Copper concentrations at YANKEECR did increase in response to algaecide applications upstream at Boardman Canal below Mammoth Reservoir. Based on measured values of copper in samples collected during monitoring, minimal to no effects on copper concentrations were observed at YHTRIB2 and SECRETRV3. Copper concentrations at sites monitored during the algaecide application events are shown in **Figures 6-14 and 6-15**. Cadmium and zinc concentrations measured at all sites during algaecide application monitoring events were below the detection limit (0.5, and 20 µg/L, respectively).

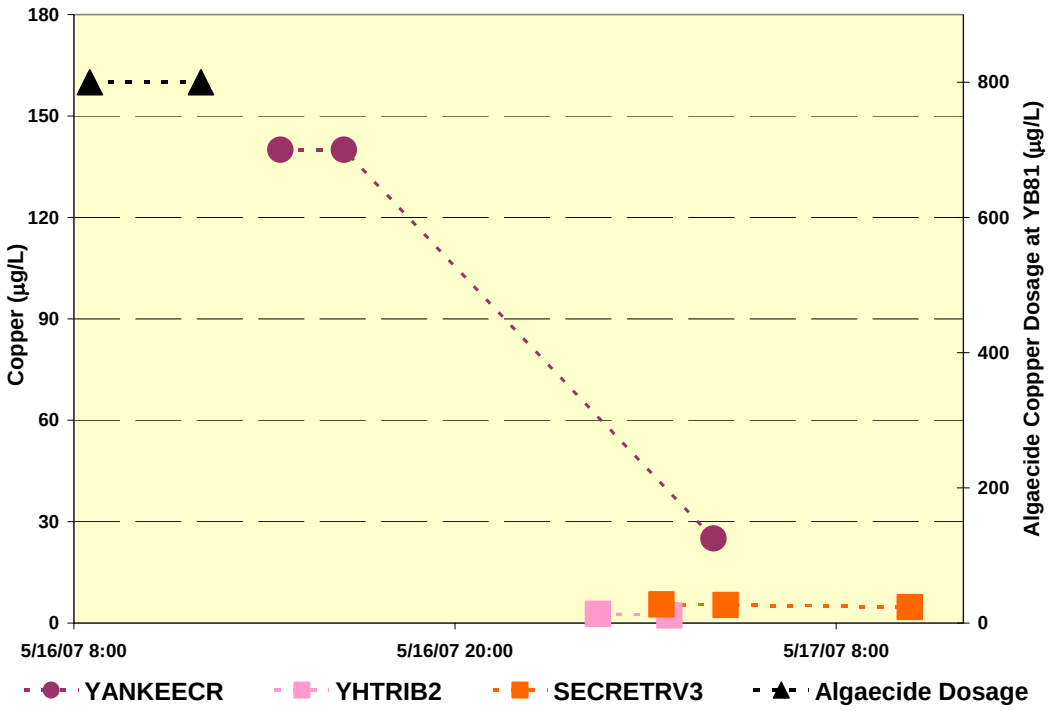

FIGURE 6-14
MEASURED COPPER LEVELS AT SECRET RAVINE WATERSHED SITES DURING MAY 16, 2007, ALGAECIDE APPLICATION EVENT

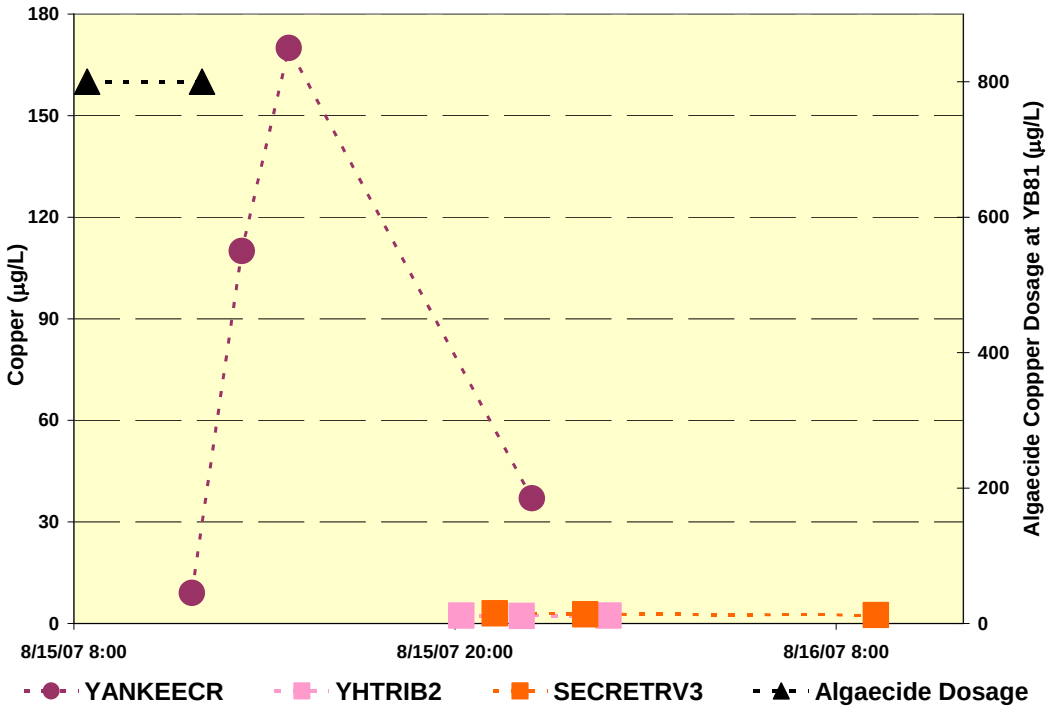

FIGURE 6-15
MEASURED COPPER LEVELS AT SECRET RAVINE WATERSHED SITES DURING AUGUST 15, 2007, ALGAECIDE APPLICATION EVENT

Soils and Sediment Quality

Algaecides are released directly to water supplies at PCWA canal system locations by staff; therefore, effects of applications on soils and sediment quality in the study area are minimal. Potential effects are likely associated with unintentional discharges to the environment during transport of algaecides to application sites and/or leaks from algaecide storage vessels at application sites. These potential effects are not likely due to training and qualifications requirements for staff involved in algaecide applications.

Biological Resources

The following sections describe potential effects of PCWA's algaecide applications on biological resources in the study area.

Terrestrial Habitat and Species

Copper in applied algaecides could have some negative effects on plants and wildlife on the margins of canals and tributaries. Exposure routes for copper through dietary consumption of contaminated prey items or direct contact with contaminated sediments are important and may affect a broad range of terrestrial species (NMFS 2007). Heavy metals, especially copper, have been found to be very toxic to amphibians, particularly at the egg and tadpole life stages (U.S. EPA 2008, B.C. Ministry of Water, Land and Air Protection 2004). Algaecides are typically applied starting in April through summer, which coincides with the breeding season and tadpole stages for several amphibian species. Birds and mammals appear to be less sensitive to copper than aquatic organisms; however, toxic effects have been documented, including reduced growth

rates, lowered egg production, and developmental abnormalities in birds, and various physiological effects on mammals, such as liver cirrhosis, damage to kidneys and the brain, and fetal mortality (U.S. EPA 2008, EXTOXNET 1994a).

Very minimal effects could occur to terrestrial habitats and species associated with trampling of vegetation at application points while algaecides are being applied.

Aquatic Habitat and Species

Based on water quality monitoring results, aquatic habitat and species in study area streams are not likely affected by PCWA activities during algaecide application events. Potential indirect effects are associated with mobilization of constituents associated with fine sediment and organic material that had settled when canals were dewatered during the outage, as described for canal cleaning activities and discussed in **Chapter 7**.

Special Status Species

Copper in applied algaecides could have some negative effects on special status species, if present, on the margins of canals and tributaries. Amphibians in particular are known to be sensitive to such water quality changes, although effects vary dramatically by species, life stage, and contaminant. Algaecides applications typically start during April through summer, which coincides with the breeding season and tadpole stages for several special status amphibians. California red-legged frog breeding occurs between late November and March, though most frogs lay eggs in March (USFWS 2002, Stebbins 2003). The foothill yellow-legged frog breeds between mid-March through early June, and the western spadefoot toad breeds late January through July (Stebbins 2003).

If present, special status plant species could also be affected by trampling while algaecide is being applied.

Based on water quality monitoring results, special status fish species in study area streams are not likely affected by PCWA activities during algaecide application events. Potential indirect effects on special status fish species are associated with mobilization of constituents associated with fine sediment and organic material that had settled when canals were dewatered during the outage, as described for canal cleaning activities and discussed in **Chapter 7**.

Herbicide Application

PCWA's herbicide application activities have the potential to affect natural resource conditions in the study area. The following sections describe potential effects of PCWA's herbicide applications on natural resources.

Physical Resources

The following sections describe potential effects of herbicide applications within the PCWA raw water distribution system on hydrologic and water quality conditions in study area streams, and soils and sediment quality.

Hydrology

Flows within canals are generally not disrupted while PCWA carries out herbicide applications within or near the canal system. Therefore, herbicide applications conducted by PCWA are not likely to affect hydrologic conditions in study area streams.

Water Quality

Potential effects of PCWA herbicide applications for managing pre-emergent vegetation, woody plants, and annual and perennial broadleaf weeds along canal berms were not evaluated through water quality monitoring. Herbicide applications along canal berms are not likely to affect water quality conditions in study area streams due to the rapid degradation of these herbicides, as described in **Chapter 2**.

Water quality was monitored at six locations to evaluate potential effects associated with AquaMaster™ glyphosate aquatic herbicide application events that occurred at Clover Valley and Mammoth reservoirs on August 2, 2007. Two canal monitoring sites and one stream site were sampled downstream from Clover Valley Reservoir in the Antelope Creek watershed, and two canal monitoring sites and one stream site were sampled below Mammoth Reservoir in the Secret Ravine watershed (**Figure 5-4**). Water quality conditions were not monitored at Auburn Ravine, Clover Valley Creek, or Miners Ravine sites, but are likely to be similar to conditions described below for Antelope Creek and Secret Ravine. **Table 6-8** below lists the aquatic herbicide application information and sites monitored for each sampling event. Water quality parameters evaluated through monitoring during the aquatic herbicide application events include water temperature, DO, pH, SC, turbidity, alkalinity, and glyphosate. The results from water quality monitoring during herbicide application events are discussed in this section by watershed. Figures providing a comparison of water quality conditions within the PCWA raw water distribution system and study area streams monitored during herbicide application monitoring events are included in **Appendix C**.

TABLE 6-8
WATER QUALITY MONITORING LOCATIONS IN THE PCWA SERVICE AREA FOR HERBICIDE APPLICATION

Site Description	Site Identification	Site Type	Watershed(s)	Application Start /End Time	Weather
Herbicide Application at Mammoth Reservoir (Glyphosate)					
Boardman Canal below Mammoth Reservoir	YB81	Canal	Miners Ravine/Secret Ravine	Start: 8/2/2007, 8:00 a.m. End: 8/2/2007, 11:30am	Warm and dry, light rain at night
Boardman Canal Outlet Release	BOARDMANCR	Canal	Secret Ravine		
Secret Ravine at Rocklin Road	SECRETRV3	Stream	Secret Ravine		
Herbicide Application at Clover Valley Reservoir (Glyphosate and Reward)					
Clover Valley Reservoir release to Clover Valley Creek and Antelope Canal	CLVRESR	Canal	Antelope Creek/Clover Valley Creek	Start: 8/15/2007, 8:25 a.m. End: 8/15/2008, 12:00 p.m.	Warm and dry
Antelope Stub Canal near Antelope Canal	ANTSTUBCR	Canal	Antelope Creek		
Antelope Creek at Midas Avenue	ANTC3B	Stream	Antelope Creek		

Antelope Creek Watershed

AquaMaster™ was applied to emergent aquatic vegetation along the perimeter of Clover Valley Reservoir on August 2, 2007. Water quality was monitored at:

- **Clover Valley Reservoir release to Clover Valley Creek and Antelope Canal (CLVRESR)**
- **Antelope Stub Canal near Antelope Canal (ANTSTUBCR)**
- **Antelope Creek near Midas Avenue (ANTC3B)**

Based on water quality results, Antelope Creek water temperatures, DO, pH, alkalinity, SC, and turbidity conditions were not affected by the aquatic herbicide application event at Clover Valley Reservoir. Minimal changes in water temperature and DO observed during monitoring are likely due to diurnal fluctuations. The aquatic herbicide application event also did not appear to affect glyphosate concentrations in Antelope Creek; all water quality samples collected at Antelope Creek watershed sites during the monitoring event had glyphosate concentrations below the measurable detection limit (6 μg/L).

Secret Ravine Watershed

AquaMaster™ was applied to emergent aquatic vegetation along the perimeter of Mammoth Reservoir on August 2, 2007. Water quality was monitored at:

- **Boardman Canal below Mammoth Reservoir (YB81)**
- **Boardman Canal Outlet Release (BOARDMANCR)**
- **Secret Ravine at Rocklin Road (SECRETRV3)**

Similar to the conditions described above within the Antelope Creek watershed, the aquatic herbicide application event did not appear to affect water temperature, DO, pH, alkalinity, SC, turbidity, or glyphosate conditions at Secret Ravine watershed sites. All water quality samples collected during the monitoring event had glyphosate concentrations below the measurable detection limit (6 μg/L).

Soils and Sediment Quality

PCWA's application of herbicides along canal berms likely result in temporary effects on soil chemistry. Chemical constituents of herbicides applied by PCWA may include triclopyr, glyphosate, dithiopyr, diquat dibromide, and non-ionic alkylphenol ethoxylate surfactants. As described in **Chapter 2**, these constituents, with the exception of diquat dibromide, degrade rapidly to inert compounds or products with low toxicity. Diquat dibromide is tightly adsorbed to soil particles, persistent, toxic to fish and wildlife, and is unavailable to soil microbes' microbial degradation and for plant uptake.

Biological Resources

The following sections describe potential effects of PCWA's herbicide applications on biological resources in the study area.

Terrestrial Habitat and Species

Application of herbicide may result in indirect mortality or damage to non-target vegetation. Herbicides may also affect wildlife species, particularly amphibians. Glyphosate herbicides, which are used near water, are generally less toxic to wildlife than other types of herbicide; however, effects vary dramatically by concentration of contaminant, species, and life stage. Some studies of glyphosates on amphibians have found negative effects at various life stages, including mortality, developmental defects, and behavioral abnormalities (B.C. Ministry of Water, Land and Air Protection 2004).Other components, such as surfactants, commonly contained in glyphosate formulations, including Roundup®, have also been found to cause severe negative effects to amphibians (USFWS 2002). Herbicides are typically applied in early spring through summer, which coincides with the breeding season for several amphibian species. Glyphosates have been found to be only slightly toxic to birds and mammals (EXTOXNET 1994b, Tu et al. 2001). Triclopyr was also found to be only slightly toxic to birds and mammals (EXTOXNET 1994b, Tu et al. 2001). According to these sources, triclopyr is not expected to bioaccumulate in wildlife. A study in Canada, however, found triclopyr to be harmful to amphibians under normal field use (Thompson et al. 2007).

Aquatic Habitat and Species

Based on results from water quality monitoring during herbicide applications, aquatic habitat and species in study area streams are not likely affected by the application of AquaMaster™ glyphosate aquatic herbicide at PCWA reservoirs. Glyphosate herbicides designed for aquatic use, such as AquaMaster™, have minimal surfactants, and thus have a low toxicity level to fish. Glyphosate dissipates in water by binding to soil particles and organic material or through microbial degradation. Any fish present in Mammoth and Clover Valley reservoirs are likely to suffer minimal effects resulting from the use of AquaMaster™ as an herbicide.

Special Status Species

Application of herbicide may result in indirect mortality or damage to untargeted special status plants or elderberry shrubs hosting the valley elderberry longhorn beetle, if present near the application area. Herbicides may also affect special status wildlife species, particularly amphibians, if present. Herbicides are typically applied in early spring through summer, which coincides with the breeding season for several special status amphibians. California red-legged frog breeding occurs between late November and March, though most frogs lay eggs in March (USFWS 2002, Stebbins 2003). The foothill yellow-legged frog breeds between mid-March through early June, and the western spadefoot toad breeds late January through July (Stebbins 2003).

Special status fishes are not likely affected by the application of the herbicides within the canal system. Herbicides applied by PCWA have a relatively short half life, and AquaMaster™ is relatively nontoxic to fishes.

Other special status species, particularly amphibians, may be negatively affected by applications of herbicides if in close proximity to the application. Water quality monitoring results during the herbicide application event do not show effects to stream habitat.

6.1.2 As-Needed Site-Specific Maintenance Activities

The following sections address potential effects of PCWA's as-needed site-specific maintenance activities on natural resource conditions in the study area. These activities include canal lining/guniting, canal repair, and pipe repair.

6.1.2.1 Canal Lining/Guniting

This section provides an overview of the potential effects of PCWA's canal lining/guniting activities.

Physical Resources

The following sections describe potential effects of PCWA canal repair activities on hydrologic and water quality conditions in study area streams, and soils and sediment quality.

Hydrology

PCWA operations during canal lining/guniting activities do not affect hydrologic conditions in Canyon Creek or Auburn Ravine. During the canal cleaning and flushing, PCWA canal system contributions to streamflow in Canyon Creek and Auburn Ravine, and/or diversions from

Canyon Creek and Auburn Ravine, do not change as a result of PCWA operations. As described above for canal cleaning and flushing activities, continuous-flow data collected from canal and stream sites within PCWA's lower Zone 1 service area during WDY 2006 were evaluated to determine effects of canal lining/guniting activities on hydrologic conditions in Clover Valley Creek, Antelope Creek, Secret Ravine, and Miners Ravine. Continuous-flow monitoring locations, and their respective watersheds, are listed in **Table 6-1**.

Table 6-9 provides PCWA's schedule of canal lining/guniting within a portion of PCWA's raw water distribution system during 2006. During these outages for canal lining/guniting, canal flows were typically interrupted during business hours to dewater canal segments, apply gunite to dewatered segments, and allow sufficient time for the new canal lining to dry.

TABLE 6-9
CANAL OUTAGES FOR CANAL LINING/GUNITE DURING 2006

Canal	Date
East Perry near Horseshoe Bar Road	March 6, 7, 8
Boardman near Valley Quail Drive	March 13, 14, 15
Baughman near headgate	March 15, 16
Baughman downstream from Mutoza spill	March 17, 20
Ferguson at Morgan Place/Wells Lane	March 17, 20
End of Stallman Canal	July 18
Boardman at Rocklin road	September 14, 21

Average daily flows for canal and stream sites evaluated during March 2006 canal lining/guniting are shown in **Figure 6-1** for sites within the Secret Ravine watershed, and in **Figure 6-2** for sites within the Miners Ravine watershed. Based on the average daily flows for sites provided in **Figures 6-1** and **6-2,** the short duration reduction in flows within the PCWA canal system during March 2006 canal lining/guniting activities are not likely to affect flow conditions in study area streams. Precipitation runoff within the watersheds of study area streams is likely to have a much greater influence on stream flow conditions during spring season canal lining/guniting activities. Precipitation during March 2006 is shown in **Figure 6-3**. Effects on flow conditions in Antelope Creek and Clover Valley Creek are likely similar to conditions shown for Secret and Miners ravines.

Canal lining/guniting activities during September 2006 are likely to have some effect on flow conditions in study area streams, although canal system contributions to flow within study area streams through unregulated releases from canal outlets are variable. Average hourly flows for the end of Boardman Canal outlet, downstream from canal lining/guniting activities, are shown in **Figure 6-16**. Average daily flows for Secret Ravine at Rocklin Road, which is located just upstream from the Boardman Canal outlet, are also shown in **Figure 6-16**. Based on flow data observed during September 2006, canal lining/guniting during the dry season does have the potential to affect hydrologic conditions in study area streams. **Figure 6-16** shows releases from the end of Boardman Canal potentially comprise approximately one-third of flow in Secret Ravine during September 2006.

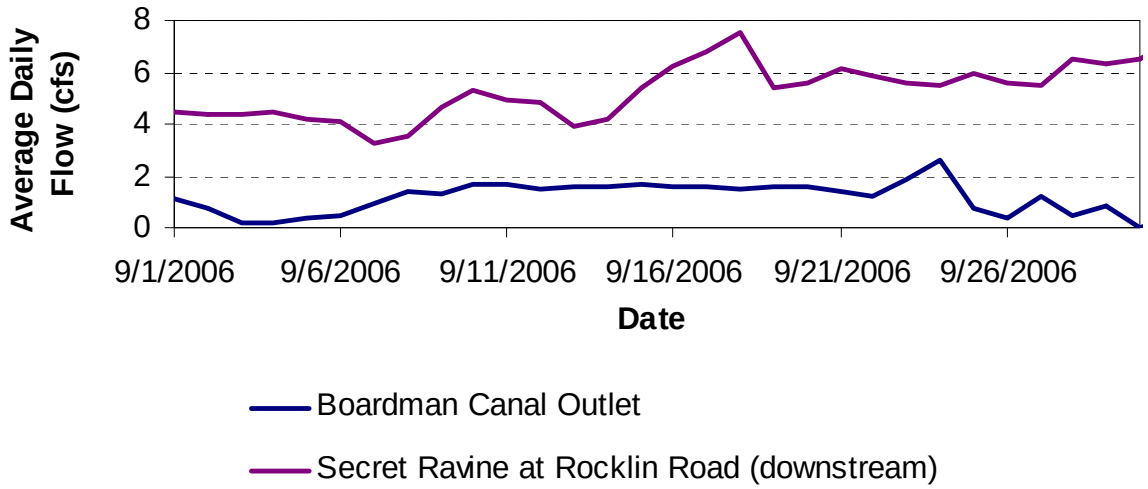

FIGURE 6-16
CANAL OUTLET AND SECRET RAVINE FLOW RESPONSES TO CANAL LINING/GUNITING ACTIVITIES

Water Quality

Water quality conditions were monitored for PCWA canal lining/guniting activities on February 16, 2007, March 16, 2007, and March 20, 2007, at sites within the Clover Valley Creek, Secret Ravine, and Miners Ravine watersheds, respectively. These locations, shown in **Figures 5-3 and 5-4**, were selected according to canal lining activity locations. **Table 6-10** lists the monitoring site names, site type, associated watershed, and information related to the canal lining/guniting activity. Water quality conditions were not evaluated in the Auburn Ravine, Antelope Creek, or Miners Ravine watersheds, but are likely to be similar to conditions described below for Clover Valley Creek, Secret Ravine, and Miners Ravine. Figures providing a comparison of water quality conditions within the PCWA raw water distribution system and study area streams monitored during monitoring events for canal lining/guniting are included in **Appendix C**.

Clover Valley Creek Watershed

Water quality conditions in the Clover Valley Creek watershed were evaluated at the following sites during canal lining/guniting activities along sections of the Antelope Canal on February 16, 2007:

- **Antelope Canal (ANTCA):** located on the Antelope Canal upstream from the Antelope Canal Outlet. This site was upstream from the canal lining activity, but was located within a dewatered section of the canal.

- **Antelope Canal Outlet Release (ANTCR):** Unregulated releases from this canal flow into an unnamed tributary that contributes flows to Clover Valley Creek.

- **Clover Valley Creek at Rawhide Road (CLVRC6)**: located on Clover Valley Creek at Rawhide Road upstream from Antelope Canal Outlet.

- **Clover Valley Creek near Argonaut Avenue (CLVRC3B)**

TABLE 6-10
WATER QUALITY MONITORING LOCATIONS IN THE PCWA SERVICE AREA FOR CANAL LINING/GUNITING ACTIVITIES

Site Description[1]	Site Identification	Type	Watershed(s)	Canal Lining Start/End Time	Weather
Antelope Canal near Antelope Canal Outlet					
Antelope Canal above Outlet Release	ANTCA	Canal	Clover Valley Creek	Start: 2/16/2007, 5:00am End: 2/16/2007, 8:00pm	Warm and dry
Antelope Canal Outlet Release	ANTCR	Canal	Clover Valley Creek		
Clover Valley Creek near Rawhide Road	CLVRC6	Stream	Clover Valley Creek		
Clover Valley Creek near Argonaut Avenue (near Golf Course)	CLVRC3B	Stream	Clover Valley Creek		
Boardman Canal downstream from Baughman Canal					
Boardman Canal below Head of Baughman Canal	YB155	Canal	Secret Ravine	Start: 3/15/2007, 5:00am End: 3/15/2007, 8:10pm	Warm and dry
Boardman Canal below Head of Baughman Canal – downstream	YB155DS	Canal	Secret Ravine		
Boardman Canal Outlet Release	BOARDMANCR	Canal	Secret Ravine		
Secret Ravine at Rocklin Road	SECRETRV3	Stream	Secret Ravine		
Secret Ravine at Roseville Parkway	SECRETRV2	Stream	Secret Ravine		
Boardman Canal near Laird Pump					
Boardman Canal near Laird Pump	315BDU	Canal	Miners Ravine/ Secret Ravine	Start: 3/20/07, 5:00am End: 3/20/07 at 6:30pm	Light Rain
Boardman Canal near Laird Pump	315BDD	Canal	Miners Ravine/ Secret Ravine		
Baughman Canal Outlet Release	BAUGHMANCR	Canal	Miners Ravine		
Tributary to Miners Ravine from Baughman Canal	BCTRIB1	Drainage	Miners Ravine		
Miners Ravine at Moss Lane	MINERSRV5	Stream	Miners Ravine		

Water Temperature and Dissolved Oxygen

Water temperature or DO levels observed at Clover Valley Creek downstream from canal lining activities were not affected by of canal lining along the Antelope Canal.

pH, Alkalinity, and Hardness

Measured pH values at ANTCR increased to up to 11.66 after flows were restored to Antelope Canal following canal lining. Alkalinity and hardness at the Antelope Canal Outlet release also increased for a short duration. Based on water quality measurements upstream (CLVRC6) and downstream (CLVRC3B) from the canal lining, pH, alkalinity, and hardness conditions in Clover Valley Creek did not appear to be affected by canal lining activities. These results are shown below in **Figures 6-17** to **6-19**.

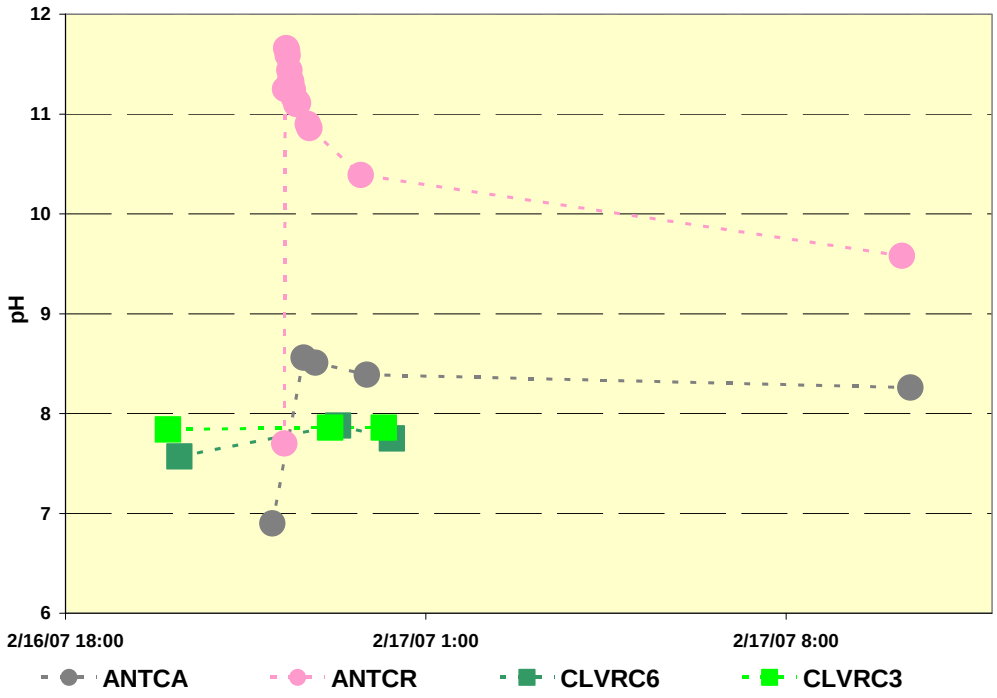

FIGURE 6-17
MEASURED PH LEVELS AT CLOVER VALLEY CREEK WATERSHED SITES DURING FEBRUARY 16, 2007, CANAL LINING EVENT

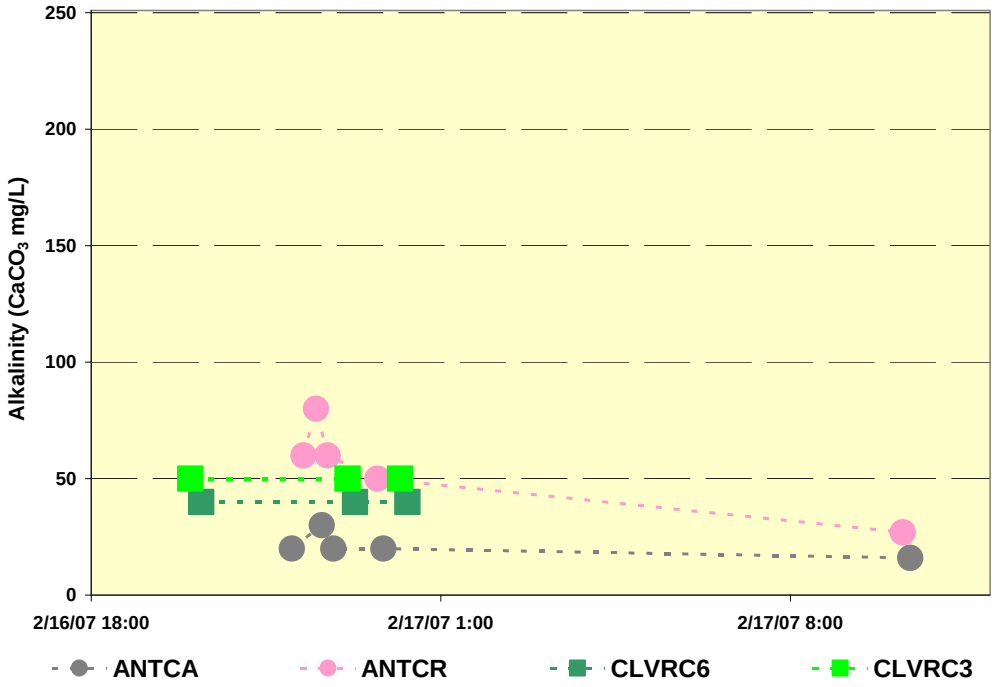

FIGURE 6-18
MEASURED ALKALINITY LEVELS AT CLOVER VALLEY CREEK WATERSHED SITES DURING FEBRUARY 16, 2007, CANAL LINING EVENT

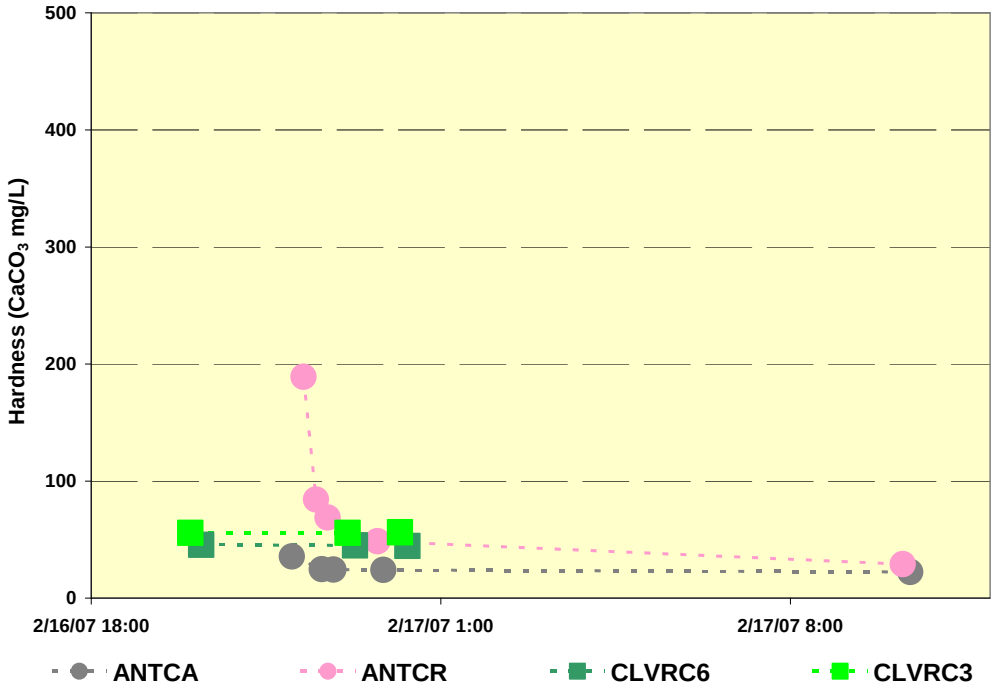

FIGURE 6-19
MEASURED HARDNESS LEVELS AT CLOVER VALLEY CREEK WATERSHED SITES DURING FEBRUARY 16, 2007, CANAL LINING EVENT

Total Suspended Solids and Turbidity

TSS and turbidity levels measured at ANTCR were very high for a short duration (about 1 hour) after flows were restored to Antelope Canal following canal lining, but were also comparably high upstream from the canal lining, at ANTCA. Samples collected at Clover Valley Creek sites suggest that Clover Valley Creek TSS and turbidity conditions, however, were not affected by canal lining. TSS and turbidity levels at Clover Valley Creek watershed sites from the canal lining monitoring event are shown in **Figures 6-20** and **6-21**.

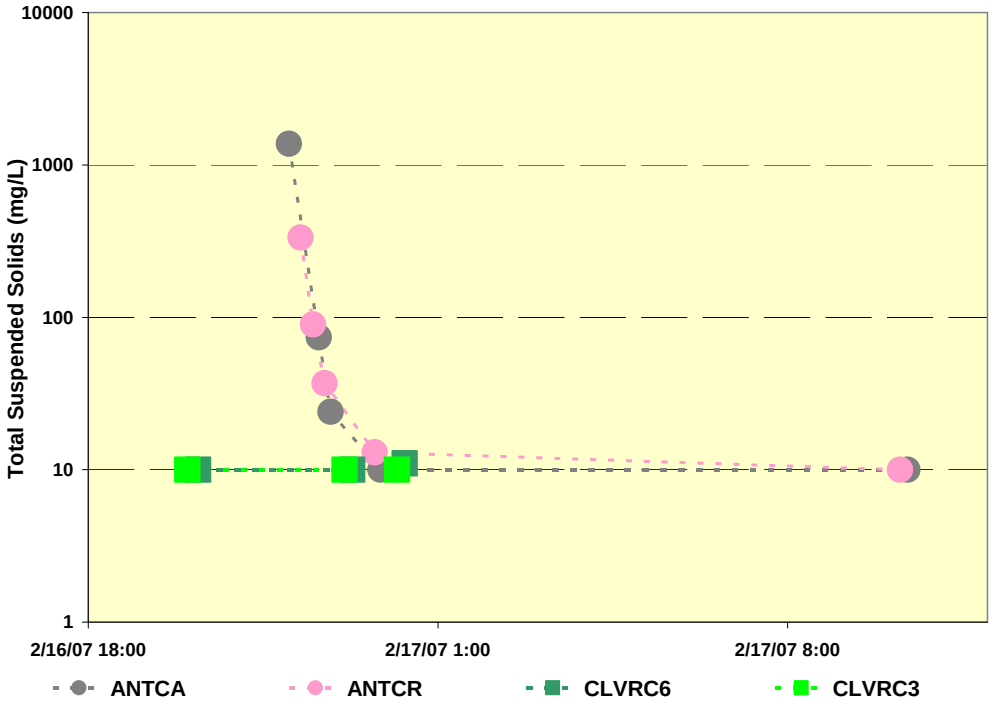

FIGURE 6-20
MEASURED TOTAL SUSPENDED SOLIDS LEVELS AT CLOVER VALLEY CREEK WATERSHED SITES DURING FEBRUARY 16, 2007, CANAL LINING EVENT

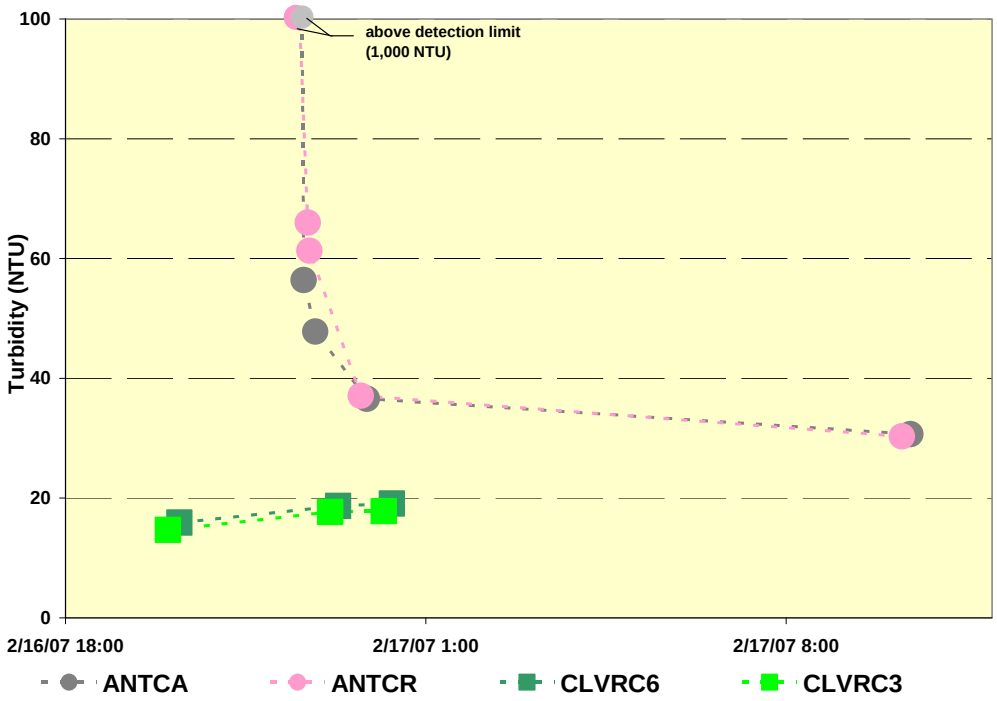

FIGURE 6-21
MEASURED TURBIDITY LEVELS AT CLOVER VALLEY CREEK WATERSHED SITES DURING FEBRUARY 16, 2007, CANAL LINING EVENT

Specific Conductivity and Ions

SC and ion concentrations (calcium, iron, magnesium, potassium, sodium, chloride, nitrate, sulfate) measured at ANTCR were high for a short duration after flows were restored to Antelope Canal following canal lining, then decreased rapidly. Based on water quality data collected during the sampling event, these elevated levels at ANTCR did not appear to affect SC or major ion concentrations downstream from canal lining at Clover Valley Creek.

Trace Elements

Measured concentrations of aluminum, barium, copper, and zinc at ANTCR were high immediately following the canal lining activity upstream. These high concentrations were likely associated with flushing of sediment and other material that settled after the canal was dewatered for canal cleaning. Aluminum levels measured at CLVRC3 increased following the canal lining activity, but also increased at Clover Valley Creek upstream from the canal lining activity (CLVRC6), suggesting that the increase is not likely associated with the canal lining event. Water quality data collected during the sampling event did not show any effects associated with the canal lining activity on barium, copper, and zinc concentrations at Clover Valley Creek. Aluminum, barium, copper, and zinc results from the canal lining monitoring event are shown in **Figures 6-22** to **6-25**. Cadmium concentrations measured at all sites during the canal cleaning monitoring event were below the detection limit (0.5 µg/L).

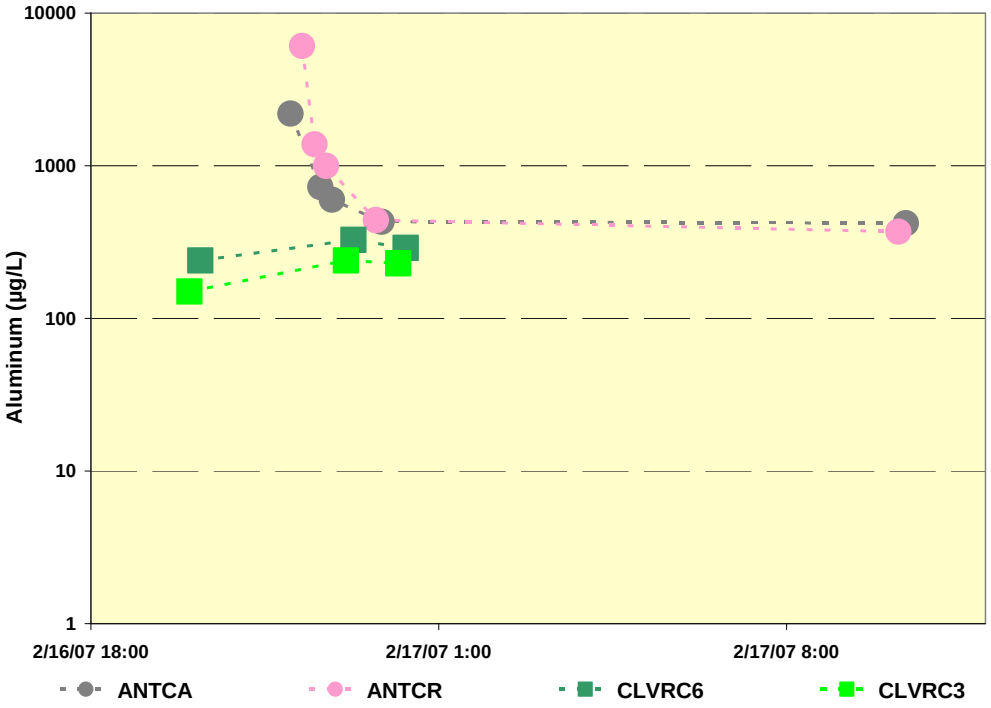

FIGURE 6-22
MEASURED ALUMINUM LEVELS AT CLOVER VALLEY CREEK WATERSHED SITES DURING FEBRUARY 16, 2007, CANAL LINING EVENT

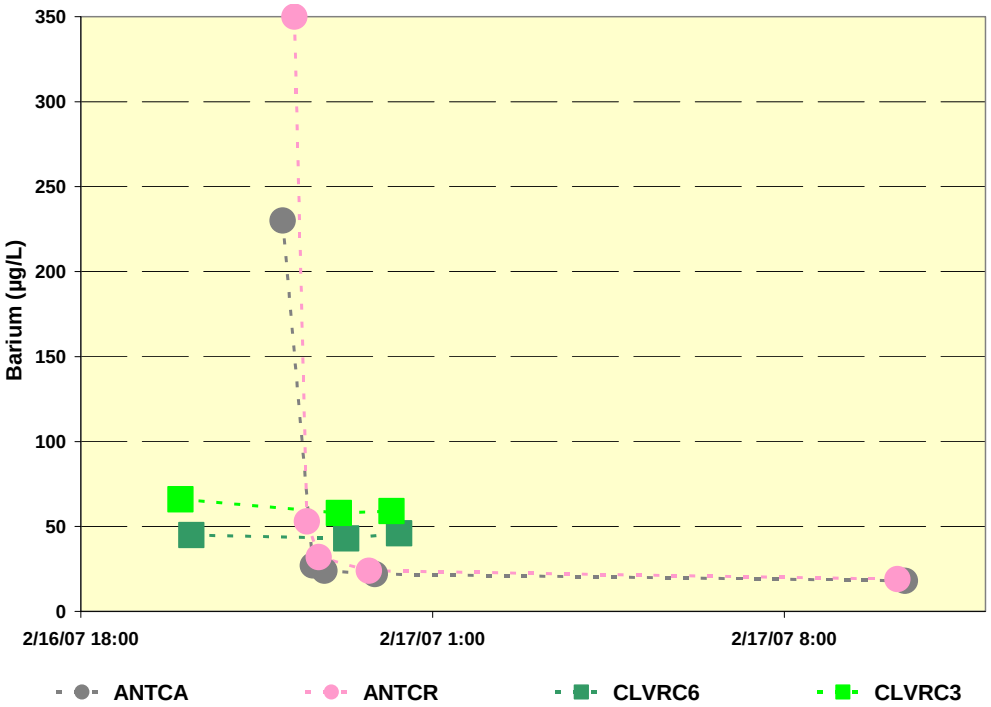

FIGURE 6-23
MEASURED BARIUM LEVELS AT CLOVER VALLEY CREEK WATERSHED SITES DURING FEBRUARY 16, 2007, CANAL LINING EVENT

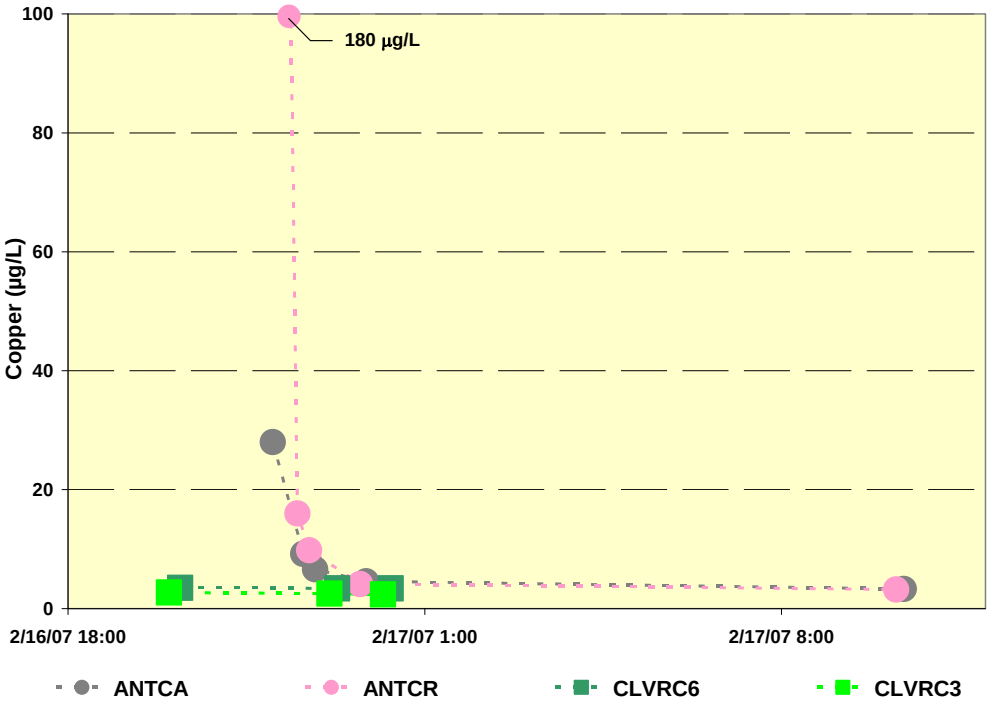

FIGURE 6-24
MEASURED COPPER LEVELS AT CLOVER VALLEY CREEK WATERSHED SITES DURING FEBRUARY 16, 2007, CANAL LINING EVENT

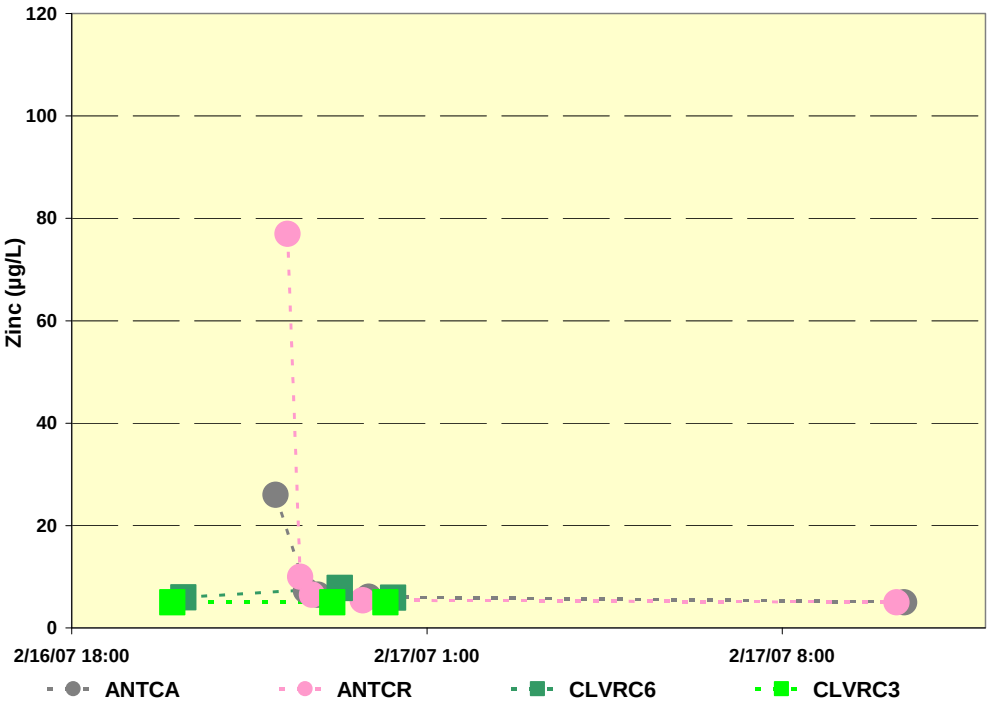

FIGURE 6-25
MEASURED ZINC LEVELS AT CLOVER VALLEY CREEK WATERSHED SITES DURING FEBRUARY 16, 2007, CANAL LINING EVENT

Secret Ravine Watershed

Water quality conditions in the Secret Ravine watershed were evaluated at the following sites after canal lining/guniting activities along a section of the Boardman Canal downstream from the head of the Baughman Canal on March 20, 2007:

- **Boardman below the head of Baughman Canal (YB155)**: located along the Boardman Canal just below the head of the Baughman Canal.
- **Boardman downstream from YB155 (YB155DS):** located downstream from the lined section along the Boardman Canal.
- **Boardman Canal Outlet Release (BOARDMANCR)**
- **Secret Ravine at Rocklin Road (SECRETRV3)**
- **Secret Ravine at Roseville Parkway (SECRETRV2)**

Water Temperature and Dissolved Oxygen

Water quality results suggest that the canal lining/guniting activity monitored did not affect water temperature or DO conditions in Secret Ravine. Minimal to no effects on water temperature and DO were observed in Secret Ravine following canal lining/guniting along the Boardman Canal. DO levels increased slightly at YB155DS and BOARDMANCR for a short duration after flows were restored to the canal following the canal lining.

pH, Alkalinity, and Hardness

Measured values for pH, alkalinity, and hardness at Secret Ravine did not appear to be affected by canal lining activities. The pH levels observed at YB155DS increased to very high levels (up to 11.62) following the canal lining activity, and also increased slightly at BOARDMANCR, but did not affect pH at SECRETRV2. These results of pH measurements are shown in **Figure 6-26**. Alkalinity and hardness values at YB155DS increased after canal lining, but these increases did not result in an increase to alkalinity or hardness for samples collected at BOARDMANCR or SECRETRV2.

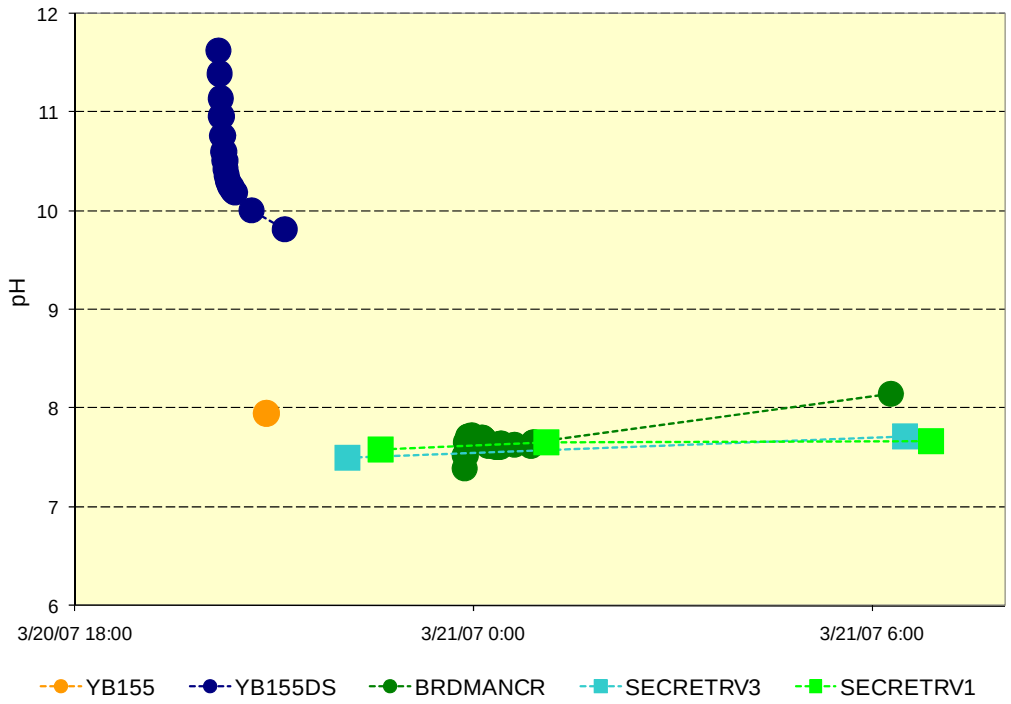

FIGURE 6-26
MEASURED PH LEVELS AT SECRET RAVINE WATERSHED SITES DURING MARCH 20, 2007, CANAL LINING EVENT

Total Suspended Solids and Turbidity

Despite increases in TSS and turbidity values at YB155DS and BOARDMANCR, TSS and turbidity values measured at SECRETRV2 do not appear to be affected by canal cleaning activities. The high TSS and turbidity values measured at canal sites downstream from the canal lining activity are likely associated with flushing of sediment and other material that settled after the canal was dewatered for canal cleaning.

Specific Conductivity and Ions

SC, calcium, iron, magnesium, potassium, sodium, chloride, nitrate, and sulfate concentrations all increased at YB155DS following canal cleaning, similar to TSS and turbidity. These increases upstream, however, did not appear to affect SC and ion concentrations at the Boardman Canal Outlet release to Secret Ravine or at SECRETRV2.

Trace Elements

Measured concentrations of aluminum were high across all sites evaluated during the canal lining monitoring event, with highest values at YB155DS immediately after flows were restored to the canal below the canal lining activity. Because aluminum concentrations were high in all samples collected during the event, aluminum levels in Secret Ravine are not likely affected by canal lining activities. Barium, copper, and zinc concentrations also increased at YB155DS after flows were restored to Boardman Canal below the canal lining activity. Based on water quality

results, concentrations of these constituents in Secret Ravine do not appear to be affected by canal lining activities upstream.

Miners Ravine Watershed

Water quality conditions in the Miners Ravine watershed were evaluated after a section of the Boardman Canal near Laird Pump was lined on March 15, 2007. The sites monitored during the event include:

- **Boardman Canal near Laird Pump, upstream (315BDU)**: located along the Boardman Canal near Laird Pump, upstream from the lining/guniting event.
- **Boardman Canal near Laird Pump, downstream (315BDD)**: located along the Boardman Canal near Laird Pump, downstream from the lining/guniting event.
- **Baughman Canal Outlet Release (BAUGHMANCR)**
- **Tributary to Miners Ravine from Baughman Canal (BCTRIB1)**
- **Miners Ravine at Moss Lane (MINERSRV5)**

Due to the extensive length of the unnamed tributary to Miners Ravine from Baughman Canal and long travel time from BAUGHMANCR to BCTRIB1, samples obtained during canal lining activities at BCTRIB1 and MINERSRV5 were intended to provide a relative comparison of water quality conditions in receiving waters downstream from BAUGHMANCR.

Water Temperature and Dissolved Oxygen

Water temperature and DO conditions at stream sites in the Miners Ravine watershed did not appear to be affected by canal lining/guniting activities along the Boardman Canal. DO levels temporarily decreased then increased at 315DD and BAUGHMANCR, but these fluctuations are not likely to affect conditions at stream sites in the Miners Ravine watershed.

pH, Alkalinity, and Hardness

Measured values of pH, alkalinity, and hardness increased to very high levels at 315DD following canal lining activities, but are not likely to affect conditions at Miners Ravine. Values for pH measured at BAUGHMANCR also increased for a short duration, then gradually decreased and stabilized to baseline levels. Results from pH measurements at Miners Ravine watershed sites during the canal lining monitoring event are shown in **Figure 6-27**.

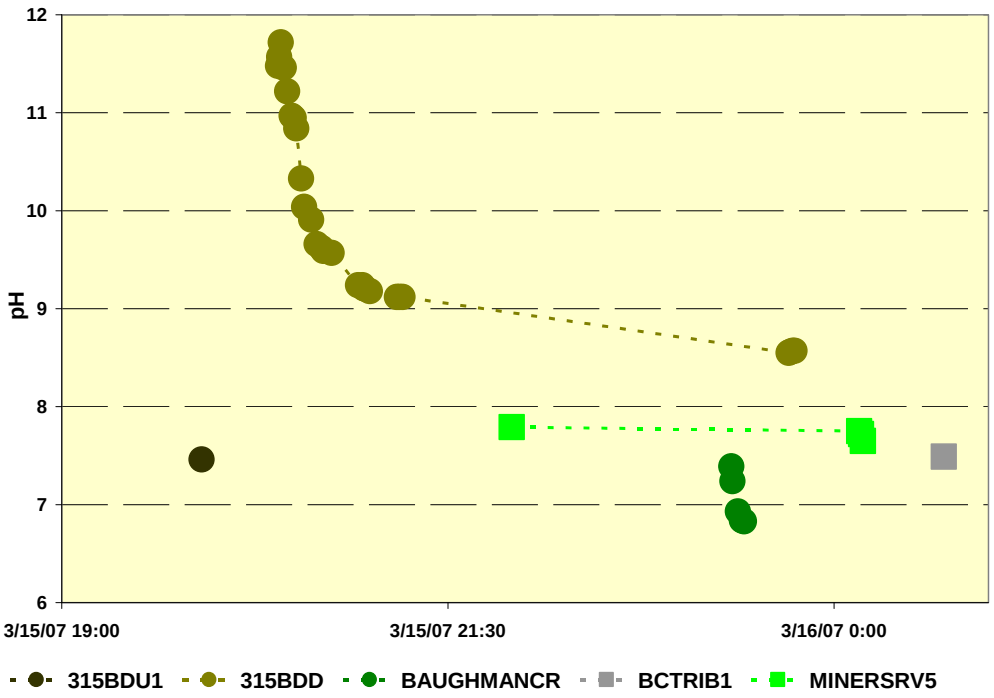

FIGURE 6-27
MEASURED PH LEVELS AT MINERS RAVINE WATERSHED SITES DURING MARCH 15, 2007, CANAL LINING EVENT

Total Suspended Solids and Turbidity

TSS and turbidity values measured at 315BDD and BAUGHMANCR increased after flows were restored to the canals following canal lining. Turbidity measured at BAUGHMANCR the exceeded detection limit (1,000 NTUs) for some samples. These increases were not likely to affect TSS and turbidity conditions in Miners Ravine. Similar to other canal dewatering activities, these high TSS and turbidity values are likely associated with flushing of sediment and other material that settled after the canal was dewatered for canal lining.

Specific Conductivity and Ions

SC and ion concentrations at Miners Ravine watershed sites exhibited a similar response to canal lining activities as those described for Clover Valley Creek and Secret Ravine watershed sites. SC increased for a short duration at 315BDD, but these increases were not likely to affect conditions downstream in Miners Ravine. Similar trends were observed with calcium, iron, magnesium, potassium, sodium, chloride, nitrate, and sulfate concentrations.

Trace Elements

Aluminum concentrations measured at all Miners Ravine watershed sites during the canal lining event were high, with the highest values at 315BDD immediately after flows were restored to the canal below the canal cleaning activity. Measured barium, copper, and zinc values at 315BDD were also high immediately following the canal lining activity. Sample concentrations of aluminum, copper, and zinc also increased at MINERSRV5 during the event. These increases at MINERSRV5 are not likely to be specifically associated with the canal lining activity, because

MINERSRV5 is upstream from direct canal system inputs to Miners Ravine streamflow, but may be related to canal cleaning activities that occurred within the canal system on March 15, 2007.

Measured concentrations of aluminum were high across all sites in the Miners Ravine watershed evaluated during the canal cleaning monitoring event, with highest values at BAUGHMANCR immediately after flows were restored to the canal below the canal lining activity. Because aluminum concentrations were high in all samples collected during the event, aluminum levels in Miners Ravine are not likely affected by canal lining activities. Barium, copper, and zinc concentrations also increased at YB155DS after flows were restored to Boardman Canal below the canal cleaning activity. Based on water quality results, concentrations of these constituents in Miners Ravine do not appear to be affected by canal lining activities upstream. **Figures 6-28 to 6-31** show aluminum, barium, copper, and zinc results for Miners Ravine watershed sites during the monitoring event for canal lining.

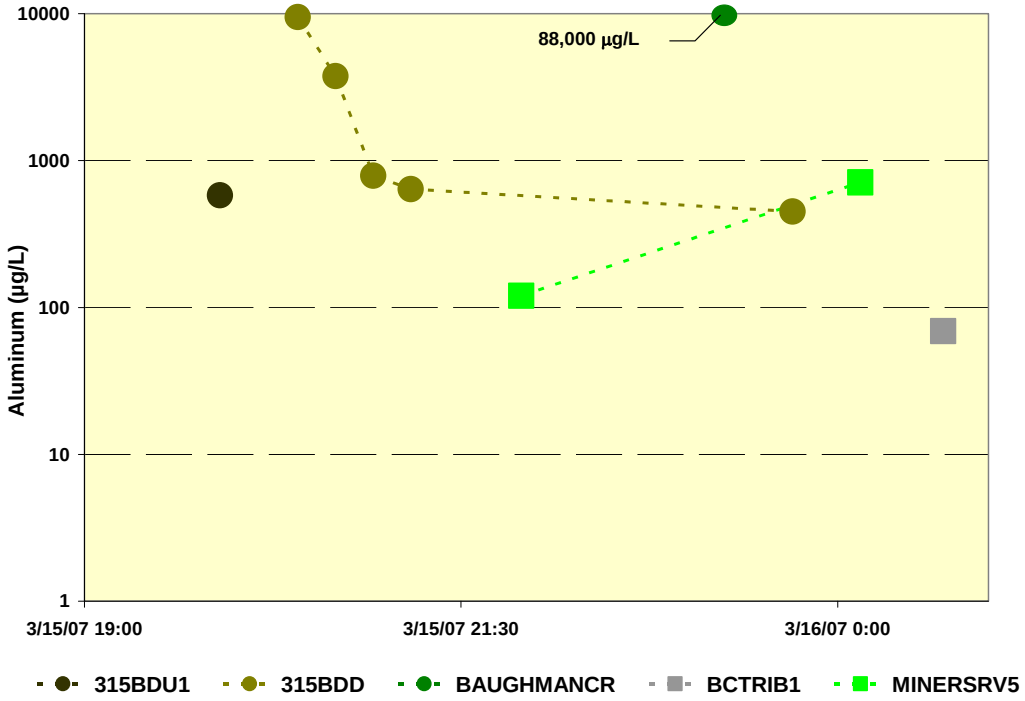

FIGURE 6-28
MEASURED ALUMINUM LEVELS AT MINERS RAVINE WATERSHED SITES DURING MARCH 15, 2007, CANAL LINING EVENT

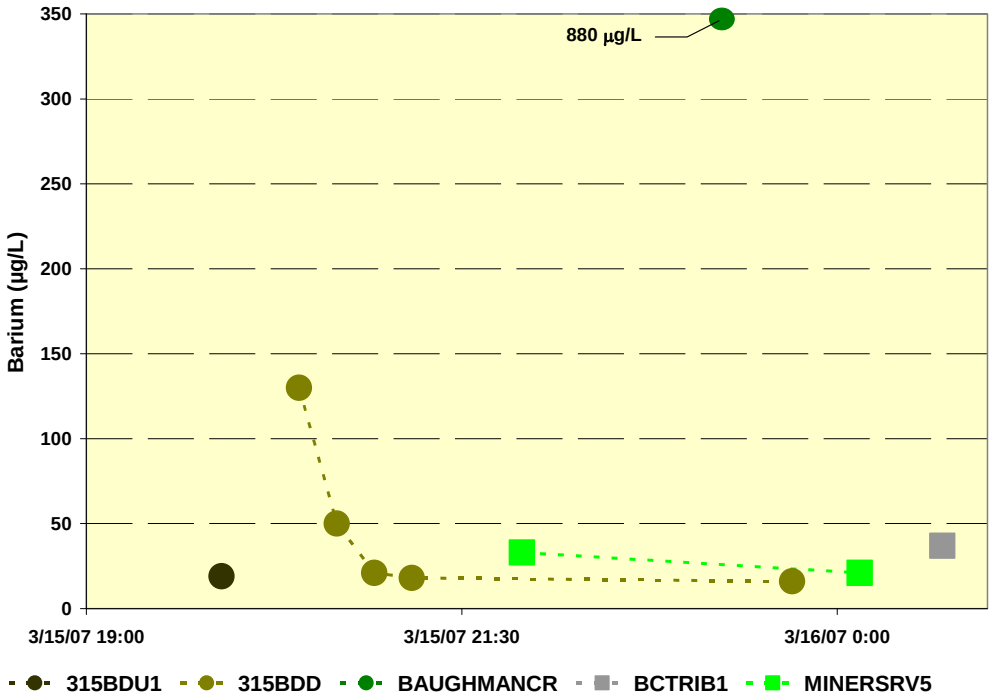

FIGURE 6-29
MEASURED BARIUM LEVELS AT MINERS RAVINE WATERSHED SITES DURING MARCH 15, 2007, CANAL LINING EVENT

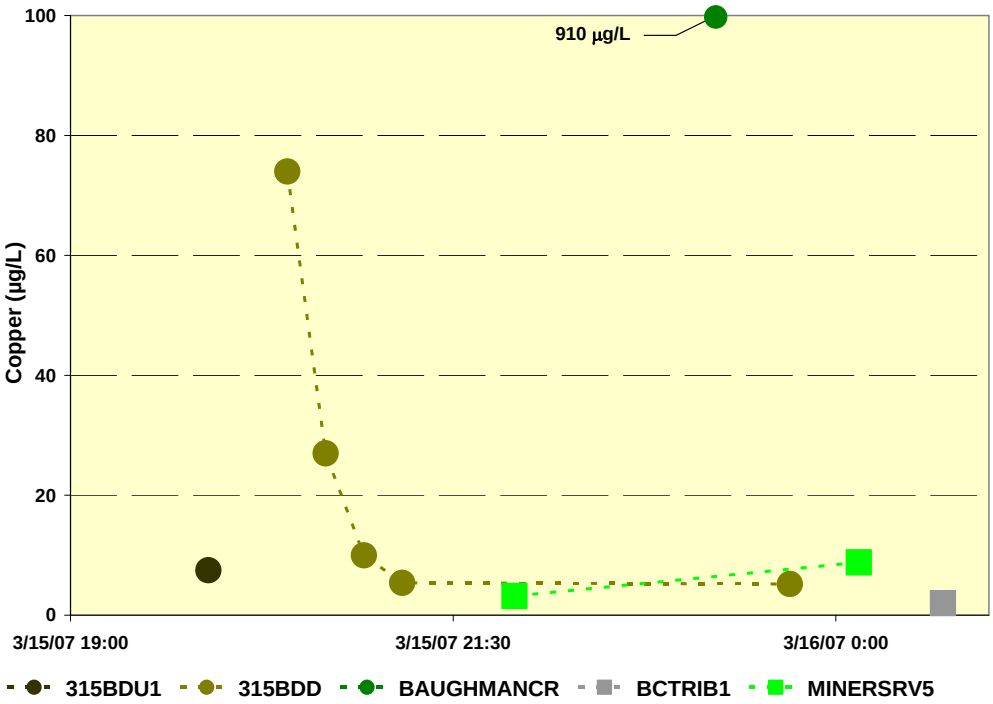

FIGURE 6-30
MEASURED COPPER LEVELS AT MINERS RAVINE WATERSHED SITES DURING MARCH 15, 2007, CANAL LINING EVENT

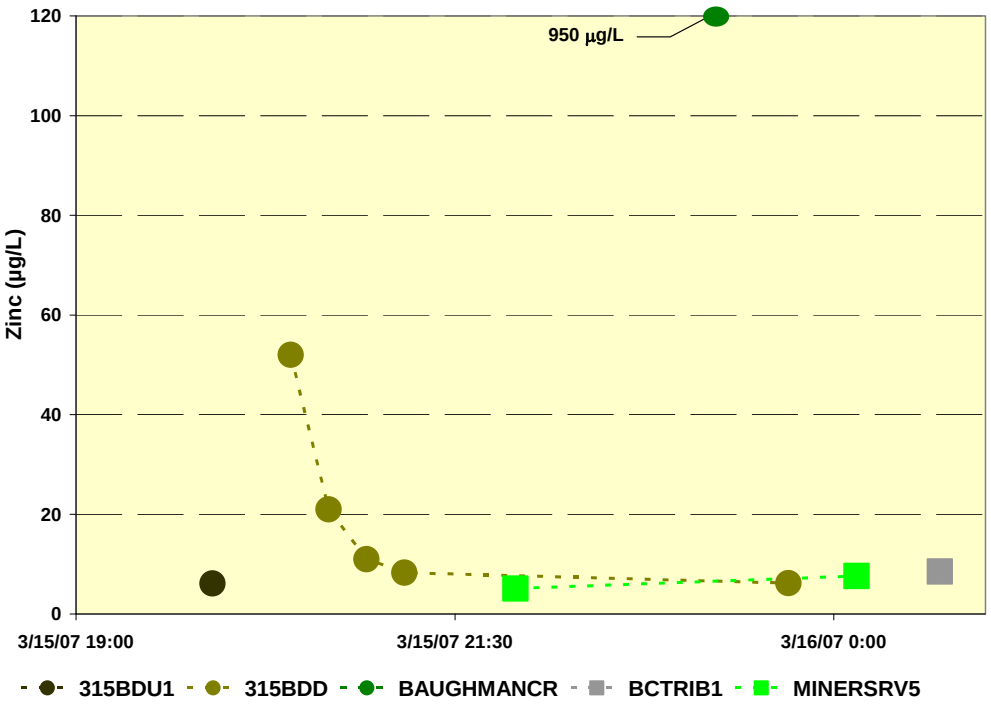

FIGURE 6-31
MEASURED ZINC LEVELS AT MINERS RAVINE WATERSHED SITES DURING MARCH 15, 2007, CANAL LINING EVENT

Soils and Sediment Quality

The potential effects of canal lining/guniting activities are similar to those described above for canal cleaning activities. Canal lining activities may introduce additional copper to study area soils through the removal of sediments from the canal with higher copper concentrations attributed to PCWA's algaecide applications, and deposition of the soils along the canal banks. Additionally, the concrete applied during canal lining activities may increase concentrations of the concrete chemical constituents at the locations of the canal lining activities. Soil compaction and erosion may occur as a result of equipment access and use along canal banks during canal cleaning and lining. Mechanical equipment may also introduce chemical contaminants (i.e., petroleum products) to soils at access sites.

Biological Resources

Terrestrial Habitat and Species

Minimal streamflow decreases in study area streams due to a short duration reduction of flows in the PCWA canal system during canal lining could result in temporary and very minimal decreases in the extent of wetland habitats that may be directly or indirectly supported by canal system operations. This could have minimal effects on species that use these wetland habitats, such as foraging birds and breeding amphibians, by decreasing the amount of available habitat. Reductions in water levels could expose amphibian eggs in the shallow, vegetated margins of drainages or adjacent wetlands. Any potential effects from temporary water reductions on species that use these habitats are expected to be minimal because canal system contributions to

flow within study area streams through unregulated releases from canal outlets are variable. The typical timing of canal lining is during winter, generally outside of the breeding period for most amphibian species; however, canal lining activities can occur throughout the year.

Lining sections of unlined canals may indirectly affect adjacent habitat and species historically supported by canal seepage. Through lining sections of previously unlined canals, oak trees and wetlands may be negatively affected by the decreased seepage along the sections and the resultant change in soil moisture and geochemical conditions.

Potential effects on water quality discussed above could indirectly affect terrestrial habitats and species. Increased loading of sediments and sedimentation from flushing activities could bury amphibian eggs. Increased concentrations of trace elements (such as aluminum and copper) could have some negative effects on plants and wildlife on the margins of canals and tributaries. Amphibians in particular are known to be sensitive to such water quality changes, although effects vary dramatically by type and concentration of contaminant, species, and water quality parameters. Elevated pH values are toxic to amphibians, and may be particularly harmful in combination with other contaminants, such as heavy metals or herbicides, particularly glyphosates (Pesticide Action Network U.K. 1996, Edginton et al. 2004, Horn and Dunson 1995). However, glyphosates and triclopyr have been found to break down faster under higher pH conditions (Tu et al. 2001).

Habitats and species could potentially be affected directly or indirectly by impacts to soils and sediments from equipment used during canal lining, including compaction, erosion, and introduction of petroleum products. Effects on habitats and species could include plant mortality or decreased plant growth. These types of impacts are expected to be relatively minimal and small in aerial extent.

Some potential negative effects could occur if raptors are nesting near canal lining work areas that may be disturbed by noise. Raptors potentially occurring in the study area include Red-shouldered Hawk, American Kestrel, Red-tailed Hawk, and Great Horned Owl. The nesting period for raptors is generally March 1 to August 15.

Aquatic Habitat and Species

Potential effects to of canal lining activities on aquatic habitat and species are likely similar to those discussed described above for canal cleaning activities.

Special Status Species

As described above, minimal streamflow decreases in study area streams due to a short duration reduction of flows in the PCWA canal system during canal lining could result in temporary and very minimal decreases in the extent of wetland habitats that may be indirectly supported by canal deliveries. This could have minimal effects on special status species that use these wetland habitats, such as special status foraging birds and breeding amphibians, by decreasing the amount of available habitat. Reductions in water levels could expose special status amphibian eggs in the shallow, vegetated margins of drainages or adjacent wetlands. Any potential effects from temporary water reductions on species that use these habitats are expected to be minimal because canal system contributions to flow within study area streams through unregulated

releases from canal outlets are variable. Potential effects may be greater during the breeding season for special status amphibian species. The California red-legged frog breeding occurs between late November and March, though most frogs lay eggs in March (USFWS 2002, Stebbins 2003). The foothill yellow-legged frog breeds between mid-March through early June, and the western spadefoot toad breeds late January through July (Stebbins 2003).

Sediment loading to streams after flows are restored to canals following canal lining activities and sedimentation may bury special status amphibian eggs, if present. Increases in concentrations of trace elements, such as aluminum and copper, could have some negative effects on special status plants and wildlife, if present, on the margins of canals and tributaries. Amphibians in particular are known to be sensitive to changes in water quality conditions, although effects vary dramatically by species, life stage, and water quality parameters. Also, increases in pH levels, which were observed at sites after canal lining activities during water quality monitoring events, have been found to be toxic to amphibians, and may be particularly harmful in combination with other contaminants, such as heavy metals or herbicides (Pesticide Action Network U.K. 1996, Edginton et al. 2004, Horn and Dunson 1995).

Special status plant species (**Tables 3-12** and **3-13**), if present, could potentially be affected directly or indirectly by impacts to soils and sediments from equipment used during canal lining, including compaction, erosion, and introduction of petroleum products. Effects on special status plant species could include mortality or decreased growth. These types of impacts are expected to be unlikely to occur.

Some potential negative effects could occur if special status raptor species are nesting near work areas that may be disturbed by noise. Special status raptors potentially occurring in the study area include Swainson's hawk, Cooper's hawk, Northern Goshawk, White-tailed Kite, and Northern Harrier. As mentioned above, the nesting period for raptors is generally March 1 to August 15.

Potential effects of canal lining activities on Chinook salmon and steelhead are the same as described for aquatic habitat and species, and likely similar to those discussed for canal cleaning activities.

6.1.2.2 Canal Repair

PCWA performs repair and/or replacement of canals, flumes, outlet structures, flow-control structures, and customer delivery points throughout the PCWA canal system on a scheduled and as-needed basis. These activities may involve minor repairs with minimal disturbance to customer deliveries and minor effects on environmental resources, while others requiring onsite construction may become more involved. The potential effects of canal repair activities on natural resource conditions are dependent of the nature and extent of the canal repair, as well as the specific environmental setting for the activity. These activities should require project-specific environmental resources analyses to assess the potential effects of the activity on natural resources, and an evaluation to determine measures to minimize potential negative effects. The following sections provide an overview of the types of effects on natural resources that may occur during PCWA's canal repair activities.

Physical Resources

The following sections describe potential effects of PCWA canal repair activities on physical resources in the study area.

Hydrology

Most canal repair activities would result in short-duration interruptions to water flow within segments of the raw water distribution system. These short-duration interruptions to flow are not are likely to affect hydrologic conditions in study area streams.

Canal repair activities requiring onsite construction and canal dewatering for more than a day should warrant a project-specific evaluation to determine potential effects on hydrologic conditions in study area streams.

Water Quality

Although no water quality data was collected during canal repair events, potential effects for canal repair activities are expected to be similar to other canal dewatering and flushing activities. In some cases, equipment may be staged inside the canal during repair. The settling, then mobilization of sediments, organic material, and constituents associated with particulates during flushing activities may result in temporary fluctuations in constituent concentrations. For example, a temporary increase in water temperatures and associated decrease in DO levels may occur. In the case of canal repair, temporary increases in TSS and turbidity are likely because sediment may be disturbed along the canals during repair work. However, these temporary changes are not likely to have substantial effects, if any, along drainage or stream sites downstream from canal repair activities.

Canal repair projects may involve the use of mechanical equipment that require hazardous materials, such as gasoline and diesel fuels, engine oil, and hydraulic fluids. Accidental spills of these substances may contaminate the canal water and receiving water tributaries and streams, adjacent soils, and other riparian habitat.

Soils and Sediment Quality

Soils and sediment quality in the study area may be affected by canal repair activities. Soil compaction and erosion may occur as a result of construction equipment access and use along canal banks. Construction equipment may also introduce chemical contaminants (i.e., petroleum products) to soils at project sites.

Biological Resources

Terrestrial Habitat and Species

Effects on terrestrial habitat and species from canal repair would vary based on the type of repair required, but would be similar to those from canal lining, though generally less severe and smaller in scale.

As with canal lining, minimal streamflow decreases in study area streams due to a short duration reduction of flows in the PCWA canal system during canal repair could result in temporary and very minimal decreases in the extent of wetland habitats that may be directly or indirectly supported by canal system operations. This could have minimal effects on species that use these wetland habitats, such as foraging birds and breeding amphibians, by decreasing the amount of

available habitat. Reductions in water levels could expose amphibian eggs in the shallow, vegetated margins of drainages or adjacent wetlands. Any potential effects from temporary water reductions on species that use these habitats are expected to be minimal.

As with canal lining, potential effects on water quality discussed above could indirectly affect terrestrial habitats and species. Increased loading of sediments and sedimentation from flushing activities could bury amphibian eggs. Increased concentrations of trace elements (such as aluminum and copper) could have some negative effects on plants and wildlife on the margins of canals and tributaries. Amphibians in particular are known to be sensitive to such water quality changes, although effects vary dramatically by type and concentration of contaminant, species, and water quality parameters.

Habitats and species could potentially be affected directly or indirectly by impacts to soils and sediments from equipment used during canal repair, including compaction, erosion, and introduction of petroleum products. Effects on habitats and species could include plant mortality or decreased plant growth. These types of impacts are expected to be relatively minimal and small in aerial extent.

Minimal loss of habitat could occur due to limited trimming or removal of vegetation necessary to access repair areas.

Some potential negative effects could occur if raptors are nesting near canal repair work areas that may be disturbed by noise. Raptors potentially occurring in the study area include Red-shouldered Hawk, American Kestrel, Red-tailed Hawk, and Great Horned Owl. The nesting period for raptors is generally March 1 to August 15.

Aquatic Habitat and Species

Potential effects to of canal repair activities on aquatic habitat and species are likely similar to those discussed described above for canal cleaning activities. In addition, construction-related contaminants could result in a reduction in the growth, survival, and reproductive success of aquatic species. The potential exists for fuel and concrete to spill into the waterway during construction. Various contaminants introduced into the water system, either directly or through surface runoff, may be toxic to fish or cause altered oxygen diffusion rates and acute and chronic toxicity to aquatic organisms, thereby reducing growth and survival.

Special Status Species

Effects on special status species from canal repair would vary based on the type of repair required, but would be similar to those from canal lining, though generally less severe and smaller in scale.

As described above, minimal streamflow decreases in study area streams due to a short duration reduction of flows in the PCWA canal system during canal repair could result in temporary and very minimal decreases in the extent of wetland habitats that may be indirectly supported by canal deliveries. This could have minimal effects on special status species that use these wetland habitats, such as special status foraging birds and breeding amphibians, by decreasing the amount of available habitat. Reductions in water levels could expose special status amphibian eggs in the shallow, vegetated margins of drainages or adjacent wetlands. Any potential effects

from temporary water reductions on species that use these habitats are expected to be minimal because canal system contributions to flow within study area streams are variable. Potential effects may be greater during the breeding season for special status amphibian species. California red-legged frog breeding occurs between late November and March, though most frogs lay eggs in March (USFWS 2002, Stebbins 2003). The foothill yellow-legged frog breeds between mid-March through early June, and the western spadefoot toad breeds late January through July (Stebbins 2003).

Sediment loading to streams after flows are restored to canals following canal repair activities and sedimentation may bury special status amphibian eggs, if present. Increases in concentrations of trace elements, such as aluminum and copper, could have some negative effects on special status plants and wildlife, if present, on the margins of canals and tributaries. Amphibians in particular are known to be sensitive to changes in water quality conditions, although effects vary dramatically by species, life stage, and water quality parameters.

Special status plant species (**Tables 3-12** and **3-13**), if present, could potentially be affected directly or indirectly by impacts to soils and sediments from equipment used during canal repair, including compaction, erosion, and introduction of petroleum products. Special status plant species, if present, could also be damaged or killed during limited trimming or removal of vegetation necessary to access repair areas. Effects on special status plant species could include mortality or decreased growth. These types of impacts are expected to be unlikely to occur.

Some potential negative effects could occur if special status raptor species are nesting near work areas that may be disturbed by equipment noise during canal repair activities. Special status raptors potentially occurring in the study area include Swainson's hawk, Cooper’s hawk, Northern Goshawk, White-tailed Kite, and Northern Harrier. As mentioned above, the nesting period for raptors is generally March 1 to August 15.

Potential effects of canal repair activities on Chinook salmon and steelhead are the same as for the aquatic habitat and species described above.

6.1.2.3 Pipe Repair

PCWA performs repair and/or replacement of pipes, culverts, and siphons throughout the PCWA canal system on a scheduled and as-needed basis. These activities may involve minor repairs with minimal disturbance to customer deliveries and minor effects on environmental resources, while others requiring onsite construction may become more involved. As described above for canal repair activities, the potential effects of pipe repair activities on natural resource conditions are dependent of the nature and extent of the pipe repair, as well as the specific environmental setting for the activity. These activities should require project-specific environmental resources analyses to assess the potential effects of the activity on natural resources, and an evaluation to determine measures to minimize potential negative effects. The following sections provide an overview of the types of effects on natural resources that may occur during PCWA’s pipe repair activities.

Physical Resources

Hydrology

Most pipe repair activities would result in short-duration interruptions to water flow within segments of the raw water distribution system. These short-duration interruptions to flow are not are likely to affect hydrologic conditions in study area streams.

Pipe repair activities requiring onsite construction and canal dewatering for more than a day should warrant a project-specific evaluation to determine potential effects on hydrologic conditions in study area streams.

Water Quality

Although no water quality data was collected during pipe repair events, potential effects for pipe repair activities are also expected to be similar to other canal dewatering and flushing activities. During pipe repair, sediment is often excavated and heavy machinery may be used. The equipment may be staged inside the canal and/or along canal banks during repair. The settling, then mobilization of sediments, organic material, and constituents associated with particulates during flushing activities may result in temporary fluctuations in constituent concentrations. The largest effects, if any, are likely to be temporary increases in TSS and turbidity downstream from pipe repair work.

Soils and Sediment Quality

Soils and sediment quality in the study area may be affected by pipe repair activities. Soil compaction and erosion may occur as a result of construction equipment access and use along canal banks. Construction equipment may also introduce chemical contaminants (i.e., petroleum products) to soils at project sites.

Biological Resources

Terrestrial Habitat and Species

Effects on terrestrial habitat and species from pipe repair would vary based on the type and magnitude of repair required, but would be similar to those from canal repair.

As with canal lining and repair, minimal streamflow decreases in study area streams due to a short duration reduction of flows in the PCWA canal system during pipe repair could result in temporary and very minimal decreases in the extent of wetland habitats that may be directly or indirectly supported by canal system operations. This could have minimal effects on species that use these wetland habitats, such as foraging birds and breeding amphibians, by decreasing the amount of available habitat. Reductions in water levels could expose amphibian eggs in the shallow, vegetated margins of drainages or adjacent wetlands. Any potential effects from temporary water reductions on species that use these habitats are expected to be minimal.

As with canal repair, potential effects on water quality discussed above could indirectly affect terrestrial habitats and species. Increased loading of sediments and sedimentation from flushing activities could bury amphibian eggs. Increased concentrations of trace elements (such as aluminum and copper) could have some negative effects on plants and wildlife on the margins of canals and tributaries. Amphibians in particular are known to be sensitive to such water quality

changes, although effects vary dramatically by type and concentration of contaminant, species, and water quality parameters.

Habitats and species could potentially be affected directly or indirectly by impacts to soils and sediments from equipment used during pipe repair, including compaction, erosion, and introduction of petroleum products. Effects on habitats and species could include plant mortality or decreased plant growth. These types of impacts are expected to be relatively minimal and small in aerial extent.

Minimal loss of habitat could occur due to limited trimming or removal of vegetation necessary to access repair areas.

Some potential negative effects could occur if raptors are nesting near pipe repair work areas that may be disturbed by noise. Raptors potentially occurring in the study area include Red-shouldered Hawk, American Kestrel, Red-tailed Hawk, and Great Horned Owl. The nesting period for raptors is generally March 1 to August 15.

Aquatic Habitat and Species

Potential effects of pipe repair activities on aquatic habitat and species are likely similar to those discussed for canal repair activities.

Special Status Species

Effects on special status species from pipe repair would vary based on the type and magnitude of repair required, but would be similar to those from canal repair.

As described above, minimal streamflow decreases in study area streams due to a short duration reduction of flows in the PCWA canal system during pipe repair could result in temporary and very minimal decreases in the extent of wetland habitats that may be indirectly supported by canal deliveries. This could have minimal effects on special status species that use these wetland habitats, such as special status foraging birds and breeding amphibians, by decreasing the amount of available habitat. Reductions in water levels could expose special status amphibian eggs in the shallow, vegetated margins of drainages or adjacent wetlands. Any potential effects from temporary water reductions on species that use these habitats are expected to be minimal. Potential effects may be greater during the breeding season for special status amphibian species. The California red-legged frog breeding occurs between late November and March, though most frogs lay eggs in March (USFWS 2002, Stebbins 2003). The foothill yellow-legged frog breeds between mid-March through early June, and the western spadefoot toad breeds late January through July (Stebbins 2003).

Sediment loading to streams after flows are restored to canals following canal repair activities and sedimentation may bury special status amphibian eggs, if present. Increases in concentrations of trace elements, such as aluminum and copper, could have some negative effects on special status plants and wildlife, if present, on the margins of canals and tributaries. Amphibians in particular are known to be sensitive to changes in water quality conditions, although effects vary dramatically by species, life stage, and water quality parameters.

Special status plant species (**Tables 3-12** and **3-13**), if present, could potentially be affected directly or indirectly by impacts to soils and sediments from equipment used during pipe repair, including compaction, erosion, and introduction of petroleum products. Special status plant species, if present, could also be damaged or killed during limited trimming or removal of vegetation necessary to access repair areas. Effects on special status plant species could include mortality or decreased growth. These types of impacts are expected to be unlikely to occur.

Some potential negative effects could occur if special status raptor species are nesting near work areas that may be disturbed by equipment noise during pipe repair activities. Special status raptors potentially occurring in the study area include Swainson's hawk, Cooper's hawk, Northern Goshawk, White-tailed Kite, and Northern Harrier. As mentioned above, the nesting period for raptors is generally March 1 to August 15.

Potential effects of pipe repair activities on Chinook salmon and steelhead are the same as for the aquatic habitat and species described above and likely similar to those discussed for canal repair activities.

6.2 REGULATORY FRAMEWORK FOR POTENTIAL EFFECTS OF MAINTENANCE ACTIVITIES

The following sections provide the regulatory framework for the potential effects of PCWA maintenance activities described above. The regulatory framework discussion is organized by Federal, State, and local regulations, and is summarized in **Table 6-11**.

6.2.1 Federal Regulations

Federal laws and regulations associated with the potential effects of PCWA maintenance activities are described below.

6.2.1.1 Clean Water Act

PCWA activities during canal cleaning activities were found to have minimal effects on water quality conditions in study area streams. Effects of canal cleaning (i.e., increases in temperature, TSS, turbidity, calcium, magnesium, nitrates, aluminum, barium, zinc, and decrease in DO level) were observed at canal release points (e.g., YANKEECR, HANSENR), but not at stream sites. Aluminum, barium, and copper levels increased slightly at stream sites (MINERSRV5 and BCTRIB1). These effects may indicate the transport of fine sediments and potential mobilization of constituents bound to sediments into receiving waters of the United States. As with yearly PG&E outages, PCWA activities during canal cleaning activities are subject to the provisions under the CWA, but they are not required to be permitted.

TABLE 6-11
SUMMARY OF REGULATORY FRAMEWORK AND POTENTIAL BEST MANAGEMENT PRACTICES APPLICABLE TO PCWA MAINTENANCE ACTIVITIES

PCWA Maintenance Activity							Effect	Natural Resource Areas Potentially Affected												Relevant Regulations																Best Management Practices (BMP)	Type of BMP		
	Scheduled				As-Needed Site Specific			Physical			Biological									Federal				State						Local								
		Weed and Brush Control									Terrestrial Habitat and Species				Special Status																							
Canal Cleaning	Physical Removal	Algaecide Application	Herbicide Application	Canal Lining	Canal Repair	Pipe Repair		Hydrology	Water Quality	Soils and Sediment Quality	Wetlands	Nesting birds	Other	Aquatic Habitat and Species	Salmonids	Amphibians	Raptors	Plants	Clean Water Act	Endangered Species Act	Magnuson-Stevens and Sustainable Fisheries Act	Migratory Bird Treaty Act	California Environmental Quality Act	Porter-Cologne	California Endangered Species Act	Fully Protected Species	Fish & Game Code §1602	Native Plant Protection Act	Placer County Conservation Plan	Placer County Stormwater Management Plan	Tree Preservation Ordinance	Oak Woodland Management		Pre-Implementation	Implementation	Ongoing/Post-Implementation
✓				✓	✓	✓	Bank erosion along unlined canals and at canal outlets and sediment loading to receiving waters	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓					✓	✓	✓	✓	✓	✓	✓					**Improve Canal Bank Stability and Install Sediment Traps at Canal Outlets**			
																																		Install velocity dissipaters at canal outlets	✓		
																																			Line banks below canal outlets			
																																			Install erosion-control blankets			
																																			Install temporary fiber rolls			
																																			Apply spray-on soil binders			
																																			Avoid Potential Wet Weather Effects			
																																			Plan and design projects to minimize land disturbance	✓		
																																			Identify areas susceptible to erosion for future canal lining activities			
																																			Choose canal crossing sites where erosion potential is low			
																																			Install erosion and sedimentation control measures after land-disturbing activities			✓

TABLE 6-11
SUMMARY OF REGULATORY FRAMEWORK AND POTENTIAL BEST MANAGEMENT PRACTICES APPLICABLE TO PCWA MAINTENANCE ACTIVITIES (CONTINUED)

PCWA Maintenance Activity							Effect	Natural Resource Areas Potentially Affected												Relevant Regulations														Best Management Practices (BMP)	Type of BMP		
Scheduled				As-Needed Site Specific				Physical			Biological									Federal				State						Local							
	Weed and Brush Control										Terrestrial Habitat and Species				Special Status																						
Canal Cleaning	Physical Removal	Algaecide Application	Herbicide Application	Canal Lining	Canal Repair	Pipe Repair		Hydrology	Water Quality	Soils and Sediment Quality	Wetlands	Nesting birds	Other	Aquatic Habitat and Species	Salmonids	Amphibians	Raptors	Plants	Clean Water Act	Endangered Species Act	Magnuson-Stevens and Sustainable Fisheries Act	Migratory Bird Treaty Act	California Environmental Quality Act	Porter-Cologne	California Endangered Species Act	Fully Protected Species	Fish & Game Code §1602	Native Plant Protection Act	Placer County Conservation Plan	Placer County Stormwater Management Plan	Tree Preservation Ordinance	Oak Woodland Management		Pre-Implementation	Implementation	Ongoing/Post-Implementation
✓	✓	✓	✓	✓	✓	✓	Disturbance or damage to sensitive species and habitat potentially present in the area.				✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓		✓	✓		✓	✓		**Protect Sensitive Species Habitat**			
																																	Provide staff with species identification training	✓		
																																	Evaluate sites with sensitive species and mark/protect sensitive species habitat			
																																	Stockpile materials away from sensitive species habitat areas		✓	
										✓	✓	✓	✓				✓	✓		✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	**Avoid Sensitive Species Areas**			
																																	Avoid disturbance to sensitive species		✓	
																																	Avoid active raptor nesting areas			
								✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓		✓	✓	✓	✓	✓		✓	✓	**Strategic Scheduling of O&M Activities**	✓		

TABLE 6-11
SUMMARY OF REGULATORY FRAMEWORK AND POTENTIAL BEST MANAGEMENT PRACTICES APPLICABLE TO PCWA MAINTENANCE ACTIVITIES (CONTINUED)

PCWA Maintenance Activity							Effect	Natural Resource Areas Potentially Affected										Relevant Regulations														Best Management Practices (BMP)	Type of BMP		
	Scheduled				As-Needed Site Specific			Physical			Biological							Federal				State					Local								
		Weed and Brush Control									Terrestrial Habitat and Species				Special Status																				
Canal Cleaning	Physical Removal	Algaecide Application	Herbicide Application	Canal Lining	Canal Repair	Pipe Repair		Hydrology	Water Quality	Soils and Sediment Quality	Wetlands	Nesting birds	Other	Aquatic Habitat and Species	Salmonids	Amphibians	Raptors	Plants	Clean Water Act	Endangered Species Act	Magnuson-Stevens and Sustainable Fisheries Act	Migratory Bird Treaty Act	California Environmental Quality Act	Porter-Cologne	California Endangered Species Act	Fully Protected Species	Fish & Game Code §1602	Native Plant Protection Act	Placer County Conservation Plan	Placer County Stormwater Management Plan	Tree Preservation Ordinance	Oak Woodland Management		Pre-Implementation	Implementation	Ongoing/Post-Implementation
✓				✓	✓	✓	Constituent loading to receiving waters from O&M activities		✓	✓				✓	✓	✓			✓	✓	✓		✓	✓	✓	✓	✓		✓	✓			**Prevent Degraded Water from Entering Streams after Maintenance Activities**			
																																Modify reservoir operations to gradually restore reservoir releases to canals at slower rate		✓	
				✓					✓	✓				✓	✓	✓			✓	✓	✓		✓	✓	✓	✓	✓		✓	✓			Apply sediment trap at storm drains for dewatering before lining activities			
																																Treat first flush flows to reduce downstream water quality effects			
	✓	✓	✓																													Implement an Aquatic Weed Management Program			✓
✓		✓	✓	✓	✓	✓	All potential effects	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	**Implement PCWA BMP Program**			✓
																																Regulatory Compliance Management for O&M Activities	✓		
✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	**Good Housekeeping Practices**			
																																Ensure proper handling of materials and wastes			
																																Use proper cleanup procedures after material use		✓	
																																Implement onsite debris and trash management practices			
																																Store materials under a roof or covering with secure tarp			

PCWA weed and brush control practices may have minimal to no water quality effects on receiving water tributaries and streams during implementation. Physical removal of vegetation may have minimal effects on TSS and turbidity if the removal of vegetation results in the dislodging or loosening pf soil along canal banks and causes loose sediment to be deposited into the canals. Algaecide applications were observed to have minimal effects on pH, which increased slightly at both canal and stream sites (YANKEECR and YHTRIB2). Copper concentrations were observed to increase at YANKEECR, and minimal effects on copper concentrations were observed at YHTRIB2 and SECRETRV3. Minimal to no effects were observed with PCWA's herbicide applications. Temporary decreases in DO levels at ANTSTUBCR and ANTC3B are likely not directly related to herbicide applications. PCWA maintains active status with their General NPDES Permit for Discharges of Aquatic Pesticides, and has an active Aquatic Weed Management Program. As part of this program, PCWA completes an evaluation for each algaecide and herbicide application which includes water quality monitoring and treatment efficacy (PCWA 2003b). PCWA also routinely monitors algaecide and herbicide product releases in an effort to identify suitable algaecides and/or herbicides for applications that may have lesser potential effects on natural resources.

PCWA canal lining/guniting practices were observed to result in temporary moderate effects on the water quality of receiving water tributaries and streams. Increases in temperature, pH, TSS, turbidity, aluminum, zinc, and copper were observed at canal outlets (ANTCR, BOARDMANCR, and BAUGHMANCR) and stream sites (CLVRC6, CLVRC3, and MINERSRV5). Although no water quality permits are required for PCWA canal lining practices, compliance with water quality standards is required. Overall, these effects are temporary and can be prevented or minimized with effective BMPs.

Canal and pipe repair activities may have minimal water quality effects on receiving water tributaries and streams. Potential minimal effects are associated with temporary increases in TSS and turbidity from sediment and/or debris entering the canals as a result of soil disturbance from heavy machinery used for canal or pipe repair. With effective BMP implementation, these temporary effects are not likely to have large or long-term impacts, if any, along drainage or stream sites downstream from repair activities. If a canal or pipe repair activity involves any discharge of dredged or fill material into waters of the United States, a Section 404 permit is required with the USACE. Obtaining a Section 404 permit also requires a Section 401 water quality certification with the RWQCB ensuring that any discharge will not violate State water quality standards. Under Section 402 of the CWA, a canal or pipe repair project may also require a general permit for construction activities and compliance under the Placer County Municipal Stormwater Management Program. Associated regulations are further described under the Porter-Cologne Water Quality Control Act.

6.2.1.2 Endangered Species Act

PCWA canal cleaning activities potentially have minimal effects on special status species. Flushing activities after canal cleaning may cause increased TSS and other constituents, and result in minimal effects on special status species, including slight decreases in the extent of

wetland habitats for special status species. Special status species habitat could be damaged by heavy equipment use or by placement of debris and soil near canals and nesting raptors in the vicinity could be disturbed by equipment noise. Under the Federal ESA, regulated by USFWS and NMFS, habitat modification or degradation could be considered a "take" of federally listed species. In which case, an incidental take permit, under Section 10 of the Federal ESA, or a federal interagency consultation, under Section 7 of the Federal ESA, is required.

Potential effects of weed and brush removal activities may require an incidental "take" permit under the Federal ESA if there is a potential for federally listed as endangered or threatened species to be affected. Physical removal of vegetation would result in direct loss of vegetation and habitat. Physical removal of vegetation often require mechanical harvesters, weed rollers, rotovators, and dredging equipment that dislodge contaminated sediments and may affect special status species, such as fish and amphibians (PCWA 2003b). However, this equipment is only used if necessary, and with precautions. Effective BMPs can be implemented to minimize the effects of physical removal of vegetation that would prevent or minimize effects on special status species. Algaecide applications may have minimal effects on special status species, particularly fish and amphibians, from potential toxicity of copper associated with the algaecide. Only slight increases in copper concentrations were observed in receiving streams during monitoring for algaecide application events. Copper concentrations likely associated with algaecide applications were observed to increase during other canal maintenance activities, and are discussed in **Chapter 7**. Herbicide applications may have minimal effects on special status terrestrial species and vegetation along PCWA reservoirs or canal banks from direct exposure to the herbicide.

PCWA canal lining/guniting practices potentially have minimal effects on special status species. Measured pH values in portions of the canal downstream from canal lining activities were high for a short time after flows were restored to the canal system. High pH values can be toxic to federally listed as endangered or threatened fish and other aquatic species.

PCWA canal and pipe repair activities may have variable effects on special status species. Heavy equipment may disturb vegetation along canal banks from access routes and increased noise levels. Construction work along canal banks could cause increased TSS and other constituents in receiving water tributaries and streams, which could affect special status species, particularly fish and amphibians, and the extent of wetland habitats for special status species. Project-specific environmental resources analyses should be performed to assess the potential effects of canal and pipe repair activities on special status species and to determine measures to minimize potential negative effects.

6.2.1.3 Magnuson-Stevens Fishery Conservation and Management Act and the 1996 Sustainable Fisheries Act

PCWA canal cleaning activities may have minimal effects on suitable fishery habitat. As described previously, measures recommended to protect EFH by NMFS are advisory, not prescriptive.

PCWA weed and brush control practices, particularly algaecide application practices, may have minimal effects on fishery resources with respect to potential copper contributions in waters of the United States. Although copper concentrations did not exceed water quality objectives in receiving water tributaries, it was observed to temporarily increase at canal outlets. The toxicity of copper to fish varies with the species and the physical and chemical characteristics of the water. Its toxicity to fish generally decreases as water hardness increases. Fish eggs are more resistant than young fish fry to the toxic effects of copper (Gangstad 1986). Because PCWA applies algaecides and herbicides consistent with NPDES permit requirements, and implements BMPs and other actions specified in a detailed PCWA Algaecide Application Program, these effects are likely reduced.

PCWA canal lining/guniting practices may have minimal effects on suitable fishery habitat. Several constituents, such as pH, turbidity, TSS, SC, and other ions temporarily increased at canal outlets, but minimal to no effects were observed in receiving water tributaries and streams. However, these effects are easily avoidable with effective BMP implementation.

PCWA canal and pipe repair activities may have minimal effects on fishery habitat. Potential sediment loading from construction activities can increase turbidity and limit the ability for fish to hide from predators. Hazardous waste runoff from construction sites can have toxic effects on fish. However, these effects are easily avoidable with effective BMP implementation. Project-specific environmental resources analyses should be performed to assess the potential effects of canal and pipe repair activities on EFH and to determine measures to minimize potential negative effects.

6.2.1.4 Migratory Bird Treaty Act

PCWA canal cleaning activities, weed and brush control practices, and canal lining/guniting practices potentially have minimal effects on migratory bird species from the use of equipment and machinery. However, it is unlikely that these effects would constitute a "take" of a migratory bird species or habitat (as defined by the MBTA) and therefore would not be subject to the MBTA.

PCWA canal and pipe repair activities may have minimal effects on migratory bird species. Noise disturbance and improper equipment staging can cause birds to abandon their nests or resting sites, and the removal of trees that provide habitat for migratory birds can reduce their populations in the vicinity of the construction site. However, with effective BMP implementation, these effects can be dramatically reduced or eliminated.

6.2.2 State Regulations

Laws and regulations governed by the State of California and associated with the potential effects of PCWA maintenance activities are described below.

6.2.2.1 California Environmental Quality Act

PCWA maintenance activities may be considered projects requiring CEQA review if there is potential for resulting in direct change in the environment, or a reasonably foreseeable indirect change in the environment. Some PCWA maintenance activities may be exempt from CEQA. Relevant exemptions include emergency projects (Section 15269), statutory exemptions described in State of California CEQA Guidelines Section 15282, and Class 1 and Class 2 categorical exemptions described in Sections 15301 and 15302. Each PCWA maintenance activity or project should be given a preliminary review to determine whether CEQA applies and whether the project may be eligible for an exemption from CEQA. If an exemption is not applicable, an initial study must be prepared to determine if the project may have a significant effect on the environment. The purposes of an initial study are to:

(1) Provide the lead agency with information to use as a basis of deciding whether to prepare an EIR or negative declaration.

(2) Enable an applicant or lead agency to modify a project, mitigating adverse impacts before an EIR is prepared, thereby enabling the project to qualify for a negative declaration.

(3) Assist the preparation of the EIR on the effects determined to be significant.

A. Focusing the EIR on the effects determined to be significant.

B. Identifying the effects determined not to be significant.

C. Explaining the reasons for determining that potentially significant effects would not be significant.

D. Identifying whether a program EIR, tiering, or another appropriate process can be used for analysis of the project's environmental effects (Section 15063.c).

An initial study prepared by PCWA for maintenance activities or projects should include, in brief form, the following:

(1) A description of the project including the location of the project.

(2) An identification of the environmental setting.

(3) An identification of environmental effects by use of a checklist, matrix, or other method, provided that entries on a checklist or other form are briefly explained to indicate that there is some evidence to support the entries. The brief explanation may be either through a narrative or a reference to another information source such as an attached map, photographs, or an earlier EIR or negative declaration. A reference to

another document should include, where appropriate, a citation to the page or pages where the information is found.

(4) A discussion of the ways to mitigate the significant effects identified, if any.

(5) An examination of whether the project would be consistent with existing zoning, plans, and other applicable land-use controls.

(6) The name of the person or persons who prepared or participated in the Initial Study (Section 15063.d).

A Negative Declaration or Mitigated Negative Declaration must be prepared by PCWA for maintenance activities or projects subject to CEQA when (1) the initial study shows that there is no substantial evidence that the project may have a significant effect on the environment; or, (2) the initial study identifies potentially significant effects, but:

(1) Revisions in the project plans or proposals (i.e., BMPs) made by, or agreed to by the applicant before a proposed mitigated negative declaration and initial study are released for public review would avoid the effects or mitigate the effects to a point where clearly no significant effects would occur.

(2) There is no substantial evidence, in light of the whole record before the agency, that the project as revised may have a significant effect on the environment (Section 15070).

A Negative Declaration prepared by PCWA and circulated for public review should include:

(a) A brief description of the project, including a commonly used name for the project, if any.

(b) The location of the project, preferably shown on a map, and the name of the project proponent.

(c) A proposed finding that the project will not have a significant effect on the environment.

(d) An attached copy of the Initial Study documenting reasons to support the finding.

(e) Mitigation measures, if any, included in the project to avoid potentially significant effects (Section 15071).

As described in **Chapter 4**, if an Initial Study concludes that a PCWA activity or project is determined to have significant effects on the environment, and EIR must be prepared. The EIR for the activity or project should evaluate the potential significant effects on environmental resources, identify a range of feasible alternatives to the project that would avoid or reduce its impacts, and identify mitigation measures that would minimize or avoid those impacts.

6.2.2.2 Porter-Cologne Water Quality Control Act

As described previously in **Chapter 4**, the CWA defines Water Quality Standards as provisions of State or Federal law, which consist of U.S. EPA and California water quality criteria and water quality objectives for designated beneficial uses for the waters of the United States.

The regulatory framework and effects for PCWA canal cleaning activities are similar to those described previously under the CWA. PCWA canal cleaning activities were found to be in compliance with State water quality standards and objectives regulated by the Central Valley RWQCB. Of the Criteria for Priority Toxic Pollutants in the State of California, cadmium, copper, and zinc were three criteria parameters monitored for during PCWA canal cleaning activities. Cadmium levels were not exceeded. The freshwater CMCs for zinc (120 µg/L) and copper (9 µg/L) were exceeded at some canal release sites monitored during the canal cleaning activities, but no exceedances were observed within receiving water tributaries or streams within the Secret Ravine and Miners Ravine watersheds. Therefore, PCWA canal cleaning activities were observed to be in compliance with state water quality standards. However, if an exceedance did occur within receiving waters of the United States, they are temporary and can be prevented and/or minimized through effective BMP implementation. Of the water quality objectives associated with beneficial uses of the Sacramento River in the Sacramento-San Joaquin Basin Plan, barium, copper, iron, zinc, DO, pH, and turbidity were monitored during PCWA canal cleaning activities. The basin plan water quality objectives for trace elements barium, copper, and zinc were exceeded at canal release points during cleaning events, but no exceedances were recorded in receiving water tributaries and streams within the Secret Ravine and Miners Ravine watersheds. Therefore, PCWA canal cleaning activities were observed to be in compliance with basin plan trace element water quality objectives for the Sacramento River. Basin plan water quality objectives for basic parameters were observed to be slightly exceeded in receiving water tributaries and streams. The DO level in the FRGTRIB1 (6.1 mg/L) was observed to be slightly below the minimum DO level for waters with designated coldwater fishery beneficial uses (7.0 mg/L) during the March 27, 2007, cleaning event. Some pH and turbidity levels at canal release points were observed to exceed the water quality objectives, but none was observed within receiving water tributaries or streams during canal cleaning events. Due to the DO decrease being so slight and temporary, it is not a large concern that PCWA can meet water quality objectives for basic parameters during canal cleaning events.

The regulatory framework for PCWA weed and brush control practices is similar to the framework described previously under the CWA. Of all water quality standards and objectives, the basin plan water quality objective for turbidity has the most potential for exceeding the limit during the physical removal of vegetation. However, increases in turbidity and suspended sediments can easily be avoided or minimized through effective BMP implementation. As described in **Chapter 4**, an NPDES permit is now required under the CWA for aquatic pesticide applications. NPDES permits for discharges to surface waters must meet the most protective (lowest) and appropriate limits in order to protect all designated beneficial uses of the receiving water, which constitute state water quality criteria and Central Valley RWQCB basin plan water quality objectives. PCWA's algaecide applications currently comply with NPDES permit requirements. Although copper levels temporarily increased at canal outlets, they remained well below water quality standards and objectives for copper during monitoring for algaecide application events. Herbicide applications were also found to be in compliance with state water quality standards and objectives regulated by the Central Valley RWQCB.

The regulatory framework and effects for PCWA canal lining/guniting practices are similar to those described previously under the CWA. No water quality standards were observed to be exceeded in waters of the United States during canal lining activities. DO concentrations were lower than the minimum level water quality objective at canal outlets, but not at tributary or stream sites. Recorded pH levels reached 11.7 at canal sites downstream from lining activities and canal outlets, but the basin plan water quality objective range for pH (6.5 to 8.5) was not exceeded at tributary or stream sites. Turbidity levels exceeded the basin plan water quality objective (increase by greater than 20 percent) in Miners and Secret ravines, but remained below 100 NTUs. Barium, iron, zinc, and copper levels were increased at canal sites downstream from the lining activity and at canal outlets, but they did not exceed water quality objectives in receiving water tributaries and streams. Turbidity was the only parameter observed to exceed water quality objective levels during canal lining activities, and may be controlled by effective BMP implementation.

The regulatory framework and effects for PCWA canal and pipe repair activities are similar to those described for the CWA. If a Section 401 certification is required, an application should be prepared and submitted for approval before project implementation. Increases in turbidity in receiving water tributaries and streams are of primary concern during these activities, and increases in turbidity and suspended sediments can easily be avoided or minimized through effective BMP implementation. The Placer County Stormwater Management Program (required under the RWQCB Phase II MS4 permit) provides guidance on the implementation of BMPs that minimize the potential effects of construction activities. A pipe repair project that results in the disturbance of greater than 1 acre of land requires a General Construction General Permit with the RWQCB. Under Construction General Permit requirements, a SWPPP is required to be prepared, be on site at all times, and be followed by a designated construction contractor to ensure that contaminants are not discharged into the river. Water quality monitoring and observation reports at construction sites is required during at least two precipitation events, the first one being the first-flush rain event. Monitoring results and other information are to be submitted in annual reports each June to the RWQCB for compliance review. Monitoring results are compared to nonenforceable EPA Parameter Benchmark Levels (see **Chapter 3**) that, if exceeded, a warning letter is sent to the permittee advising implementation of more effective BMPs to minimize waste discharges.

6.2.2.3 California Endangered Species Act

Under the California ESA, the effects on special status species from PCWA maintenance activities during PCWA canal cleaning activities, PCWA weed and brush control practices, canal lining/guniting practices, and canal and pipe repair activities are similar to those described previously under the Federal ESA. However, the California ESA addresses the incidental take of State-listed species as threatened or endangered.

6.2.2.4 California Fish and Game Code-Fully Protected Species

Under the Fish and Game Code-Fully Protected Species, the effects on special status species from PCWA canal cleaning activities, PCWA weed and brush control practices, canal

lining/guniting practices, and canal and pipe repair activities, are similar to those described previously under the Federal ESA. However, this code addresses the incidental take of fully protected species. DFG is unable to authorize incidental take of fully protected species, such as White-tailed Kite and the California Black Rail, when activities are proposed in areas inhabited by those species. Therefore, the take of any fully protected species for project implementation is prohibited.

6.2.2.5 California Fish and Game Code Section 1602 – Lake and Streambed Alteration Program

In accordance with the Lake and Streambed Alteration Program, PCWA is required to notify DFG of any proposed activity that may substantially modify study area streams or lakes. Potential PCWA maintenance activities that may require notification include actions that will substantially divert or obstruct the natural flow of any river, stream, or lake; substantially change or use any material from the bed, channel, or bank of, any river, stream, or lake; or deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake. If PCWA canal repair or pipe repair activities have the potential to modify streams or lakes as described above, PCWA should provide notification to DFG under the Lake and Streambed Alteration Program.

6.2.2.6 California Native Plant Protection Act

This act applies to endangered and "rare" plant species, subspecies, and varieties of wild native plants in California. PCWA canal cleaning, weed and brush control, canal lining/guniting, and canal and pipe repair activities may affect endangered and "rare" plant species during the use of equipment and machinery in canals and along canal banks. PCWA weed and brush control practices may also have moderate effects on endangered and "rare" plant species. Physical removal of vegetation could result in direct loss of vegetation and habitat. Herbicide applications near special endangered and "rare" plant species may expose it to the toxic effects of herbicides. However, with proper application and effective BMP implementation, these effects can be prevented or minimized.

6.2.3 Local Requirements and Considerations

The following sections describe the framework for local requirements during PCWA maintenance activities.

6.2.3.1 Placer County Conservation Plan

As described in **Chapter 4**, the PCCP includes plans with goals to protect fish and wildlife and their habitat and protect streams, wetlands and other water resources, as well as coverage under several environmental permits to be issued to Participating Entities. With PCCP long-term environmental permits described in **Chapter 4**, PCWA will be covered for activities projects that require it.

The regulatory framework for PCWA maintenance activities related to the PCCP are the same as the those described for CWA, ESA, Porter-Cologne Water Quality Control Act, California ESA, California Fish and Game Code-Fully Protected Species, and Lake and Streambed Alteration Program.

6.2.3.2 Placer County Stormwater Management Plan

PCWA construction activities during canal and pipe repair projects may be subject to Construction Site Stormwater Runoff Control guidelines the Placer County SWMP. Projects within Placer County will be designed using BMPs for stormwater discharges. The SWMP provides guidance in establishing BMPs before, during, and after construction activities, as well as long-term maintenance BMPs.

Placer County has established procedures specified in the county Grading and Erosion Prevention Ordinance for applying and enforcing construction site pollution control measures, including site plan reviews, requiring erosion and sediment control BMPs, inspections, and enforcement of violations.

6.2.3.3 Placer County Code, Tree Preservation Ordinance

Lining of previously unlined section of PCWA's canal system may indirectly affect adjacent trees historically supported by canal seepage. Also, PCWA canal and pipe repair activities may require the removal of trees. Placer County's tree ordinance sets county-wide requirements for projects within riparian zones, permit requirements for removal of landmark trees, removal of more than 50 percent of trees, and commercial firewood cutting, and establishes tree preservation zones. For example, the removal of more than 50 percent of existing native trees (equal to or greater than 6 inches in diameter at breast height), and of any landmark tree, is subject to the issuance of a tree permit. A "landmark tree" means a tree or grove of trees designated by resolution of the board of supervisors to be of historical or cultural value, an outstanding specimen, an unusual species and/or of significant community benefit (i.e., palms, along English Colony Road, oak canopy tree areas, Deodar cedars on Highway 49, major heritage oak trees). Tree preservation zone provisions are applicable to the Dry Creek-West Placer Community Plan, Granite Bay Community Plan, portions of the Loomis Basin General Plan, and the Auburn-Bowman Community Plan. A tree preservation zone map is available in the Placer County Planning Office for more details on zoning areas

6.2.3.4 Placer County Oak Woodland Management Plan

As described above, PCWA's canal lining, canal repair, and pipe repair activities may affect trees, including oaks, adjacent to canals. The regulatory framework related to the Placer County Oak Woodland Management Plan for canal lining, and canal and pipe repair activities are similar to those described in the Placer County Tree Preservation Ordinance. As part of this plan, projects are subject CEQA assessments for oak woodland habitats.

6.3 BEST MANAGEMENT PRACTICE OPTIONS TO ADDRESS POTENTIAL EFFECTS OF MAINTENANCE ACTIVITIES

Potential BMPs to reduce potential effects of PCWA maintenance activities on natural resources are summarized in Table 6-11, and described below. The list of BMP options is not comprehensive; instead, it provides examples of BMPs that may be implemented to minimize particular potential effects of PCWA canal maintenance activities. Several BMP options for maintenance activities are similar to those for operations activities described in Section 5.3; therefore, are not described as thoroughly in this section.

6.3.1 Pre-Implementation Best Management Practices

Below are potential pre-implementation BMPs for reducing potential effects of PCWA maintenance activities on natural resources in the study area.

6.3.1.1 Improve Canal Bank Stability and Install Sediment Control Measures at Canal Outlets

Canal bank erosion along unlined canals may occur after canal flows are restored following dewatering activities associated with canal cleaning and lining activities. The following measures to improve canal bank stability are described in **Chapter 5**:

- Install velocity dissipaters at canal outlets
- Line banks below canal outlets

Additional BMP options to address potential effects of bank erosion below canal outlets and sediment loading in receiving waters from dewatering during maintenance activities are described below.

Install Erosion-Control Blankets in Areas of Soil Disturbance

Erosion-control blankets and turf reinforcement mats combine vegetative growth with synthetic materials to form a high-strength mat that prevents soil erosion in drainage areas and on steep slopes. Where applicable, PCWA may apply a geotextile blanket or biodegradable mat on graded slopes to minimize actively bared and easily eroded soils. These blankets also enhance vegetative growth and provide removal of particulates through sedimentation and soil infiltration (EPA 2005b). PCWA is already implementing this type of BMP, where possible.

Install Temporary Fiber Rolls in Areas of Soil Disturbance

Fiber rolls (also called fiber logs or straw wattles) are tube-shaped erosion-control devices filled with straw, flax, rice, coconut fiber material, or composted material (EPA 2008a). Temporary fiber rolls are typically made of rice straw, are contained in tubular black netting, and can be staked down along a sloped area. Rice straw is weed free and naturally biodegradable, which can enhance the soil and help vegetation become established. Each roll is wrapped with ultraviolet (UV)-degradable polypropylene netting for longevity or with 100 percent

biodegradable materials like burlap, jute, or coir. Fiber rolls are used on slopes to reduce runoff velocity and control or capture eroded sediment to prevent sediment loading in receiving water streams. On steep slopes, fiber rolls used in conjunction with a properly designed and installed erosion-control blanket may be very effective in reducing erosion and sedimentation.

Apply Spray-On Soil Binders in Areas of Soil Disturbance

Spray-on emulsion is often used as a temporary tackifier for hydroseeding or mulch, or a stand-alone, heavy-duty soil binder for erosion control. Plant-based, polymer, and cementious-based emulsions penetrate the topsoil and bind soil particles together. These agents form a protective, flexible film to strengthen the soil surface and provide bank stabilization and erosion control. Polymer emulsions may be applied with hydroseeders, water trucks, or other spraying devices. Spraying devices with a mechanical agitator or mixing apparatus or hydraulic recirculation are known to be most effective. These emulsions are best applied to low or moderate slopes, and best avoided in areas where the binder would likely be removed in the near future or in areas with high-volume sheet flow because it has a tendency to be washed away. Reapplication of soil binders may be necessary to effectively stabilize the soil throughout the season.

6.3.1.2 Avoid Potential Wet Weather Effects

Avoidance of potential adverse effects of PCWA maintenance activities during wet weather, when and where feasible, can be very effective. BMP options to avoid potential wet weather effects for PCWA maintenance activities are described below.

Plan and Design Projects to Minimize Land Disturbance

Scheduled maintenance activities, particularly canal and pipe repair, can be planned and designed with consideration in minimizing excavation and land disturbance. This BMP involves avoiding land disturbance during periods of high precipitation, and land disturbance in areas vulnerable to erosion. PCWA is already implementing this type of BMP, when possible.

Identify Areas Susceptible to Erosion for Future Canal Lining Activities

During maintenance activities, PCWA staff may identify segments of unlined canals or lined areas along the canal that are visibly disturbed and/or susceptible to bank erosion for future canal lining activities. Future lining of these segments typically reduces erosion and sloughing of canal banks. PCWA already implements this type of BMP.

Choose Canal Crossing Sites Where Erosion Potential is Low

Maintenance activities, such as canal lining and canal cleaning, may require hoses and/or other equipment to rest across the canal. Areas along canals with visible erosion or loose sediment should be avoided and equipment should be located along stable canal sections. PCWA is already implementing this type of BMP.

6.3.1.3 Protect Sensitive Species and Sensitive Species Habitat

Before conducting maintenance activities, special status species and sensitive species habitat can be protected by the following BMPs described in **Chapter 5**:

- Provide staff with species identification training.

- Evaluate sites with sensitive species and mark/protect sensitive species habitat.

In addition to options described in **Chapter 5** for the "Evaluate sites with Sensitive Species and Mark/Protect Sensitive Species Habitat" BMP option, a protective curtain can be placed around sensitive plant species and/or habitat near herbicide application areas to minimize the exposure of special status species and/or habitat to the potential toxic effects of herbicides. Types of protective curtains include tarps or a pesticide containment pad made of impermeable materials, such as synthetic liners.

6.3.1.4 Strategic Scheduling of Maintenance Activities

Maintenance activities can be scheduled, or BMPs implemented, at specific times of the year to avoid or minimize potential effects on terrestrial and aquatic biological resources. Activities can be planned to avoid species sensitive periods and to avoid wet weather erosion effects. For example, a project or activity can be scheduled to avoid periods during bird nesting and/or amphibian breeding seasons. Projects requiring equipment and machinery can be scheduled during a time of low erosion potential, such as the dry season. PCWA is already implementing this type of BMP, when possible.

6.3.1.5 Regulatory Compliance Management for Operations and Maintenance Activities

Before maintenance activity or project implementation, permits may need to be obtained and BMPs implemented to comply with rules and regulations. BMP checklists are available from many governmental resources as planning guides for environmental compliance. An example is EPA's "Managing Your Environmental Responsibilities: A Planning Guide for Construction and Development" that describes BMPs that should be implemented before, during, and after canal and pipe repair activities. In addition, there are several guidance documents online providing information on delegating specific tasks to employees for a construction project with an associated General NPDES Construction Stormwater Permit, such as a manager who would be responsible for knowing the location and ensuring implementation of a project SWPPP. Regulatory compliance activities include periodically updating documents, such as PCWA's Aquatic Weed Management Program, which is reviewed annually and updated, as needed.

6.3.2 Implementation Best Management Practices

The following sections identify potential BMPs to reduce potential effects associated with PCWA maintenance activities on natural resources within the PCWA raw water distribution area that should be considered during implementation of PCWA maintenance activities.

6.3.2.1 Protect Sensitive Species and Sensitive Species Habitat

Special status species and sensitive species habitat can be protected during implementation of some maintenance activities by applying the following BMP:

Stockpile Materials Away from Sensitive Species Habitat Areas

Before conducting canal cleaning or canal lining activities, PCWA may designate areas that should be avoided based on observed sensitive species or known sensitive species habitat areas. During canal cleaning or canal lining activities, PCWA personnel would stockpile any debris (i.e., vegetation, sediment, and/or gunite removed from canals) away from these known occurrences or areas of sensitive species habitat, or only in previously disturbed areas, to minimize potential effects of these materials on natural resources through physical damage to vegetation/species by deposition of material or constituent loading to receiving streams. PCWA is already implementing this type of BMP.

6.3.2.2 Avoid Sensitive Species Areas

During operations activities, PCWA personnel can do several things to prevent potential effects on terrestrial species and disturbance to terrestrial species habitat. Examples of BMP options follow. During maintenance activities, PCWA personnel can do several things to avoid potential effects on terrestrial species and disturbance to terrestrial species habitat. Several BMP options for PCWA maintenance activities are similar to those described in **Chapter 5** for operations activities, including:

- Avoid disturbance to sensitive species

An additional BMP option to avoid sensitive species during maintenance activity implementation is described below.

Avoid Active Raptor Nesting Areas

PCWA staff can avoid potential impacts to raptors through avoiding active raptor nesting areas during maintenance activities. PCWA may conduct raptor survey at locations of scheduled maintenance activities during the breeding season (generally March through August) to scan for active nests. If active nests are observed, the area should be avoided to the maximum extent possible. If activities do occur in the area, noise and other disturbance should be kept to a minimum. PCWA is already implementing this type of BMP for canal lining activities, when possible.

6.3.2.3 Prevent Degraded Water from Entering Streams After Operations and Maintenance Activities

Water flows restored to the canal system immediately following maintenance activities that involve canal dewatering may flush accumulate debris and sediment, along with associated constituents, to receiving streams. BMPs may be implemented to prevent or reduce the amount of degraded water from PCWA's canal system from entering streams. BMP options for maintenance activities previously described in **Chapter 5** include:

- Modify reservoir operations to gradually restore reservoir releases to canals at a slower rate

Additional BMPs that may prevent degraded water from entering streams after maintenance activities are described below.

Apply Sediment Trap at Storm Drains for Dewatering Before Canal Lining

For some types of maintenance activities that require complete dewatering of ponded water, such as canal lining, water remaining in canals is pumped out of a canal segment before preparing segments for canal lining. These waters may exhibit elevated concentrations of constituents and should not be discarded to receiving waters or storm drains. Temporary sediment traps can be installed at nearby storm drains to filter sediment and associated constituents from small volumes of water removed from canals.

Treat First Flush Flows to Reduce Downstream Water Quality Effects

Results from water quality monitoring associated with canal lining activities at locations below newly lined canal segments demonstrated pH values that were higher in comparison to sites upstream from newly lined segments. Water with elevated pH values may be treated to buffer potential changes to pH that may occur through geochemical interactions of ions in canal waters with newly lined gunite sections. Nontoxic solutions that may lower pH and neutralize potential effects of canal lining on pH would reduce potential water quality effects on receiving streams.

6.3.3 Ongoing or Post-Implementation Best Management Practices

Potential ongoing or post-implementation BMPs for maintenance include the following option described in **Chapter 5**:

- Implement PCWA BMP Program

Additional ongoing or post-implementation BMP options for maintenance activities are described below.

6.3.3.1 Avoid Potential Wet Weather Effects

Install Erosion- and Sedimentation-Control Measures After Land-disturbing Activities

If PCWA maintenance activities may disturb land during the wet season, loose sediment and/or material in the vicinity of the canal system should be contained using sediment-control measures, such as a tarp surrounded with fiber rolls, to protect the materials from being transported into downstream waterways. PCWA already implements this type of BMP, when possible.

6.3.3.2 Prevent Degraded Water from Entering Streams After Operations and Maintenance Activities

Implement an Aquatic Weed Management Program

PCWA currently implements an Aquatic Weed Management Program. As part of this program, PCWA completes an evaluation for each algaecide and herbicide application which includes water quality monitoring and treatment efficacy (PCWA 2003b). PCWA also routinely monitors

algaecide and herbicide product releases in an effort to identify suitable algaecides and/or herbicides for applications that may have lesser potential effects on natural resources.

6.3.3.3 Good Housekeeping Practices

Good housekeeping is practiced to maintain clean and orderly work sites and to prevent materials originating in the work site area from affecting natural resources. Good housekeeping practices include plans, procedures, and activities designed to prevent or minimize potential pollutant runoff into waterways. PCWA's Hazardous Materials Plan describes these practices in detail. Examples of good housekeeping BMPs are as follows:

Ensure Proper Handling of Materials and Wastes

Spill kits should be kept nearby and used to prevent further contamination if wastes are accidentally spilled. If a spill is large, the spill should be reported to the Office of Environmental Health Hazard Assessment (OEHHA). PCWA is already implementing this type of BMP.

Use Proper Cleanup Procedures After Material Use

PCWA staff should not wash excess gunite into canals following completion of canal lining activities. Once canal lining activities are completed, excess gunite should be contained and properly disposed. If equipment used for canal lining activities needs to be rinsed, wastewater should be captured, contained in a storage vessel, and exported to a disposal facility. PCWA is already implementing this type of BMP.

Implement Onsite Debris and Trash Management Practices

During PCWA maintenance activities, PCWA should (1) keep debris and trash under cover either in an enclosed trash container, (2) prevent waste materials to accumulate on the ground, and (3) inspect maintenance sites daily for litter and debris. If feasible, construction and demolition debris such as wood, metal, and concrete, should be recycled. PCWA is already implementing this type of BMP.

Store Materials Under a Roof or Covering with a Secure Tarp

Proper storage of pollutant materials, such as fuel, oil, concrete, and other hazardous liquids, should be considered for materials used for maintenance activities. When pollutant materials must be stored on site, they should be stored in a secure, covered location with secondary containment provisions. Additional options include designating specific areas on site for material delivery and storage, location of material storage areas away from waterways and storm drain outlets, installation of containment berms between stored materials and site drainage system, proper labeling of materials and containers, and keeping material containers tightly sealed after use. Maintenance site supervisors should check for leaching or spreading of contaminants from areas where potentially hazardous materials are stored. PCWA already implements this type of BMP.

6.4 SUGGESTIONS FOR FURTHER STUDIES

Based on results of NRMP studies, PCWA maintenance may affect natural resources conditions within the study area. Higher concentrations of trace metals, particularly aluminum and copper, were observed at sites monitored within the PCWA canal system compared to stream sites for sampling events associated with PCWA's maintenance activities that involved dewatering of canal segments. These data may inconclusively suggest that the PCWA canal system is a source for loading of some constituents to study area streams.

Additional water quality monitoring should be conducted at sites to characterize potential effects of PCWA maintenance activities on water quality conditions. Water quality monitoring sites for maintenance event-based monitoring should include:

- Canal sites immediately upstream and downstream from the maintenance activities within the PCWA canal system
- End of canal outlets downstream from maintenance activities
- Stream sites upstream and downstream from canal system contributions

Nearby routine water quality monitoring sites within the same watersheds as the maintenance sites should also be included during maintenance event-based water quality monitoring to characterize effects of maintenance activities. One of the focal points for additional studies should be to evaluate aluminum and copper inputs to study area streams from the PCWA canal system. During algaecide application events, additional and more frequent water quality monitoring at select canal outlets downstream from Clover Valley and Mammoth reservoirs during and after algaecide applications. Water quality results for these events, coupled with flow data at algaecide application points and canal outlets, would provide PCWA with the data to calculate the mass balance for copper and estimate mass loading of copper to study area streams during algaecide applications. Water quality monitoring should also be conducted upstream and downstream from BMPs implemented by PCWA to reduce potential impacts to water quality to evaluate BMP effectiveness. Sample timing for all maintenance event-based water quality monitoring should be determined based on hydrologic conditions at each site to characterize potential constituent loading to study area streams following maintenance activities.

As described in **Chapter 5**, additional sediment quality monitoring at numerous sites exhibiting variable soil conditions along the canal system and study area streams may help to determine potential sources of trace metals in PCWA canals and study area streams. Soil sampling for representative soil types should be coordinated with maintenance event-based water quality monitoring. Soil samples should be collected from sediments removed from canals during canal cleaning and canal lining activities, and from undisturbed sites of representative soil types, as characterized by PCWA (2005), near and upstream from canal and stream water quality monitoring sites within watersheds of Clover Valley Creek, Antelope Creek, Secret Ravine, and Miners Ravine.

Additionally, effects of canal lining activities on wetlands and/or trees, including oak trees, located adjacent to canals are not clearly understood. Further studies should be conducted to evaluate potential effects of canal lining on wetlands and/or trees adjacent to canals. Studies may include evaluating potential changes to moisture and geochemical conditions of soils near potentially affected wetlands and/or trees before and after canal lining activities.

CHAPTER 7.0
POTENTIAL EFFECTS, REGULATORY FRAMEWORK, AND BEST MANAGEMENT PRACTICES FOR INTERRELATED PCWA OPERATIONS AND MAINTENANCE ACTIVITIES

This chapter provides an overview of the potential effects of interrelated PCWA O&M activities on natural resource conditions in the study area, the regulatory framework for effects, and potential BMPs to reduce effects of interrelated PCWA O&M activities on natural resources.

7.1 POTENTIAL EFFECTS OF INTERRELATED PCWA OPERATIONS AND MAINTENANCE ACTIVITIES ON NATURAL RESOURCES

This section describes potential effects of PCWA O&M activities that, when combined, may increase adverse effects to natural resources. Interpretations of the potential effects of interrelated PCWA activities are based on the potential effects of operations activities discussed in **Chapter 5** and potential effects of PCWA maintenance activities discussed in **Chapter 6**. Potential interrelated effects associated with canal or pipe repair, however, are not addressed in this chapter. As described in **Chapter 6,** canal repair and pipe repair activities should require project-specific environmental resources analyses to assess the potential effects of the activity on natural resources, and an evaluation to determine measures to minimize potential negative effects.

7.1.1 Yearly Outages

PCWA operations during the PG&E yearly outages in combination with other PCWA O&M activities may increase adverse effects to natural resources. No interrelated effects are anticipated on natural resources during PCWA operations related to yearly outages and:

- Seasonal delivery schedule changes
- Seasonal flood management practices
- Maintenance related to physical removal of vegetation along PCWA's raw water distribution system
- Maintenance related to herbicide applications along PCWA's raw water distribution system

The following summarizes potential effects of PCWA operations during yearly outages that may be interrelated to potential effects observed during other PCWA O&M activities:

- Routine Operations – During routine PCWA operations, the PCWA canal system provides direct contributions to flows within study area streams through regulated releases to streams used for conveyance to customers, unregulated releases from canal

outlets, and indirect contributions through customer return flows (USACE and PCWA 2008). These canal system contributions to streamflow have a positive effect on hydrologic conditions in study area streams, creating and sustaining suitable habitat conditions for many aquatic species during the dry season. These positive effects on natural resources, when combined with potential negative effects on hydrological conditions associated with PCWA's operations during the outages, likely result in interrelated effects to natural resources. Potential interrelated effects to biological resources, including wetlands supported by canal contributions, Central Valley steelhead, and Chinook salmon, are representative of historic conditions within the study area.

- Canal Cleaning – Removal of debris and sediment from the canals during canal cleaning activities potentially reduces adverse interrelated effects of PCWA operations during yearly outages on water quality conditions in study area streams. PCWA's canal cleaning activities remove much of the unconsolidated sediment, organic material, and associated copper from algaecide applications that may settle in canals when canals are dewatered during the outage.

- Weed and Brush Control – Algaecide Application: Interrelated effects of PCWA operations during yearly outages and PCWA's algaecide applications were observed during water quality monitoring events for yearly outages, particularly within the Secret Ravine watershed. Measured copper values at canal and stream sites in the Secret Ravine watershed during the October 2007 sampling event increased after flows were restored to the canal system. The higher copper values observed during the yearly outages were likely attributed to mobilization of copper associated with fine sediment and organic material remaining within the canals after canal cleaning activities, or that had accumulated and settled when canals were dewatered during the outage. The affects on water quality from these interrelated activities likely result in adverse effects on terrestrial and aquatic biological resources.

- Canal lining – Removal of debris and sediment from the canals during canal preparation for lining activities, along with improved canal bank stability when canals are lined, likely decreases potential adverse effects of PCWA operations during PG&E yearly outages on water quality conditions in study area streams.

7.1.2 Seasonal Delivery Schedule Changes

No interrelated effects are anticipated on natural resources during PCWA operations related to seasonal delivery schedule changes in combination with other PCWA O&M activities.

7.1.3 Seasonal Flood Management Practices

PCWA operations during seasonal flood management practices in combination with other PCWA O&M activities may increase adverse effects to natural resources. No interrelated effects

are anticipated on natural resources during PCWA operations related to seasonal flood management practices and:

- Yearly outages
- Seasonal delivery schedule changes
- Routine operations
- Maintenance from physical removal of vegetation along PCWA's raw water distribution system
- Maintenance from herbicide applications along PCWA's raw water distribution system

The following summarizes potential effects of PCWA operations during seasonal flood management practices that may be interrelated to potential effects observed during other PCWA O&M activities:

- Canal Cleaning – Removal of debris and sediment from the canals during canal cleaning activities potentially reduces adverse interrelated effects of PCWA operations during seasonal flood management practices on water quality conditions in study area streams. PCWA's canal cleaning activities remove much of the unconsolidated sediment and organic material that accumulates in canals and may be flushed from canals during seasonal flood management practices. These effects are likely similar to conditions generally exhibited across study area streams during periods of high precipitation runoff.

- Weed and Brush Control – Algaecide Application – Flood management practices have the potential to cause adverse effects to natural resources when combined with algaecide applications along PCWA's raw water distribution system. Potential adverse effects may occur through loading of copper remaining within the canals after canal cleaning activities to wetlands and streams, and accumulation of copper in wetland and stream sediments may affect biological resources.

- Canal Lining – Within sections of the canal system that are lined or recently lined before PCWA seasonal flood management practices, canal lining activities potentially result in reduced adverse interrelated effects from PCWA operations during seasonal flood management practices. Removal of debris and sediment from the canals during canal preparation for lining activities, along with improved canal bank stability when canals are lined, potentially decreases adverse effects of PCWA operations during seasonal flood management practices on water quality conditions in study area streams, similar to conditions generally exhibited across study area streams during periods of high precipitation runoff.

7.1.4 Routine Operations

Routine PCWA operations in combination with other PCWA O&M activities may increase adverse effects to natural resources. No interrelated effects are anticipated on natural resources during PCWA operations related to routine operations and:

- Seasonal delivery schedule changes
- Seasonal flood management practices
- Routine operations
- Canal cleaning along PCWA's raw water distribution system
- Physical removal of vegetation along PCWA's raw water distribution system
- Herbicide applications along PCWA's raw water distribution system

The following summarizes potential effects of PCWA operations during routine operations that may be interrelated to potential effects observed during other PCWA O&M activities:

- Yearly Outages – When combined with operations during PG&E yearly outages, negative effects on hydrological conditions associated with PCWA's routine operations during the yearly outages may increase adverse effects to natural resources. These potential interrelated effects are summarized above in the section describing interrelated effects associated with PCWA operations during PG&E yearly outages. As described in **Chapter 5**, flow contributions associated with PCWA routine operations have an overall positive effect on hydrologic conditions in study area streams.
- Canal Lining – Removal of debris and sediment from the canals during canal preparation for lining activities, along with improved canal bank stability when canals are lined, likely decreases potential adverse effects of routine operations on water quality conditions in study area streams.

7.1.5 Canal Cleaning and Flushing

PCWA operations during canal cleaning in combination with other PCWA O&M activities may increase adverse effects to natural resources. No interrelated effects are anticipated on natural resources during PCWA operations related to canal cleaning and:

- Seasonal delivery schedule changes
- Routine operations
- Physical removal of vegetation along PCWA's raw water distribution system

- Herbicide applications along PCWA's raw water distribution system
- Canal lining along PCWA's raw water distribution system

The following summarizes potential effects of PCWA operations during canal cleaning that may be interrelated to potential effects observed during other PCWA O&M activities:

- Yearly Outages – As described above, removal of debris and sediment from the canals during canal cleaning activities likely decreases potential adverse effects of PCWA operations during yearly outages on water quality conditions in study area streams.
- Seasonal flood management practices – As described above, removal of debris and sediment from the canals during canal cleaning activities likely decreases potential adverse effects of PCWA operations during seasonal flood management practices on water quality conditions in study area streams.
- Weed and Brush Control – Algaecide Application – PCWA's canal cleaning activities, when combined with algaecide applications along PCWA's raw water distribution system, likely have adverse interrelated effects to natural resources. Water quality data collected during canal cleaning activities, summarized in **Chapter 6**, show increased concentrations of copper at study area stream sites immediately following canal cleaning. Increased concentrations of copper are likely the result of the mobilization of copper associated with fine sediment and organic material remaining within the canals after canal cleaning activities or that had settled within upstream and/or downstream canal sections that were dewatered for canal cleaning. Copper loading to wetlands and streams, and accumulation of copper in wetland and stream sediments may affect biological resources.

7.1.6 Weed and Brush Control – Physical Removal of Vegetation

No interrelated effects are anticipated on natural resources during physical removal of vegetation in combination with other PCWA O&M activities.

7.1.7 Weed and Brush Control – Algaecide Application

Algaecide applications along PCWA's raw water distribution system in combination with other PCWA O&M activities may increase adverse effects to natural resources. No interrelated effects are anticipated on natural resources during algaecide applications and:

- Seasonal delivery schedule changes
- Routine operations
- Physical removal of vegetation along the PCWA canal system

- Herbicide applications along PCWA's raw water distribution system

The following summarizes potential interrelated effects of PCWA algaecide applications when combined with other PCWA O&M activities:

- Yearly Outages – PCWA's algaecide applications, when combined with operations during yearly outages, will likely result in adverse interrelated effects to natural resources. As described above, higher copper concentrations observed at sites during yearly outage water quality monitoring events were likely attributed to mobilization of copper associated with fine sediment and organic material that had settled when canals were dewatered during the outage. Copper loading to wetlands and streams, and accumulation of copper in wetland and stream sediments may affect biological resources.

- Seasonal Flood Management Practices – Algaecide applications along PCWA's raw water distribution system have the potential to cause adverse effects to natural resources when combined with seasonal flood management practices. Potential adverse effects may occur through copper loading to wetlands and streams, and accumulation of copper in wetland and stream sediments may affect biological resources.

- Canal Cleaning – As described above, PCWA algaecide applications, when combined with canal cleaning activities, likely result in adverse interrelated effects to natural resources. Increased concentrations of copper in study area streams following canal cleaning activities are likely the result of the mobilization of copper from algaecide applications associated with fine sediment and organic material that had settled when canals were dewatered for canal cleaning. Accumulation of copper in wetland and stream sediments may affect biological resources.

- Canal Lining – Similar to potential interrelated effects associated with algaecide applications and canal cleaning activities, PCWA algaecide applications, when combined with canal lining activities, likely cause adverse interrelated affects to natural resources. Measured copper values in study area streams following canal lining activities were marginally higher compared to routine operations. The higher values result from the mobilization of copper from algaecide applications associated with fine sediment and organic material that had settled when canals were dewatered for canal lining.

7.1.8 Weed and Brush Control – Herbicide Application

No interrelated effects are anticipated on natural resources during PCWA herbicide applications in combination with other PCWA O&M activities.

7.1.9 Canal Lining

PCWA canal lining activities in combination with other PCWA O&M activities may increase adverse effects to natural resources. No interrelated effects are anticipated on natural resources during PCWA operations related to canal lining and:

- Yearly outages
- Seasonal schedule delivery changes
- Seasonal flood management practices
- Canal cleaning along PCWA's raw water distribution system
- The physical removal of vegetation along PCWA's raw water distribution system
- Herbicide applications along PCWA's raw water distribution system

The following summarizes potential effects of PCWA operations during canal lining that may be interrelated to potential effects observed during other PCWA O&M activities:

- Routine Operations – Similar to conditions for seasonal flood management practices and described above, removal of debris and sediment from the canals during canal preparation for lining activities, along with improved canal bank stability when canals are lined, likely decreases potential adverse effects of routine operations on water quality conditions in study area streams.
- Weed and Brush Control – Algaecide Application – As described above, canal lining activities, when combined algaecide applications, likely have adverse interrelated effects to natural resources. Higher concentrations of copper observed in study area streams following canal lining activities were likely due to the mobilization of copper from algaecide applications associated with fine sediment and organic material that had settled when canals were dewatered for canal lining. Accumulation of copper in wetland and stream sediments may affect biological resources.

7.2 REGULATORY FRAMEWORK FOR POTENTIAL EFFECTS OF INTERRELATED PCWA OPERATIONS AND MAINTENANCE ACTIVITIES

The regulatory framework for potential effects of PCWA operations activities described in **Chapter 5**, along with the regulatory framework for potential effects of PCWA maintenance activities described in **Chapter 6**, apply to the potential interrelated effects described in this chapter. The regulatory framework for each of the potential interrelated PCWA O&M activities described that may have adverse effects on natural resources when combined with other O&M activities is summarized in **Tables 5-3** and **6-11**. The following sections provide an overview of

the Federal and State regulations, and local requirements and considerations applicable to the potential effects of interrelated O&M activities described above.

7.2.1 Federal Regulations

Federal laws and regulations associated with the potential effects of interrelated PCWA O&M activities are described in **Chapters 5** and **6**, and listed below:

- CWA
- ESA
- Magnuson-Stevens Fishery Conservation and Management Act and the 1996 Sustainable Fisheries Act
- MBTA

7.2.2 State Regulations

Laws and regulations governed by the State of California and associated with the potential effects of interrelated PCWA O&M activities are described in **Chapters 5** and **6**, and listed below:

- CEQA
- Porter-Cologne Water Quality Control Act
- California ESA
- California Fish and Game Code-Fully Protected Species
- California Fish and Game Code Section 1602 – Lake and Streambed Alteration Program
- California Native Plant Protection Act

7.2.3 Local Requirements and Considerations

The following local requirements and considerations are associated with the potential effects of interrelated PCWA O&M activities are described in **Chapters 5** and **6**:

- PCCP
- Placer County SWMP
- Placer County Code, Tree Preservation Ordinance

- Placer County Oak Woodland Management Plan

7.3 BEST MANAGEMENT PRACTICE OPTIONS TO ADDRESS POTENTIAL EFFECTS OF INTERRELATED PCWA OPERATIONS AND MAINTENANCE ACTIVITIES

The BMPs to address potential effects of PCWA operations activities described in **Chapter 5**, along with the regulatory framework for potential effects of PCWA maintenance activities described in **Chapter 6**, also apply for the potential interrelated effects described in this chapter. Potential BMPs to reduce potential effects of interrelated PCWA O&M activities on natural resources are summarized in **Tables 5-3** and **6-11**, and listed below. The list of BMP options is not comprehensive; instead, it provides examples of BMPs that may be implemented to minimize particular potential effects of interrelated PCWA O&M activities.

7.3.1 Pre-Implementation Best Management Practices

Below are potential pre-implementation BMPs for reducing potential effects of interrelated PCWA O&M activities on natural resources in the study area.

- Improve canal bank stability and install sediment traps at canal outlets
    - Install velocity dissipaters at canal outlets
    - Line banks at canal outlets
    - Install erosion-control blankets in areas of soil disturbance
    - Install temporary fiber rolls in areas of soil disturbance
    - Apply spray-on soil binders in areas of soil disturbance
- Avoid potential wet weather effects
    - Patrol canals and remove potential obstructions to prevent erosion and propery damage
    - Minimize amount of water purchased from PG&E during periods of high precipitation
    - Distribute flood releases from canal system by releasing flows at numerous intermediate outlets
    - Plan and design projects to minimize land disturbance
    - Install erosion and sedimentation control measures after land-disturbing activities
    - Identify areas susceptible to erosion for future canal lining activities
    - Choose canal crossing sites where erosion potential is low
- Protect sensitive species and sensitive species habitat

  - Provide staff with species identification training
  - Evaluate sites with sensitive species and mark/protect sensitive species habitat
  - Stockpile materials away from sensitive species habitat areas
- Strategic scheduling of maintenance activities

7.3.2 Implementation Best Management Practices

The following sections are implementation BMPS to reduce potential effects of PCWA maintenance activities on natural resources:

- Avoid sensitive species areas
  - Avoid disturbance to sensitive species
  - Avoid active raptor nesting areas
- Prevent degraded water from entering streams after O&M activities
  - Modify canal operations to gradually restore reservoir releases to canals at slower rate
  - Apply sediment trap at storm drains for dewatering before canal lining
  - Treat first flush flows to reduce downstream water quality effects

7.3.3 Ongoing or Post-Implementation Best Management Practices

The following are ongoing post-implementation BMPs to reduce the potential interrelated effects of PCWA O&M activities on natural resources:

- Regulatory compliance management for O&M activities
- PCWA Best Management Practice Program
- Good housekeeping
  - Ensure proper handling of materials and wastes
  - Use proper cleanup procedures after material use
  - Implement onsite debris and trash management practices
  - Store materials under a roof or covering with a secure tarp

CHAPTER 8.0
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